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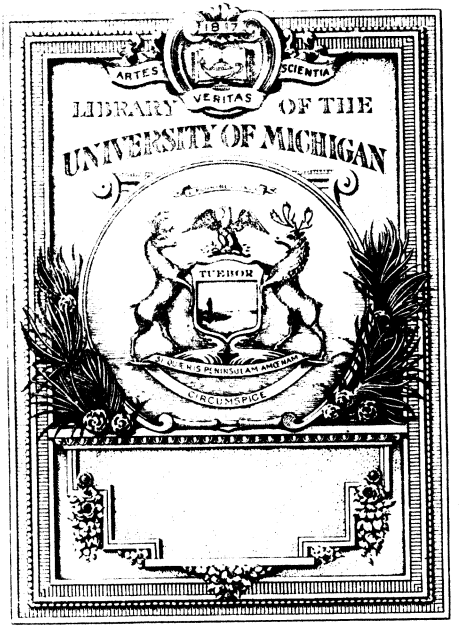
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Porto Rico and the Virgin Islands

VOLUME III—Part 2

Tertiary Mollusca from the Lares District, Porto Rico—*Bela Hubbard*

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TERTIARY MOLLUSCA FROM THE LARES DISTRICT, PORTO RICO

By Bela Hubbard

INTRODUCTION

The material here described was collected in making a study of the geology of the Lares District in the summer of 1916, under the auspices of the New York Academy of Sciences and the Insular Government of Porto Rico. The present paper is a part of the report on the geology of the Lares District, the completion of which has been delayed two years by the war. As the section dealing with the general geology and stratigraphy has not yet been completed, the present report, dealing with the Tertiary Palaeontology, is published in advance. It will be noted under the descriptions of the species, that full use has been made of the material collected by Dr. C. P. Berkey in 1914, by Dr. D. R. Semmes in 1915, and by Dr. A. K. Lobeck in 1916, and in some cases their specimens have been used for illustration.

No attempt will be made here to describe the stratigraphy, but the following tabulation of the subdivisions* of the Younger Series of the north coast is given in explanation of the horizons referred to under the descriptions of the species.

Younger Series

San Juan formation (Berkey, 1915)

Pleistocene to Recent.

UNCONFORMITY

Arecibo Group (Arecibo formation of Berkey, Pepino formation of Hill and Vaughan)	Quebradillas limestone (Berkey, 1915) Upper Oligocene (Bowden)
	Los Puertos limestone (Hubbard, 1917) Upper Oligocene
	Cibao Limestone (Hubbard, 1917) Middle Oligocene
	Lares formation (Hubbard, 1917) Middle Oligocene
	San Sebastian shale (Berkey, 1915) Middle Oligocene

UNCONFORMITY

Older Series (Berkey, 1915)

Cretaceous

*These subdivisions were made and described by the writer in a short paper presented before the New York Academy of Sciences, Section of Geology and Mineralogy, in February, 1917.

Acknowledgments

Acknowledgments are made to Señor Narciso Rabell, of San Sebastian for aid in collecting fossils and for the interest which he took in the field work; to C. J. Maury for the opportunity of comparing some of the material with hers; to Miss A. L. Hepburn, Columbia University Library, for valuable assistance in securing the many necessary but scattered palaeontological references; and to Dr. A. W. Grabau for advice and assistance in describing many of the species.

FOSSIL LOCALITIES

Field Numbers.

1. Lares road, north side, near K. 38 — San Sebastian shale.
7. On the cart road 1.75 miles north-east of Lares. — Lares limestone.
8. About 0.5 mile north of No. 7. — Lares limestone.
10. About 1 mile north-east of No. 8. — Lares limestone.
23. About 5.5 miles north of Lares, and about 2 miles north of Central Soller. — Echinoid zone of Cibao limestone.
24. About 6.5 miles north of Lares, on cart road to Camuy, at southern boundary of the belt of pepino hills. — Base of Los Puertos limestone.
41. On the cart road to Camuy, 0.25 mile south of the village of Cienega, near the Central Alianza. — Quebradillas limestone.
42. On the cart road to Camuy, 0.25 mile north of the Central Alianza. — Quebradillas limestone.

52(a). On the cart road to Collazo 1.75 miles south of Quebradillas, and a short distance north-west of the village of San Antonio. — Quebradillas limestone.

59. Valley of the Guajataca River, 1 mile south of Planas. — Los Puertos limestone.
61. On the upland surface near the valley, and 0.3 mile south of No. 59. — Los Puertos limestone.
62. About 0.6 mile south of No. 61, on the lowland just south of the belt of pepino hills. — Cibao limestone.
64. About 0.3 mile south of No. 62, on cart road to Collazo. — Cibao limestone.
65. On the cart road 2 miles north-east of Collazo. — Lares limestone.
72. Lares road at K. 28.6. — San Sebastian shale.
74. Lares road at K. 29.3. — San Sebastian shale.
75. Lares road at K. 30.4. — San Sebastian shale.
76. Lares road at K. 32.9. — San Sebastian shale.
83. Collazo Falls section, at top of second falls below the bridge. — San Sebastian shale.

84. Collazo Falls section, at base of second falls below the bridge. San Sebastian shale.

86. Collazo Falls section, at top of fourth falls below the bridge. San Sebastian shale.

89. Collazo Falls section, below the sixth falls below the bridge, in the lowest horizon exposed in the section. San Sebastian shale.

92. Lares road at K. 28.8, in ledge 12 feet above the road. San Sebastian shale.

100. Talus at base of the cuesta north of Lares. Lares limestone.

118. On the upland surface 0.25 mile north-west of Lares plaza. San Sebastian shale.

120. About 180 yards north-west of No. 118. San Sebastian shale.

126. Lares road, near K. 37. San Sebastian shale.

140. Base of the cuesta on west side of the Camuy River valley at the fork of the cart road to Utuado and the new road to Arecibo San Sebastian shale.

142. Cuesta at No. 140, in the limestone cliff overlying the basal shale. Lares limestone.

158. On cart road to Camuy, about 500 yards north-west of K. 19.5 of the new Arecibo-lares road. Cibao limestone.

161. About 500 yards north-west of No. 158, on the same cart road. Cibao limestone.

162. About 600 yards north-west of No. 161, on the same cart road. Echinoid zone, Cibao limestone

165. Near the point of emergence of the subterranean Camuy River. Cibao limestone.

167. A short distance north of No. 165, on the west side of the Camuy River. Cibao limestone.

174. About 0.5 mile north of No. 167, west side of the Camuy River on cart road to Camuy. Los Puertos limestone.

176. About 0.75 mile north of No. 174, on the same road. Los Puertos limestone.

179. About 0.4 mile north of No. 176, on the same road. Los Puertos limestone.

182. About 0.6 mile northwest of No. 179, and about 0.5 mile south of the ford where the cart road crosses to the east side of the Camuy River. Los Puertos limestone.

191. On the automobile road between Camuy and Quebradillas, near K. 40.5. Quebradillas limestone.

192. On the same automobile road, near K. 40. Quebradillas limestone.

198. On the automobile road west of Quebradillas, near K. 28.7. Quebradillas limestone.

204. Sea cliffs at the east mouth of the American Railroad tunnel at the mouth of the Guajataca River, north coast. Quebradillas limestone.

205. In the railroad cut 80 yards west of the railroad bridge over the Guajataca River, and 450 yards east from the automobile road grade crossing. Quebradillas limestone.

209. Guajataca River valley, west of the village of San Antonio. Quebradillas limestone.

216. About 1.75 miles south of K. 14.7 (Isabela-Aguadilla automobile road), on cart road near Arenales bajos. Quebradillas limestone.

217. Nearly 0.5 mile south of No. 216. Quebradillas limestone.

220. Near Arenales altos, about 2.5 miles south of No. 217, and 150 yards east of the cart road. Los Puertos limestone.

225. On the cart road near Robles, 25 feet below the summit of the cuesta. Top of the Lares limestone.

226. Zone about 90 feet below No. 225. Lares limestone.

227. A 40 foot exposure of marl on the cart road south of No. 226, and 250 feet below the summit of the cuesta. Lares limestone.

229. About 1 mile north of K. 17.5 (Lares road), on cart road near Hato arriba. Base of Lares limestone.

230. A short distance south of No. 229, and about 50 feet lower in elevation. Top of San Sebastian shale.

231. About 100 yards south of No. 230, at a slightly lower elevation. Coral zone of upper San Sebastian shale.

232. About 200 yards south of No. 231, and 1,350 yards north of K. 17.5 (Lares road), at an approximate elevation of 180 feet above the road. A five foot exposure of marl marking the *Clementia dariena* zone. San Sebastian shale.

232(b). A fifteen foot exposure immediately overlying No. 232, and remarkable for the abundance of *Turritella tornata*. San Sebastian shale.

233. On a small secondary cuesta a short distance south of No. 232. San Sebastian shale.

234. South of No. 233 on the same cuesta. San Sebastian shale.

235. South of No. 234, and 1,050 yards north of K. 17.5 (Lares road) at an elevation of 180 feet above the road. San Sebastian shale.

236. South of No. 235, and 900 yards north of K. 17.5. San Sebastian shale.

237. South of No. 236, and 820 yards north of K. 17.5, at an elevation of 100 feet above the road. San Sebastian shale.

244. On the cart road to Camuy, 1 mile north-east of Lares, in limestone quarry near summit of the cuesta. Lares limestone.

254-5-6. Talus from the cuesta north of Lares. Taken from the road along the Guajataca River, about 0.75 mile north of Lares plaza. Lares limestone.

261. Collazo Falls section, at base of second falls below the bridge, and overlying No. 84. San Sebastian shale.

262. Collazo Falls section, at top of third falls below the bridge. San Sebastian shale.

263. Collazo Falls section, half way between top and bottom of the fourth falls below the bridge. San Sebastian shale.

264. Collazo Falls section, immediately underlying No. 263. San Sebastian shale.

265. Collazo Falls section, at base of the fourth falls below the bridge. San Sebastian shale.

267. Collazo Falls section, near the base of the section, overlying No. 89. San Sebastian shale.

268. Collazo Falls section, in the red sandstone at the sixth falls below the bridge, and overlying No. 267. San Sebastian shale.

280. About 880 yards north of Moca on cart road. Lares formation, shale facies.

281. About 1,100 yards north of Moca on cart road. Lares formation, shale facies.

282. About 1,150 yards north of Moca on cart road. Lares formation, shale facies.

287. About 1.25 miles north on Moca on cart road. Top of the Cibao limestone.

313. Sea cliff 0.75 mile northeast of the Point Borinquen Light House, from a stratum 55 feet above sea level. Quebradillas limestone.

314. The same cliff, in a stratum 10 feet above sea level. Quebradillas limestone.

317. About 1.25 miles north of K. 2 (Aquadilla-Isabela automobile road), on cart road, 350 yards north of the American Railroad grade crossing. Quebradillas limestone.

318. A short distance south of No. 317, in railroad cut, about 200 yards northeast of grade crossing. Quebradillas limestone.

319. In quarry east of cart road, and about 0.6 mile north of K. 2 (Aguadilla-Isabela road). Quebradillas limestone.

324. Small limestone outlier about 300 yards south of K. 1.7 (Lares road). Lares limestone.

330. Southwest of bridge over Culebrines River near K. 2 (Aguadilla-Aguada automobile road). Lares limestone.

331. Aguadilla-Aguada road, south of sugar railroad crossing near K. 2. Lares limestone.

332. Same road, about 300 yards southwest of No. 331. Lares limestone.

333. On automobile road to Rincon, 1,150 yards west of Aguada. Exposure on north side of road. Lares limestone.

334. Same road, 100 yards west of No. 333. Lares limestone.

335. Same road, 290 yards west of No. 334. Lares limestone.

343. Same road, 640 yards northeast of bridge over the Rio Grande. Lares limestone.

344. Same road, south of No. 343, and 460 yards north of bridge over the Rio Grande. Lares limestone.

370. Exposure in sea cliff on south side of the American Railroad track at Point Jiguero, 930 yards northeast of the lighthouse. The San Juan formation may be seen here, plastered on the Tertiary limestone.
Lares limestone.

616. Uppermost stratum in quarry 0.5 mile south-east of Auguada, on south side of road, and northeast of the American Railroad grade crossing.
Lares limestone.

619. Same as No. 616, but from lowest exposure in the quarry.
Lares limestone.

621. Exposure on south side of railroad tracks, about 580 yards south-east of the Aguada railroad station. Lares limestone.

664. East side of Camuy River valley, 2.25 miles southeast of Camuy.
Quebradillas limestone.

670. East side of Camuy River valley, 1 mile southeast of No. 664.
Quebradillas limestone.

671. Same locality as No. 670, but from a stratum a few feet above the latter.
Quebradillas limestone.

678. East side of Camuy River valley, about 1.5 miles due south of No. 671, and about 0.75 mile north of No. 182. Quebradillas limestone.

749(a). On cart road, about 0.5 mile north of bridge at Collazo.
Lares limestone.

757. One mile northeast of Lares, on the cuesta, in quarry near No. 244.
Lares limestone.

758. Same locality as No. 757, but at a slightly higher horizon.
Lares limestone.

800. About 100 yards south-east of No. 24. Top of Cibao limestone.

801. In railroad cut at east end of railroad bridge over the Guajataca River, north coast. This locality is about 50 yards east of No. 205.
Quebradillas limestone.

The following localities are recorded from field notes of Dr. C. P. Berkey.

10. North of the military road in the vicinity of Carolina.
Quebradillas limestone.

77. Military road 1.5 kilometers west of Ponce. Upper Ponce formation.
(Corresponds with the Quebradillas limestone.)

78. Three kilometers west of Ponce. Upper Ponce formation.

95. Near K. 28 Lares road. San Sebastian shale.

96. A short distance west of Lares on the Lares road.
San Sebastian shale.

98. In the railroad cut near the bridge over the Guajataca River, north coast. Quebradillas limestone.

176. Vicinity of Moca. Lares formation, shale facies.

SYSTEMATIC DESCRIPTION OF SPECIES

Genus **Atrina** Gray

Atrina rabelli, new species

Plate X, Figure 1

Margins of shell are arcuate strongly folded upward, particularly the anterior and posterior portions; central convex zone with flat lateral slopes, the cross-section of the valve being broadly V-shaped; surface marked by small, regular concentric ripples which become obsolete on the lateral margins; central convex zone marked by two low radial ribs which die out near the ventral margin. Length 71 mm., semi-diameter 15 mm., height 100 mm.

A single external mold was found showing only the ventral half of the shell. It is a large, rapidly widening form of the type of *A. chipolana* Dall, but is distinct from any form yet described. This shell is named in honor of Señor Rabell, geologist, of San Sebastian, who has taken an active interest in the geological work of the N. Y. Academy of Sciences and rendered every possible assistance to the geologists in their field work.

Locality.—204.

Horizon.—Quebradillas limestone.

Genus **Pecten** Müller

Pecten (Pecten) laresense, new species

Plate X, Figures 2, 3

Shell small of the concavo-convex type; right valve extremely convex, left valve shallow concave; shell equilateral; ears small and strongly ribbed radially; right valve with twenty-seven square smooth ribs and nearly flat interspaces of equal width, marked by fine, sharp, raised concentric threads which rise on the sides of the ribs; left valve with similar ribs and interspaces but with ribs medially grooved distally; ears of left valve with imbricate radial threads; anterior ear of left valve concave and correspondingly convex in the right; byssal notch small, ctenolium apparently lacking; submargins on both valves absent, the ribs extending to the base of ear; interior grooved and lirate ventrally; cardinal crura obscure and irregular; small amorphous pair of auricular crura; provinculum distinct; adductor scars markedly posterior. A right valve measures in length 20 mm., height 17 mm., diameter 8.5 mm.; left valve measures in length 20 mm., height 17 mm., concave diameter 2 mm.

This shell is distinct from any other Pecten in the Porto Rican fauna.

Type localities.—231, 232, 233.

Other localities.—232 (b), 126, 118, 236, 1.

Horizon.—San Sebastian shale. (abundant and widely distributed.)

Pecten (Euvola) reliquus Brown and Pilsbry variety **portoricoensis,** new variety

Plate X, Figure 4

Only right valves were found, which agree closely with the specimens of *P. reliquus* in the Columbia University Gatun collections. The Porto Rican shell differs in having fewer, higher ribs with narrow interspaces, and in having the lateral slopes faintly ribbed instead of smooth as in the Gatun shell. The most perfect right valve has fourteen strong rounded ribs with several faint ones on each lateral slope. Length 35 mm., height 34 mm., diameter 3 mm. Fragments were collected showing a size of at least 50 mm.

The left valves seem to have been easily destroyed, as none were found in the Panama collections.

Type locality.—165.

Other localities.—161, 198.

Range.—Cibao limestone to Quebradillas limestone.

Pecten (Nodipecten) nodosus Linné

Plate X, Figure 5

Pecten nodosus Linnè, Syst. Nat., No. 164, 1758.

Pecten magnificus Gabb, Trans. Amer. Phil. Soc., XV, p. 256, 1873 (not of Sowerby).

Pecten (*Nodipecten*) *nodosus* Dall, Trans. Wagner Inst. Sci., III, pt. 4, p. 717, 1898.

Pecten (*Nodipecten*) *nodosus* Maury, Bull. Amer. Paleont., V, No. 29, p. 186, 1917.

The specimens show three prominent strongly nodose ribs, one in center of valve and two lateral. These alternate with two lower, subnodose ribs marked by a median and two lateral threads. The subnodose ribs break up into scaly threads adjacent to the sub margins. The most perfect specimen measures in length 29 mm.

height 28 mm., semi-diameter 7 mm., but fragments were found showing a height of 40 mm.

Type locality.—198.

Other locality.—42.

Horizon.—Quebradillas limestone (not abundant).

Pecten (Chlamys) collazoensis, new species

Plate XI, Figure 1

Shell small, slightly convex; surface with twenty-one to twenty-two rounded ribs and narrower rounded interspaces; ribs ornamented with fine, thin, erect scales extending the whole width of the rib, and on either side at juncture with the interspace, a row of minute, densely crowded, bead-like spinules, which are much smaller and more densely crowded than the scales on tops of the ribs. Submargins and ears sculptured with a continuous series of squamose radial threads; anterior ear (of right valve) longer than the posterior ear, and with deep byssal notch. Length 11.5 mm., height 12.5 mm., semi-diameter 2 mm.

No well preserved left valves were found. This shell is apparently the progenitor of *P. portoricoensis.*

Localities.—Collazo Falls, 232, 233?

Horizon.—Lower? San Sebastian shale. (some doubtful specimens were found in the upper part of the San Sebastian shale.)

Pecten (Chlamys) portoricoensis, new species

Plate XI, Figures 2, 3

The typical form is a moderate sized shell (length 24.5 mm., height 26.5 mm., diameter 9 mm), equivalve, sub-equilateral; ears moderately large, unequal (anterior larger); byssal notch large but not deep; ctenolium inconspicuous; single pair of cardinal crura; valves grooved within, and scalloped and lirate at ventral margin; surface with twenty-six to twenty-seven rounded ribs and slightly narrower, flatly rounded interspaces; ribs ornamented with one to three rows of fine spinose scales which in the young shells show a tendency toward the beaded ornamentation of *P. collazoensis.* This feature usually persists longer next the submargins than centrally. Following this *P. collazoensis* stage, the ribs and interspaces become smoother, the latter relatively broader; a medium thread or keel appears on each rib, and on this keel the small scales become narrower, more spinose and more widely spaced. When the shall is half grown, lateral keels, similarly spinose, appear low down on the sides of the ribs. These correspond in position with the lateral beads of the *P. collazoensis* stage but there is always a gap between

the two where the sides of the ribs are smooth. Finally, in the adult, an interstitial thread, ornamented like the keels, appears in each interspace. In the last stage of some adult specimens an additional pair of spinose lateral keels appears one on each side of the median keel. On the lateral slopes next the submargins the ribs break up into densely squamose threads, which, decreasing in size, continue in unbroken series across the submargins and the ears. The right anterior ear differs from the others in having a strongly rugose area adjacent to the submargin, and above this the radial threads are strong and coarsely squamose. *Camptonectes* striation is very plain on unworn specimens.

This is an extremely variable shell, apparently related to *P. thetides* Sowerby. It is the most abundant *Pecten* in the Tertiary of north side of the island and numerous specimens show intergradations between the different varieties, thus fortunately preventing the error of making two or more species. The typical forms are especially interesting in that they show the species to have been derived from *P.* (*Chlamys*) *collazoensis,* which was not found in horizons above the San Sebastian shale. *P. portoricoensis* ranges from the San Sebastian shale through the Lares limestone, and has been found by Dr. Berkey in the Ponce limestone on the south side of the island.

This shell is obviously derived from *P. collazoensis,* and both might conceivably be included under one specific name. The latter, however, retains its typical ornamentation throughout, without the slightest tendency toward a change, whereas in *P. portoricoensis* the *P. collazoensis* stage has become so accelerated that it is unnoticeable in some specimens and absolutely lacking in variety *reticulatis.*

Type localities.—234, 235, 343.

Other localities.—232, 118, 261, 1, 332, 76, and Collazo Falls, 244.

Stratigraphic range.—Throughout the San Sebastian shale, and in the lower Lares limestone also found by Dr. Berkey in the Juana Diaz shale.

Pecten (Chlamys) portoricoensis, new species variety **reticulatis**

Plate XI, Figure 4

Shell, while smaller than the type, is similar in every respect, except that in the young the ribs are crossed by fine, sharp, densely but evenly spaced

concentric lamellae, which thicken slightly on crossing the ribs, the whole producing a reticulate ornamentation. This feature is most noticeable centrally, since adjacent to the submargins are the typical scales, which do not appear until later on the ribs of the central portion of the shell. The reticulate ornamentation persists until the shell has reached one-quarter or one-third adult size, and is then replaced by the typical spinose scale. The lateral spinose keels and the interstitial threads do not appear until the shell has reached maturity. Average size specimen measure in length 16.5 mm., height 18 mm., diameter 6 mm. The largest specimen measures 24 mm. in height.

Type localities.—343, 619.

Other locality.—74.

Range —San Sebastian shale and Lares formation.

Pecten (Chlamys) portoricoensis, new species variety **grandis**

Plate XI, Figures 5, 6

This shell differs from the type and from variety *reticulatis* chiefly in its much greater size, and, except in gerontic individuals, in its relatively flatter valve. Unfortunately the specimens are all more or less worn in the umbonal region, but the *reticulatis* ornamentation seems to predominate in the young. Some specimens, however, show in the young shell in *P. collazoensis* ornamentation, especially near the submargins. In some individuals the interstitial thread does not appear until the last stages of growth. In others it appears early but is not spinose until the adult stage is reached. In still others the ribs remain unornamented until the adult stage, though this may be due partly to wear. In the largest shells there are five threads on the ribs in the last stages of growth, and two additional threads sometimes appear in the interspaces. The camptonectes striation is obscured by the growth lines, which are especially strong in this variety.

A large flat-valved specimen measures in length 36 mm., height 39 mm., semi-diameter 8.5 mm. In this specimen the ribs are low and broad. A gerontic shell from the San Sebastian shale measures, in length 30 mm., height 32 mm., semi-diameter 8.5 mm. These gerontic shells show a perodic swelling and contraction of the ribs and are

notably convex. Superficially, they look like another species, especially when the ribs are worn smooth.

Type localities.—76, and K. 29.2 Lares road.

Other localities.—158, 229, 263, 72, 344, 233, 263 (bottom 3rd falls), 757, 165 ?, Collazo Falls, and vicinity of Collazo (float), 140, 1, 261, 244.

Range.—San Sebastian shale, Lares limestone, Cibao limestone.

Pecten (Chlamys) grabaui, new species

Plate XII, Figure 1

Shell transversely sub-ovate, equivalve, moderately convex with the greatest convexity toward the umbones; length 27 mm., height 26.5 mm., diameter 11.5 mm.; umbonal third of shell smooth, remainder with twenty-three low rounded ribs and slightly narrower shallow rounded interspaces; following the smooth stage appear faint regular widely spaced raised concentric threads, strongest on the ribs, which become more distinct as the ribs increase ventrally. These threads then become irregular, break up into three rows of fine sharp scales on the ribs. The ribs become threaded and grooved distally, the scales giving a squamose character to the threads. There are as many as five of these longitudinal threads on the distal portions of some ribs. Likewise, in the interspaces an interstitial thread appears which is similarly squamose. Thus in the final stage of growth there is a typical *Chlamys* ornamentation. On the lateral slopes the ribs break up into squamose radial threads, which continue across the submargins and ears: ears unequal, the anterior ears being longer and more strongly sculptured; byssal notch deep; ctenolium fine; double pair of cardinal crura; auricular crura low, indistinct; camptonectes striation strong.

In first going over the specimens it seemed as though three or four species were represented, but intermediate forms made it necessary to group them as variations of an exceedingly variable species similar to *P.* (*Chlamys*) *indecisus* Dall, a form from the Vicksburg Oligocene. Like the latter, this shell shows variations which are intermediate between a true *Chlamys* and an *Amusium*. As the type of the species, that form is chosen which best illustrates the greatest number of characters common to the group.

Type localities.—343, 619.

Horizon.—Lares formation.

Pecten (Chlamys) grabaui, new species
variety **aguadensis**

Plate XII, Figure 2

Shell moderately convex in umbonal region, nearly flat ventrally; surface nearly smooth, but with obsolete ribs visible chiefly as orange colored rays in the epidermis; camptonectes striation distinct; concentric lamellae, characteristic of the group, visible only under a lens. They are frequently worn off, leaving microscopic impressed lines in their place; submargins radially striate; ears rather strongly radially sculptured as in the other varieties; interior of shell strongly lirate, the lirae being paired and corresponding with the juncture of rib and interspace on the exterior. The interior is otherwise the same as in the other varieties; ctenolium distinct; length 18.5 mm., height 18.5 mm., semi-diameter 3.5 mm.

This interesting variety is a typical *Chlamys* in shape but has many of the characters of Amusium. It seems to be the primitive member of this group, since the other varieties pass through the smooth *aguadensis* stage more or less early in growth and develop the ribbed stage.

Localities.—619, 333, 331.

Horizon.—Lares formation.

Pecten (Chlamys) grabaui, new species
variety **hatoensis**

Plate XII, Figure 3

Ribs appear very early, and become high and rounded; concentric lamellae regular and widely spaced, but becoming irregular near ventral margin where the ribs are radially grooved and interstitial thread appears in each interspace; submargins radially striate; ears strongly sculptured; ctenolium distinct; crura as in the type form; lirae obsolete except distally. Length 21.5 mm., height 21 mm., diameter 8.5 mm.

Some specimens do not reach the high ribbed stage, but ribs are rather low and rounded throughout, with the concentric lamellae crowded ventrally and showing a tendency to alternate in strength. Another specimen from a higher horizon and which may be a mutation from this variety, has high, strong ribs, in which the irregularity of the lamellae, grooving of ribs, and interstitial threads appear much earlier in the growth of the shell, and in the interspaces shows as many as thee interstitial threads in the final adult stage.

Type localities.—332, 225.

Other localities.—343, 229, 333, 287, 167 ?, 62.

Range.—Lares formation to Cibao limestone.

Pecten (Chlamys) grabaui, new species
variety **guayabensis**

Plate XII, Figure 4

Shell marked by smooth submargins. The specimens can be arranged into a series, as in variety *hatoensis*, varying from low to high, strong, rounded ribs, and with concentric lamellae varying from simple and distinctly spaced, to irregular and crowded. As in variety *hatoensis*, the ribs appear early, covering the entire shell except the prodissoconch. Interior of the shell faintly lirate throughout. Shell otherwise like the type form of the group. The largest specimen measures in length 17 mm., height 17.5 mm., semi-diameter 4.5 mm.

Type localities.—62, 332.

Other locality.—282.

Range.—Lares formation to Cibao limestone.

The probable relationship of the group is shown in the following table.

Table 1

Pecten (Chlamys) grabaui, new species		
Horizon	Group with smooth submargins	Group with striate submargins
Cibao limestone	variety *guayabensis* (shell ribbed)	variety *hatoensis* (shell ribbed)
Lares formation	variety *aguadensis* (shell smooth)	*P. grabaui* (type form) (partially ribbed)
San Sebastian shale	?	

Pecten (Chlamys) hodgii, new species

Plate XII, Figure 5

Shell sub-ovate, sub-equilateral, strongly convex in umbonal region, slightly convex in ventral region; ears sub-equal, deep byssal notch and strong ctenolium; surface with twenty rounded ribs and deep, rounded, narrower interspaces; both ribs and interspaces grooved with fine radial threads which are densely spinose; ears and the rather broad submargins marked by subspinose radial threads; inner margin strongly scalloped and interior grooved.

In the early stages of growth the ribs are not radically threaded, and the ornamentation consists of closely spaced, minute, sharp transverse scales on the ribs which join with raised concentric lamellae in the interspaces. When the shell has reached one third full size, the radial threads appear and the scales break up into minute densely spaced spines, which, ventrally, become elevated, curved, and U-shaped with concave side toward the beaks. Throughout most of the early stages the interspaces are devoid of threads and spinules, which appear much later than they do on the ribs. The concentric lamellae become obsolete ventrally.

This shell is apparently closely related to an unlabelled specimen in the Kemp collection from Gatun, which seems to be a new species. In the latter the transverse scale stage is retained longer, the concentric lamellae are noticeable throughout, and the spinules are not long or conspicuous as in the Porto Rican shell. If they are related, the Gatun shell would seem to be the more primitive of the two. It may be related to *P. oxygonum canalis* and *P. oxygonum optimum* of Brown and Pilsbry and to *P. gabbi* Dall. Dr. Maury has described a similar and apparently related shell *P. camuycencis* from the Quebradillas limestone. One complete right valve and some fragments were found. This shell is named in honor of Dr. Edwin T. Hodge, who studied the geology of the Coamo District, Porto Rico.

Locality.—314.

Horizon.—Quebradillas limestone (rare).

Pecten (Aequipecten) lobecki, new species

Plate XIII, Figure 1

Shell sub-orbicular, equilateral, moderately convex, ears large, smooth, apparently sub-equal (portion of anterior ear concealed); shell sculptured with fourteen strong rounded ribs and sub-equal rounded interspaces; con-

centric sculpture of fine raised lamellae, strong in the interspaces, obsolete on tops of the ribs; fine concentric striae in the interspaces between the lamellae, and from one to three radial threads in each interspace, which with the concentric lines produce a cancellate structure. The ribs are nearly smooth apparently because of wear, but occasionally show faint radial threads distally; submargins narrow, smooth, not depressed. Length 25 mm., height 24 mm., semi-diameter 4 mm.

A single left valve was found which resembled in some respects *P. cercadica* Maury.

Locality.—619.

Horizon.—Lares limestone.

Pecten (Plagioctenium) rabelli, new species

Plate XII, Figure 6

Shell suborbicular, slightly oblique in adult, sub-equivalve (right valve slightly more convex); ears small, subequal; shell with thirteen to fourteen strong, smooth, rounded ribs, with slightly narrower, smooth rounded interspaces; right anterior ear with faint radial theads, other ears smooth; submargins narrow, smooth, depressed, ctenolium distinct. The surface of the valves presents no very marked feature to the unaided eye, but under a strong lens, very minute, closely, evenly spaced and remarkably regular concentric lines are visible, crossing the entire shell, including the ears. In the largest specimens a gerontic character appears in the periodic swelling and contracting of the ribs. These gerontic shells are more convex than the others. Length 36 mm., height 34 mm., semi-diameter 8 mm. A smaller specimen has a semi-diameter of 5 mm.

Localities.—K. 29.2-29.3 Lares road, K. 25 Ponce-Adjuntas road, Juana Diaz, Yauco.

Horizon.—San Sebastian shale, Juana Diaz shale.

Pecten (Plagioctenium) cercadica Maury

Plate XIII, Figures 2, 3

Pecten cercadica Maury, Bull. Amer. Paleont., V, No. 29, p. 188, Pl. 34, fig. 11, 1917.

Shell bilaterally symmetrical, sub-equivalve (right valve of slightly greater convexity); submargins broad, smooth except for faint growth lines; ears large, sub-equal, nearly smooth, triangular in outline except the right anterior, which is marked by deep byssal notch and byssal sulcus below, and surface of ear with five imbricated radial threads; ctenolium absent or obscure; other ears marked by very faint radial threads or striation, strongest

near base of ear; surfaces of valves similar and marked by fourteen to seventeen strong rounded ribs and slightly narrower interspaces, the whole crossed by fine close growth lines, periodically incised so as to give the effect of obscure beading of the ribs, a feature not evident on worn specimens; valves grooved within, but lirate only near ventral margins; single pair of strong cardinal crura. Average size;—length 21 mm., height 21 mm., semi-diameter 3.5 mm.; largest specimen;—length 26 mm., height 27 mm., semi-diameter 4.5 mm.

This shell resembles *P.* (*Plagioctenium*) *andersoni* Arnold of the Pacific Coast Miocene, but is smaller. The latter species differs in having the left valve more convex than the right. The shell here described appears to correspond to Maury's description which was based on a left valve only.

Type localities.—619, 333, 324.

Other localities.—331, 227 (top 30 feet).

Horizon.—Lares limestone.

Pecten (Plagioctenium) borinquenense, new species

Plate XIV, Figures 1, 2

Shell sub-orbicular, sub-equivalve, slightly oblique, sub-marginal slopes slightly concave (left valve slightly less); sculpture of the two valves dissimilar. Right valve with sixteen to nineteen strong flat ribs of T-rail cross-section, wider than interspaces, especially in the unworn specimens where the lateral overhang obscures the borders of the interspaces; interspaces rounded and sculptured with raised concentric threads, very regular and evenly spaced (one-fifth mm. apart in ventral part of shell); tops of ribs marked by obscure median keel; concentric threads cross the ribs and are bowed up in the form of lamellae on crossing the median keel. The ribs are usually worn smooth showing the lamellae on top as a series of V-shaped striations; ears sub-equal, small; hinge line less than half the length of shell, sub-margins nearly smooth; ctenolium obscure and marked by deep byssal groove bordering the line of teeth; byssal notch small; adductor scar large, central; left valve with seventeen to twenty-one strong, high, rounded ribs and sub-equal rounded interspaces; both ribs and interspaces crossed by fine raised concentric threads, somewhat irregular and more distantly spaced than in the right valve, and worn or obscure on crossing the ribs; ears sub-equal and sculptured by radial grooves and incremental lines; sub-margins as in the right valve. Interior of both valves smooth or faintly fluted, but strongly fluted and lirate around the ventral margins; greatest convexity in the umbonal region. The ribs of both valves are rounded in the epionic stage. Adult shell measures in length 32 mm., height 31 mm., diameter of right valve 10 mm.

This shell has ribs similar to *P. diegensis* Dall of the Pacific Coast Pleistocene, but is otherwise a different shell. Maury's *P. caimitica,* a single left valve from the Santo Domingo Miocene is similar to the left valve of this shell.

Locality.—313.

Horizon.—Upper Quebradillas limestone.

Genus **Amusium** Bolten

Amusium papyraceum Gabb

Pleuronectia papyracea Gabb, Trans. Amer. Phil. Soc., V, p. 257, 1873.

Amusium papyraceum Dall, Trans. Wagner Inst. Sci., III, pt. 4, p. 718, 1898; *Idem,* pt. 6, p. 1586, 1903.

Amusium papyraceum Maury, Bull. Amer. Paleont., V, No. 29, p. 190, Pl. 26, fig. 22, 1917.

Found only in fragments, indicating a size of 35 by 36 mm.

Localities.—118, (talus), 261.

Horizon.—San Sebastian shale.

Amusium mauryi, new species

Plate XIV, Figure 3

Shell small, thick, moderately convex, entirely smooth except for very fine growth lines; ears sub-equal, large, sub-triangular; juncture of ears with shell slightly depressed, but not otherwise marked off. The interior of the valve is inaccessible, but there seem to be no internal ribs or else very obscure ones. They do not show on the exterior, and there are no radial rays or striations of any sort. The shell is unusually solid. It is probably related to *A. luna* Brown and Pilsbry, and to *A. mortoni* Ravenel, but differs from these in its small size and relatively much larger ears. Length 19 mm., height 19.5 mm., semi-diameter 3 mm.

A single left valve, which was at first included with the specimens of *A. papyraceum.* Dr. Maury, in looking over the specimens, pointed out the mistake.

Locality.—Collazo Falls.

Horizon.—San Sebastian shale.

Amusium (Propeamusium) hollicki Maury

Locality.—75.

Horizon.—San Sebastian shale.

Genus **Spondylus** Linné

Spondylus bostrychites? Guppy

Spondylus bifrons Sowerby, Quart. Jour. Geol. Soc., VI, p. 53, 1849; not of Goldfuss, Petref., II, p. 99, pl. 106, figs. 10a-c, 1835.
Spondylus bostrychites Guppy, Proc. Sci. Assoc. Trinidad, p. 176, 1867.
Spondylus bostrychites Gabb, Trans. Amer. Phil. Soc., XV, p. 257, 1873.
Spondylus bostrychites Dall, Trans. Wagner Inst. Sci., III, pt. 4, p. 758, 1898; pt. 6, p. 1586, 1903.
Spondylus bostrychites Maury, Bull. Amer. Paleont., V, No. 29, p. 190, pl. 32, fig. 4, 1917.

A small internal mold of a *Spondylus,* which, because of its small hinge area and sub-equal valves, is identified doubtfully with the above species. Length 22 mm., height 26 mm., diameter 15 mm.

Localities.—162, 23?, 126.

Range.—San Sebastian shale to Cibao limestone.

Spondylus gumanomocon Brown and Pilsbry

Spondylus americanus Gabb, Trans. Amer. Phil. Soc., V, p. 257, 1873; not of Lamarck.
Spondylus gumanomocon Brown & Pilsbry, Proc. Acad. Nat. Sci. Phila., p. 514, 1912 (footnote).
Spondylus gumanomocon Maury, Bull. Amer. Paleont., V, No. 29, p. 191, 1917.

An internal mold and a fragment of the external mold were found of a shell which is like *S. gumanomocon* but somewhat smaller. It may be a small variety or the young shell. Lower valve strongly convex, beak long, erect; surface with strong ribs 5 mm. apart, apparently spinose, and alternating with three or four small obscure ribs. The ribs are slightly wavy; upper valve orbicular, slightly convex; ribs known only from the internal mold but seem to be like those of the upper valve except that they are finer; hinge line about 24 mm. in length. The internal mold shows the beak of the lower valve to be considerably excavated. Length 55 mm., height of lower valve 66 mm., of upper valve 54 mm., diameter 29 mm.

From the proportions of the internal mold it will be seen that this shell is less elongate than *S. gumanomocon* as described from Santo Domingo. The upper valve is much flatter than the Gatun species, *S. scotti* Brown & Pilsbry, but the shell is about the same size as the latter and is similarly sculptured.

Localities.—140, 162.

Range.—San Sebastian shale to Cibao limestone.

Genus **Ostrea** (L) Lamarck

Ostrea antiguensis Brown

Plate XV, Figure 1

Ostrea antiguensis Brown, Proc. Acad. Nat. Sci. Phil., p. 614, Pl. 19, fig. 7; Pl. 20, figs. 1, 5, 6, 1913.

These shells were at first regarded as a variety of *O. haitensis,* but on comparison, were found to be the same as Dr. Maury's Porto Rican specimens, identified by Dr. Pilsbry as *O. antiguensis,* accordingly that determination is accepted, although it is difficult to believe that the reflexed character of the upper valve is a specific character.

All of the specimens here described were taken from a zone of yellow chalk in the upper Quebradillas exposed in sea cliffs near Pt. Borinquen. The abundance of these large oysters is remarkable. They reach an enormous size and thickness, but the largest specimen collected measures in length 140 mm., height 130 mm., diameter (the two valves together) 110 mm. These forms are obviously geronitc individuals. The lower valves are strongly curved upward ventrally toward the center, but are reflexed (or curved down) on the lateral margins. Likewise, the upper valves are curved down on the lateral margins, and strongly reflexed at the ventral margin, which results in a strong interlocking of the two valves. The upper valves are almost as thick as the lower ones. The upper valves reach their maximum thickness between the center and the ventral margin, and in both valves the animal has excavated its body cavity directly below the beaks by resorption of the prismatic layers at this point with increased deposition farther on toward the ventral margin. Thus as seen in a longitudinal section of the shell these layers resemble the stratification in a migrating sand dune. The excavated body cavity occupies but a small portion of the interior of the shell.

Other specimens were found which, although almost as large as those above described, are apparently not gerontic individuals. The reflexed character of the upper valve is slightly or altogether absent, and the shell does not attain a great thickness. The spinose ribs (about 9 in number) and rounded furrows are well shown on these specimens, whereas they are obsolete or extremely irregular on the gerontic forms. The adductor scar is high and nearly central in the

thin shells, but well toward the anterior margin in the gerontic shells. It is deeply impressed in the latter. The resilifer is remarkably small for shells of this size.

Localities.—314; San Juan District (Semmes).

Horizon.—Upper Quebradillas limestone. Also reported from the "Guanica shaly limestone" by Dr. Maury.

Ostrea haitensis Sowerby

O. haitensis Sowerby, Quart. Jour. Geol. Soc. London, VI, p. 53, 1850.
O. haytensis Gabb, Trans. Amer. Phil. Soc., XV, p. 257, 1873.
O. veatchii Gabb, Pal. Cal., II, p. 34, Pl. 11, fig. 59; Pl. 17, fig. 21, 1869.
O. hermanni Conrad, Proc. Acad. Nat. Sci. Phila., V, p. 267, 1853.
O. vespertina Conrad, Pac. R. R. Rept., V, p. 325, Pl. 5, figs. 36-38, 1855; Gabb, Pal. Cal., II, p. 107, 1869.
O. virginica Guppy, Quart. Jour. Geol. Soc., XXII, p. 577, 1866. Not of Gmelin.
O. virginica var. *californica* Marcou, Geol. No. Am., 1858.
O. haitensis Guppy, Quart. Jour. Geol. Soc. London, XXXII, p. 532, 1876.
O. haitensis Dall, Trans. Wagner Inst. Sci., III, pt. 4, p. 685, 1898. *Idem*, pt. 6, p. 1586, 1903.
O. haitensis Maury, Bull. Amer. Paleont., V, No. 29, p. 182, Pl. 31, figs. 1, 2, 1917.

The shells are rather thin, orbicular in outline, and strongly plicate with seven or eight sharply angular ribs, very high centrally at the ventral margin, and sharply angular furrows between. The ribs are not noticeably spinose; resilifer shelf-like, due to excavated beak; adductor situated in central-posterior portion of vale. The shells do not attain a large size, the largest specimen measuring in length 72 mm., height 74 mm., diameter of lower valve about 30 mm.

Localities.—225, 800.

Range.—Lares limestone, Cibao limestone.

Ostrea haitensis Sowerby, variety?

Plate XV, Figures 2, 3

Some small shells were found in which the lower valves are sculptured like *O. haitensis,* with spinose ribs, frequently angular, while the upper valves are nearly smooth. The lateral inner mar-

gins adjacent to the beaks are finely crenulate, a feature not shown in the specimens of *O. haitensis.* Largest specimen measures in length 36 mm., height 43 mm., diameter lower valve 7 mm. A smaller more orbicular lower valve measures in length 22 mm., height 25 mm., diameter 6.5 mm. These little shells may be the young of *O. haitensis,* or a variety.

Locality.—62.

Horizon.—Cibao limestone.

Ostrea virginica Gmelin

O. virgiana of Lister and others.
O. virginica Gmelin, Syst. Nat., p. 3336, 1792; Dilwyn, Descr. Cat., 1, p. 277, 1817; Lam., Anim. s. Vert., VI, p. 207, 1819.
O. edulis Akerly, Am. Monthly Mag., II, p. 296, 1818 (not Linné).
O. virginiana Sowerby, Genera, *Ostrea,* f. 2, 1822.
O. borealis Lamarck, Anim. s. Vert., VI, p. 204, 1819.
O. canandenis Lamarck, *op. cit.,* p. 207, 1819.
O. triangularis Holmes, Proc. Elliot Soc., I, p. 29, 1856.
O. fundata Holmes, Post-Pl. Foss. S. Car., p. 11, Pl. 2, fig. 10, 1858.
O. semicylindrica Say, Jour. Acad. Nat. Sci. Phila. (1), II, p. 258, 1822.
O. virginica Gabb, Trans. Amer. Phil. Soc., XV, p. 257, 1873.
O. virginica Guppy, Quart. Jour. Geol. Soc. London, XXXII, p. 532, 1876.
O. virginica Dall, Trans. Wagner Inst. Sci., III, pt. 4, p. 687, 1898.
O. virginica Maury, Bull. Amer. Paleont., V, No. 29, p. 184, 1917.

The specimens show the usual great variation, but comparison with recent specimens of *O. virginica* shows no constant differences. The Porto Rican shells vary from elongate, subtriangular to ovate; beak of lower valve usually pointed, straight or slightly curved laterally; resilifer elongate in the large shells; lower valves are frequently of extreme convexity, while the upper valves are gently convex or flat, but very irregular; beak of lower valve excavated. An average seized lower valve measures in length 50 mm., height 90 mm., diameter 33 mm. Some are much broader, and a few specimens reach a much greater size and greater thickness. Color usually bluish, mottled with white.

Type locality.—282.

Other localities.—281, 65, 227 (top 30 ft.), 7 to 8 (on road-flat).

Horizon.—Upper lares limestone (very characteristic).

Ostrea sellæformis Conrad

variety **portoricoensis,** new variety

Plate XIII, Figures 4, 5, 6

Shell of moderate size, pear-shaped to elongate oval, never attaining very great thickness; valves dissimilar; lower valve with numerous radial ribs imbricated by raised laminae; resilifer deep; margins of ligament area marked by narrow groove which continues for some distance along the inner margins adjacent to the beak, and is denticulate (or marked by row of small pits) throughout; remainder of inner margin fluted by the ribs, or, in some specimens, smooth; adductor scar large, oval, nearly central; beak more or less curved laterally; upper valve smaller, convex to nearly flat; surface nearly smooth or marked usually by even, widely spaced, slightly raised concentric lamellae; beak curved laterally but less pointed than in lower valve, and with shorter ligament area; resilifer moderately impressed or even raised and convex in some individuals; lateral grooves indistinct or absent; inner margin crenulate adajacent to beaks, but smooth ventrally; adductor scar smaller than in lower valve and uniformly pear-shaped in all specimens. An average sized shell measures, lower valve, in length 62 mm., height 70 mm., upper valve, in length 42 mm., height 60 mm. Diameter (both valves) 19 mm. The upper valves of the young shells are more convex. A typical young upper valve measures in length 23 mm., height 33 mm., diameter 7 mm.

Type localities.—343, 333, 176, 59, 800.

Other localities.—619, 332, 64.

Range.—Lares limestone, Cibao limestone, Los Puertos limestone.

Ostrea collazica Maury

Shell sub-elongate to sub-orbicular, heavy, attaining great thickness in large individuals; valves dissimilar; lower valve convex, with numerous small irregular radial plications which divaricate from a median or slightly posterior zone; plications finely imbricated by thin, slightly raised laminae; beak strongly recurved laterally; ligamental area extremely long in large specimens; resilium deep but becoming shallow in gerontic individuals; margins of ligamental area marked off by narrow crenulated groove; inner margins near the beak finely crenulated; upper valve flat, with beak similarly recurved, usually more closely gyrate; surface smooth except for the thin laminae; interior similar to lower valve except for an amorphous, tooth-like process, located on the inner margin just anterior to the ligamental area, which is transversely denticulate or marked by cross grooves. In some specimens the margins of both valves are similarly marked near the beaks; adductor scars of both valves large and situated slightly posterior. Average size adult;—length 75 mm., height 85 mm.

Fragments indicate that the shell reaches a considerably larger size, in which the lower valve is greatly thickened. Two of these large lower valves were found in which the tendency of the beak to curve laterally has apparently been almost lost, the beak being long and pointed. An unusual feature of this shell is the small amount of prismatic structure. Some of the specimens are made up almost entirely of nacreous laminae of micaceous thinness.

This shell is of the *O. sellæformis divaricata* type, and the young individuals might readily be taken for a variety of *O. sellæformis.* The full grown flat upper valves with their closely gyrate beak bear a strong resemblance to *O. vaughni* Dall of the Tampa Silex beds.

Type localities.—7 to 8 (float), Lares road just east of Collazo bridge, K. 29.2 to 29.3 Lares road.

Other localities.—100, 226, 231, 233, 267, 89, 232(b), 236.

Range.—San Sebastian shale to Lares limestone. Characteristic of the San Sebastian shale, and occuring in the lowest fossiliferous zone of the latter.

Ostrea cahobasensis Pilsbry and Brown variety **portoricana,** new variety

Plate XVI, Figure 1; Plate XVII, Figure 1

Shells reach a very large size, and are characterized by their elongate form and long, pointed, and usually straight beak. The young shells are much less elongate in form. The body cavity tends to remain the same size during growth, most of the addition in height being in the beaks. The resilifer is shallow in the lower valve, and convex in the upper valve, and in both valves it is bordered by a broad, prominent ridge on each side. The latter are marked off from the lamellae of the lateral slopes by a deep impressed zone, in which there is no trace of dentition or crenulation. The beaks may be twisted or straight, and there is considerable variation in the outline of the shells due to the accidents of growth. The shells apparently grew in crowded colonies. The lower valve is convex, the upper slightly convex, or nearly flat in the younger shells. The beak of the lower valve always projects far beyond the beak of the upper valve, and in the young, is deeply excavated within, below the resilifer. The position of the adductor scar is variable, being rather high in the young, but travels ventrally with the growth of the shell, until, in the largest individuals, it is located at the ventral one-third or one-fourth of the shell. The large shells have an hour glass-shaped body cavity, consisting of a deep round cavity immediately below the resilifer, a contraction centrally, and a large crescent-shaped ventral cavity which begins opposite the adductor scar, and swings around below the

scar, and close to the ventral margin. This is a fairly constant feature of the larger shells, and is strongly developed in some of the young or half grown shells. The surface of both valves is marked only by concentric lamellae, and shows no signs of radial fluting of ribs. The lamellae are, however, occasionally quite irregular. This shell, while apparently answering the description of the Haitian species, shows differences of varietal rank. The largest specimen measures in length 100 mm., height 270 mm., diameter (both valves together) 95 mm.

Localities.—West of Guanica Mill in basal limestone a few feet above the contact with the Older Series (Lobeck) Fragments of a similar shell were found in the Lares limestone, but their identity with the Guanica shell is by no means certain.

Horizons.—Ponce limestone, Lares limestone (doubtful).

Genus **Lithophaga** Bolten

Lithophaga nigra d'Orbigny

Lithodomus niger d'Orbigny, De la Sagra, Hist. Polit. y Nat. Isla de Cuba, pt. 2, V, p. 351, 1845; Atlas, VIII, Pl. 28, figs. 10, 11, 1855 (Spanish Ed.).
Modiola caribæa Philippi, Abbild. u. Beschr., III, p. 20. Pl. 2, fig. 5, 1847.
Modiola antillarum Philippi, *op. cit.* p. 20, Pl. 2, fig. 4, 1847; Zeitscher., p. 116 (not of d'Orbigny); young shell.
Mytilus lithophagus Gibbes, S. Car. Cat., p. 22, 1848; not of Linné.
Lithophagus nigra Morch, Cat. Yoldi, II, p. 56, 1853.
Lithophagus antillarum Reeve, Conch. Icon., X, Pl. 2, fig. 7, 1857.
Lithophaga nigra Dall, Trans. Wagner Inst. Sci., III, pt. 4, p. 799, 1898; Bull. 90, U. S. Nat. Mus., p. 129, 1915.
Lithophaga nigra Maury, Bull. Amer. Paleont., V., No. 29, p. 194, 1917.

This shell is known from the Tampa Silex beds, and continues to the recent fauna of the Antilles. The recent shell of Cuba as described by d'Orbigny, has a length of 50 mm. The Porto Rican fossils differ only in size, the largest measuring in length 30 mm., height 9 mm., diameter 8 mm. The occurrence is chiefly in the form of internal molds, but fragments of the shell show the vertical striae which end abruptly at a transverse oblique line extending from the beaks to the posterior ventral margin.

Locality.—225.

Horizon.—Upper Lares limestone.

Genus **Leda** Schumacher

Leda peltella Dall

Plate XVII, Figure 6

Leda acuta Gabb, Trans. Amer. Phil. Soc., XV, p. 255, 1873. Not *L. acuta* Conrad, 1832, nor Sowerby, 1837.
Leda peltella Dall, Trans. Wagner Inst. Sci., III, pt. 4, p. 579, Pl. 32, fig. 5; *Idem*, pt. 6, p. 1586, 1903.
Leda peltella Maury, Bull. Amer. Paleont., V, No. 29, p. 161, Pl. 26, fig. 9, 1917.

One of the most abundant fossils in the Quebradillas limestone. The posterior sulcation is always broad and distinct; anterior sulcation narrow and often indistinct. Length 11 mm., heigh 6.5 mm., semi-diameter 3 mm. No specimens were found less than 9 mm. in length.

Type locality.—204.

Other locality.—660.

Horizon.—Quebradillas limestone.

Genus **Arca** Linné

Arca yaquensis Maury

Arca yaquensis Maury, Bull. Amer. Paleont., V, No. 29, p. 164, Pl. 30, fig. 14, 1917.

Several specimens were found of a very small *Arca* which closely resembles Maury's *A. vaquensis,* a somewhat doubtful species from the Santo Domingan Oligocene. The Porto Rican shells show no distinctive characters, and are placed with *A. yaquensis* because they correspond more closely to this than to any other species. The specimens are very numerous and all about the same size, hence it is unlikely that they are young individuals. Length 8 mm., height 4.5 mm.

Type locality.—204.

Other locality.—225.

Range.—Lares limestone to Quebradillas limestone.

Arca dariensis Brown and Pilsbry

Plate XV, Figure 5

Arca dariensis Brown and Pilsbry, Proc. Acad. Nat. Sci. Phila., p. 362, Pl. 22, fig. 10, 1911.

Umbo prominent, at anterior third of shell; surface with thirty-three flat ribs and sub-equal flat interspaces, the whole crossed by fine raised concentric lines, strongest on ribs and giving to the latter a nodular appearance; ribs broaden anteriorly and posteriorly, the ten posterior and the five or six anterior ribs medially grooved. Length 26 mm., height 16.5 mm., semi-diameter 5.5 mm.

This *Arca* is smaller than the Gatun species, and may be a variety of it. It also resembles the shell described by Toula as *Arca* cf. *consobrina* Moore.

Localities.—Collazo Falls, 261?, 232(b).

Horizon.—San Sebastian shale.

Arca (Scapharca) cf. **donacia** Dall

Plate XV, Figures 6, 7

Arca (Scapharca) donacia Dall, Trans. Wagner Inst. Sci., III, pt. 4, p. 649, Pl. 33, fig. 13, 1898.

The size and sculpture answers Dall's description of this species, especially the raised concentric threads in the interspaces of the left valve, a feature lacking on the right valve. It differs from the Bowden form in the number of ribs (27), and in having a shallow median depression, strongest in the left valve. Length 8.5 mm., height 6.5 mm. A smaller shell measures in length 6.75 mm., height 4.5 mm.

Locality.—204.

Horizon.—Quebradillas limestone.

Arca, species indet.

Plate XVII, Figures 2, 3

Shell small, very convex; beaks at anterior third; anterior and posterior ends equally rounded; hinge area broad, especially anteriorly, with beaks widely separate; surface with twenty-five broad, quadrate, rather low ribs and equally wide, shallow rounded interspaces; central ribs medially grooved distally; hinge margin three-fourths the length of shell and slightly raised

above hinge area; hinge area transversely grooved or striate posteriorly; teeth fine, numerous; interior of valves unknown. Average size measures in length 19 mm., height 10.5 mm., diameter 12 mm. Largest specimen measures in length 25 mm., height 13.6 mm., diameter 16 mm.

Type locality.—230.

Other localities.—233, 232(b).

Horizon.—Upper San Sebastian shale.

Arca (Scapharca) collazica Maury

The material collected by the writer consists only of internal molds. An average sized specimen measures in length 16.5 mm., height 9.5 mm., diameter 7.5 mm.

Localities.—333, 619, 64, 232(b).

Range.—Upper San Sebastian shale to Cibao limestone. Very abundant.

Subgenus **Barbatia** Gray

Barbatia (Acar) reticulata Gmelin

Arca reticulata Gmelin, Syst. Nat., VI, p. 3311, 1792.

Arca reticulata Sheldon, Palaeontographica Americana, I, p. 20, Pl. 4, figs. 8-12, 1916.

Barbatia (Acar) reticulata Maury, Bull. Amer. Paleont., V, No. 29, p. 166, Pl. 30, fig. 16, 1917.

A single fragment was found, sufficiently complete to identify. Length indeterminate, height 6 mm.

Locality.—204.

Horizon.—Quebradillas limestone.

Barbatia cf. **bonaczyi** Gabb

Plate XIV, Figure 4

Barbatia bonaczyi Gabb, Trans. Amer. Phil. Soc., XV, p. 254, 1873.

Arca umbonata Dall, Trans. Wagner Inst. Sci., III, pt. 4, p. 620, Pl. 38, figs. 4, 4a, 1898. Not of Lamarck.

Barbatia cf. *bonaczyi* Maury, Bull. Amer. Paleont., V, No. 29, p. 165, Pl. 30, fig. 15, 1917.

A single external mold of a right valve resembling *B. bonaczyi* Gabb, but smaller. It is nearer the size of *B.* cf. *bonaczyi* described

by Maury, but the sculpture is coarser. It is very probably a variety, but the specimen is too poor for complete description. The ribs are crowded centrally and sparser at the ends of the valve. Those on the posterior slope lose their bearded character and become scaly. Valve with shallow median sulcation. Length about 12 mm., height 6 mm.

Locality.—204.

Horizon.—Quebradillas limestone.

Genus **Glycimeris** Da Costa

Glycimeris portoricoensis, new species

Plate XV, Figure 6

Shell sub-orbicular; beaks not prominent; surface with about thirty strong sub-angular to rounded ribs and sub-angular interspaces, the whole crossed by fine raised concentric threads, regular and evenly spaced. The ribs near the ventral margin broaden rapidly at the expense of the interspaces, and become round in cross-section. Interior of shell unknown. Largest specimen measures in length 19 mm., height 17 mm., semi-diameter 4 mm.

This shell resembles *G. acuticostata* Sowerby, but has broader, more rounded ribs.

Localities.—204, 182, 318.

Range.—Upper Los Puertos limestone to Quebradillas limestone (typical of the latter).

Glycimeris collazoensis, new species

Plate XV, Figures 4, 5

Shell sub-orbicular, beaks not prominent; hinge area short; teeth numerous, in uninterrupted series; surface with thirty-four low angular ribs and angular interspaces; each rib with fine keel or thread on the apex, and with the appearance of a groove on either side of this median thread; inner margin scalloped ventrally; length 15 mm., height 16 mm., semi-diameter, 4 mm.

This shell resembles *G. gatunensis* Toula, but the latter is smaller and more transversely elongate. It also resembles *G. portoricoensis* of the Quebradillas limestone, of which it may possibly be the progenitor. *G. portoricoensis* differs chiefly in its larger size, more rounded ribs, and strong concentric growth lines.

Locality.—261.

Horizon.—Lower San Sebastian shale.

Genus **Venericardia** Lamarck

Venericardia scabricostata? Guppy

Cardita scabricostata Guppy, Quart. Jour. Geol. Soc. London, XXII, p. 293, Pl. 18, fig. 10, 1866.
Cardita scabricostata Gabb, Trans. Amer. Phil. Soc., XV, p. 252, 1873.
Cardita scabricostata Guppy, Quart. Jour. Geol. Soc. London, XXXII, p. 531, 1876.
Venericardia scabricostata Dall,, Trans. Wagner, Inst. Sci., III, pt. 6, pp. 1428, 1586, 1903.
Venericardia scabricostata Maury, Bull. Amer. Paleont., V., No. 29, p. 198, Pl. 33, fig. 1, 1917.

Shell with prominent beaks; 18 to 20 high nodose ribs and narrower, V-shaped interspaces which are crossed by strongly marked growth lines; lunule broad, short, and distinct. Length about 4.5 mm., height 4 mm., semi-diameter 1.5 mm. The specimens found are much smaller than *V. scabricostata,* and yet seem to be mature shells; they may be a variety.

Locality.—225.

Horizon.—Lares limestone.

Venericardia cerrogordensis Maury, new variety

Venericardia cerrogordensis Maury, Bull. Amer. Paleont., V, No. 29, p. 199, Pl. 33, fig. 3, 1917.

A single fragment of anterior half of a left valve, which seems to be a variety of this species, somewhat larger than the Santo Domingo shell. About fourteen strong ribs with strongly beaded keel; interspaces wider than ribs, shallow, with wavy growth lines and showing an obscure crenulated radial thread on either side at base of rib. Length about 27 mm., height about 23 mm., semi-diameter, etc., 5.5 mm.

This may be a distinct species but the specimen is so incomplete that it has been identified with the nearest form. The specimen was found in a piece of road metal at K. 26.5 Lares road and its horizon is unknown. The rock is a white limestone like the Quebradillas and contains a mold of *Chione* cf. *woodwardi* Guppy.

Genus **Chama (Linné)** Bruguière

Chama involuta Guppy

Chama involuta Guppy, Geol. Mag. London, decade 2, I, p. 436, Pl. 17, figs. 5a-c, 1874; Quart. Jour. Geol. Soc. London, XXXII, p. 531, 1876.
Chama involuta Dall, Trans. Wagner Inst. Sci., III, pt. 6, pp. 1398, 1586, 1903.
Chama involuta Maury, Bull. Amer. Paleont., V, No. 29, p. 199, Pl. 33, figs. 4, 5, 6, 1917.

The Porto Rican specimens are unusually large, but apparently of this species. The largest specimen is fragmental, but shows a height of 52 mm. Judging from the specimens, it attaches by either valve. The beak is strongly prosogyrate, making over one complete turn. The lamellae are strongly fluted, almost spinose on one specimen.

Localities.—204, 98(Berkey).

Horizon.—Quebradillas limestone.

Chama portoricana, new species

Plate XVII, Figure 5

Beak closely prosogyrate; surface with extremely crowded, thin, high lamellae, which on the largest specimen rise 8 mm. above the shell surface. These lamellae are quite regular, being gently fluted over the body of the shell, but spinose at the margin in the adult; shell marked by rounded umbonal ridge; inner margin finely crenulate; cardinal area pustulose; strong bifid and crenulate cardinal tooth in the right valve, with crenulate lateral; shell attaches by either valve, but the cardinal tooth remains in the right valve in either case; adductor scars large; pallial line distinctly impressed. Length 48 mm., height 35 mm., diameter of convex valve about 12 mm. A smaller attached valve measures length 22 mm., height 18 mm., diameter 9 mm.

This shell differs from *C. congregatoides* Maury in its more regular and higher lamellae, and in its more elongate form.

Locality.—204.

Horizon.—Quebradillas limestone.

Genus **Lucina** (Bruguière) Lamarck

Lucina collazoensis, new species

Plate XVIII, Figures 1, 2

Shell transversely ovate, convex, produced posteriorly, beaks being slightly forward of center and frequently so close together that they practically touch;

hinge line long and straight, nearly nine-tenths the length of the shell. The largest specimen, somewhat distorted so as to increase the convexity, measures in length 65 mm., height 40 mm., diameter 45 mm. A smaller shell, not distorted, measures in length 39 mm., height 31 mm., diameter 25 mm.

This is a ponderous shell of the type of *L. corpulenta* Dall, but unusual for its elongate form and long straight hinge line. It occurs chiefly as internal molds of both valves intact, but the form is often distorted by pressure. Fragments of external mold show the surface to be nearly smooth, marked only by fine growth lines, periodically incised at irregular intervals.

There is an undescribed shell in the Kemp collection from the lower Gatun beds which is apparently this species, or very close to it.

Localities.—74, 92, 86, Collazo (float).

Horizon.—San Sebastian shale (abundant at Collazo Falls).

Lucina cf. **chrysostoma** (Meuschen) Philippi

Plate XVIII, Figure 3

Tellina crysostoma Meuschen, Mus. Gevers., p. 482, 1787 (typographical error).

Lucina chrysostoma Philippi, Abb. und Beschr. neue Conchyl., II, p. 206, Pl. 1, fig. 3, 1847.

Venus edentula Chemnitz, Conch. Cab., VII, Pl. xl, figs. 427-9, 1784; Gmelin, Syst. Nat., VI, p. 3286, 1792; not of Linné, Syst. Nat., ed. 10, p. 689, 1758.

Anodontia alba Link, Beschr. Rostock Samml., p. 56, 1807.

Lucina edentula Reeve, Conch. Icon., *Lucina*, Pl. ii, fig. 9, 1850; Heilprin, Trans. Wagner Inst., I, pp. 102-3, 1886.

Loripes chrysostoma Arango, Fauna Mal. Cubana, p. 257, 1878.

Lucina chrysostoma Dall, Trans. Wagner Inst., III, pt. 6, p. 1354, 1903.

Loripes edentula Gabb, Trans. Amer. Phil. Soc., XV, p. 251, 1873.

Lucina chrysostoma Maury, Bull. Amer. Paleont., V, No. 29, p. 202, Pl. 35, fig. 2, 1917.

Resembles *L. chrysostoma* of the Caloosahatchie Pliocene, but the largest and most convex specimens resemble the recent *L. globosa* Forskol. Only internal molds have been found, which show lunule impression, and posterior sulcation close to dorsal margin. The specimens range in length 39 mm., height 36 mm., diameter 22 mm. to length 135 mm., height 115 mm., diameter 95 mm.

Localities.—205, 174. 10, 78, 98, 176? (Berkey). Mona Island, south side of Vieques Island, Guanica, and Ponce (Lobeck).

Horizons.—Los Puertos, Quebradillas limestones, and Ponce formation. These large shells are very abundant as internal molds in the Tertiary formations of the north and south coasts.

Genus **Phacoides** Blainville

Phacoides (Miltha) riocanensis Maury

Phacoides (*Miltha*) *riocanensis* Maury, Bull. Amer. Paleont., V, No. 29, p. 205, Pl. 35, fig. 7, 1917.

The Porto Rican shells are the same size as those of the Santo Domingan Oligocene. There seem to be no important differences. The former shells have a slight differentiation in the concentric lamellae, two lamellae of secondary strength alternating with each primary one. A shallow median sulcus is a noticeable feature near the ventral margin, but does not extend to the beak. Length about 47 mm., height about 45 mm., semi-diameter 7.5 mm.

Localities.—335, 204, 220, 225, 318, 317.

Range.—Lares limestone, Cibao limestone, Los Puertos limestone, Quebradillas limestone. This species is widespread but not abundant.

Phacoides (Miltha), species indet.

Plate XVIII, Figure 4

Shell of moderate size, convex, slightly inequalateral; hinge area narrow, short, beaks incurved and nearly in contact; anterior margin broadly rounded, posterior margin roundly truncate, basal margin nearly straight; posterior sulcus close to margin; concentric sculpture of fine, even, raised lamellae, about 1/3 mm. apart at ventral margin, and with fine growth lines in the spaces between. Height of shell about 24 mm., length about 34 mm., semi-diameter 7 mm.

Only a single fragment was found which was too incomplete for an accurate description, but differed from any other species. This shell resembles *P.* (*Miltha*) cf. *smithwoodwardi* Maury, a species from the same horizon, but is more elongate than the latter, and has the posterior sulcus much closer to the margin.

Locality.—204.

Horizon.—Quebradillas limestone.

Phacoides (Miltha), species indet.

Plate XVIII, Figure 5

Shell small, orbicular, moderately convex. Sculpture of fine concentric lamellae like *P. hillsboroense;* deep radial sulcus crossing the posterior one-quarter of shell and extending to ventral margin. Fine concentric striae between the lamellae are visible under a lens. Length 12 mm., height 12.5 mm., semi-diameter 3.5 mm.

Only one specimen was found, the external mold of a left valve. It may possibly be the young of a large species like *P. riocanensis.*

Locality.—52(a).

Horizon.—Quebradillas limestone.

Phacoides (Pseudomiltha) laresensis, new species

Plate XVIII, Figure 6

Shell sub-orbicular, nearly equilateral, moderately convex; surface with concentric lamellae of the type of *P. hillsboroense,* but very regular instead of wavy as in the latter; concentric striae between the lamellae; lunule narrow, deeply impressed; escutcheon large, marked off by a narrow sulcus which broadens at the posterior margin; concentric sculpture flexed sharply upward over the escutcheon, where it becomes coarser; surface of shell marked by faint radial striae; cardinal area edentulate; interior of shell unknown. The shell is thin, and in most of the specimens is worn partially or wholly away, leaving only the internal mold. Length 36 mm., height 34 mm., diameter 18 mm.

Localities.—262, Collazo Falls, 232(b)?

Horizon.—San Sebastian shale.

Phacoides (Lucinisca) calhounensis Dall

Plate X, Figure 6

Phacoides (Lucinisca) calhounensis Dall, Trans. Wagner Inst. Sci., III, pt. 6, p. 1371, Pl. 52, fig. 16, 1903.

Phacoides calhounsis Maury, Bull. Amer. Paleont., V, No. 29, p. 204, 1917. (Typographical error.)

These shells are variable but have the same general characters as the Florida form. The majority of the specimens are the same size as the latter, but occasionally attain a considerably greater size. The greater prominence and sparcity of the concentric ridges in the mm-

bonal region is a noticeable feature. The radial ribs are finer and somewhat crowded on the posterior slope and to a lesser extent on the anterior slope. Dall does not mention this character but it may be observed in his illustration. The intersections of the radials with the concentric ribs have a tendency to form spinose nodes, especially in the adult stage near the lateral margins. This gives the shell a superficial resemblance to *P. hispaniolana* Maury, but the sculpture of the latter is much finer. The Porto Rican shell has a large and distinct lunule. An average size specimen measures in length 10 mm., height 9.5 mm., semi-diameter 2.5 mm. The largest specimen measures in length 13 mm., height 12 mm., semi-diameter 4 mm.

Type locality.—204.

Other localities.—52(a), 77(Berkey).

Horizon.—Quebradillas limestone (abundant); Ponce limestone.

Genus **Divaricella** Von Martens

Divaricella prevaricata Guppy

Divaricella prevaricata Guppy, Proc. U. S. Nat. Mus., XIX, No. 1110, p. 327, Pl. 30, fig. 4, 1896.

Divaricella prevaricata Dall, Trans. Wagner Inst. Sci., III, pt. 6. pp. 1389, 1587, 1903.

Divaricella prevaricata Maury, Bull. Amer. Paleont., V., No. 29, p. 207, Pl. 35, fig. 10, 1917.

The divaricate lines are finer than those of the Santo Domingo shell. The single specimen found measures in length 7 mm., height 5.75 mm.

Locality.—204.

Horizon.—Quebradillas limestone.

Genus **Codakia** Scopoli

Codakia (Jagonia) magnoliana Dall

variety **borinquenense,** new variety

Plate XVII, Figure 4

A single right valve was collected. It is slightly smaller than the shell described from the North Carolina Miocene, and the concentric sculpture is more pronounced. The radials are slightly wavy as in

Codakia orbicularis, and increase by intercalation. They vary in strength, parts of the shell being marked by ribs finer and more crowded than in adjacent portions of the surface. The shell is noticeably inequilateral. The lunule is long and narrow. Length 10 mm., height 8 mm., semi-diameter 4 mm.

Localities.—204, 671.

Horizon.—Quebradillas limestone.

Genus **Cardium** (Linné) Lamarck

Cardium (Lævicardium) cf. **serratum** Linné

Cardium serratum Linné, Syst. Nat., ed. 19, p. 680, 1758.
Cardium lævigatum Lamarck, Anim. s. Vert., VI, pt. 1, p. 11, 1819 (not of Born, Mus. Vind. Test., p. 47, 1780; nor of Linné, Syst. Nat., X, p. 680, 1758).
Cardium citrinum Wood, Gen. Conch., p. 223, Pl. 54, fig. 3, 1815.
Liocardium pictum Ravenel, Proc. Acad. Nat. Sci. Phila., for 1861, p. 44, 1862.
Cardium hiatus "Meuschen" *fide* Krebs, W. I. Cat. Shells, p. 115, 1864.
Cardium lineatum Krebs, *op. cit.*, not of Gmelin, 1792.
Cardium pristis Valenciennes, *fide* Krebs, *op. cit.*
Cardium oviputamen Reeve, Conch. Icon., *Cardium,* Pl. 7, fig. 36, 1844.
Cardium venustum Gabb, Trans. Amer. Phil. Soc., XV, p. 251, 1873.
Cardium serratum Dall, Proc. U. S. Nat. Mus., XIX, No. 1110, p. 327, 1896; not *serratum* of Pennant, 1778).
Cardium serratum Dall, (in part), Trans. Wagner Inst. Sci., III, pt. 5, p. 1110, 1900.
Cardium serratum Brown and Pilsbry, Proc. Acad. Nat. Sci. Phila., p. 367, 1911.
Cardium serratum Maury, Bull. Amer. Paleont., V, No. 29, p. 212, Pl. 36, fig. 8, 1917.

Numerous internal molds apparently of this species, and of about the same size as those of the Santo Domingo Oligocene were found. They average about 20 mm. in height. Fragments of external mold show numerous fine thread-like radial ribs. Some specimens show a slight radial sulcation anteriorly.

Localities.—204, 225, 333?, 64.

Range.—Lares limestone to Quebradillas limestone.

Cardium (Trachycardium) muricoides, new species

Plate XIX, Figure 1

Shell sub-ovate, convex; surface with about 36 spinose ribs and narrower, rounded, transversely striate interspaces; interior of valves grooved and scalloped at ventral margins. All ribs except the three anterior ones have a

lateral keel on each edge at the top. The three anterior ribs have only one such keel, placed on the anterior side. The first ten ribs (including the three single keeled ones) are ornamnted with longitudinally ovate, long, erect, or slightly hooked spines along the anterior keel, but spreading out over the center of the rib. All the remaining ribs have the spines on the posterior side. From the eleventh rib to the eighteenth inclusive, the spines are like those of the ten anterior ribs, but commencing with the nineteenth rib the spines posteriorly become narrower, blade-like, set longitudinally on the rib, and curved posteriorly over the adjacent interspace. All the ribs are flat topped, but the posterior ribs have the tops sloping posteriorly. Length 30 mm., height 32.5 mm., semi-diameter 11 mm.

This shell is twice as large as *C. bowdenense* Dall. The ornamentation especially of the rib is nearer to that of *C. muricatum* than to that of any other species. It is apparently related to *C. (Trachycardium) gatunensis* Toula, and is one of the early members of the *C. muricatum* group.

Type locality.—179.

Other localities.—225, 24?, and (doubtfully) near Guanica Central (Lobeck).

Range.—Lares limestone, Cibao limestone, Los Puertos limestone.

Cardium (Trachycardium) cinderellæ Maury variety **alternatum,** new variety

Plate XIX, Figures 2, 3, 4

Shell equivalve, slightly inequilateral; beaks high, strongly incurved; hinge line rather long; surface with about thirty-six broad, flat ribs with narrow interspaces; ribs appear medially grooved when worn smooth. When perfect, they show a single row of high, vaulted, inverted V-shaped spinose scales, which cover the width of the rib, and are somewhat unevenly spaced, though not crowded. There is a strong tendency toward alteration of ribs with large and ribs with small spines. This is more marked in some specimens than in others. It is a feature not mentioned in Maury's description of the Santo Domingo shell, but shows in the illustration of the latter. The interspaces are faintly grooved radially, and strongly transversely striate; valves internally grooved, and inner margins strongly scalloped ventrally. Length 29 mm., height 33 mm., diameter 26 mm.

The sculpture is like *C. cinderellæ* Maury, but the shell is larger, shorter, and more convex. It may possibly deserve a specific name, but the specimens are too fragmental to warrant this.

Localities.—225, 226, 280, 281, 331.

Horizon.—Lares formation.

Cardium (Trigonocardia) sambaicum Maury variety **portoricoensis,** new variety

Plate XIX, Figures 5, 6

No complete shells were found, but fragments large enough to show the outline of the shell. They seem to be quite variable. There are some specimens in which the ribs are worn smooth as in Maury's illustration from Santo Domingo. Some specimens show the ribs slightly wider than the interspaces, but usually the reverse is true, especially in the ventral portion of the shell. Fine raised concentric threads cross the interspaces and cross the ribs between the nodes. These threads are much finer and more crowded where they cross the ribs. In the interspaces they are very irregular, and frequently end short at the center of the interspace. These terminated threads have a tendency to alternate from opposite sides of the interspace as though shearing or faulting had displaced them. The nodes on the ribs are high and prominent. The shells are smaller and less convex than the Santo Domingo form, but the number of ribs, truncation and outline of the shell are about the same. Length 13 mm., height 13 mm., semi-diameter 5 mm.

Locality.—204.

Horizon.—Quebradillas limestone.

Cardium, new species (aff. **C. sambaicum** Maury)

Plate XIX, Figure 7

Fragment indicating a shell of the size and general outline of *C. sambaicum* Maury, but with a somewhat different sculpture of the ribs. Shell with about 25 strong ribs, high and rounded on top, and slightly narrower U-shaped interspaces. The whole is crossed by fine, close concentric threads, quite irregular, and of which every second, third or fourth one on crossing the ribs expand into broad semi-cone shaped scales the pieces of which are toward the beak. These scales are irregularly spaced, and are especially crowded near

the ventral margin. Where the ribs are worn, these scales appear as thin arched lamellae. Length of shell about 20 mm.

Locality.—204.

Horizon.—Quebradillas limestone.

Cardium (Trigonocardia) haitense Sowerby

variety **cercadicum** Maury

Plate XIX, Figure 8

Cardium haitense Sowerby, Quart. Jour. Geol. Soc. London, VI, p. 52, Pl. 10, fig. 11, 1849 (in part).

Cardium (Trigonocardia) haitense variety *cercadicum* Maury, Bull. Amer. Paleont., V., No. 29, p. 212, Pl. 36, fig. 6, 1917.

This shell corresponds closely to Maury's variety *cercadicum* of Santo Domingo. The truncation is sharp; ribs with inverted V-shaped nodules; ribs on the truncation have a few scattered spinose nodules; ribs flat, those anterior to the truncation having the flat tops sloping anteriorly, thus giving the ribs an asymmetric V-shaped cross-section. There are nine ribs on the truncation, and fourteen on the main body of the shell. Concentric threads in the interspaces, which, in the anterior part of the shell occasionally cross the ribs. The nodules on the ribs are rather low and indistinct except on the rib which marks the truncation, where they are prominent. Length 10 mm., height 11 mm., semi-diameter, etc., 5 mm.

Localities.—204, 52(a), 192, 77 ? (Berkey).

Horizon.—Quebradillas limestone (characteristic), and in the Ponce limestone.

Cardium (Trigonocardia) haitense Sowerby

variety **areciboense,** new variety

Plate XIX, Figure 9

Very close to *C. haitense cercadicum* Maury, but shorter and more sharply truncate, and with fewer, coarser ribs which are more de-

cidedly angular. The ribs on the truncation near the dorsal margin have regularly spaced V-shaped spines, pointing sharply upward. The nodules and concentric threads are otherwise exactly like those of variety *cercadicum*. There are six ribs on the truncation and eleven on the remainder of the shell. Length 10 mm., height 14 mm., semi-diameter 6 mm.

Locality.—204. Also Berkey 77.

Horizon.—Abundant in the Quebradillas limestone and occurring also in the Ponce limestone.

Genus **Clementia** Gray

Clementia dariena Conrad

Plate XIX, Figures 10, 11, 12

Meretrix dariena Conrad, Pac. R. R. Rep., V, p. 328, Pl. 6, fig. 55, 1856.
Clementia dariena Gabb, Jour. Acad. Nat. Sci. Phila. (2) VIII, p. 344, Pl. 44, fig. 16, 16a, 1881.
Clementia dariena Dall, Trans. Wag. Inst. Sci., III, pt. 6, p. 1235, 1903.
Clementia dariena Toula, Jahrb. der K. K. Geol. Reichanst. Wien, LVIII, p. 725, Pl. 27, figs. 9, 10, 1908.
Clementia dariena Brown & Pilsbry, Proc. Acad. Nat. Sci. Phila., p. 371, Pl. 28, fig. 1, 1911.

The typical Porto Rican shells are smaller than those of the Panama region and Costa Rica, but otherwise show no marked differences. The Porto Rico shells are not dwarfed forms, but merely arrested in growth, the average adult being an exact replica of a Gatun shell when the latter is two-thirds grown. This might lead to the supposition that the Porto Rican analogue is a primitive form of the Gatun shell, except for the fact that the former occasionally reaches a size as great as the average Gatun shell and is exactly simliar, even to the loss of ribs near the ventral margin. To emphasize this point, an average specimen from Dr. Kemp's Gatun collection (in the Columbia University museum) is illustrated here together with one of the large Porto Rican shells, for comparison.

A comparison of the Porto Rican shells with available sources is shown in the following table.

TABLE 2

Source	Length mm.	Height mm.	Diameter mm.	Number of prominent ribs	Breadth of ventral ribless zone mm. (meas. vertical)
Gabb, illustration. Sapote, Costa Rica	57	47.5	33.5	26–35	10
Brown & Pilsbry, illustration. Gatun	65	63	?	26?	18
Toula, illustration. Gatun	67	56	?	28	19
Toula, description. Gatun	47	38	?	?	?
Kemp collection, specimen. Upper Gatun	63	61.5	36	33	23
Kemp collection, specimen. Lower Gatun	51	43	25.5	31	7
do	48	44	24.5	30	10
do (young shell)	27	25?	14	22?	0
Porto Rico, San Sebastian shale at Collazo Falls	48	44.5	26	27	13
Porto Rico, San Sebastian calcareous shale at Robles.	41	34	19		
do	39	31	23		
do	38	33.5	20		
do	38	35.5	18.5		
do	37.5	33	19.5		
do	35	32.5	20		
do	35	32.5	17.5	25–30	0–5
do	35	33	17		
do	?	34	20		
do	?	33	15		
do	?	32	20		
do	?	29	17.5		
do	?	28	19		

It will be noticed from this table that there is considerable variation in size and proportions among the specimens. This is due in part to distortion by pressure as regards the proportions. If the average of these measurements is taken and the height and diameter expressed in terms of the length as unity, we have the following relationship:

	Length	Height	Diameter	Average length mm.
Gabb's illustration. Sapote, Costa Rica	1	0.83	0.59	57
Kemp's large specimen from the upper Gatun	1	0.98	0.57	63
Kemp's smaller specimens from the lower Gatun	1	0.88	0.51	42
Large Porto Rico specimen from the Collazo district	1	0.93	0.54	48
Smaller Porto Rico specimens from the Robles district	1	0.87	0.51	37

It will be noticed that in the larger specimens there is a relatively greater increase in the height and diameter, due to the slight change in shape of the shell with growth. The measurements from Gabb's illustration are of doubtful value in this comparison.

The uniformity of size and number of ribs is a feature brought out in the table. The Porto Rican shells have about the same number of ribs as the Gatun shells, and in the ribbed stage are about the same size. The Gatun shells usually, and the Porto Rican shells occasionally grow beyond this stage with loss of ribs, an ontogerontic character. The Gatun shells were longer lived, apparently living under more favorable conditions than those of the upper San Sebastian shale in Porto Rico.

Localities.—232(b), 233, Collazo Falls, 83, 84, Juana Diaz.

Horizon.—San Sebastian shale, Juana Diaz shale.

Genus **Cytherea** Bolten

Cytherea (Cytherea) berkeyi, new species

Plate XX, Figures 1, 2, 3

Shell large, convex, very inequilateral; right valve with two posterior bifid and one anterior simple cardinal teeth; left valve with one middle bifid and anterior and posterior simple cardinals; left anterior papilliform small

out distinct; adductor scars and pallial line strongly impressed, the latter granulose; pallial sinus large, broad, rounded, ascending; inner margins minutely crenulate; small auxiliary adductor scars, situated close to dorsal margin between beaks and principal anterior adductor scars, and nearer to the latter; obscure, irregular impressed line in interior of each valve, descends vertically from anterior end of beak and dies out midway between beak and ventral margin; surface of valves marked by numerous small radial ribs, somewhat wavy, evenly spaced, and fairly uniform in size, but becoming coarser over the posterior third of the shell, where they alternate in strength, with occasionally two or three small ribs alternating with one lagrer one; the whole cut by fine, low, sharp, raised concentric lamellae, evenly spaced near the beaks, but gradually increasing to 2, 3, or 4 mm. apart toward the ventral margin, where they suddenly become irregularly spaced and crowded, apparently a gerontic character. These concentric lamellae are delicately fluted by the radials in the umbonal region. Minute growth lines cross the sculpture between the lamellae. The concentric sculpture is nowhere as prominent as the radial which increases in coarseness ventrally. The largest specimen, an internal mold collected by Dr. Berkey, measures in length 85 mm., height 68 mm., diameter 48 mm.

A large shell of the same type as *C. tarquinia* Dall and also resembling *C. lacerata* Hanley, a recent shell from China, and *C. antiqua* King, recent, from Chile and Patagonia. It differs from all of these in having the radial sculpture predominate over the concentric sculpture.

Localities.—318, 41, 78, 98(Berkey). Bayamon and Ponce (Lobeck).

Horizon.—Quebradillas limestone Ponce limestone.

Genus **Pitaria** Römer

Pitaria (Hyphantosoma) carbasea Guppy

Plate XVI, Figure 2

Cytherea (Circe) carbasea Guppy, Quart. Jour. Geol. Soc., XXII, p. 292, Pl. 18, fig. 13, 1866.

Callista carbasea Gabb, Trans. Amer. Phil. Soc., XV., p. 250, 1873.

Pitaria (Hyphantosoma) carbasea Dall, Trans. Wagner Inst. Sci., III, pt. 6, p. 1266, 1903.

This shell occurs abundantly as internal molds, but only one fragment of external mold was found showing the delicate sculpture. The pallial sinus is sub-angular, deep, reaching nearly to the middle of the valve; interior of shell smooth; exterior surface marked by fine, somewhat wavy or irregular concentric lamellae crossed by fine

divaricate lines, strongest anteriorly, and forming two zigzag zones near the middle of the valve. These divaricate lines, when viewed under a lens are seen to consist of rows of pits in the lamellae; lunule large, demarked by fine sharp impressed line, and crossed faintly by the concentric lamellae, thus being rendered indistinct. The shells vary considerably in size, the largest internal mold measuring in length 32 mm., height 26 mm., diameter 16 mm.

Type localities.—64, 225.

Other localities.—619, 233, 343, 232(b).

Range.—San Sebastian shale, Lares limestone, and Cibao limestone. Abundant in the Cibao limestone.

Genus **Chione** Megerle von Mühlfeldt

Chione woodwardi Guppy

Plate XIII, Figure 7

Venus Woodwardi Guppy, Quart. Jour. Geol. Soc. London, XXII, p. 292, Pl. 18, fig. 1, 1866; *Idem.* XXXII, p. 530, 1876.

Chione Woodwardi Dall, Trans. Wagner Inst. Sci., III, pt. 6, p. 1291, 1903.

Chione Woodwardi Maury, Bull. Amer. Paleont., V, No. 29, p. 218, Pl. 37, fig. 6, 1917.

This is one of the most abundant fossils in the Quebradillas limestone. The shells show no differences from those described from Jamaica and Santo Domingo.

Localities—204, 217, 52(a), 670, 179, 225. Near Bayamon (Semmes and Lobeck). Near Guanica Central (Lobeck). Vieques Island (Lobeck). 77 (Berkey). Culenbrinas Point, Ponce, and K. 2.4 Ponce-Adjuntas road (Mitchell).

Horizons.—Lares limestone ?, Quebradillas limestone, Ponce limestone.

Chione (Lirophora) hendersoni Dall

Venus paphia Guppy, Quart. Jour. Geol. Soc. London, XXII, p. 292, 1866. Not of Linné.

Chione paphia Gabb, Trans. Amer. Phil. Soc., XV, p. 249, 1873.

Venus paphia Guppy, Geol. Mag., decade 2, I, p. 442, 1874, etc., *ex parte.*: Quart. Jour. Geol. Soc., XXXII, p. 530, 1876.

Chione (*Lirophora*) *hendersoni* Dall, Trans. Wagner Inst. Sci., III, pt. 6, p. 1295, Pl. 55, fig. 22, 1903.

Chione (*Lirophora*) *hendersoni* Maury, Bull. Amer. Paleont, V, No. 29, p. 219, Pl. 37, fig. 8, 1917.

The Porto Rican shells are apparently closer to the Santo Domingo than to the Bowden shells. The specimens show the obscure crenulation at base of ribs, and the sudden thickening of the ribs over the anterior portion of shell. There are eleven or twelve large, widely spaced ribs. They are obsolete in the umbonal region. Interior of shell has deeply impressed pallial line and adductor scars; pallial sinus short and angular. An average specimen measures in length 31 mm., height 22 mm., diameter 14.5 mm. The largest measures in length 36 mm., height 27 mm., semi-diameter 8 mm.

Localities.—179, 331, 343, 64, 619 ?.

Range.—Lares limestone to Los Puertos limestone.

Genus **Tellina** (Linné) Lamarck

Tellina strophoidea, new species

Plate XX, Figures 4, 5

Shell moderately elongate, sub-equilateral; beaks inconspicuous; surface with numerous elevated, sharp concentric lamellae, which, on adult specimens, frequently merge on the posterior part of shell into fewer, coarser lamellae; numerous radial striae can be seen under a lens in transverse light. Ventrally they are interrupted by the lamellae, but toward the beaks they become more distinct and continuous, so that on the nuclear portion of the shell they are nearly as strong as the concentric sculpture, resulting in an extremely fine cancellate ornamentation; posterior slope with two radial folds and a moderately deep sulcus between. The upper fold is narrower and less pronounced; posterior dorsal margin marked by accentuation of the lamellae into a slight ridge. In the adult shells the lowest fold is, in the right valve, double, with a slight sulcus between. This is only noticeable at the distal end of the fold. The lamellae bend sharply upward on crossing the lower fold; lunule extremely narrow; interior of shell unknown. Length 48 mm., height 27 mm., semi-diameter 6 mm.

This shell is nearest to *T. strophia* Dall, which it resembles in sculpture, but is considerably less elongate.

Localities.—204, 216, 98(Berkey).

Range.—Throughout the Quebradillas limestone.

Tellina portoricoensis, new species

Plate XX, Figure 6

Shell resembling *T. strophoidea* but with much finer concentric sculpture. Shell sub-equilateral, slightly convex; beaks low; surface with fine, sharp, hardly raised concentric lamellae, at first uniform and evenly spaced, but ventrally becoming slightly irregular, with every fifth or sixth one more prominent than the others; low, inconspicuous double fold on the umbonal ridge, becoming almost obsolete distally, and over which the concentric lamellae are flexed sharply upward in crossing; fine obscure growth lines between the lamellae; faint radial rays seen only in oblique light; interior of shell unknown. Length 42 mm., height 23 mm., semi-diameter 5 mm.

Locality.—204.

Horizon.—Quebradillas limestone.

Tellina (Scissula) grabaui, new species

Plate XVI, Figures 3, 4

Shell small, elongate, slightly convex, sub-equilateral; anterior rounded, posterior roundly truncate; surface with fine growth lines, periodically incised, replaced on the umbonal ridge by widely spaced, sharp concentric lamellae, which cross a faint sulcus above the umbonal ridge and, decreasing in size and strength, continue to the dorsal margin; growth lines crossed by faint, wavy oblique lines, becoming more distinct as they approach the umbonal ridge, where they end suddenly, in contact with the concentric lamellae. These oblique lines begin near the anterior margin and slope downward toward the posterior. Interior of shell unknown. Length 20 mm., height 11 mm., semi-diameter 2.5 mm.

This shell is close to *T.* (*Scissula*) *lampra* Dall, of the Chipola Oligocene. It is also close to *T. rowlandi* Toula, a species from the Gatun formation. *T. caribea* d'Orbigny seems to be the living representative of these shells. *T.* (*Scissula*) *cercadica* Maury, a shell from the Santo Domingo Oligocene, is a similar but less elongate form.

Locality.—204.

Horizon.—Quebradillas limestone.

Tellina, species aff. **T. (Angulus) atossa** Dall

Plate XI, Figure 7

A single left valve of a Tellina of uncertain identity. Shell moderately convex, showing prominent lateral teeth; surface with

fine sharp concentric lamellae, strongest near the ventral margin, and obscure growth lines between the lamellae. The latter are accentuated on the anterior slope; shallow radial sulcus located next to the posterior dorsal margin. Interior of shell unknown. In outline and general appearance, it resembles *T.* (*Angulus*) *atossa* of the Tampa Silex beds. Length about 20 mm., height 14 mm., semidiameter 4 mm.

Locality.—204.

Horizon.—Quebradillas limestone.

Genus **Metis** H. and A. Adams

Metis trinitaria Dall

Plate X, Figure 7

Metis trinitaria Dall, Trans. Wagner Inst. Sci., III, pt. 5, p. 1041, Pl. 46, fig. 24, 1900.

cf. *Tellina biplicata* Guppy, Quart. Jour. Geol. Soc., XXXII, p. 530, 1876. Not of Conrad.

Metis trinitaria Maury, Bull. Amer. Paleont., V, p. 226, 1917.

The specimens differ somewhat from Dall's description, being more nearly equilateral, and the pallial sinuses of the two valves being subequal and of equal height. The shell seems to be quite variable, however. Ventral margin arcuate, with broad median sinus in the right valve; sharp, rounded posterior fold with a second obscure fold higher up; surface marked by growth lines and faint radial striations, the latter fading out toward the lateral margins. There is some variation in the size and proportions as shown by the following measurements of internal molds:

Length 52 mm., Height 44 mm., Diam. 23 mm.
Length 54 mm., Height 44 mm., Diam. 19 mm.
Length 48 mm., Height 39 mm., Diam. 16 mm.

Some internal molds of this shell, collected in Porto Rico in 1915 by Dr. D. R. Semmes, were shown to Dr. Dall, who identified them as *M. trinitaria*. This species is reported from Trinidad and Cuba, and doubtfully from Santo Domingo. Specimens from Sombrero,

W. I., in the Columbia University collections seem to be of this species, but are considerably larger than the Porto Rican shells.

Localities.—204, 678, 61, 319, 801. 98(Berkey). San Juan district (Semmes). Culebrinas Point (Mitchell).

Horizon.—This shell is the chief horizon marker of the Quebradillas limestone along the north coast. The internal molds are found in great numbers in many localities. It occurs rarely in the Los Puertos limestone, and Ponce limestone.

Genus **Solen** Linné

Solen (Plectosolen) collazoensis, new species

Plate XI, Figure 8

Shell produced anteriorly, with beaks 7.5 mm. behind the anterior margin; both ends roundly truncate; height slightly less in middle of shell than at the ends; beaks inconspicuous; surface marked only by growth lines, strengthened on anterior slope, and a narrow furrow extending from the beaks to the anterior-ventral corner. Length 42 mm., height 11 mm., diameter 6.5 mm.

This is a small straight shell of the section *Plectosolen,* having a strong resemblance to the Eocene forms of the Paris Basin, such as *S. plagiaulax* Cossmann, and *S. laversinensis* Lef. and Wat. It is probably of the type of *S. obliquus* Sowerby. It also resembles a small *S. obliquus* Spengler, but is a true *Plectosolen.*

The description is based on a single specimen from the black shale at Collazo Falls. The specimen is badly fractured, though nearly complete.

Localities.—261, Juana Diaz, Yauco.

Horizon.—San Sebastian shale, Juana Diaz shale.

Genus **Psammosolen** Risso

Psammosolen sancti-dominici Maury

Psammosolen sancti-dominici Maury, Bull. Amer. Paleont., V, No. 29, p. 228. Pl. 37, fig. 13, 1917.

Only two fragments were found, but the marking is distinct and characteristic, and leaves no doubt as to the identity. One specimen seems to be about the same size as the Santo Domingo specimens

described by Maury. The other specimen is smaller. The broad median sulcation is barely noticeable.

Locality.—204.

Horizon.—Quebradillas limestone.

Genus **Semele** Schumacher

Semele, species indet.

Shell equivalve, nearly equilateral; beaks low; ends of shell rounded; anterior and posterior dorsal margins make angle of 125°; umbonal ridge low, obscure; escutcheon long and narrow; lunule short, and same width as the escutcheon; surface sculpture of fine, even, sharp concentric lamellae; about fourteen to every 10 mm.; no radial striation visible. Length 35 mm., height 30 mm., diameter 14 mm.

This may be a new species, but the specimens are poor and do not permit an exact description, being known only from internal molds and a few fragments of external mold. The sculpture is finer than that of *S. claytoni* Maury. The shell resembles *S. chipolana* Dall, but is more elongate.

Locality.—225.

Horizon.—Lares limestone.

Genus **Thrachia** Blainville

Subgenus **Cyathodonta** Conrad

Cyathodonta reedsi Maury

Shell equivalve, sub-equilateral, moderately convex; anterior dorsal slope slowly descending, anterior rounded, posterior roundly truncate; sculpture of about twenty-five rounded to sub-angular concentric ripples, markedly wavy or irregular, and owing to the thinness of the shell, equally strong in the internal molds. The ripples have a strong tendency to become oblique on the anterior third of the shell; umbonal ridge low, rounded, beyond which the ripples die out, leaving the posterior dorsal smooth except for growth lines. A right valve shows a low obscure radial fold about one-third the distance from the umbonal ridge to the dorsal margin; beaks rather high and strongly incurved. Gerontic individuals show a complete loss of concentric ripples in the final stages of growth. Adult shell measures in length 27 mm., height 19 mm., semi-diameter 6 mm.

This shell is apparently nearest to *C. gatunensis* Toula but is more

elongate, more nearly equilateral, and the smooth posterior slope higher and more produced. It is not as convex as the Gatun shell.

Type Locality.—204.

Other locality.—225 ?.

Range.—Lares ? limestone to Quebradillas limestone.

Genus **Corbula** Lamarck

Corbula collazica Maury

Localities.—Collazo Falls, and doubtfully at 120 and 225.

Horizons.—Typical of the San Sebastian shale, and occurs doubtfully as high as the Lares limestone.

Genus **Teredo** Linné

Teredo incrassata Gabb

Kuphus incrassatus Gabb, Trans. Amer. Phil. Soc., XV, p. 246, 1873; Jour. Acad. Nat. Sci. Phila., new ser., VIII, p. 342, Pl. 44, fig. 12a-e.
Teredo fistula? Guppy, Quart. Jour. Geol. Soc., XXXII, p. 529, 1876.
Teredo incrassata Dall, Trans. Wagner Inst. Sci., III, pt. 6, p. 1587, 1903.
Teredo incrassata Maury, Bull. Amer. Paleont., V, No. 29, p. 235, Pl. 39, fig. 24, 1917.

The tubes vary in diameter, but average 20 mm. They attain considerable length, but are usually found broken in short pieces.

Localities.—86, 10, Collazo Falls, 758, 162, 182, 179, 332, 619, 621, 616, 225, 23, 335, 330, 324, 74, 370, 749(a), 334.

Horizons.—San Sebastian shale, Lares limestone, Cibao limestone, Los Puertos limestone, Quebradillas limestone. Extremely abundant.

Outside the Lares District, this species has been found by Lobeck on Vieques Island (south and east sides), and in basal Tertiary beds near Yauco, P. R. It has been found by Berkey at localities 10 and 78, and by Mitchell in the Ponce formation and Juana Diaz shale.

Genus **Dentalum** Linné

Dentalium, species indet.

Shell long, slender, nearly straight, slowly tapering, circular in cross-section; shell thick, the aperture being only about one-half the diameter of the tube; surface polished, and marked with numerous fine, very regular

longitudinal threads, visible only under a hand lens and transverse light. The threads appear, under a lens, to be minutely beaded, but under a microscope, this appears to be the result of fine raised concentric growth lines, strongest in the interspaces between the longitudinal threads. There are about one hundred longitudinal threads on a tube of 1 mm. diameter. The shell structure is strongly fibrous, the fibrous striations appearing on the longitudinal threads as seen under the microscope. The apex is not shown in any of the specimens. The largest fragment, with a diameter of 1 mm. measures 13 mm. in length. The tapering of the tube is hardly discernible in this length.

Many fragments were found in the lower black shale of a minute *Dentalium*, the largest of which is only about 1 mm. in diameter, and the majority of which average less than ½ mm.

Locality.—261.

Horizon.—San Sebastian shale.

Genus **Calliostoma** Swainson

Calliostoma portoricoensis, new species

Plate XXI, Figure 1

Whorls seven, including a rather high protoconch of two smooth, round whorls; remaining whorls flat; suture narrow but deeply impressed; surface of whorls with six spirals and strongly marked oblique growth lines which cut the spirals, giving them a wavy appearance. The five uppermost spirals are small, sharply raised, with wider concave interspaces. The two spirals immediately below the suture are somewhat smaller and show a tendency to group together. The sixth spiral, immediately above the suture, is very much larger, broad, and bluntly rounded, and forms the peripheral keel; base with eight prominent, broad, flat spirals and fine raised oblique growth lines crossing the spirals and grooves between. Aperture and umbilical area not visible in the specimen. Length 11 mm., diameter 9 mm.

A single specimen was found of a *Calliostoma* remarkable for its elongate conical base (more than two-thirds as long as the spire).

Locality.—204.

Horizon.—Quebradillas limestone.

Genus **Turbo** Linné

Turbo fetkii, new species

Plate XXI, Figure 2

Shell small; whorls six; the first two flat topped, strongly keeled; the remaining whorls sub-round, but with slight angulation and broad flat

shoulder, nearly one-third the axial width of the whorl; suture deeply channelled; rounded spirals of two to three different sizes, increasing by intercalation, with total of about twenty on the body whorl, and of these five are very prominent; entire surface crossed by oblique incremental lines, strongest between the spirals; spirals and incremental lines visible in the sutural channel. Height 13 mm., diameter 11 mm.

The above description is based on a single specimen, in which the anterior portion of the body whorl is missing. The shell is remarkable for its extremely deep, squarely channelled suture. The spirals are smooth or with microscopic crenulation produced by the crossing of the growth lines. The spiral anterior to the suture is never prominent. This shell is like *T. rhectogrammicus* Dall, of the Florida Pliocene, but differs from the latter chiefly in its smaller size and its deeply channelled suture. Its suture is like that of *T. spenglerianus* Gmelen, a recent shell from the West Indies, but the latter is much larger and has more spirals. This shell is named in honor of Dr. C. R. Fetke, who has worked on the Geology of the eastern end of Porto Rico.

Locality.—313.

Horizon.—Quebradillas limestone.

Turbo dominicensis Gabb

variety **quebradillensis,** new variety

Shell larger than the Santo Domingo variety, *T. dominicensis laloi* Maury, the internal mold measuring in height (with tip of spire missing) 37 mm., maximum diameter 33 mm. Like the Santo Domingo variety, the final whorl is angulated, as presumably are the earlier whorls, though this cannot be ascertained from the specimen. It is more like Gabb's type, however, in having the majority of the spirals crenulate. On the final whorl the spiral anterior to the suture is more strongly crenulate than the others. Anterior to this, on the shoulder, are four minor crenulate spirals, the two central ones being slightly more prominent than the other two. At the shoulder angulation is a very strong, plain spiral, which projects sharply upward above the surface of the shoulder. The remainder of the whorl is ornamented with eight or more strong simple spirals, each alternating with a single minor crenulate spiral. The basal portion of the whorl is not preserved. From the small portion visible in the specimen, it seems that the ornamentation of the earlier whorls is similar, but with fewer spirals. The outer lip is lirate for a short distance, there being thirteen lirae and a posterior notch below the shoulder angulation.

This shell was found among the material collected by Dr. Lobeck in the Quebradillas limestone near Bayamon. It consists of a single

internal mold and a portion of the external mold of the same specimen, which shows the sculpture of the final whorl and a small portion of the spire. A few internal molds, possibly of the same species were found in the Quebradillas limestone of the Lares district.

Locality.—Near Bayamon (Lobeck), 204?

Horizon.—Quebradillas limestone.

Genus **Liotia** Gray

Liotia (Arene) coronata Dall

variety **portoricoensis,** new variety

Plate XXI, Figure 3

Shell small, five whorls, including flat, smooth naticoid protoconch of two whorls. Two spiral keels appear on the third (or first post-nuclear) whorl. A third spiral appears on the fourth whorl just above the suture; suture deeply channelled; shoulder of third and fourth whorls marked by fine beaded spiral ridge immediately below the suture. Fine growth lines crossed the shoulder and produce a slight beading of the uppermost spiral keel; final whorl smooth except for strongly incised growth lines, which are stronger than the almost obsolete spirals. The final whorl tends to lose the coiling habit, becoming almost free from the preceding whorl. Only a single specimen was found, and the aperture and base of the shell are unknown. Height 5 mm., diameter 5 mm.

The first four whorls of this shell are quite similar to Dall's Tampa species. In the Porto Rican shell the longitudinal wrinkles, characteristic of the Tampa shell, become obsolete on the fourth whorl, but reappear strongly on the last whorl. The Porto Rican variety seems to have been derived from the Tampa species, and is an interesting example of a phylogerontic form.

Locality.—204.

Horizon.—Quebradillas limestone.

Genus **Xenophora** Fischer de Waldheim

Xenophora conchyliophora (Born)

Trochus conchyliophorus Born, Mus. Caes. Vind. p. 333, 1778.
Trochus agglutinans Lamarck, Anim. sans Vert., VII, XIV.
Phorus agglutinans Gabb, Trans. Amer. Phil. Soc., XV, p. 241, 1873.

Xenophora conchyliophora Dall, Trans. Wagner Inst. Sci., III, pt. 2, pp. 360-362, 1892; Bull. 90, U. S. Nat. Mus., p. 105, Pl. 15, figs. 1, 3, 1915.

Xenophora conchyliophora Maury, Bull. Amer. Paleont., V, No. 29, p. 133, Pl. 23, fig. 7, 1917.

The Porto Rican specimens show no differences from the typical forms of this species.

Localities.—204, 225, 24.

Range.—Lares limestone to Quebradillas limestone. Very abundant in the Quebradillas.

Genus **Neritina** Lamarck

Neritina (chipolana var.?) **collazoensis,** new species

Plate XXI, Figure 4

Shell small, fragile, polished, with low spire, and apparently three whorls. A single specimen was obtained, in which the spire has been crushed and the aperture is not visible. The outline of the shell and the surface markings are like *N. chipolana* Dall, but with the markings more crowded and numerous, and all being discontinuous. These lines show, however, the same arrangement in groups of three or four, with zig-zags and curves. The curves are frequently convex in opposite directions in adjacent lines, leaving circular areas between the lines, a feature which is also characteristic of the Chipola species, judging from Dall's illustration (Wagner Inst., III, pt. 4, Pl. 23, fig. 19, 1898). The lines are very narrow, and a dark reddish purple in color. The shell is slightly smaller than the Chipolan form, the height being 4 mm. and the maximum diameter 4.5 mm. In places where the epidermis has been chipped off, exceedingly fine and very regular growth lines may be seen with a lens.

This shell was obtained from a stratum of lignitic shale in the Collazo Falls section, and is associated with fossil leaves and minute, thin-shelled bivalves, apparently fresh water forms. This stratum is intercalated in marine beds, and is of interest in showing the conditions existing in this locality during deposition of the San Sebastian shale.

Locality.—261.

Horizon.—San Sebastian shale.

Genus **Hipponyx** Defrance

Hipponyx portoricoensis, new species

Plate XXI, Figures 5, 6

Shell small, obliquely conical; apex at or near posterior extremity, often overhanging, and slightly recurved; surface with irregular bifurcating radi-

ribs and less prominent fluted concentric lamellae; interior with faint but large horse-shoe shaped scar.

This shell is very variable, but in all specimens the apex is blunt and rounded. Some specimens show hardly any recurvature to the apex, while in others this feature is marked, and in all cases it is to be left. A strongly recurved specimen measures in diameter of aperture about 7 mm., height of apex above base 4 mm. A low flat shell without curvature measures in diameter 10 mm., height of apex 3 mm. The largest specimen measures in diameter 11 mm., height of apex 6.5 mm.

Localities.—204, 220, 23 ?.

Range.—Los Puertos limestone to Quebradillas limestone.

Genus **Calyptræa** Lamarck

Calyptræa cf. **centralis** Conrad

Infundibulum centralis Conrad, Am. Jour. Sci., XLI, p. 348, 1841; Med. Tert., p. 80, Pl. 45, fig. 5, 1845.
Trochita centralis Emmons, Geol. N. C., p. 276, fig. 193, 1858.
Infundibulum concentricum H. C. Lea, Trans. Amer. Phil. Soc., (2), IX, p. 249, Pl. 35, fig. 39, 1845 (young shell).
Crochita collinsii Gabb, Jour. Acad. Nat. Sci. Phila., (2), VIII, p. 342, Pl. 44, figs. 11, 11a, 1875.
Infundibulum candeanum d'Orbigny, Moll. Cuba, II, p. 190, Pl. 24, figs. 28, 29, 1842.
Galerus candeanus Dall, Hemphill's Shells, p. 335, 1883.
Galerus parvulus Dunker, Jahrb. Deut. Mal. Ges., p. 244, 1875.
Calyptrea candeana Dall, Blake Rept., p. 284, 1889.
Calyptrea centralis Dall, Trans. Wagner Inst. Sci., III, pt. 2, p. 353, 1892.

A single external mold was found which is apparently this species. Diameter of base 8 mm., height of apex 4 mm.

Locality.—204.

Horizon.—Quebradillas limestone.

Genus **Crucibulum** Schumacher

Crucibulum auricula Gmelin

variety **portoricoensis,** new variety

Plate XXI, Figures 7, 8

Cup typical of *C. auricula* Gmelin. Surface with fine, irregular, dichotomous radial lines, crossed by fine wavy growth lines. Form varies from

high, acute apex to low apex with broad base. Cup uniform in size and shape in all the specimens. A shell with low apex measures in diameter of base 20 mm. height of apex 7 mm.

Localities.—204. (also Berkey 98).

Horizon.—Quebradillas limestone (fairly abundant).

Crucibulum auricula? variety

Plate XXI, Figure 9

This is probably one of the many variations of *C. auricula.* Only a few fragmental specimens were obtained, and the interior is unknown.

Apex sub-central; coarse radial ribs, somewhat irregular, bifurcating and trifurcating. Diameter 14 mm., height of apex 6 mm.

Locality.—204.

Horizon.—Quebradillas limestone.

Crucibulum (Dispotæa) collazum, new species

Plate XXI, Figure 10

Shell small, smooth; apex eccentric, sharp, strongly gyrate in the normal direction; basal margin sub-circular, with large rounded sinus on the side below the apex. On either side of the sinus the margin flares, or flattens out, and is thickened, being analogous to the thickened outer lip or varix of coiled gastropods; cup large, deep, and about one-half free from the shell wall. Most of the free half has been broken away in the specimen illustrated, but when perfect, it has a tortuous, or S-shaped curvature, and overhangs the apex cavity, being suggestive of the internal appendage of a *Calyptræa.* Diameter of aperture 7 mm., height of apex 4 mm.

Two specimens were collected, both showing the marginal sinus, which is therefore assumed not to be an accident of growth. The shell illustrated appears to be an adult specimen. The other shell is smaller, with a correspondingly smaller marginal sinus.

Localities.—84, 261.

Horizon.—San Sebastian shale.

Genus **Natica** Scopoli

Natica canrena? (Linne) Moerch

Nerita canrena (Linné in part) Auct., Moerch, Malak. Blatt., XXIV, p. 62, 187
Natica canrena Gabb, Trans. Amer. Phil. Soc., XV., p. 223, 1873.

Natica canrena Guppy, Quart. Jour. Geol. Soc., XXXII, p. 518, 1876.
Natica canrena Dall, Trans. Wagner Inst. Sci., III, pt. 2, pp. 364-365, 1892.
Natica canrena Brown and Pilsbry, Proc. Acad. Nat. Sci. Phila., p. 508, 1912.
Natica canrena Maury, Bull. Amer. Paleont., V, No. 29, p. 134, Pl. 23, fig. 10, 1917.

A small *Natica* was found which is probably the young of *N. canrena*. The specimen shows on the last whorl the faint oblique striations, which start at the suture. Diameter 7 mm. Several internal molds, possibly of this species, were found in the Cibao limestone at locality 22. The largest measures in height 22 mm., diameter 25 mm.

Locality.—204.

Horizon.—Quebradillas limestone.

Natica (Ampullina?) collazoensis, new species

Plate XXI, Figures 11, 12

Shell large, moderately high spired; suture deeply impressed; whorls six to eight; umbilicus partly covered by callus, or entirely open in some specimens, in which the callus may have been broken away. Some specimens show the last whorl strongly flattened below the suture, while in others the whorl is evenly rounded. This is probably a sex difference; shell thin; surface with numerous fine, impressed spiral lines, and much finer, almost microscopic growth line threads, periodically incised, marking a resting stage in the growth of the shell. The growth lines are remarkable for their evenness. Largest specimen measures in height 66 mm., diameter, 52 mm.

The shell in size and general appearance resembles *Ampullina amphora* Heilprin, and is probably related to the large Eocene forms. It has some resemblance to *Natica* species indet. Brown & Pilsbry (Proc. Acad. Nat. Sci. Phila., p. 360, Pl. 25, figs. 1, 2, 1911), a Gatun shell.

Localities.—262, 265, 86 (base of falls), Collazo Falls, 264 (bottom 3rd falls), 83, 235.

Horizon.—San Sebastian shale. (very abundant).

Genus **Epitonium** Bolten

Epitonium (Cirsotrema) collazoensis, new species

Plate XXII, Figures 1, 2

Shell with three and one-half whorls measures in height 25 mm., maximum diameter 13 mm.; whorls rounded; suture distinct, but not deep; whorls with about twenty-four slightly oblique, moderately strong longitudinal ribs

and two opposite rows of sub-continuous varices, the last varix being at the outer lip; longitudinal ribs fluted by another series of oblique ribs of equal strength, descending to the left at about 45°, continuing from suture to suture, and being more or less interrupted by the longitudinal series of ribs. At base of body whorl, both series of ribs terminate against a strong, rugose or rope-like spiral, which encircles the umbilical area, and is interrupted only by the varices. Over the entire surface of the shell is a fine microscopic cloth-like texture composed of three intersecting series of threads, one series vertical, another parallel with the 45° ribs, and the third series descending to the right at about 45°. The three series are named in order of their relative strength, the vertical series being strongest, and locally obscuring the other two series. Aperture circular. In general appearance the shell is typical of the high spired forms of this group.

A single decollate specimen was found of an Epitonium which is remarkable for its microscopic texture, which is somewhat of the nature of that of *E. textuvestitum* Maury, but the shell is quite different from the latter. Apparently the nearest relatives of this shell are to be found in the Paris Basin beds. Two such forms, very similar, though smaller, are *Cirsotrema subspinosum* (Grat.) of the Aquitanien, and *C. bourgeoisi* de Boury, of the Helvetian. This relationship is of considerable significance in considering the age of the San Sebastian shale.

Locality.—K. 29.2-3 Lares road.

Horizon.—San Sebastian shale.

Genus **Turritella** Lamarck

Turritella tornata Guppy

variety **portoricoensis**, new variety

Plate XXI, Figures 13, 14

Shell corresponds with Guppy's description, except that in the last few whorls the anterior keel is double, and there are frequently as many as four spiral threads in the median concavity. There are also from one to two threads on the shoulder and likewise on the slope below the lower keel. The base is spirally threaded and marked by accentuated growth lines. The beading of the spirals is lacking or obscure, due probably to the poor state of preservation of the specimens. All specimens are decollate. The largest has a maximum diameter of 14 mm. and height (4 whorls) of 26 mm.; the average sized specimen has a maximum diameter of 10 mm.

This species is extremely abundant in the San Sebastian shale. Nearly all specimens are poorly preserved casts or internal molds, and the ornamentation is difficult to make out.

Type locality.—232(b).

Other localities.—225, 331, 333, 343, Collazo Falls, 226, 262, 83, 233.

Range.—San Sebastian shale to Lares limestone.

Turritella planigyrata Guppy

T. planigyrata Guppy, Proc. Sci. Assoc. Trinidad, p. 169, 1867; Geol. Mag., p. 408, Pl. 18, fig. 5, 1874.
T. planigyrata Gabb, Trans. Amer. Phil. Soc., XV, p. 240, 1873.
T. planigyrata Guppy, Quart. Jour. Geol. Soc., XXXII, p. 519, 1876.
T. planigyrata Maury, Bull. Amer. Paleont., V, No. 29, p. 129, Pl. 22, fig. 14, 1917.

A fragment comprising the last three whorls. Height 14 mm., maximum diameter 8.5 mm. The specimen agrees with the descriptions by Guppy and Gabb, and there seems to be no doubt of the identity.

Locality.—234.

Horizon.—San Sebastian shale.

Turritella mitchelli, new species

Plate XXII, Figure 3

A single decollate specimen with seven and one-half whorls. Shell large, high spired (apical angle 5°); whorls flat and continuous; suture indistinct or invisible; whorls marked by three prominent crenulated spirals and minor, minutely beaded spiral threads; the whole surface covered by minute spiral striae and longitudinal growth lines, the latter producing the crenulation in the spirals. In front of each suture is a flat area, less than one-third the axial width of the whorl, marked by two to three obscure spiral threads; next in order come a single primary spiral, followed by two fairly prominent secondary spirals in the median portion of the whorl. The anterior third of the whorl is marked by the two most prominent primary spirals with a narrow channel between them, giving the effect of a doubled spiral band. The anterior member of this pair is slightly larger than the other on the last two whorls. Of the microscopic sculpture above mentioned, the spiral striae are the most prominent on the primary ridges, and obsolete in the interspaces, whereas the reverse is true of the growth lines, which results in the strongest beading being on the minor spirals in the interspaces. The base is sulcated below the anterior primary spiral, and is moderately convex anterior to this sulcus. The surface of the base is marked only by the spiral striae and growth lines, which here are markedly wavy or vermicular. The

suture is distinct on the last two whorls, but on the spire it is invisible, being concealed by the anterior primary spiral, which overhangs it. Height 59 mm., maximum diameter 22 mm.

As the protoconch and upper portion of the spire are missing, it is difficult to trace the relationship of this shell with other species. The succession and arrangement of spirals is similar to *T. halensis* Dall, a shell from the Flint River Oligocene. The finer sculpture and beading resemble *T. altilira* Conrad, of the Gatun formation, and *T. calostemma* Pilsbry & Brown, of the Oligocene of Haiti. This shell is undoubtedly a member of the *T. tornata—T. altilira* group, and is probably closest to *T. calostemma*. Berkey found a similar, and apparently related shell from the basal Tertiary near Juana Diaz. It differs in having four equally strong major spirals. This shell is named in honor of Dr. G. J. Mitchell.

Locality.—Collazo.

Horizon.—San Sebastian shale.

Turritella portoricoensis, new species

Plate XXI, Figure 15

Shell small; spire acute; about ten rounded whorls with about fifteen fine spiral threads with sub-equal intervals; suture distinct, but not channelled until the last three whorls; whorls at first evenly rounded with spiral threads of equal strength, but later becoming angulated by accentuation of spiral threads into a keel at periphery of whorl and another at anterior end of whorl, overhanging the suture; first three whorls loosely coiled; protoconch missing on all specimens. The angulation begins at about the seventh whorl. A specimen with nine whorls measures in height 13 mm., maximum diameter 4 mm.

The young of this shell has the whorls of *T. plebeia* Say, and in the adult, the whorls are like those of *T. æquistriata* Conrad, in some respects. The later whorls also resemble *T. subannulata acropora* Dall, but are not quite as angular as in the latter species. The nearest Antillean forms are *T. planigyrata* Guppy, of Santo Domingo, and *T. gatunensis* Conrad, of Panama. The Porto Rican shell is probably a less specialized member of this group.

Locality.—204.

Horizon.—Quebradillas limestone.

Turritella berkeyi, new species

Plate XXII, Figure 4

Shell extremely high spired, slender; whorls twenty-one; earliest whorls simple, with two keels of equal size; anterior and posterior slopes of whorls straight and of equal width; simple rounded median depression between the two keels; last ten whorls with the posterior keel becoming double and the shoulder of the whorl becoming gently convex, features which are quite prominent in the adult stage; beginning with the eighth or ninth whorl an obscure spiral appears on the anterior extermity of the whorl just above the suture and partially overlapped by the succeeding whorl; surface throughout is lacking in ornamentation. Height 73 mm., maximum diameter 11 mm.

This shell may possibly be a primitive form of *T. perattennuata* Heilprin. It resembles *T. alcida* Dall, but is very much more slender. Other somewhat similar forms are *T. altilirata* Conrad, and *T. variabilis* variety *alticosta* Conrad.

Locality.—204.

Horizon.—Quebradillas limestone.

Genus **Petaloconchus** Lea

Petaloconchus domingensis Sowerby

Petaloconchus domingensis Sowerby, Quart. Jour. Geol. Soc., VI, p. 51, Pl. 10, fig. 8, a, b, c, 1849.

Petaloconchus sculpturatus Gabb, Trans. Amer. Phil. Soc., XV, p. 240, 1873. Not of Lea.

Petaloconchus sculpturatus Guppy, Quart. Jour. Geol. Soc., XXXII, p. 519, 1876.

Vermetus (*Petaloconchus*) *sculpturatus* Dall (in part), Trans. Wagner Inst. Sci., III, pt. 2, pp. 305, 306, 1892.

Petaloconchus domingensis Brown and Pilsbry, Proc. Acad. Nat. Sci. Phila., p. 359, 1911.

Petaloconchus domingensis Maury, Bull. Amer. Paleont., V, No. 29, p. 128, Pl. 22, fig. 11, 1917.

A single specimen was found, showing part of the coiled portion of the shell. There seems to be no doubt as to the identity. The fragment with three whorls measures in height 8 mm., diameter 6 mm., diameter of whorl about 3 mm.

Locality.—204.

Horizon.—Quebradillas limestone.

Petaloconchus? collazoensis, new species

Plate XXI, Figure 16

Tube of small diameter (2.5 mm.); surface smooth except for faint growth lines; tip of spire missing in specimens, but one specimen shows a loosely, irregularly coiled cylindrical spire of five whorls; diameter of spire 10 mm.; whorls are in contact, but coiled with a 5 mm. radius, leaving large umbilical opening, the whole resembling the coiled steam pipes of a cylindrical boiler. The specimens show that the coiling habit ceases abruptly, the tubes then growing in all directions, almost tying knots.

Localities.—263, Collazo Falls.

Horizon.—San Sebastian shale.

Genus **Pyramidella** Lamarck

Pyramidella portoricoensis, new species

Plate XXI, Figure 17

Shell small, conic, smooth, rather low spired; seven flat whorls with sharp median spiral offset, forming, with the sharply beveled shoulder of the overlapping whorl, a broad, square sutural channel. The median offset, or angulation, continues around the body whorl; suture of earlier whorls is narrow; large circular perforation extends the entire length of the axis, and is very conspicuous as seen from the base; columella tri-plicate; posterior plication large and distinct; the other two small and obscure, of which the anterior one is situated at the extreme base of the columella; aperture oval; outer lip simple; height 4.75 mm., diameter 2 mm.

This shell resembles *P.* (*Longchæus*) *forulata* Guppy, but its umbilicus places it with the typical group of *Pyramidella.* The suture is of the type of *P. semicanaliculatus* Maury.

Locality.—204.

Horizon.—Quebradillas limestone.

Genus **Modulus** Gray

Modulus modulus Linné

variety **basileus** Guppy

Monodonta basilea Guppy, Geol. Mag., new ser. decade 2, I, p. 434, Pl. 16, fig. 2, 1874.

Modulus basilea Dall, Trans. Wagner Inst. Sci., III, pt. 2, p. 294, 1892.

Modulus modulus var. *basilea* Dall, Trans. Wagner Inst. Sci., III, pt. 6, p. 158, 1903.

This shell is apparently the same as that described by Guppy from the Bowden. It agrees with Guppy's description, especially in its low spire, and tuberculated, carinate whorls. On the lower portion of the final whorl, however, it apparently differs somewhat from the Bowden shell in having spirals of variable size, the primaries alternating with one or more fine secondary threads. Judging from Guppy's illustration, the aperture of the Porto Rican shell is broader. The outer lip is denticulate, but the interior is not preserved, so as to show whether the lirate character exists or not. Height of shell is 14 mm., diameter 13 mm.

Apparently the modern representative of this shell is *M. lenticularis* (Chemn.) Auct., which according to Tryon is synonymous with *M. modulus* Linné.

Locality.—East side of Vieques Island (Collected by A. K. Lobeck).

Horizon.—Quebradillas limestone.

Genus **Bittium** (Leach M. S.) Gray

Bittium species indet.

Plate XXI, Figure 18

Whorls six (or more), with three raised spirals crossed by sharp ribs of equal height, and about twelve to a whorl; prominent nodes produced at intersections of ribs and spirals; suture deeply impressed; height (6 whorls) 11 mm., diameter 5 mm.

A single specimen, too imperfect to identify or describe fully.

Locality.—204.

Horizon.—Quebradillas limestone.

Genus **Cerithium** Adanson

Cerithium portoricoensis, new species

Plate XXII, Figures 5, 6

Shell small, slender; protoconch unknown; whorls twelve or thirteen, rounded, with obscure varices of irregular occurrence on the last six whorls, and usually a prominent varix on the body whorl; first three whorls with three primary spirals crossed by about twelve narrow rounded ribs, more prominent than the spirals, and slightly nodose where they cross the latter, the whole producing a cancellate structure with rectangular pits; a fourth

primary spiral appears on the fourth whorl; beginning with the sixth whorl, secondary, less prominent spiral threads appear, two immediately above the suture, and one between each of the four primaries. The two uppermost secondaries do not appear until the seventh whorl; on last four whorls the ribs have increased to about twenty in number, are irregular, low, and obscure, being marked chiefly by the lines of nodes where they cross the primary spirals. The ribs usually become obsolete on the anterior two-thirds of the body whorl; aperture short, slightly more than half the length of the body whorl; posterior canal small, U-shaped; anterior canal not quite covered by inner lip; outer lip slightly thickened; three average specimens have the following measurements:

Height 20 mm., Maximum Diameter 6 mm.
Height 17 mm., Maximum Diameter 5 mm.
Height 16 mm., Maximum Diameter 5 mm.

This shell has a superficial resemblance to *C. coccodes* Dall, and to *Clava chipolana* Dall.

Locality.—204.

Horizon.—Quebradillas limestone (abundant).

Cerithium quebradillensis, new species

Plate XXI, Figures 7, 8

A single decollate specimen with six whorls; earliest whorls roundly angular, with shoulder and peripheral keel; last three whorls with about 12 high, rounded ribs, sub-nodose at the keel; all whorls with primary spirals and secondary spiral threads; last four whorls with very fine tertiary spiral threads; earliest whorls show two closely grouped primary spirals at the keel, the upper one slightly stronger and forming the periphery of the whorl; a third primary occurs at (just posterior to) the suture; these primaries persist throughout, and a fourth primary spiral occurs on the base, being covered in the preceding whorls. It lies close to the suture; the secondary spirals at first form a group of three on the shoulder, another group of three below the keel, and a single one between the primary spirals of the keel. The three on the shoulder are markedly stronger than the other secondaries, a feature which persists throughout; on the third whorl (of the decollate specimen) the tertiary spiral threads appear, the first just above the sutural primary, the next ones intercalated between the secondaries in the group below the keel. The tertiaries do not appear on the shoulder until the fourth whorl; the shoulder, adjacent to the suture, is, in all whorls, marked by a rather wide band, at first smooth, but later marked by from one to six tertiary threads; all whorls are marked by fine, raised growth lines, or longitudinal threads, which produce a minute beading on crossing the spirals, and which in the earlier whorls, produce with the spirals a fine cancellate ornamentation; the primary spirals of the later whorls have a secondary superimposed thread, which is beaded by the growth lines; the base is slightly concave

and is sculptured with spirals of four sizes, more or less alternating. The single primary, above described, is sculptured with numerous minute spiral threads; pillar smooth, with no callus, anterior notch small, short, recurved; slight suggestion of a posterior notch; aperture ovate. Height 32 mm., diameter 15 mm.

The most striking feature of this shell is the sudden change in the character of ornamentation of the whorls, with the appearance of the ribs. This final ribbed sculpture resembles that of *C. callisoma* Dall, from the Caloosahatchie Pliocene, but the Porto Rican shell differs from the latter in its concave base and general turritelolid aspect. It is apparently not closely related to any species of the Antillean region.

Locality.—204.

Horizon.—Quebradillas limestone.

Cerithium (Campanile) collazum, new species

Plate XXIII, Figures 1, 2

Shell large, conic, rapidly enlarging; whorls flattened to slightly rounded, with a median concavity in the later whorls of adult individuals; suture deeply impressed; each whorl with a flat, narrow shelf or shoulder projecting beyond the preceeding whorl; surface of whorls with medium fine, nodose spirals like those of *C. halense* Dall, but with different arrangement. Just behind the suture are one to two very finely nodose spiral threads, one of which is frequently obscured by the overlapping whorl. Behind these is the largest spiral, ornamented with small round nodes about 2 mm. apart. The remainder of the whorl is ornamented with finer spirals, nodose, and alternating in size. The median concavity of the later whorls comes immediately posterior to the large noded spiral above described. The interspaces are slightly narrower than the spirals; base flattened, slightly convex, smooth; aperture roundly quadrate; columella stout, with single prominent fold, anterior notch short, large, recurved. A large decollate specimen with six whorls measures **in height 48 mm., maximum** diameter 28 mm.

An interesting feature of this shell is the presence in the adult stage of an impressed spiral line near the periphery of the base, which marks the line of juncture with each succeeding whorl. This is an adult character, and is lacking in the earlier whorls. It is apparently an illustration of the inheritance of an acquired character. Another interesting feature is the change in form of the whorl from rounded in youth to flattened, and finally to a concave form in the final stages of old individuals.

It would seem that this shell is related to some of the large, conical forms from the Flint River Oligocene, such as *C. halense* Dall, as its ornamentation is quite similar to the latter. It differs notably in the shape of its whorls, and in this latter respect, is more like the large species of *Campanile* from the Paris Basin Eocene. Maury has described the internal mold of a larger, but similar shell from the San Sebastian shale *Campanile* (*Portoricia*) *laricum* Maury, which may be a related species or a variety. Maury's species differs chiefly in its flatter and more concave whorls, as well as in its considerably greater size.

Localities.—262, Collazo Falls, 142?, 236, 749(a).

Range.—San Sebastian shale to lower Lares limestone.

Genus **Strombus** Linné

Strombus proximus? Sowerby

Strombus proximus Sowerby, Quart. Jour. Geol. Soc., VI, p. 48, Pl. 9, fig. 8, 1849.

Strombus pugilis Gabb (in part), Trans. Amer. Phil. Soc., XV, p. 233, 1873. Not *pugilis* Linné. Exclude other synonyms.

Strombus proximus Guppy, Quart. Jour. Geol. Soc., XXXII, p. 521, 1876.

Strombus pugilis Dall (in part), Trans. Wagner Inst. Sci., III, pt. 1, p. 177, 1890. Not *pugilis* Linné.

Strombus proximus Maury, Bull. Amer. Paleont., V, No. 29, p. 119, Pl. 20, figs, 4, 5, 1917.

Only incomplete specimens were found, which are identified doubtfully with this species.

Localities.—204, Mona Island (Lobeck).

Horizon.—Quebradillas limestone, Ponce limestone.

Strombus bifrons? Sowerby

A single specimen was found among the material collected from the Quebradillas limestone near Bayamon by Dr. Lobeck. The internal mold shows that the shell is the same shape as *S. bifrons,* and measures in height (with tip of spire missing) 32 mm., diameter 19 mm. It is apparently an immature specimen, for the outer lip does not flare to any extent, and the anterior notch is not noticeably recurved. The ornamentation consists of spirals like those of *S. bifrons,* but with the nodes or spines rather obsolete on the final

whorl, in which respect it resembles *S. gatunensis* Toula. *S. bifrons* is characteristic of the Aphera and Sconsia formations in Santo Domingo.

Locality.—Near Bayamon (Lobeck).

Horizon.—Quebradillas limestone.

Genus **Orthaulax** Gabb

Orthaulax gabbi? Dall

Plate XXIII, Figure 3

A single specimen was obtained from the sea cliff at the mouth of the Guajataca River in a stratum of very resistant limestone. The specimen had been exposed to the polishing action of the waves, and the original coloring, a light mottled brown, is preserved on the body of the shell near the aperture. The surface of the body whorl and spire are marked by the numerous faint longitudinal growth lines characteristic of the genus. Viewed from above, the outline is subcircular, with a slight triangularity as in *O. pugnax* Heilprin and *O. gabbi* Dall. The apical angle is about the same as that of *O. gabbi,* but considerably more acute than that of *O. aguadillensis* Maury, a shell apparently from the same horizon. A marked subangularity of the body whorl is very similar to that of *O. gabbi.* Above this angulation the whorl is strongly convex; below it, the whorl is concave, with a slight convexity midway between the angularity and the anterior end of the shell. The angularity is strongest at the aperture, on the inner lip, but is obsolete over the final two thirds of the body whorl. A slight shoulder is developed above the angulation on the final portion of the body. Height of shell 65 mm., diameter 38 mm.

This shell was examined by Dr. Dall, who states that while the specimen is too poor for positive identification, it is probably *O. gabbi,* a shell characteristic of the Chipola horizon. A comparison with *O. aguadillensis* Maury, a fragmental specimen, shows that the shell here described is quite a different species.

Locality.—204.

Horizon.—Quebradillas limestone.

Orthaulax portoricoensis, new species

Plate XXV, Figures 1, 2, 3, 4, 5

Under this heading are included all the large Strombus-like internal molds, which are among the most abundant forms to be found in the Quebradillas limestone. One of these internal molds was figured by Semmes, in his report on the San Juan District, as *Strombus,* species indet. The internal molds, taken by themselves, are generically indeterminate, but resemble the molds of a large *Strombus.* Fortunately, a few of these internal molds were found with portions of the external mold adhering to the specimens, which proves beyond a doubt that these large shells belong to the genus *Orthaulax.* They attain a size much greater than any species of *Orthaulax* yet known.

The specimens illustrated by figures 1 and 2 were examined by Dr. Dall, who states that:

1. Figure 1 is undoubtedly an *Orthaulax,* possibly the same species as Figure 2, but having a more acute or pointed spire.

2. Figure 2 is also an *Orthaulax,* new species, almost certainly the same species as an undescribed form from Santa Cruz.

3. Neither of these specimens is the same species as the shell described in this report as *O. gabbi?* Dall.

A large number of specimens, in addition to the two examined by Dr. Dall, show considerable variation in size and elevation, or acuteness of the spire. The fact that all these variations can be found in shells collected from a single fossiliferous pocket in the limestone, would indicate that they are for the most part variations of a single species, although more than one species of *Orthaulax* occur in the Quebradillas formation.

The apical angle as measured from the external molds, varies from 78° to 90° (largest specimen); and from the internal molds, varies from 60° to 85°. The following are measurements taken from a few of the internal molds:

	Height	Diameter	Apical Angle
1	155 mm	105 mm	83°
2	115	80	85
3		75	82
4		60	75
5...(Fig. 1)		40	60
6...(Fig. 2)	80	53	73
7	75	50	75
8	70	43	72
9	70	40	71
10	60	35	68

From these measurements, it will be observed that the smaller shells have a higher, more acute spire. This may be a varietal difference. Figures 3 and 4 show the internal mold of one of these smaller shells in which the final whorl has begun to envelop the spire, thus indicating that all of these small shells may be immature individuals. Figure 1 shows the internal mold of the spire, and the external mold of the enveloping dome of an adult shell. The curious openwork structure replacing the shell wall is the cast of the burrowing of a sponge or some other organism. This boring animal seems to have taken a special liking to the thick-shelled *Orthaulax* and other ponderous gastropods of the Quebradillas formation. The burrows became infiltrated with lime carbonate, which solidified with the surrounding limestone. The shell structures were then removed by solution, leaving the casts of these burrows in the form of a complex network resembling calcareous algae. Figure 5 shows the dome of an adult shell of the low spired type, and illustrating the degree to which the shell had been riddled with globular chambers, frequently connected by long worm-like passages.

Localities.—204, 41, 52(a), 801, and numerous other localities not recorded. An excellent specimen was collected by Dr. A. K. Lobeck on the east coast of Vieques Island.

Horizon.—Quebradillas limestone, Los Puertos limestone. Characteristic of the Quebradillas of the entire north coast of Porto Rico, as shown by the collections of Berkey and Semmes.

Genus **Cypræa** Linné

Cypræa spurcoides? Gabb

Cypræa spurcoides Gabb, Trans. Amer. Phil. Soc., V, p. 235, 1873.
Cypræa spurcoides Maury, Bull. Amer. Paleont., V, No. 29, p. 115, Pl. 19, figs. 7, 8, 9, 1917.

Apparently the same as the form described from Santo Domingo, except that the crenulations of the two lips are more nearly equal in number. Height 24 mm., maximum diameter 18 mm.

Locality.—204.

Horizon.—Quebradillas limestone.

Cypræa sancti-sebastiani Maury

Localities.—262, 232(b), 263?, 233, 235, 237, Juana Diaz.

Horizon.—San Sebastian shale, Juana Diaz shale.

Genus **Cassis** Lamarck

Cassis, species indet.

Plate XXII, Figure 9

Internal molds of a shell which may possibly be a new species. The distinguishing feature is the presence of a strong varix on the body whorl on the side opposite the aperture. Outer lip simple, apparently not thickened. The specimens are uniform in size and appear to be adult. The external sculpture, judging from impressions on the internal molds, consists of from eighteen to twenty broad spirals on the last whorl, with correspondingly fewer spirals on the earlier whorls. Height 30 mm., diameter 23 mm.

This shell is apparently of the type of *Phalium aldrichi* Dall, but is not quite as broad as the latter.

Localities.—232(b), 236.

Horizon.—San Sebastian shale.

Genus **Dolium** Lamarck

Subgenus **Malea** Valenciennes

Malea camura Guppy

Malea camura Guppy, Quart. Jour. Geol. Soc., XXII, p. 287, Pl. 17, fig. 9, 1866.
Malea ringens Gabb (in part), Trans. Amer. Phil. Soc., XV, p. 223, 1873.

Malea camura Guppy, Quart. Jour. Geol. Soc., XXXII, p. 525, 1876.
Malea camura Dall, Trans. Wagner Inst. Sci., III, pt. 6, p. 1584, 1903.
Malea camura Maury, Bull. Amer. Paleont., V, No. 29, p. 112, Pl. 19, fig. 3, 1917.

The specimens average about 37 mm. by 27 mm. Only internal molds were found with a few fragments of external mold.

Locality.—204; and Berkey 98.

Horizon.—Quebradillas limestone (abundant).

Genus **Columbella** Lamarck

Subgenus **Strombina** Moerch

Strombina portoricana, new species

Plate XXIII, Figure 4

Protoconch of two whorls, rather large, smooth, naticoid; post-nuclear whorls six to seven, moderately convex; suture distinct, but not channelled, and becoming obscure on last whorl; surface of whorls smooth except for faint growth striae, and by hump-like varices, or swellings, occurring as early as the third post-nuclear whorl; body whorl with spiral lines, alternating in strength, on the pillar and lower part of whorl, but very faint over the remainder of the whorl, and more closely spaced near the suture and on the pillar. A specimen with eight whorls and base of pillar missing measures in height 19.5 mm., diameter 9 mm. The largest specimen measures in height 33 mm., diameter 17 mm.

No complete specimens were found, and none showing the lip or aperture. This shell is apparently related to the group represented by *S. lessepsiana* Brown & Pilsbry, *S. prisma* Pilsbry & Johnson, and *S. cyphonotus* Pilsbry & Johnson.

Locality.—204.

Horizon.—Quebradillas limestone.

Genus **Phos** Montfort

Phos costatus Gabb

Plate XXII, Figure 10

Phos costatus Gabb, Trans. Amer. Phil. Soc., XV, p. 212, 1873.
Phos costatus Maury, Bull. Amer. Paleont., V, No. 29, p. 88, Pl. 14, figs. 13, 14, 1917.

The specimens correspond closely to those figured by Maury from Santo Domingo. Protoconch not preserved in any of the specimens.

An adult specimen measures in height 29 mm., diameter 14 mm. Number of whorls eight.

Locality.—204.

Horizon.—Quebradillas limestone (abundant).

Phos elegans Guppy

variety **portoricoensis**, new variety

Plate XXII, Figure 11

Shell small (height about 20 mm.), high spired; whorls rounded, with about fourteen rather sharply rounded ribs, crossed by primary, and frequently alternating smaller secondary spirals; small tubercules at intersections of spirals and ribs; occasionally two or three longitudinal threads between the ribs which do not cross the spirals; ribs irregularly spaced, especially on the body whorl, where a varix is formed at or near the aperture; ribs on the spire frequently vary in size, but do not form varices.

All the specimens are fragmental, but sufficient to show the entire shell except the protoconch. This variety is probably closest to the Santo Domingan occurrence of the species.

Locality.—192.

Horizon.—Quebradillas limestone.

Genius **Murex** Linné

Murex (Phyllonotus) cornurectus Guppy

M. (*Chicoreus*) *megacerus* Gabb, Trans. Amer. Phil. Soc., XV, p. 202, 1873. Not *M. megacerus* Sowerby.

M. cornurectus Guppy, Quart. Jour. Geol. Soc., XXXII, p. 521, Pl. 28, fig. 4, 1876.

M. (*Phyllonotus*) *cornurectus* Maury, Bull. Amer. Paleont., V, No. 29, p. 103, Pl. 16, figs. 9, 10, 1917.

An internal mold, together with a portion of the external mold, was found of a large *Murex* which seems to be this species. Height (of last three whorls) 80 mm., diameter (of internal mold) 45 mm.

Locality.—204.

Horizon.—Quebradillas limestone.

Genus **Alectrion** Montfort

Alectrion gurabensis Maury

variety **portoricoensis,** new variety

variety **varicum,** new variety

Plate XXII, Figures 12, 13, 14, 15

Plate XXIV, Figure 19

The Arecibo limestone contains an abundance of a small shell which is like *A. gurabensis* Maury, a Santo Domingan form, but which has some very evident differences from the latter. These shells fall into two distinct varieties, one with coarse ribs, the other with finer, more numerous ribs and a pronounced varix. The former are here called variety *portoricoensis,* the latter variety *varicum.* The former is by far the most abundant of the two. Both forms are smaller and have fewer whorls than the Santo Domingo type, but they are not young shells as shown by the uniformity in size among a large number of specimens. No specimen of either variety was found which measures more than 8 mm. in height.

The following table shows the relation of the two varieties to the type form from Santo Domingo, as described by Maury (Bull. Amer. Paleont., V, No. 29, p. 91, Pl. 15, fig. 21, 1917):

Locality.—204.

Horizon.—Quebradillas limestone.

Genus **Fusus** Lamarck

Fusus henekeni Sowerby

Plate XVIII, Figure 5

Fusus henekeri Sowerby, Quart. Jour. Geol. Soc., VI, p. 49, 1849.

Fusus henekeni Gabb, Trans. Amer. Phil. Soc., XV, p. 204, 1873.

Fusus henekeni Guppy, Geol. Mag., p. 439, 1874; Quart. Jour. Geol. Soc., XXXII, p. 524, Pl. 28, fig. 6 (type), fig. 2 (var. *haitensis*), 1876.

Fusus henekeri Dall, Trans. Wagner Inst. Sci., III, pt. 6, p. 1584, 1903.

Fusus henekeni Grabau, Smithsonian Misc. Coll., XLIV, No. 1417, p. 19, 1904.

Fusus henekeni Maury, Bull. Amer. Paleont., V, No. 29, p. 78, Pl. 12, fig. 1, 1917.

A single specimen was found, with protoconch and body whorl missing. Only primary and secondary spirals show on the specimen.

TABLE 3

Characters	*A. gurabensis* Maury Santo Domingo	*A. gurabensis* var. *portoricensis* Porto Rico	*A. gurabensis* var. *varicum* Porto Rico
Size	Height 11 mm. Diameter 6 mm.	Height 7 mm. Diameter 4.5 mm.	Height 8 mm. Diameter 4.5 mm.
Nuclear whorls	3 smooth	2–2.5	2?
Post-nuclear whorls	6	5	5
Character of post-nuclear whorls	Convex, angulated and shouldered; ribs narrow, round; wider interspaces.	Convex, sub-angular and shouldered.	Earlier whorls sub-angular—the last two are rounded.
Suture	Wavy	Wavy	Slightly wavy
Ribs on body whorl	11	12 Slightly oblique	13–14 Oblique
Spirals on spire.	Penultimate whorl 3 strong, widely spaced 3 weaker above 3 weaker below	Penultimate whorl same as in the Santo Domingo shell	3rd post-nuclear 1 weak posterior 3 strong median 2 weak anterior enultimate 3 weak posterior 3 strong median 4 weak anterior
Spirals on body	3 or 4 weak posterior 3 strong median 12 weak anterior	2–3 weak posterior 3–4 strong median 10–13 weak anterior	3 weak posterior 3 strong median 12 weak anterior
Spirals on pillar	8	6–7, arrangement—2 strong alternate with 2 weak	?
Aperture	Round	Sub-Round	Round
Outer lip	8 lirae	Thin 15 lirae, alternate long and short	Thickened by strong varix
Inner lip	Posterior denticle	Smooth, moderately thick callus. Posterior denticle absent or obscure.	Smooth, moderately thick callus. Posterior denticle
Anterior canal..	Well defined	Broad and deep	?

This is probably a small variety, otherwise very close to the type form, but more specimens are required for a complete description. The spire of eight whorls measures in height 20 mm., maximum diameter 8.5 mm.

Locality.—204.

Horizon.—Quebradillas limestone.

Genus **Turbinella** Lamarck

Turbinella chipolana Dall

variety **precursor,** new variety

Plate XXIII, Figures 6, 7

Shell small, fusiform, consisting of three and one-half nuclear whorls and three post-nuclear whorls; protoconch like *T. chipolana* Dall and *T. regina* Heilprin, in having a swollen tip, succeeded by smaller nuclear whorls. The tip consists of one and one-half volutions, is transversely ovate, and is peculiar in having a shallow median constriction. The two succeeding nuclear whorls considerably smaller in diameter, the first being gently convex, the last nearly flat. The latter is succeeded abruptly by sculptured whorls with seven rounded, not nodose ribs, and prominent spirals, of which there are four on the first two, and about twenty-three on the final whorl and pillar. The spirals are separated by wider interspaces. The whorls are marked by a prominent, narrow and wavy sub-sutural band or shoulder, sculptured with at first one and later with two spirals. The interspace immediately below the shoulder is strongly impressed. The spirals are of equal strength, except on the pillar, where faint intercalated threads appear. The entire post-nuclear surface is marked by fine raised longitudinal growth lines, strongest in the interspaces between the spirals. Height of shell 17.5 mm., maximum diameter 7 mm.; height of protoconch 3½ mm., diameter of tip of protoconch 2⅓ mm.

This shell is probably the ancestor of *T. chipolana* Dall. It is apparently adult, its small size being indicative of its primitive character. The same is true of variety *areciboense,* a mutation from the San Sebastian shell occurring in the Quebradillas limestone. All the material available was gone over thoroughly with the purpose of trying to find some molds or fragments which would show that these shells reach a larger size, but the results were negative. It seems, therefore, safe to assume that the primitive *Turbinellas* were small forms, which did not reach their maximum size

until the Pliocene. Analogous cases may be seen in some of the genetic groups of *Fusus* (Grabau, A. W. Phyl. Fusus, Smithson. Miscl. Coll., XLIV, No. 1417, 1904).

Locality.—84.

Horizon.—San Sebastian shale.

Turbinella chipolana Dall

variety **areciboense,** new variety

Plate XXIII, Figure 8

A single specimen in which the lower half of the body whorl is missing. Protoconch like that of variety *precursor*, but without median construction of the tip, and with the third whorl almost entirely concealed by the overlapping of the first post-nuclear whorl, giving the appearance of a two-whorl protoconch. The tip is slightly larger (diameter 3 mm.) than that of *precursor*, and slightly more swollen when compared with the succeeding whorls. The whorl following the tip is nearly flat, whereas in *precursor* it is noticeably convex. The first post-nuclear whorl has ribs, spirals, and subsutural band, or shoulder, as in *precursor* and represents the *precursor* stage. On the next and following whorls, however, the ribs become nodose, and on later whorls there are more spirals than in *precursor*, with occasionally a fine intercalated spiral. The longitudinal growth lines are similar to those of *precursor*, but show a tendency to alternate in strength. The subsutural band, or shoulder, is prominent in the first two post-nuclear whorls and marked by a single spiral; on the third whorl it is inconspicuous, and marked by two spirals, as in the later whorls of *precursor*, while on the fourth and fifth (or final) whorls it has disappeared altogether. This fact is interesting in showing the tendency to lose a primitive character which has apparently been completely lost in the Chipolan shell. Height of fragment 20 mm., maximum diameter 11 mm.

This shell is a mutation from variety *precursor,* the *precursor,* or simple ribbed stage being accelerated and limited to the first post-nuclear whorl. The later whorls have nodose ribs and represent what may be termed the *areciboense* stage. This shell is best interpreted as a local mutation not in the direct line leading to *T. chipolana* and *T. regina.*

Locality.—204.

Horizon.—Quebradillas limestone.

Genus **Xancus** Bolten

Xancus validus Sowerby

Turbinellus validus Sowerby, Quart. Jour. Geol. Soc., VI, p. 50, 1849.
Turbinella valida Gabb, Trans. Amer. Phil. Soc., XV, p. 218, 1873.
Turbinellus validus Guppy, Geol. Mag., p. 438, 1874; Quart. Jour. Geol. Soc., XXXII, p. 523, 1876.
Turbinella scolymus Tryon (in part) Man. Conch., IV, p. 70, 1882. Not the recent shell.
Turbinella validus Dall, Trans. Wagner Inst. Sci., III, pt. 1, p. 99, 1890.
Turbinella scolymus Dall (in part), Trans. Wagner Inst. Sci., III, pt. 1, p. 97, 1890.
Xancus validus Maury, Bull. Amer. Paleont., V, No. 29, p. 83, Pl. 13, fig. 5, 1917.

Apparently rare. Only a few fragments were found, showing the sculpture.

Locality.—204.

Horizon.—Quebradillas limestone.

Xancus, new species?

Plate XXIII, Figure 9

Known only from fragments. Spire unknown; shell apparently like *X. validus* Sowerby and *X. wilsoni* Conrad, but differing chiefly in the greater number of tubercles, or spines, which are along a contracted zone below the rounded shoulder. There are four high, strong columellar folds, the anterior one being smaller than the others. The lower portion of the body whorl is sculptured with strong spirals as in *X. validus*. The exterior of the remainder of the shell is unknown, except for the presence of the tubercles. Height of body whorl 67 mm., maximum diameter about 50 mm.

Locality.—244, 254-5-6.

Horizon.—Lares limestone.

Genus **Mitra** Lamarck

Mitra henekeni Sowerby

Plate XXIV, Figure 1

Mitra henekeri Sowerby, Quart. Jour. Geol. Soc., VI, p. 46, Pl. 9, fig. 5, 1849.
Mitra henekeni Gabb, Trans. Amer. Phil. Soc., XV., p. 219, 1873.
Mitra henekeni Guppy (in part), Quart. Jour. Geol. Soc., XXXII, p. 528, 1876.
Mitra henekeni Maury, Bull. Amer. Paleont., V, No. 29, p. 74, Pl. 12, figs. 5, 5a, 1917.

A single fragmental specimen of a young shell. Protoconch missing. Seven whorls. Height 20 mm., diameter 7 mm.

Locality.—204.

Horizon.—Quebradillas limestone.

Mitra symmetrica Gabb

Mitra symmetrica Gabb, Trans. Amer. Phil. Soc., XV, p. 220, 1873.
Mitra symmetricus Maury, Bull. Amer. Paleont., V, No. 29, p. 75, 1917.

A single fragmental specimen, consisting of the last two whorls with anterior portion missing. Columellar folds not shown; whorls flattened, slightly convex; suture distinct, but not impressed; aperture elongate-ovate; surface with flattened spirals and much narrower grooves between, which are marked by growth lines. Height 25 mm., diameter 12 mm.

It has been suggested that *M. symmetrica* may be the young of *M. titan* Gabb.

Locality.—280.

Horizon.—Lares formation.

Genus **Olivella** Swainson

Olivella muticoides Gabb

variety **portoricoensis,** new variety

Plate XXIV, Figures 2, 3

The shells vary from high to low spired, and also in the number of columellar plications. They include the types represented by *O. muticoides* and *O. muticoides* variety *canaliculata* of Santo Domingo, and there are all gradations between. The sutural canal is extremely broad in all specimens; columellas callus very thick; three to four columellar plications, with several faint ones posterior to these; largest specimen measures in height 12 mm., diameter 4.5 mm.

Localities.—204, 671; Aguila Point, K 75.2 Ponce-Penuelas road (Mitchell).

Horizon.—Quebradillas limestone (extremely abundant); and Ponce limestone.

Olivella portoricoensis, new species

Plate XXIV, Figure 4

Shell small, smooth, moderately high spired; whorls about six; protoconch missing on all specimens; suture distinct, impressed below upper margin of the succeeding whorl, leaving a gap between top of whorl and surface of the preceding whorl; a raised spiral thread appears above the suture, barely showing above the upper margin of the overlapping whorl; columella with two spiral grooves; callus moderately thick; anterior notch shallow, inconspicuous. Height of shell 12 mm., diameter 5 mm.

The distinguishing feature of this shell is the spiral thread at the suture. This thread is not continued on the body whorl.

Localities.—204, 216.

Horizon.—Quebradillas limestone.

Genus **Cancellaria** Lamarck

Cancellaria lævescens Guppy

Plate XXIV, Figures 5, 6

Cancellaria lævescens Guppy, Quart. Jour. Geol. Soc., XXII, p. 289, Pl. 17, fig. 12, 1866.
Cancellaria lævescens Gabb, Trans. Amer. Phil. Soc., XV, p. 239, 1873.
Cancellaria lævescens Maury, Bull. Amer. Paleont., V, No. 29, p. 64, Pl. 10, fig. 6, 1917.
Cancellaria lævescens Dall, Trans. Wagner Inst. Sci., III, pt. 1, p. 43, 1890.

The specimens are smaller than the Jamaican shells, and show all variations between complete loss of cancellation on the body whorl and merely a diminution of strength of cancellation near the aperture. In the latter cases, the spirals continue, but the ribs are irregular in occurrence and indistinct or absent for considerable intervals. In some shells the ribs on the body whorl become merely irregular crowded growth lines; callus very thick; columella with at least three prominent plaits; aperture not widening anteriorly as does that of the Jamaican shell. An average shell measures in height 23 mm., diameter 14 mm. The largest complete specimen measures 26 mm. by 15 mm., while a fragment indicates that the shells attain a size slightly larger than this.

Locality.—204.

Horizon.—Quebradillas limestone (abundant).

Genus **Turris** Bolten

Turris albida Perry

variety **haitensis** Sowerby

Plate XXIV, Figure 7

Pleurotoma haitensis Sowerby, Quart. Jour. Geol. Soc., VI, p. 50, 1849.
Turris albida var. *haitensis* Maury, Bull. Amer. Paleont., V, No. 29, p. 50, Pl. 8, fig. 4, 1917.

A few specimens were collected which agree closely with this variety. The largest specimen (spire with body whorl missing) measures in height 22 mm., diameter 8 mm.

Locality.—204.

Horizon.—Quebradillas limestone.

Turris albida Perry

variety cf. **virgo** Lamarck

Pleurotoma virgo Lamarck, Anim. s. Vert., VII, p. 94, 1822.
Pleurotoma virgo Moore, Quart. Jour. Geol. Soc., IX, p. 130, 1853.
Turris (*Surcula*) *virgo* Gabb, Trans. Amer. Phil. Soc., XV, pp. 206, 207, 1873.
Turris albida var. *virgo* Maury, Bull. Amer. Paleont. V, No. 29, p. 50, Pl. 8, fig. 6, 1917.

A single fragment showing portions of the last two whorls, and indicating a shell of about 60 mm. height. An unusual feature is the absence of secondary spirals. It seems to be an adult form which has retained the form of the young variety *virgo*. Another special feature is the coarseness of the spirals, the prominent median keel being especially broad and thick, resembling the keels of *Ecphora quadricostata*. The suture is indistinct. Interspaces between spirals marked only by the characteristic oblique growth lines.

Locality.—204.

Horizon.—Quebradillas limestone.

Genus **Drillia** Gray

Drillia consors Sowerby

variety **portoricoensis**, new variety

Plate XXIV, Figures 8, 9

Shell small, moderately slender; whorls about nine; sutural band as in the type, but nearly half the axial width of the whorl; sculpture of fron

four to five prominent spirals, and about 18 sharp ribs which do not cross the sub-sutural band, the latter being smooth, and concave on either side of the spiral ridge which divides the band. The concavity below this spiral ridge is over twice the width of that above the ridge, and much more deeply concave. Height 15 mm., diameter 5 mm.

This shell is close to *D. consors,* but has some distinctive differences. One of the specimens shows the protoconch fairly well. It is rather large, smooth, naticoid, and apparently consists of two whorls. The first post-nuclear whorl is sculptured with ribs only, the spirals being too fine to observe (if present at all) and the sub-sutural band not appearing until the second sculptured whorl.

Locality.—204; Berkey 98.

Horizon.—Quebradillas limestone.

Drillia grabaui, new species

Plate XXIV, Figure 10

Shell small, slender; decollate specimen (5 whorls) measures in height 14 mm., diameter 4 mm.; protoconch of two smooth, rather large, globular whorls; post-nuclear whorls with sharp, widely spaced ribs and fine, flattened spiral threads, not crossing the ribs and slightly arcuate between the ribs; sub-sutural band like that of *D. consors,* but narrower and wavy, or fluted, and marked with faint spiral threads and arcuate growth lines indicating a fairly deep, semi-circular posterior sinus. On the penultimate whorl, there are six strong spirals, with three additional ones just below the band, which are fine, crowded, and about the same strength as those on the band. On the body whorl there are twenty-two spirals, and the ribs extend well toward the anterior portion of the shell before dying out. The ribs, spirals, and band appear together immediately following the protoconch stage.

This shell has a slight resemblance to *D. maonrisparum* Maury, of the Santo Domingan Oligocene, but differs in its slightly larger size, more slender form, different protoconch, and absence of any varix. It probably belongs to the *D. consors* group.

Locality.—204.

Horizon.—Quebradillas limestone.

Drillia portoricoensis, new species

Plate XXIV, Figures 11, 12

Shell with ten whorls, including protoconch of two smooth, globular volutions; post-nuclear whorls sculptured with low, straight longitudinal ribs and faint spirals, visible only between the ribs, except on the anterior half

of the body whorl, where they are much stronger, and slightly nodose where they cross the ribs; sub-sutural band of the *D. consors* type, with dividing spiral ridge prominent in the earlier whorls, but becoming low and inconspicuous in the adult; band slightly wrinkled where it laps over the ribs of the preceding whorl; lower half of band slightly concave, and smooth except for faint, microscopic spiral lines, and growth lines indicating a broad, sub-angular posterior sinus; adult shells with a strong, thick varix at the outer lip. Height of shell 16 mm., diameter (excluding varix) 5.5 mm.

This shell is easily recognizable from its conspicuous varix, and its almost obsolete sculpture.

Locality.—204.

Horizon.—Quebradillas limestone.

Drillia semmesi, new species

Plate XXIV, Figure 13

Shell small, broader and lower spired than is usual in members of this genus; whorls seven, including a large protoconch of two smooth, rounded whorls, the first small, the second considerably larger; first post-nuclear whorl sculptured with about thirteen sharp ribs extending from suture to suture, and crossed by three raised spiral ridges, producing a cancellate sculpture; all post-nuclear whorls sharply shouldered, and the ribs, on crossing the shoulder, are strongly arched backward, a feature most noticeable in the later whorls; shoulders of the last four whorls are marked by obscure spirals; later whorls retain the three primary spirals, and on the fourth whorl, smaller intercalated secondary spirals appear. The uppermost primary spiral marks the shoulder angulation. The body whorl has about twelve prominent (or "primary") spirals, with some of the interspaces marked by one or two faint (or "secondary") spirals. All post-nuclear whorls show longitudinal growth lines, arcuate on the shoulder, indicating a wide U-shaped posterior notch. Aperture and anterior portion of shell unknown. Length of most complete specimen, with lower portion of body whorl missing, 8 mm., diameter 4 mm.

This shell is named in honor of Dr. D. R. Semmes, in recognition of his work on the San Juan District of Porto Rico.

Locality.—204.

Horizon.—Quebradillas limestone.

Genus **Cythara** Schumacher

Cythara cf. **elongata** Gabb

Mangilia elongata Gabb, Trans. Amer. Phil. Soc., XV, p. 211, 1873; Jour. Acad. Nat. Sci. Phila., VIII, p. 351, Pl. 46, fig. 34, 1881.

Cythara elongata Dall, Trans. Wagner Inst. Sci., III, pt. 6, p. 1583, 1903.
Cythara elongata Maury, Bull. Amer. Paleont., V, No. 29, p. 59, Pl. 9, fig. 12, 1917.

A single poorly preserved specimen, which seems to be this species or one very closely related. Height 7.5 mm., diameter 3 mm.

Locality.—204.

Horizon.—Quebradillas limestone.

Genus **Terebra** Adanson

Terebra quebradillensis, new species

Plate XXIV, Figure 14

Shell small, slender; protoconch of two smooth globular whorls, slightly larger than the succeeding post-nuclear whorl; twelve post-nuclear whorls, rounded as in *T. berlinerœ* Maury; sub-sutural band nearly one-third the axial width of the whorl, marked off by deep, narrow furrow, and faintly striated by one or two spiral threads as in *T. wolfgangi* Toula; about eighteen arcuate ribs on each whorl, which cross the furrow and sub-sutural band without interruption or change of direction; remainder of whorl below sub-sutural band marked by about nine spiral threads (sixteen on last whorl) which vary in size. A prominent spiral is situated next to the furrow. The rest are finer, and crowded together in groups of two or three. In the earlier whorls they are more uniform in size and distribution; and fewer in number; columella short and non-plicate. The largest specimen measures in height 18 mm., diameter 4 mm.

This shell resembles *T. berlinerœ* Maury in its convex whorls and the character of the spiral threads. It differs in its smaller size and wider sub-sutural band. It resembles *T. wolfgangi* Toula in its bisected or trisected sub-sutural band.

Localities.—204, and near Ponce (Mitchell).

Horizon.—Quebradillas limestone, Ponce limestone.

Genus **Conus** Linné

Conus catenatus Sowerby

Plate XXIV, Figure 15

Conus catenatus Sowerby, Quart. Jour. Geol. Soc., VI, p. 45, Pl. 9, fig. 2, 1849.
Conus interstinctus Guppy, Quart. Jour. Geol. Soc., XXII, p. 288, Pl. 16, fig. 3, 1866.
Conus catenatus Gabb, Trans. Amer. Phil. Soc., XV, p. 230, 1873.

Conus catenatus Guppy, Quart. Jour. Geol. Soc., XXXII, p. 527, 1876.
Conus catenatus Maury, Bull. Amer. Paleont., V, No. 29, p. 38, Pl. 5, fig. 4; Pl. 6, figs. 1, 2, 1917.

The specimens vary from concave to only slightly concave spire, from high to moderately low spire, and there is considerable range in size. Upper whorls carinated; last five whorls rounded on shoulder and broadly channelled above, with faint arcuate growth lines crossing the channels; posterior third of body whorl smooth; anterior two-thirds marked by spiral threads which alternate with much finer, obscure threads. There are many variations, some of the specimens resembling *C. cercadensis* Maury, other resembling *C. kitteredgei* Maury, but all evidently variations of *C. catenatus*. A typical shell measures in height 31 mm., diameter 17 mm.

Locality.—204. Also found by Berkey in the vicinity of Quebradillas.

Horizon.—Quebradillas limestone.

Conus cf. **marginatus** Sowerby

Plate XXIV, Figure 16

Conus marginatus Sowerby, Quart. Jour. Geol. Soc., VI, p. 44, 1849.
Conus marginatus Gabb, Trans. Amer. Phil. Soc., XV, p. 230, 1873.
Conus marginatus Guppy, Quart. Jour. Geol. Soc., XXXII, p. 528, Pl. 29, fig. 5, 1876.
Conus (Chelyconus) marginatus Cossmann, Jour. de Conch., LXI, pp. 44-46, Pl. 3, figs. 14, 15, 1913.
Conus marginatus Maury, Bull. Amer. Paleont., V, No. 29, p. 46, Pl. 7, fig. 11, 1917.

A small conus which has features in common with *C. marginatus* and may be the young of the latter. Whorls eight, including two nuclear; spire moderately high, scarcely concave; whorls carinate except last whorl, which is rounded at the shoulder; whorls of the spire flat above, while the final whorl is slightly channelled above; posterior half of body smooth; anterior half with twelve smooth, flat, spiral bands separated by deep grooves marked by raised longitudinal threads, which are limited to the grooves and do not cross the spiral bands. Height 7.5 mm., diameter 4 mm.

Locality.—204.

Horizon.—Quebradillas limestone.

Genus **Bullaria** Rafinesque

Bullaria paupercula Sowerby

Bulla paupercula Sowerby, Quart. Jour. Geol. Soc., VI, p. 52, 1849.
Bulla paupercula Gabb, Trans. Amer. Phil. Soc., XV, p. 246, 1873.
Bulla paupercula Guppy, Geol. Mag., p. 437, 1874; Quart. Jour. Geol. Soc., XXXII, p. 518, 1876.
Bulla paupercula Dall, Trans. Wagner Inst. Sci., III, pt. 1, p. 18, 1890.
Bulla striata Dall, Trans. Wagner Inst. Sci., III, pt. 6, p. 1583, 1903.
Bullaria paupercula Maury, Bull. Amer. Paleont., V, No. 29, p. 18, Pl. 3, fig. 8, 1917.

The specimens are internal molds, but their general outline seems sufficient to identify them with this species. Fragments of external mold show faint spiral grooves on the anterior part of the shell. Spire depressed. Height 15 mm., diameter 10 mm.

Localities.—204, 664, 235 ?.

Horizon.—Quebradillas limestone, Ponce limestone.

Bullaria portoricoensis, new species

Plate XXIV, Figure 17

Shell cylindrical, length nearly twice the diameter; spire sunken, imperforate; aperture longer than shell, extending above the truncate apex; surface with fine, slightly wavy impressed spiral lines, covering all of the shell except the summit, and crossed by slightly curved growth lines. An average specimen measures in height 20 mm., diameter 11.5 mm.

The most striking characteristic of this shell is its cylindrical form. The young shell is more globose in form, resembling one of the elongate forms of *B. granosa.*

Locality.—204.

Horizon.—Quebradillas limestone.

Bullaria granosa Sowerby

Plate XXIV, Figure 18

Bulla granosa Sowerby, Quart. Jour. Geol. Soc., VI, p. 51, Pl. 10, fig. 10, 1849.
Bulla granosa Gabb, Trans. Amer. Phil. Soc., XV, p. 246, 1873.
Bulla granosa Guppy, Geol. Mag., p. 437, 1874; Quart. Jour. Geol. Soc., XXXII, p. 518, 1876.
Bullaria granosa Maury, Bull. Amer. Paleont., V, No. 29, p. 20, Pl. 3, fig. 10, 1917.

The specimens are slightly more globular than the Santo Domingo shells. There is a great range in size, but the specimens fall into two groups, one of a large size averaging 20 mm. in height and 16.5 mm. in diameter, and the other a small size averaging 14 mm. in height and 11 mm. in diameter. The small shells have a large range in size and proportions, some of the measurements being:

Height	Diameter
17 mm.	15 mm.
11 mm.	8 mm.
16.5 mm.	12.5 mm.
11.5 mm.	10 mm.

The surface sculpture of the shells agrees closely with the shells from the Santo Domingo Oligocene.

Localities.—204, 209?, 216, 52(a), 191, 225, 678. San Juan district (Semmes). Culebrinas Point? (Mitchell).

Horizons.—Lares limestone to Quebradillas limestone, Ponce limestone? Extremely abundant in the Quebradillas limestone.

Plate X

Fig. 1. *Atrina rabelli* n. s.; nat. size; external mold.
Fig. 2. *Pecten* (*Pecten*) *laresense* n. s.; x 1.6; left valve.
Fig. 3. *Pecten* (*Pecten*) *laresense* n. s.; x 2; right valve.
Fig. 4. *Pecten* (*Euvola*) *reliquus* Brown and Pilsbry, var. *portoricoensis* n. var.; x 2.3.
Fig. 5. *Pecten* (*Nodipecten*) *nodosus* Linné; x 1.8.
Fig. 6. *Phacoides* (*Lucinisca*) *calhounensis* Dall; x 2.6; immature shell; gutta-percha cast.
Fig. 7. *Metis trinitaria* Dall; x 0.75; internal mold, left valve.

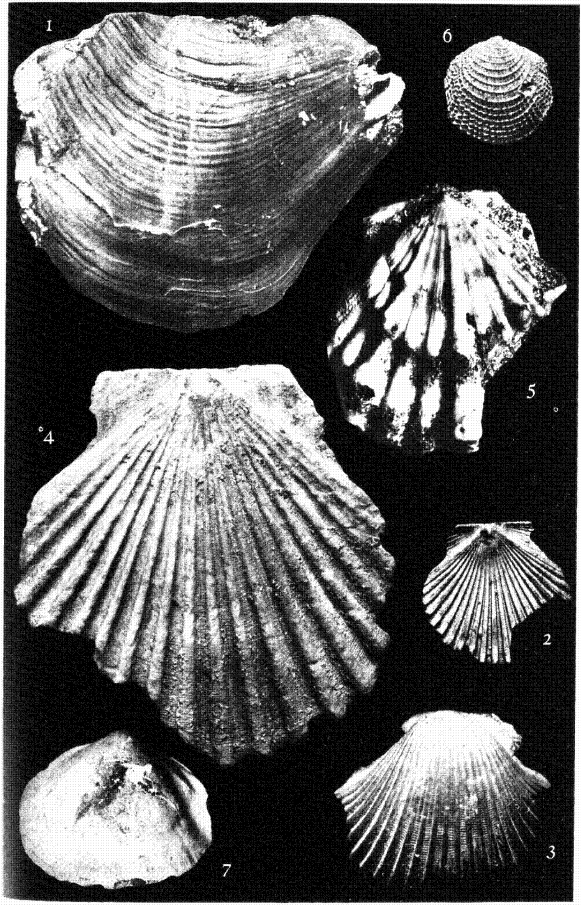

Plate XI

Fig. 1. *Pecten* (*Chlamys*) *collazoensis* n. s.; x 3.5.
Fig. 2. *Pecten* (*Chlamys*) *portoricoensis* n. s.; x 2.25; right valve.
Fig. 3. *Pecten* (*Chlamys*) *portoricoensis* n. s.; x 2; left valve.
Fig. 4. *Pecten portoricoensis* var. *reticulatis;* x 2.25.
Fig. 5. *Pecten portoricoensis* var. *grandis;* x 3.3; fragment showing prominent ribs.
Fig. 6. *Pecten portoricoensis* var. *grandis;* x 3.3; fragment of another shell showing low ribs.
Fig. 7. *Tellina* sp. aff. *T.* (*Angulus*) *atossa* Dall; x 1.8; gutta-percha cast.
Fig. 8. *Solen* (*Plectosolen*) *collazoensis* n. s.; x 14.

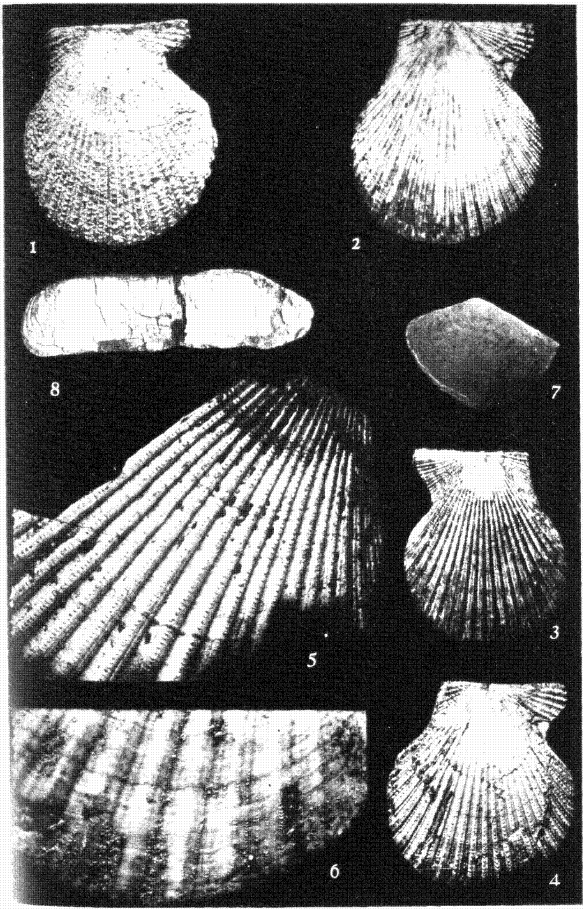

Plate XII

Fig. 1. *Pecten* (*Chlamys*) *grabaui* n. s.; x 2.25.
Fig. 2. *Pecten grabaui* var. *aguadensis;* x 2.2.
Fig. 3. *Pecten grabaui* var. *hatoensis;* x 2.
Fig. 4. *Pecten grabaui var. guayabensis;* x 2; ears defective.
Fig. 5. *Pecten* (*Chlamys*) *hodgii* n. s.; x 2.8.
Fig. 6. *Pecten* (*Plagioctenium*) *sebastiensis* n. s.; x 1.4.

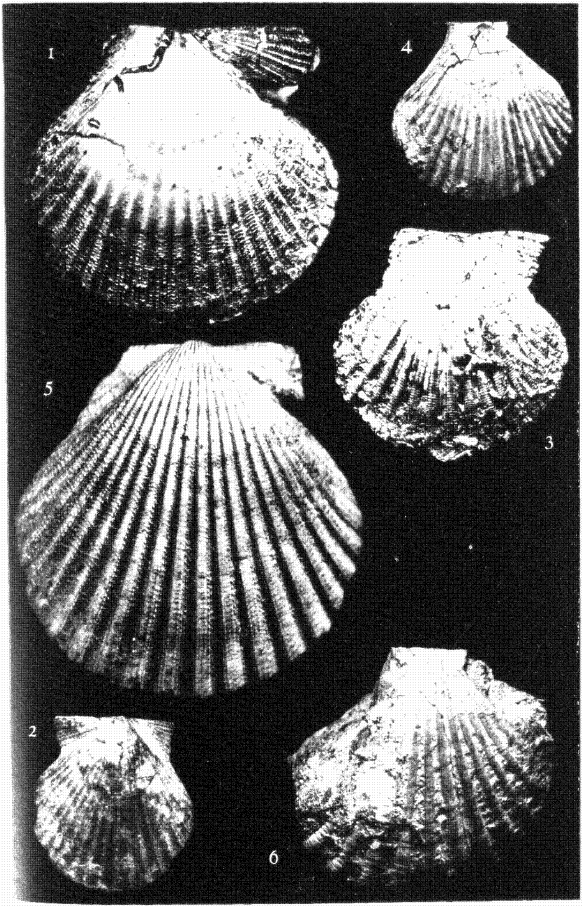

Plate XIII

Fig. 1. *Pecten* (*Aequipecten*) *lobecki* n. s.; x 2.5.

Figs. 2, 3. *Pecten* (*Plagioctenium*) *cercadica* Maury; x 1.9.

Fig. 4. *Ostrea sellæformis* Conrad, variety *portoricoensis* n. var.; nat. size; lower valve, adult shell.

Figs. 5, 6. *Ostrea sellæformis* var. *portoricoensis;* nat. size; upper valves, exterior and interior; young.

Fig. 7. *Chione woodwardi* Guppy; nat. size; gutta percha cast.

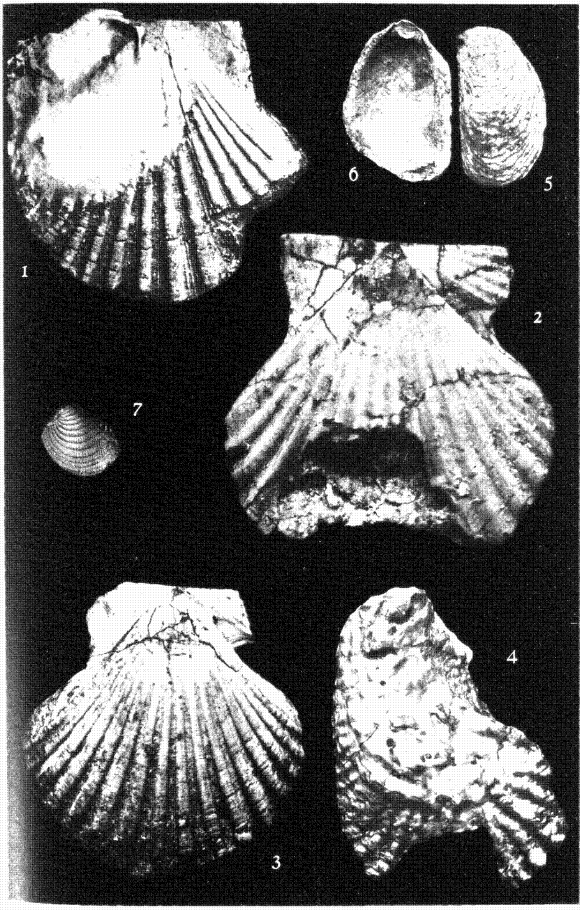
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Plate XIV

Fig. 1. *Pecten* (*Plagioctenium*) ***borinquenense*** n. s.; x 2.5; right valve.
Fig. 2. *Pecten borinquenense;* x 2.5; left valve.
Fig. 3. *Amusium mauryi* n. s.; x 3.4.
Fig. 4. *Barbatia* cf. *bonaczyi* Gabb; x 2.9; gutta-percha cast.
Fig. 5. *Arca dariensis* Brown and Pilsbry; x 2.2.
Fig. 6. *Arca* (*Scapharca*) cf. *donacia* Dall; x 3.7; right valve, gutta-percha cast.
Fig. 7. *Arca* cf. *donacia;* x 4; left valve, gutta-percha cast.

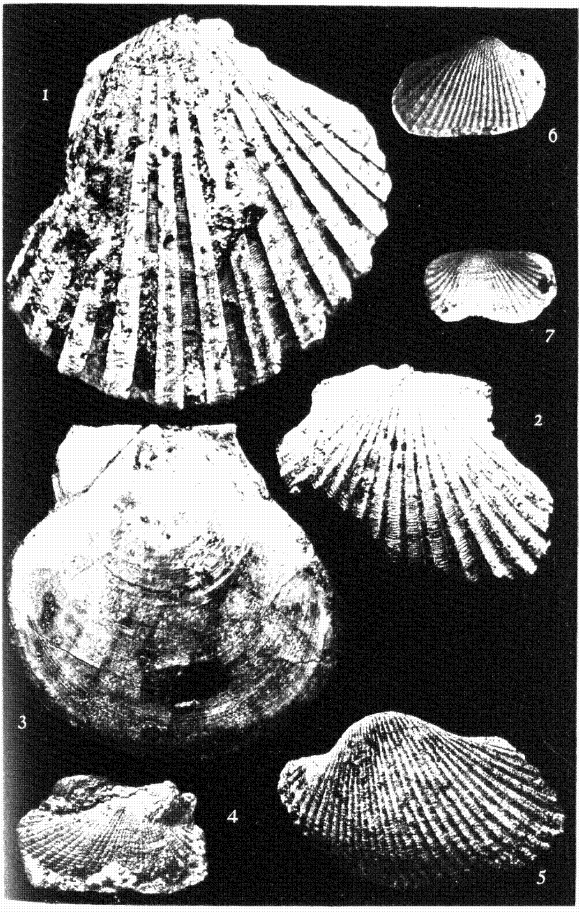


Plate XV

Fig. 1. *Ostrea antiguensis* Brown; x 0.9; lower valve.
Fig. 2. *Ostrea haitensis* Sowerby var.?; x 1.3; interior, young shell.
Fig. 3. *Ostrea haitensis* var.?; x 1.3; exterior, young.
Figs. 4, 5. *Glycimeris collazoensis* n. s.; x 1.5.
Fig. 6. *Glycimeris portoricoensis* n. s.; x 1.5; gutta-percha cast.

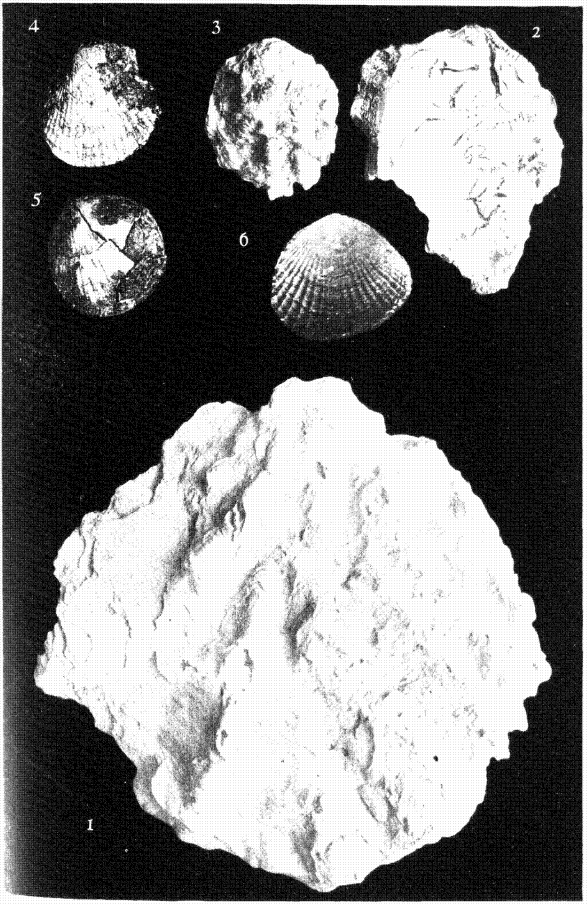


Plate XVI

Fig. 1. *Ostrea cahobasensis* Pilsbry and Brown, variety *portoricana* n. var.; x 0.6; valves together; specimen collected by A. K. Lobeck.

Fig. 2. *Pitaria* (*Hyphantosoma*) *carbasea* Guppy; x 2.2; gutta-percha cast.

Figs. 3, 4. *Tellina* (*Scissula*) *grabaui* n. s.; x 2.5; gutta-percha casts.

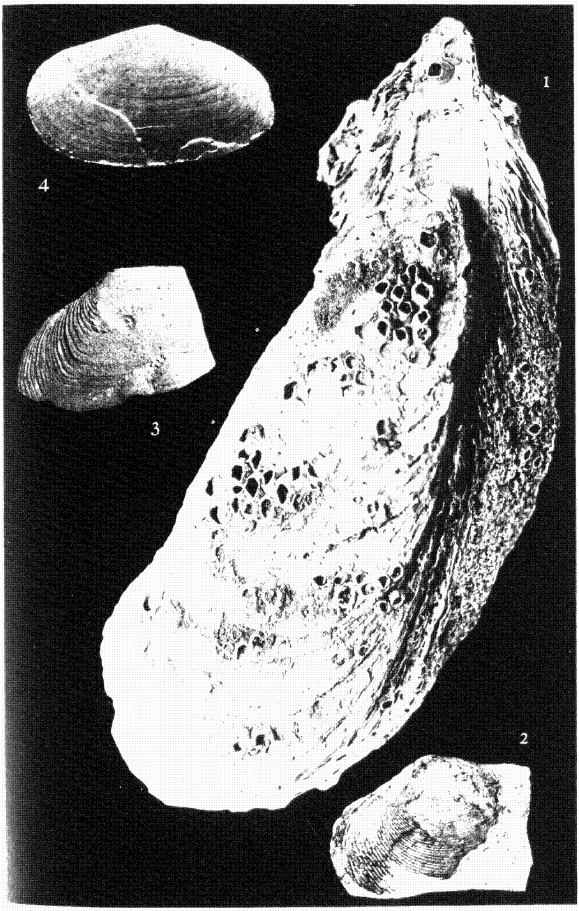


Plate XVII

Fig. 1. *Ostrea cahobasensis* Pilsbry and Brown, variety *portoricana* n. var.; x 0.6; lower valve, specimen collected by Lobeck.

Figs. 2, 3. *Arca* sp. indet.; x 2.2.

Fig. 4. *Codakia* (*Jagonia*) *magnoliana* Dall, variety *borinquenense* n. var.; x 2.5; gutta-percha cast.

Fig. 5. *Chama portoricana* n. s.; x 0.8; internal mold with portions of external mold of the lamellae at the margin.

Fig. 6. *Leda peltella* Dall x 2.4; gutta-percha cast.

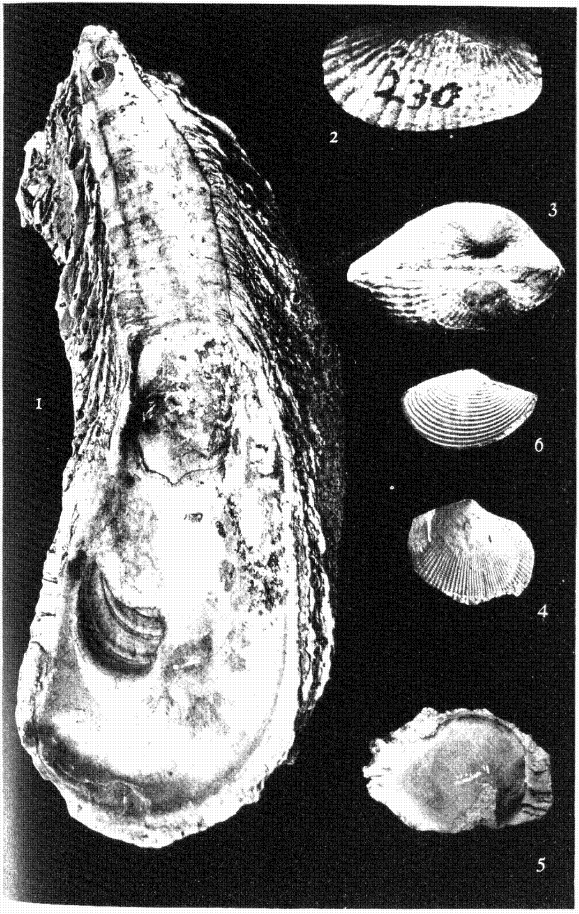


Plate XVIII

Fig. 1. *Lucina collazoensis* n. s.; x 0.7; left valve, int. mold.
Fig. 2. The same specimen,—dorsal view; x 1.1.
Fig. 3. *Lucina* cf. *chrysostoma* (Meusch.) Philippi; nat. size; internal mold.
Fig. 4. *Phacoides* (*Miltha*) sp. indet.; x 1.4; gutta-percha cast.
Fig. 5. *Phacoides* (*Miltha*) sp. indet.; x 2.6; gutta-percha cast.
Fig. 6. *Phacoides* (*Pseudomiltha*) *laresensis* n. s.; x 1.4; internal mold, with portions of the shell preserved near the beak, showing the sculpture.

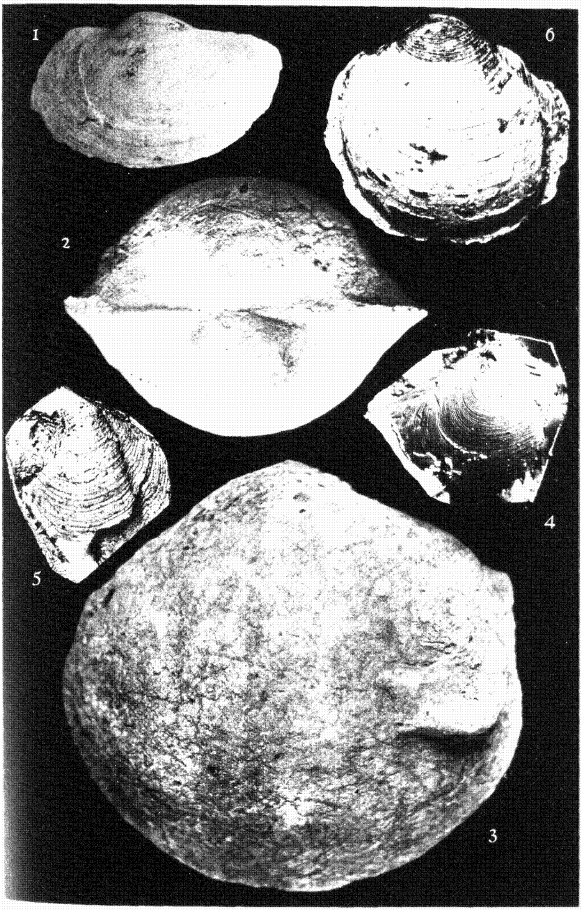


Plate XIX

Fig. 1. *Cardium muricoides* n. s.; x 2.6; gutta-percha cast.

Fig. 2. *Cardium* (*Trachycardium*) *cinderellæ* Maury, variety *alternatum* n. var.; x 2.2; int. mold.

Figs. 3, 4. *Cardium cinderellæ* var. *alternatum;* x 2.6; gutta-percha casts showing variations in the sculpture.

Figs. 5, 6. *Cardium* (*Trigonocardia*) *sambaicum* Maury, variety *portoricoensis* n. var.; x 2; gutta-percha casts.

Fig. 7. *Cardium* n. s.? (aff. *C. sambaicum* Maury); x 2.5; gutta-percha cast.

Maury; x 2.5; gutta-percha cast.

Fig. 8. *Cardium* (*Trigonocardia*) *haitense* var. *cercadicum*

Fig. 9. *Cardium haitense* variety *areciboense* n. var.; x 2.5; gutta-percha cast.

Fig. 10. *Clementia dariena* Conrad; x 1.1 int. mold, specimen from Robles, P. R.

Fig. 11. *Clementia dariena* Conrad; x 0.95; int. mold, specimen from Collazo, P. R., somewhat distorted by pressure.

Fig. 12. *Clementia dariena* Conrad; x 0.95; specimen from the Gatun formation, Panama, collected by Prof. J. F. Kemp.

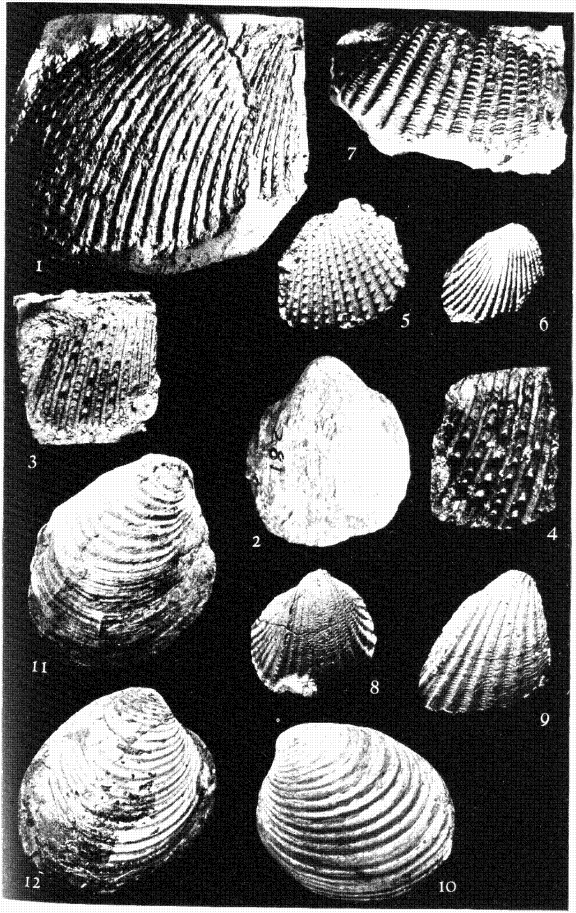


Plate XX

Fig. 1. *Cytherea* (*Cytherea*) *berkeyi* n. s.; x 0.75; int. mold, specimen collected by Prof. Berkey.

Fig. 2. Same specimen, dorsal view; x 0.7.

Fig. 3. Same specimen; x 0.75; gutta-percha cast from fragment of the external mold.

Fig. 4. *Tellina strophoidea* n. s.; x 2.5; right valve, gutta-percha cast.

Fig. 5. *Tellina strophoidea;* x 1.3; left valve, gutta-percha cast.

Fig. 6. *Tellina portoricoensis* n. s.; x 1.5; right valve, gutta-percha cast.

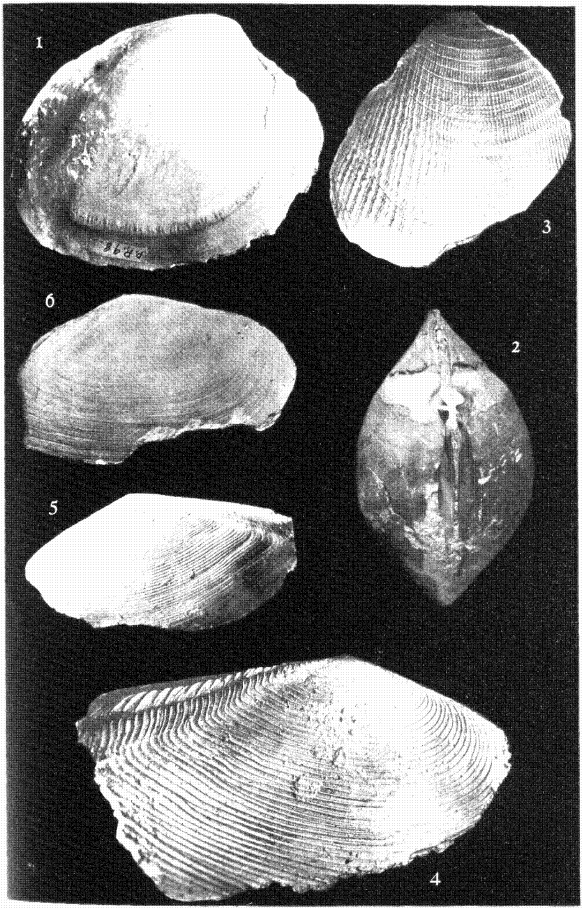


Plate XXI

Fig. 1. *Calliostoma portoricoensis* n. s.; x 2.5; gutta-percha cast.
Fig. 2. *Turbo fetkii* n. s.; x 2.6; gutta-percha cast.
Fig. 3. *Liotia* (*Arene*) *coronata* Dall, variety *portoricoensis* n. var.; x 4; gutta-percha cast.
Fig. 4. *Neritina* (*chipolana* var. ?) *collazoensis* n. s.; x 2.
Fig. 5. *Hipponyx portoricoensis* n. s.; x 2; gutta-percha cast.
Fig. 6. *Hipponyx portoricoensis;* x 2; gutta-percha cast, showing variation with strongly recurved apex.
Fig. 7. *Crucibulum auricula* Gmelin variety *portoricoensis* n. var.; x 1.3; gutta-percha cast, specimen collected by Prof. Berkey.
Fig. 8. Same specimen; x 3.3; gutta-percha cast of the internal cup.
Fig. 9. *Crucibulum auricula?* var.; x 2.3; gutta-percha cast.
Fig. 10. *Crucibulum* (*Dispotœa*) *collazum* n. s.; x 2; interior, showing cup.
Fig. 11. *Natica* (*Ampullina?*) *collazoensis* n. s.; x 0.75; decollate shell with rounded whorls.
Fig. 12. *Natica collazoensis;* x 0.7; decollate shell with angulated whorls (int. mold).
Figs. 13, 14. *Turritella tornata* Guppy variety *portoricoensis* n. var.; x 1.1; int. molds.
Fig. 15. *Turritella portoricoensis* n. s.; x 2.7; gutta-percha cast.
Fig. 16. *Petaloconchus? collazoensis* n. s.; x 1.5.
Fig. 17. *Pyramidella portoricoensis* n. s.; x 3.6; gutta-percha cast.
Fig. 18. *Bittium* sp. indet.; x 2; gutta-percha cast.

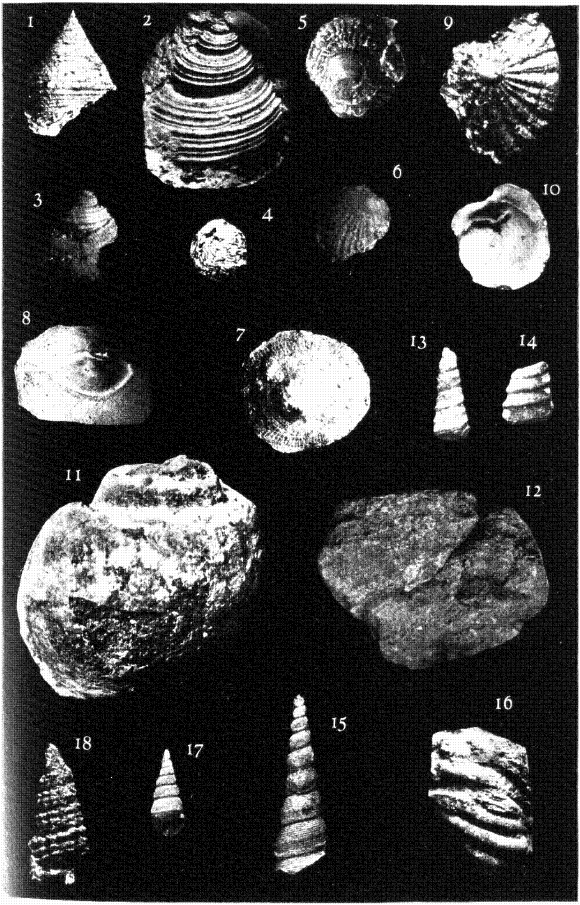


Plate XXII

Fig. 1. *Epitonium* (*Cirsotrema*) *collazoensis* n. s.; x 2.2.
Fig. 2. Same specimen; x 1.5.
Fig. 3. *Turritella mitchelli* n. s.; x 1.4.
Fig. 4. *Turritella berkeyi* n. s.; x 0.85; gutta-percha cast.
Fig. 5. *Cerithium portoricoensis* n. s.; x 3.7; gutta-percha cast, showing protoconch.
Fig. 6. *Cerithium portoricoensis;* x 2.3; gutta-percha cast, showing varix on body whorl.
Fig. 7. *Cerithium quebradillensis* n. s.; x 2.6; plastolin cast.
Fig. 8. Same specimen; x 2.2; showing aperture and pillar.
Fig. 9. *Cassis* sp. indet.; x 0.8; int. mold.
Fig. 10. *Phos costatus* Gabb; x 0.8; gutta-percha cast.
Fig. 11. *Phos elegans* Guppy variety *portoricoensis* n. var.; x 1.4; gutta-percha cast.
Fig. 12. *Alectrion gurabensis* Maury variety *portoricoensis* n. var.; x 2.2; gutta-percha cast.
Fig. 13. *Alectrion gurabensis* var. *portoricoensis;* x 2.2; gutta-percha cast, showing aperture.
Figs. 14, 15. *Alectrion gurabensis* variety *varicum* n. var.; x 2.2; gutta-percha casts.

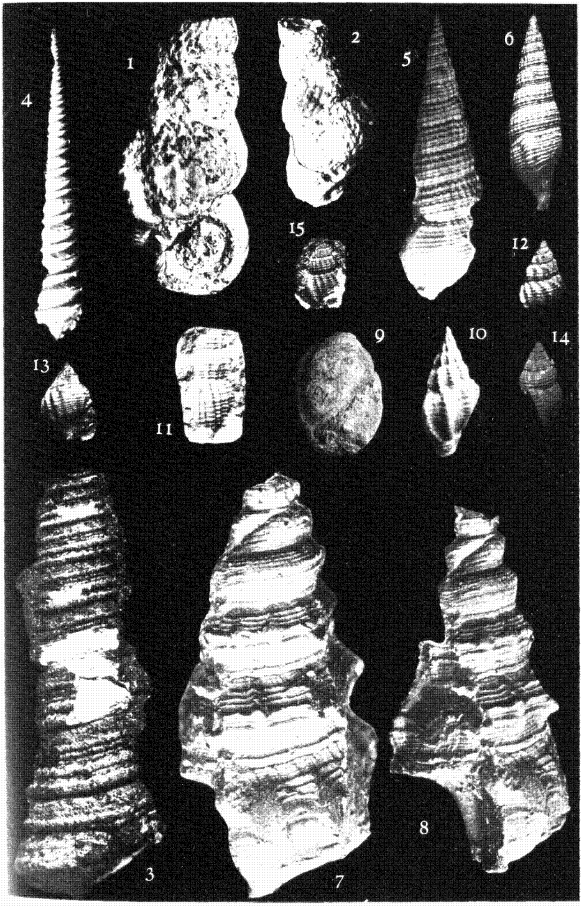


Plate XXIII

Figs. 1, 2. *Cerithium* (*Campanile*) *collazum* n. s.; x 1.1.
Fig. 3. *Orthaulax gabbi?* Dall; x 0.9.
Fig. 4. *Strombina portoricana* n. s.; x 2.7; gutta-percha cast.
Fig. 5. *Fusus henekeni* Sowerby; x 2.3; gutta-percha cast.
Fig. 6. *Turbinella chipolana* Dall variety *precursor* n. var.; x 2.5.
Fig. 7. Same specimen; x 3.7; aperture view.
Fig. 8. *Turbinella chipolana* variety *areciboense* n. var.; x 2.6; gutta-percha cast.
Fig. 9. *Xancus* n. s.?; nat. size; int. mold of portion of body whorl.

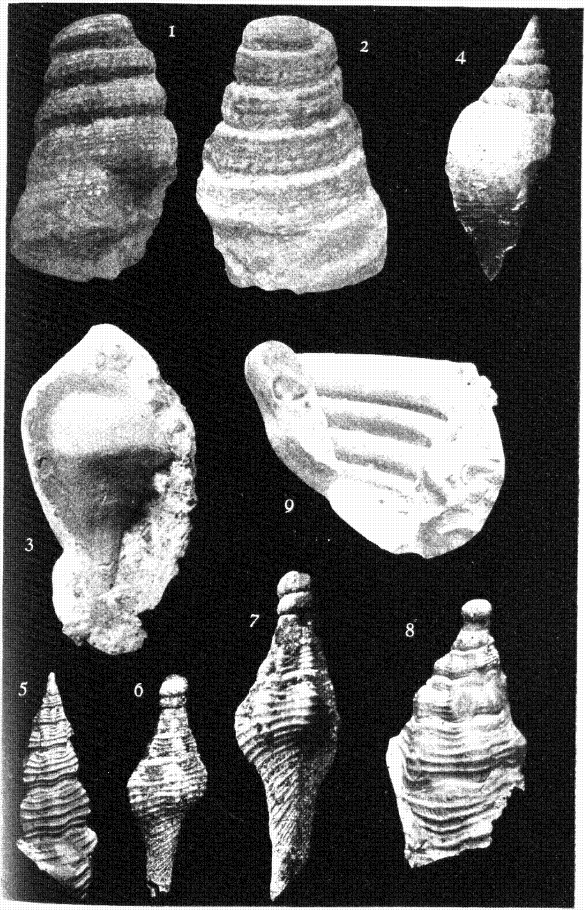


Plate XXIV

Fig. 1. *Mitra henekeni* Sowerby; x 2; gutta-percha cast.

Fig. 2. *Olivella muticoides* Gabb variety *portoricoensis* n. var.; x 1.75; gutta-percha cast, showing a low spired shell.

Fig. 3. *Olivella muticoides* var. *portoricoensis;* x 1.75; gutta-percha cast, showing a high spired shell.

Fig. 4. *Olivella portoricoensis* n. s.; x 3.1; gutta-percha cast.

Fig. 5. *Cancellaria lævescens* Guppy; x 0.8; gutta-percha cast showing shell with smooth body whorl.

Fig. 6. *Cancellaria lævescens;* x 0.8; gutta-percha cast, showing reappearance of cancellate ornamentation on the final portion of the body whorl.

Fig. 7. *Turris albida* Perry variety *haitensis* Sowerby; x 1.4; gutta-percha cast.

Fig. 8. *Drillia consors* Sowerby variety *portoricoensis* n. var.; x 3.5; gutta-percha cast.

Fig. 9. *Drillia consors* var. *portoricoensis;* x 2.3; gutta-percha cast.

Fig. 10. *Drillia grabaui* n. s.; x 2.3; gutta-percha cast.

Fig. 11. *Drillia portoricoensis* n. s.; x 2.3; gutta-percha cast showing varix.

Fig. 12. *Drillia portoricoensis;* x 2.3; gutta-percha cast.

Fig. 13. *Drillia semmesi* n. s.; x 2.25; gutta-percha cast.

Fig. 14. *Terebra quebradillensis* n. s.; x 18; gutta-percha cast.

Fig. 15. *Conus catenatus* Sowerby; x 1.5; gutta-percha cast of specimen collected by Prof. Berkey.

Fig. 16. *Conus* cf. *marginatus* Sowerby; x 3.6; gutta-percha cast.

Fig. 17. *Bullaria portoricoensis* n. s.; x 2.2; int. mold.

Fig. 18. *Bullaria granosa* Sowerby; x 2.25; gutta-percha cast.

Fig. 19. *Alectrion gurabensis* Maury variety *portoricoensis* n. var.; x 4; gutta-percha cast, showing the aperture and pillar

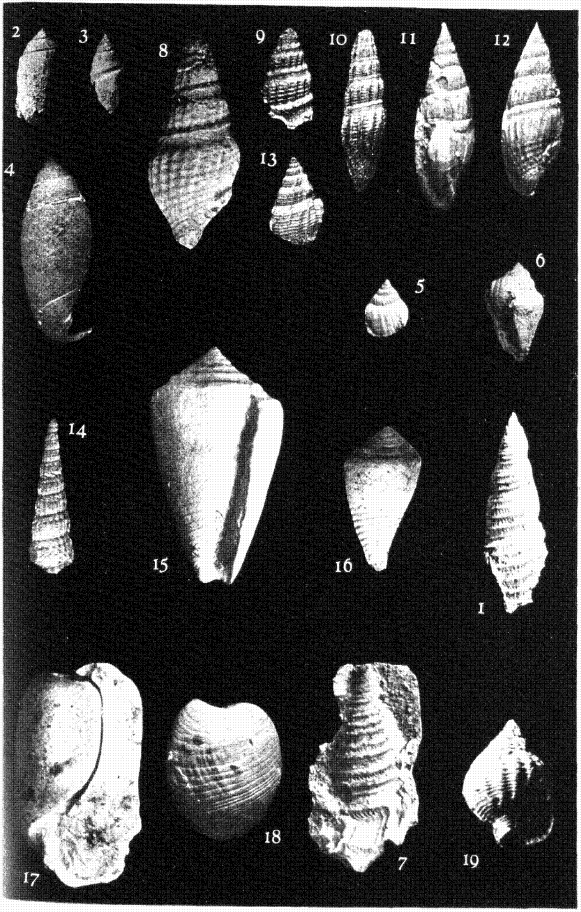


Plate XXV

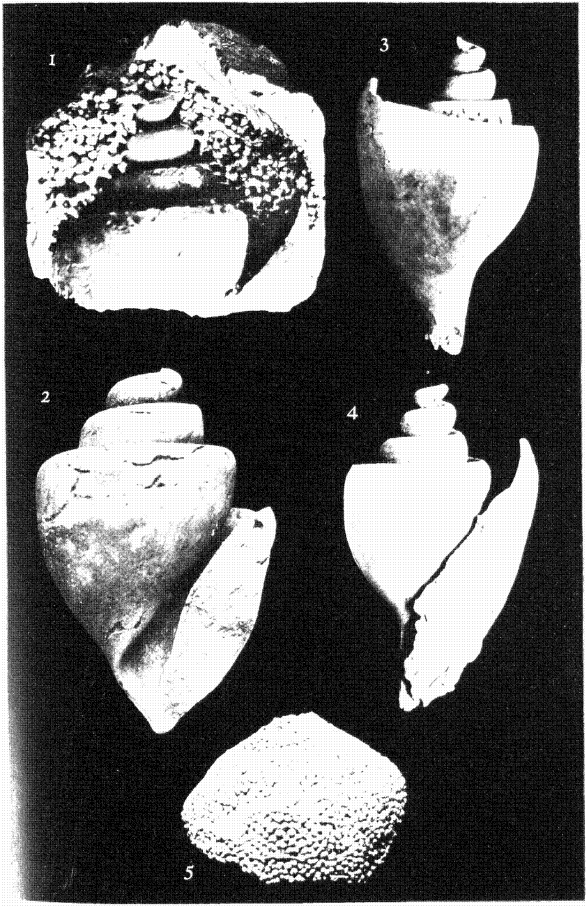
Fig. 1. *Orthaulax portoricoensis* n. s.; x 0.85; internal and external mold of the upper half of the shell showing most of the shell wall replaced by casts of a burrows made by a boring sponge or other organism.

Fig. 2. *Orthaulax portoricoensis;* x 0.85; internal mold of a large, low spired shell.

Fig. 3. *Orthaulax portoricoensis;* x 0.85; internal mold of a small, high spired shell, probably an immature individual.

Fig. 4. Reverse side of the same specimen shown in Fig. 3.

Fig. 5. *Orthaulax portoricoensis;* x 0.85; case of the upper portion of a mature shell, made up entirely of the burrow casts illustrated in Fig. 1.



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