

THE MIOCENE AND RECENT MOLLUSCA OF PANAMA BAY*

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INTRODUCTION

The material studied has been in the Paleontological collection of Columbia University for several years. The label on the material reads as follows: "Brought up by marine dredge from depths varying from 10. ft. to 40. ft. in the mud at the mouth of the Rio Grande near La Boca about one mile from the mainland in Panama Bay." It was apparently collected by Mr. Donald F. MacDonald in 1907, formerly Geologist of the Canal Commission, and sent by him to Columbia University. The material has been partially identified by Dr. J. J. Galleway and Mr. S. W. Lowman in 1923. I discovered that this collection is a mixture of Lower Miocene and Recent shells, for the collector was unable to keep them separate under the circumstances. The faunas of the two horizons which are separated and the relative abundance of each species are as follows:—

LOWER MIOCENE SPECIES

1. <i>Arca dariensis</i> Brown and Pilsbry	a
2. <i>Arca</i> cf. <i>pennelli</i> Gabb	r
3. <i>Arca</i> cf. <i>pittceri</i> Dall	r
4. <i>Arca</i> (<i>Scapharca</i>) <i>golfoyaguensis</i> Maury	r
5. <i>Cancellaria harrisi</i> Maury	r
6. <i>Cancellaria lacuescens</i> Guppy	r
7. <i>Cardium</i> sp.	r
8. <i>Cardium parvulum</i> n. sp.	r
9. <i>Clementia dariena</i> Conrad	r
10. <i>Codakia orbicularis</i> Linne	r
11. <i>Conus imitator</i> Brown and Pilsbry	r
12. <i>Corbula silirostris</i> n. sp.	r
13. <i>Corbula</i> cf. <i>collazica</i> Maury	r
14. <i>Corbula glypta</i> n. sp.	r
15. <i>Corbula</i> cf. <i>sivistiana</i> Adams	a

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16.	<i>Crassitellites rudis</i> n. sp.	r
17.	<i>Crepidula plana</i> Say	r
18.	<i>Crepidula</i> cf. <i>plana</i> Say	r
19.	<i>Distortrix gatunensis</i> Toulà	r
20.	<i>Drillia zooki</i> Brown and Pilbry	r
21.	<i>Drillia limonetta</i> Olsson	a
22.	<i>Lucina</i> cf. <i>callozoensis</i> Hubbard	r
23.	<i>Marginella</i> cf. <i>cineracea</i> quadriplicata Böse	a
24.	<i>Marginella evax</i> n. sp.	a
25.	<i>Melongena mengeana</i> Dall	r
26.	<i>Metula cancellata</i> Gabb	r
27.	<i>Mytaca limoniana</i> Dall	r
28.	<i>Natica guppyana</i> Toulà	a
29.	<i>Natica youngi</i> Maury	a
30.	<i>Ostrea</i> sp.	r
31.	<i>Patella caliculus</i> n. sp.	r
32.	<i>Patella calix</i> n. sp.	r
33.	<i>Pecten</i> cf. <i>circularis</i> Sowerby	r
34.	<i>Pecten filitexlus</i> n. sp.	r
35.	<i>Pecten</i> (<i>Amusium</i>) <i>luna</i> Brown and Pilbry	a
36.	<i>Pecten reliquus</i> Brown and Pilbry	a
37.	<i>Phacoids hispaniolana</i> Maury	r
38.	<i>Phos costatus</i> Gabb	a
39.	<i>Pitaria acuticostrata</i> Gabb	r
40.	<i>Pitaria labreana</i> Maury	r
41.	<i>Polinices stanislav-maunieri</i> Maury	a
42.	<i>Solarium gatunense</i> Toulà	r
43.	<i>Strombina elegans</i> n. sp.	r
44.	<i>Strombina laevistriata</i> n. sp.	a
45.	<i>Strombina tenuilineata</i> n. sp.	a
46.	<i>Tellina cibaoica</i> Maury	r
47.	<i>Tellite costracana</i> Olsson	r
48.	<i>Tellina panamaensis</i> n. sp.	r
49.	<i>Tellina tenuilineatus</i> n. sp.	r
50.	<i>Terebra cracilenta</i> n. sp.	r
51.	<i>Terebra gausapata laevifascila</i> Maury	r

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|-------------------------------------|---|
| 52. <i>Terebra gatunensis</i> Toulà | r |
| 53. <i>Venus ebergenyi</i> Böse | a |
| 34. <i>Venus walli</i> Guppy | a |

RECENT SPECIES

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|---|---|
| 1. <i>Cardium parvulum</i> n. sp. | r |
| 2. <i>Cardium procerum</i> Sowerby | a |
| 3. <i>Cardium</i> sp. | r |
| 4. <i>Crepidula plana</i> Say | r |
| 5. <i>Crepidula</i> cf. <i>plana</i> Say | r |
| 6. <i>Drillia inequistriata</i> n. sp. | r |
| 7. <i>Oliva callosa</i> n. sp. | r |
| 8. <i>Oliva</i> cf. <i>littoralis</i> Lamark | r |
| 9. <i>Ostrea</i> sp. | r |
| 10. <i>Patella caliculus</i> n. sp. | r |
| 11. <i>Pecten circularis</i> Conrad n. var. | r |
| 12. <i>Pecten</i> cf. <i>latiauritus fucicobes</i> Dall | r |
| 13. <i>Potamides meta</i> n. sp. | r |
| 14. <i>Psammobia</i> sp. | r |
| 15. <i>Rada maxima</i> n. sp. | r |
| 16. <i>Triton</i> cf. <i>barthelemeyi</i> Bernardi | a |
| 17. <i>Tapes staminea</i> Conrad | r |

The undescribed species are not easy to place in the proper horizon, because the Miocene fossils are well and beautifully preserved, and most shells of the two horizons are equally fresh. I tentatively separate them upon these criteria; (1) species most closely resembling described forms, (2) the degree of their freshness in comparison with other collections, and (3) by the range of other species which were attached to the shells.

On application of the above criteria there seems to be little doubt the shells belong to two horizons, Gatun formations and Recent. The number of species of each group shows that the Recent sea mud does not extend very deep, and that it lies unconformably on Lower Miocene.

SYSTEMATIC DESCRIPTION

PHYLUM MOLLUSCA

Class PELECYPODA Goldfuss

Family ARCIDÆ Dall

Genus ARCA Lamarck

ARCA cf. PENNELLI Gabb

Plate 1, Fig. 1.

Arca pennelli Maury, Bull. Amer. Paleo., Vol. 5, No. 29, 1917, p. 177, pl. 29, fig. 8.

Shell inequilateral, very oblique; amphidetic area wide; beaks distant, conspicuous; hinge line transversely dentate, with many small similar teeth; surface sculptured by 35 squarish plicæ with concentric impressed lines making beads of the plicæ on the marginal part of the shell.

Height, 42; length, 52 mm.

OCCURRENCE: Formation Santo Domingo.

HORIZON: Gatun formation.

ARCA cf. PITTICERI Dall

Plate 1, Fig. 2.

Arca pitticeri Dall, Smith. Misc. Coll., Vol. 59, No. 2, 1912, p. 9.

Shell small, upper and basal margin subparallel, beaks small, at the anterior about one-fourth of the length of the valve; surface sculptured by 30 squarish plicæ beautifully beaded by the impressed concentric lines; interspaces narrower than plicæ, marked by fine concentric striations. Ligament area narrow, lanceolate, marked by two curved grooves.

Height, 12; length, 17 mm.

OCCURRENCE: Gatun Stage, Costa Rica

HORIZON: Gatun formation.

ARCA DARIENSIS Brown and Pilbry

Plate 1, Figs. 3, 3a.

Arca dariensis Brown and Pilbry, Proc. Acad. Nat. Sci. Philadelphia, Vol. 63, 1911 p. 302, pl. XXII, fig. 10.

Shell long, upper and basal margin subparallel; beaks small, at the anterior two sevenths of the length; valve slightly unequal, the left surpassing the other along the basal margin; surface sculptured by 31 radial, squarish plicæ; interspaces considerably wider than the plicæ, marked by numerous fine,

concentric lamellæ; toward the ends of both valves the plications widen and are divided by a median groove, on both sides of which the plicæ become nodulose. Left valve closely nodulose at the lower part, short, scaly near the beaks. Sulcus shallow; ligament area narrow, lanceolate, marked by two or three curved grooves. Interior radially striate, the margins crenulate.

Height, 16; length, 32 mm.

OCCURRENCE: Gatun formation, Isthmus of Panama.

HORIZON: Gatun formation.

ARCA (SCAPHARCA) GOLFOYAQUENSIS Maury

Plate 1, Fig. 4.

Scapharca golfoyaquensis Maury, Bull. Amer. Paleol., Vol. 5, No. 29, 1917, p. 168, pl. 28, fig. 5.

Shell inequilateral, oblique; lunule depressed; cardinal area sculptured by diverging curved grooves; surface sculptured by 38 squarish plicæ, beaded by concentric impressed lines; posterior broad and anterior narrow, hinge line long, with numerous vertical teeth, oblique at both ends.

Height, 34; length, 49 mm.

OCCURRENCE: Zone H (Lower Miocene) Rio Cana at

Caimito, Santo Domingo.

HORIZON: Gatun formation.

Family OSTREIDAE Lamarck

Genus OSTREA Linné

OSTREA, sp.

Plate 1, Fig. 5.

This is a young shell. It is small, thin and elongate, with variable outline, broadly attached to some foreign body; the shell margin bends abruptly up at a right angle. The beak is obscurely denticulate.

HORIZON: Gatun formation.

OSTREA, sp.

Plate 1, Fig. 6.

This shell is young, small, obscurely denticulated, wider than long, outline variable, outer margin strongly upturned and sharply folded. The two specimens are broadly attached to the recent Triton shells, and the margin, abruptly bends up at a right angle.

HORIZON: Recent.

Family PECTINIDAE Lamarck

Genus PECTEN Müller

PECTEN RELIQUUS Brown and Pilsbry

Plate 1, Fig. 7.

Pecten sp. (vielleicht n. sp.) Toulou, Jahrb. K. K. Geol. Reichsanst., 1908, LVIII, p. 755, text-figs. 12, 13.

Pecten reliquus Brown and Pilsbry, Proc. Acad. Nat. Sci. Philadelphia, Vol. 64, 1912, p. 510, pl. 24, fig. 3.

The valves are gently convex towards the beaks; the right valve is somewhat more convex than the left. There are about 24 plicæ on the right valve which have very deep sloping sides, and are parted by interspaces wider than the ribs. Over all these, there is a fine concentric sculpture of delicate lamellæ which remains much more prominent in the interplical spaces. The anterior ear is nonplcate.

Height, 58; width, 60 mm.

OCCURRENCE: Gatun formation, Panama Canal Zone.

HORIZON: Gatun formation.

PECTEN CIRCULARIS Sowerby

Plate 2, Figs. 9, 9a.

Pecten circularis Sowerby, Proc. Zool. Soc. London, 1835, p. 110.—Arnold, U.S.G.S. Prof. Pap. 47, 1906, p. 125, pl. 44, Figs. 6 and 7.

Valves subequal about as long as high; very convex, inequilateral, the posterior part of the disk being somewhat obliquely produced; margins sharply serrate. The right valve has 19 to 21 flat-topped plicæ, with sides steeply sloping; the interspaces are much narrower than the plicæ, sculptured by obsolete, wavy lines of growth; hinge line about two-thirds the length of the shell; ears equal in length; anterior ear with four faint plicæ and numerous imbricating incremental lines; byssal notch deep, with more faint radials on the lower half. Left valve darker in color than the right, with sharp, concentric laminæ on its disk. Cardial crura well developed. Color pattern from light to dark brownish red.

Height, 44; width possibly 49; diam., 22 mm.

HORIZON: Recent.

PECTEN cf. CIRCULARIS Sowerby

Plate 1, Fig. 8

Pecten circularis Sowerby, Proc. Geol. Soc. London, 1835, p. 110

This shell is somewhat longer than high, subequivalved, biconvex, being somewhat obliquely produced posteriorly; margins more or less sharply serrate; sides being straight and sloping at a steep angle. There are 19 to 21 prominent squarish, flat-topped plicæ, ornamented with looped incremental lines near the periphery of the disk; interspaces very much narrower than the plicæ flat, ornamented by a dense fringe of fine, sharp, concentric lamellæ; hinge line more than one half as long as the disk; anterior ear is somewhat longer than the posterior, and ornamented by low ridges and numerous imbricating concentric lines; posterior ear nearly rectangularly truncated; byssal notch of medium size.

Length, 40; diameter, 22 mm.

HORIZON: Probably Gatun formation.

PECTEN FILEXTUS n. sp.

Plate 2, Fig. 10

Shell of medium size, biconvex, inequilateral. Right valve with 19 low, flat-topped plicæ, have sides gently sloping; interspaces narrower than the plicæ, with fine, sharp, imbricating lamellæ. Posterior ear slightly notched, anterior nearly rectangularly truncated. Hinge line longer than one half of the length. This species differs from the Recent *P. circularis* by its more prominent concentric striations.

Height, 38; length 36; diam., 18 mm.

HORIZON: Probably Gatun formation.

PECTEN cf. LATIAURITUS FUCICOLUS Dall

Plate 2, Fig. 11

Pecten latiauritus var. *fucicolus* Dall, Trans. Wagner Free Inst. Sci., Vol. 3, pt. 4, 1898, p. 710.—Arnold, U.S.G.S. Prof. Paper 47, 1906, p. 131, pl. 46; fig. 8.

Shell slightly longer than high, subequivalved, inequilateral, slightly convex; disk oblique, sides nearly straight; margins rough; 15 low, rounded, wide plicæ, sculptured, with obsolete concentric laminæ on the disk; ears unequal, posterior one much longer than the anterior, nearly rectangularly truncated, byssal notch deep, with five prominent radials on both ears, with

concentric lamellæ, hinge line about two-thirds of the length; no sinus between the posterior ear and the disk; surface crossed by zigzag streaks of white.

Height, 43; width, 45 mm.

HORIZON: Recent.

PECTEN LATIAURITUS Conrad **SPLENDENS** n. var.

Plate 2, Fig. 12.

Pecten latiauritus Rogers, The Shell Book, p. 417.

Shell slightly longer than high, subequivalved, slightly convex, inequilateral; disk oblique to the hinge line; sides nearly straight; margins rough. Left valve with 14 plicæ prominent, rounded; interspaces almost equal to the plicæ, sculptured by numerous fine concentric lamellæ; hinge line longer than two-thirds the length of the disk; posterior ear longer than the anterior, the former nearly rectangularly truncated, the latter deeply notched, each sculptured by fine radials with numerous concentric lines. Shell brownish red.

This species differs from *P. latiauritus* Conrad var. *fucicolus* Dall in its fine thread-like concentric striations.

Height, 22; length, 23 mm.

HORIZON: Recent.

PECTEN LATIAURITUS Conrad **INDENTUS** n. var.

Plate 2, Fig. 13.

Shell slightly longer and high, subequivalved, slightly convex, inequilateral, the disk being somewhat oblique to the hinge line; sides nearly straight; margins serrate. Right valve with 14 squarish plicæ and flat interspaces equal to the plicæ sculptured by fine, prominent concentric lamellæ; hinge line longer than two-thirds the length of the disk; posterior ear longer than the anterior, the former nearly rectangularly truncated, the latter deeply notched, each sculptured by about five radials with concentric imbricating lamellæ.

This species differs from the above two varieties in its squarish plications.

Height, 21; length, 22 mm.

HORIZON: Recent.

PECTEN (AMUSIUM) LUNA Brown and Pilsbry

Plate 2, Fig. 14.

Pecten luna Brown and Pilsbry, Proc. Nat. Sci. Philadelphia, Vol. 64, 1912, p. 514, pl. 33, fig. 1.

Shell subcircular, slightly convex, ears comparatively small, depressed below the plane of the valve and separated by a ledge; surface, smooth, with faint growth line and very fine radial striæ. Internal surface sculptured with paired plicæ and equal interspaces.

OCCURRENCE: Gatun formation, Isthmus of Panama

PECTEN (AMUSIUM) sp.

Plate 3, Fig. 15.

Shell rather small, rather flat, smooth with faint growth line; internally sculptured by paired ridges.

HORIZON: Gatun formation.

Family CRASSATELLIDÆ Dall

Genus CRASSATELLITIDÆ Krüger

CRASSATELLITES RUDIS n. sp.

Plate 3, Fig. 16.

Shell solid, attenuated anteriorly; umbos small, depressed; resilifer present; hingeplate heavy, flat, with two cardinal teeth in each valve; lateral teeth present, one posterior present; adductor impressions deep, pallial line simple. Surface sculptured by numerous, concentric, nodulose lamellæ which become prominent ridges near the umbo. This feature is very characteristic.

Height, 31; length, 47 mm.

HORIZON: Gatun formation.

Family LUCINIDÆ Fleming

Genus LUCINA Brugier

LUCINA cf. CALLOZOENSIS Hubbard

Plate 3, Fig. 17.

Lucina callozoensis Hubbard, N. Y. Acad. Sci. Vol. III, pl. 2, 1920, p. 109. pl. 18, fig. 1, 2.

Shell lenticular, transversely elongated, surface with prominent growth lines. This specimen has been crushed.

Height, 38?; length 49; diam., 27 mm.

HORIZON: Gatun formation.

Genus CODAKIA Scopoli

CODAKIA ORBICULARIS (Linné)

Plate 3, Fig. 18.

Venus orbicularis Linné, Syst. Nat., ed. 10, 1758, p. 688.

Codakia orbicularis Maury, Bull. Amer. Paleol., No. 29, 1917, p. 202, pl. 35. Fig. 1.

Shell of medium size, rounded posteriorly and anteriorly; beaks small; surface rather scaly, sculptured by many radial plicæ, alternating with finer threads especially on the posterior end, anterior with numerous, fine, concentric lamellæ.

Height, 33; length, 39 mm.

OCCURRENCE: Lower Miocene, Camito, Santo Domingo.

HORIZON: Gatun formation.

Genus MYRTAEA Turton

MYRTAEA LIMONIANA Dall

Plate 3, Fig. 19.

Myrtaea limoniana Dall, Trans. Wagner Free Inst. Sci. Vol. 3, pt. 6, 1903, p. 1358, pl. 52, Fig. 10.—Olsson, Bull. Amer. Paleo., No. 39, 1922, p. 221, pl. 32, Fig. 11, 23.

Shell small, thin, and slightly convex, surface sculptured by fine, thin and sharp, elevated, concentric lamellæ, slightly nodulose; beaks small and pointed; lunule more smooth than the rest of the surface.

OCCURRENCE: Gatun Stage, Port Limon, Costa Rica.

HORIZON: Gatun formation.

Genus PHACOIDES Blainville

PHACOIDES (LUCINISCA) HISPANIOLANA Maury

Plate 3, Fig. 20.

Phacoides hispaniolana Maury, Bull. Amer. Paleo. No. 29, 1917, p. 204, pl. 35, fig. 4.

Shell thin, subcircular, slightly convex, beaks small, acute, directed forward. On the umbo, only concentric lines are shown; the center of the valve is sculptured by radial plicæ and concentric lines, marked by minute spinose beads on the intersecting places of the two sets of sculpture, the primary radial plicæ alternate with two or three fine secondary striae which disappear towards the beaks. Hinge line normal with two strong lateral teeth and one cardinal tooth.

Height, ?; length, 9 mm.

OCCURRENCE: Gatun Stage, Port Limon, Costa Rica.

HORIZON: Gatun formation.

Family CARDIIDÆ Fischer

Genus CARDIUM Linné

CARDIUM cf. PROCERUM Sowerby

Plate 3, Fig. 21.

Cardium procerum Sowerby, Proc. Zool. Soc. London, 1883, p. 83,—Martini and Chemnitz, Sip. conchylien-cabinet, Vol. X, 1889, p. 58, pl. 10, Fig. 12, 13.

Shell very convex, nearly equilateral, rounded oval. Slightly higher than long. Umbos prominent, incurved, turned slightly forward. Surface marked by 24 radiating squarish plicæ with fine concentric lamellæ. Two cardinal teeth, one anterior and one posterior in each valve. No lunule or escutcheon present. Ligament external. Adductor impressions very shallow.

Height, 47; length, 43 mm.

HORIZON: Recent.

CARDUM PARVULUM n. sp.

Plate 3, Fig. 22.

Shell less convex than that preceding, nearly equilateral, slightly longer than high. Umbos incurved, turned slightly forward. Surface marked by 24 radiating plicæ, somewhat sharp, interspaces narrower than the plicæ, with fine concentric lamellæ.

This specimen is characterized by its small size, and differs from *C. procerum* Sow. in its oblong form, but it might be a young shell.

Height, 12; length, 14 mm.

HORIZON: Probably Recent.

CARDIUM sp.

Plate 3, Fig. 23.

An internal mold, showing the internal sculpture of the genus.

HORIZON: Gatun formation.

Family VENERIDÆ Leach

Genus CLEMENTIA Gray

CLEMENTIA DARIENA (Conrad)

Plate 4, Fig. 24.

Moretrix darisna Conrad, Pacific R. R. Report, V, p. 328, pl. 6, Fig. 55.

Clementia darisna Brown and Pilsbry, Proc. Acad. Nat. Sci. Philadelphia, Vol. 63, 1911, p. 371, pl. 6, fig. 55.

Shell thin, large, oblique, inequilateral; beaks prominent; surface sculptured by concentric ridges which become low, imbricating lamellæ on the umbo, some of the ridges sometimes discontinuous.

Height, 56; length, 58; and diam., 33 mm.

OCCURRENCE: Gatun formation, Costa Rica and Santo Domingo.

HORIZON: Gatun formation.

Genus VENUS Linne

VENUS EBERGENYII Böse

Plate 4, Fig. 25.

Venus ebergenyi Böse, Bol. Inst. Geol. Mex., No. 22, 1906, p. 28, pl. 2. figs. 4-17.

Shell subtriangular, inequilateral, anteriorly round, posteriorly angular, ornamented with high concentric ridges which die out gradually into low lamellæ towards the umbo, on the ridges obscurely striated vertically, between the ridges covered by many lamellæ; umbo rather small; lunule depressed, minutely striated; posterior area prominent, striated.

Height, 17; length, 29 mm.

OCCURRENCE: Paso Real near Tuxtepec, Cax., Mex.

HORIZON: Gatun formation.

VENUS WALLI Guppy

Plate 4, Figs. 26, 26a.

Venus walli Guppy, Jour. Geol. Soc. London, Vol. 22, 1866, p. 581.

Shell subtrigonal, inequilateral, anteriorly rounded, posteriorly angular, sculptured by numerous small, close radiating pliculæ, interrupted by high concentric crenulate ridges which are higher and closer towards the ventral margin; umbo rather small; lunule impressed, minutely striated, circumscribed by a sharp groove; posterior cardinal area prominent, striated.

On the disk the pliculæ are distinctly paired; but on the umbo, the concentric ridges die out gradually into lamellæ and the pliculæ are evenly interspaced.

Height, 42; length, 55 mm.

OCCURRENCE: Lower Miocene, Manzanillo, Trinidad

HORIZON: Gatun formation.

Genus TAPES Megerle

TAPES STAMINEA Conrad

Plate 4, Fig. 27.

Tapes staminea Rogers, The Shell Book, 1908, p. 335.

Shell rounded posteriorly and anteriorly; beaks small but prominent; surface sculptured by 50 uneven radial plicæ, beautifully beaded at some portions; with numerous concentric impressed lines on the ribs, interspaces narrow, with the concentric, imbricating lamellæ. Lunule slightly nodulose.

Height, 12; length, 19 mm.

HORIZON: Recent.

Genus *PITARIA* Roemer

PITARIA (LAMELLICONCHA) ACUTICOSTATA Gabb

Plate 4, Fig. 28.

Pitaria acuticostata Gabb, Trans. Amer. Phil. Soc., Vol. 15, 1873, p. 250.—Maury, Bull. Amer. Paleo., No. 29, 1917, p. 216, pl. 37, fig. 2.

Shell of medium size, oval triangular; anterior rounded, sculptured by many concentric ridges and with faint radial striae.

Height, 31; width, 41 mm.

OCCURRENCE: Zone G, Lower Miocene, Santo Domingo.

HORIZON: Gatun formation.

PITARIA (LAMELLICONCHA) LABREANA Maury

Plate 4, Fig. 29.

Pitaria labreana Maury, Jour. Ac. Nat. Sci. Phila. (2) 15, 1912, p. 57, pl. 9, figs. 14, 15.

Shell small, elongate, oval, anterior rounded, rather compressed, sculptured by many concentric round-edged lamellae which die out gradually towards the beaks; beaks small.

Height, 21; length, 21 mm.

OCCURRENCE: Brighton, Trinidad.

HORIZON: Gatun formation.

Family TELLINIDÆ Deshayes

Genus *TELLINA* Linn.

TELLINA CIBAOICA Maury

Plate 4, Fig. 30.

Tellina cibaoica Maury, Bull. Amer. Paleo., Vol. 5, No. 29, 1917, p. 223, pl. 38, fig. 10.

Shell medium in size, very highly polished; shallowly sulcate posteriorly; right valve has two lateral teeth. Surface sculptured by very fine, impressed lines obsolete posteriorly, and marked by exceedingly fine close radial striae.

Height, 27; length, 45 mm.

OCCURRENCE: Lower Miocene, Rio Cana at Caimito, Santo Domingo.

HORIZON: Gatun formation.

TELLINA COSTARICANA Olsson

Plate 4, Fig. 31.

Tellina costaricana Olsson, Bull. Amer. Paleol., No. 39, 1922, p. 251, pl. 26, figs. 6, 9.

Shell rather small, depressed; beaks small and inconspicuous about the middle of the shell so that the anterior and posterior ends are of nearly the same length; posterior wide and rounded; the anterior narrower and less rounded at its extremity; sides nearly straight, surface sculptured by even concentric lines which are slightly lamellose on the postero-dorsal margin.

Height, 22; length, 38 mm.

OCCURRENCE: Gatun Stage, Banana River, Costa Rica.

HORIZON: Gatun formation.

TELLINA PANAMANENSIS n. sp.

Plate 5, Fig. 32.

Shell medium in size, inequilateral, beaks small, posterior end rounded and wide, the anterior less wide and round, surface sculptured by concentric, imbricating lamellæ which are very prominent, and marked by numerous close radial lines which only can be seen under a lens.

This species is related to *T. costaricana* Olsson, but differs from it by its prominent concentric, imbricating lamellæ.

Height, 27; length, 43 mm.

HORIZON: Gatun formation.

TELLINA TENUILINEATUS n. sp.

Plate 5, Fig. 33.

Shell medium in size, possibly nearly equilateral, beaks depressed, small, posterior wide and rounded; surface sculptured by slightly wavy concentric impressed lines, with very fine close radial lines.

This species is characterized by its nearly equilateral form and especially its slightly wavy concentric impressed lines.

Height, 30 mm.; length?

HORIZON: Probably Gatun formation.

Family PSAMMOBIIDÆ Dall

Genus PSAMMOBIA Lamarck

PSAMMOBIA sp.

Plate 5, Fig. 34.

Shell inequilateral, posterior wide and rounded, anterior less wide but

still rounded; beaks small but prominent, hinge line rather long; surface sculptured by numerous fine lamellæ with fine, close, radial striæ.

This specimen is related to Recent *P. maxima*, but it is medium in size and not as fresh as recent shells.

Height, 37; length, 46 mm.

HORIZON: Probably Gatun formation.

Family MACTRIDÆ Gray

Genus RAETA Gray

RAETA MAXIMA, n. sp.

Plate 5, Fig. 35.

Shell rather large, anterior rounded, beaks small; surface sculptured by concentric ridges, more than 40 in number, some of the ridges discontinued and marked by broader, concentric ridges internally, resilifer present.

This shell is closely related to *R. canaliculata* Say but differs in its ridge-bounded escutcheon, and larger shell.

Height, 86; length, 74 mm.

HORIZON: Recent.

Family CORBULIDÆ Fleming

Genus CORBULA Lamarck

CORBULA cf. COLLAZICA Maury

Plate 5, Figs. 36, 36a.

Corbula collarica Maury, N. Y. Acad. Sci. Vol. III, pt. 1, 1920, p. 44, pl. 6, figs. 10, 11.

Shell oval triangular, rather small, anterior end rounded and the posterior produced, truncated obliquely, surface sculptured with many fine close set, even, concentric ridges, alternating with linear interspaces.

Height, 16; length, 23 mm.

HORIZON: Gatun formation.

CORBULA ALTIROSTRIS n. sp.

Plate 5, Fig. 37.

Shell inequilateral, very convex; beaks small but prominent; very short scaly at the middle part; surface sculptured by numerous concentric lamellæ.

This species is related to *C. chittyana* Adams but differs in its prominent umbo.

Height, 24 mm.; length ?

HORIZON: Gatun formation.

CORBULA GLYPTA n. sp.

Plate 5, Fig. 38, 38a.

Shell rather small, thin, oval triangular, inequilateral, posterior rounded, and anterior angular, truncated obliquely; beaks small; depressed transversely cross the valve. Surface sculptured by numerous fine lamellæ; lunule impressed.

This species is related to *C. kjoeriana* Adams, but differs in its depressed shell.

Height, 13; length, 24 mm.

HORIZON: Probably Gatun formation.

CORBULA cf. SWIFTIANA Adams

Plate 5, Fig. 39.

Corbula swiftiana Adams, Bull. of U.S. Nat. Mus. No. 37, 1889, pl. 2, fig. 5.

Shell inequilateral, convex, posterior somewhat angular, anterior rounded; beaks small; surface sculptured by numerous fine concentric lamellæ, slight lamellæ posteriorly.

Height, 25; length, 31 mm.

HORIZON: Gatun formation.

Class GASTROPODA Snails

Subclass STREPTONEURA Spengel

Order ASPIDOBANCHIA Schweigger

Family PATELLIDÆ Carpenter

Genus PATELLA Linné

PATELLA CALIX n. sp.

Plate 5, Fig. 40.

Shell cup-shaped, oval, depressed conical, with subcentral apex. Surface sculptured by the primary alternating with several secondary radial plicæ, and with concentric ridges. The concentric sculpture on intersecting the radial, raises into beads.

HORIZON: Probably Gatun formation.

PATELLA CALICULUS n. sp.

Plate 6, Fig. 41.

Shell small, cup-shaped, oval, depressed conical, with sub-central apex. Surface sculptured by the primary plicæ alternating with several secondary radial plicæ, and with concentric ridges. The concentric sculpture on intersecting the radial, raises a row of beads surrounding the apex. Apex depressed.

This species is characterized by its sculpture and a few plicæ.

HORIZON: Probably Recent.

Family SOLARIIDÆ Chenu

Genus SOLARIUM Lamarck

SOLARIUM GATUNENSE Toulà

Plate 6, Fig. 42.

Solarium gatunense Toulà, *Jahr. der Geol. Reich.* 1909, p. 692, pl. 25. (1), fig. 3.

Shell depressed conical, narrowly and deeply umbilicate; whorls angular, aperture somewhat equilateral. Surface sculptured by spirals with beaded and granulated character, and becoming obsolete on the later whorls so the spirals become smooth except for growth-lines.

Height, 26; width, 36 mm.

OCCURRENCE: Gatun formation Panama Canal; Costa Rica.

HORIZON: Gatun formation.

Family CAPULIDÆ Cuvier

Genus CREPIDULA Lamarck

CREPIDULA PLANA Say

Plate 6, Fig. 43. 44.

Crepidula plana Say. U. S. Nat. Mus., Bull. 37, 1889, pl. 50.

Shell flat, elongate, apex marginal; platform covering about half the length of the shell. The Gatun specimens are small.

HORIZON: Two shells belong to Gatun formation (fig. 43) and one Recent (fig. 44).

CREPIDULA cf. PLANA Say

Plate 6, Fig. 45.

Shell elongate, apex marginal, not enrolled; platform covering about half the length of the shell. The shell is very much distorted instead of flat; otherwise it fits this species perfectly.

HORIZON: Probably Recent.

Family NATICIDÆ Forbes

Genus NATICA Scopoli

NATICA GUPPYANA Toulà

Plate 6, Fig. 46.

Natica (Stigmaulax) guppyana Toulà, Jahrb. der K.-K. Geol. Reichsanstalt, Wien., 1909, Vol. 38, p. 696, pl. 25, fig. 6.—Olsson, Bull. Amer. Paleol., No. 39, 1922, p. 156, pl. 13, figs. 13, 14, 15.

Shell with short spire and large body whorl; aperture large, semicircular, expanded, broad round anteriorly. Surface sculptured by even, wide and deep sulcations, which cross the face of the whorl from its upper suture to the umbilicus.

Height, 21; width, 16 mm.

OCCURRENCE: Gatun, Banana River, Costa Rica.

HORIZON: Gatun formation.

NATICA YOUNGI Maury

Plate 6, Fig. 47, 47a

Natica youngi Maury, Bull. Amer. Paleol., No. 29, 1917, p. 135, pl. 23, figs. 11, 12.

Shell subglobular, with short spire and large body whorl; aperture subcircular; whorls 5, rounded; surface smooth except for growth lines; posterior callus of inner lip thickest at the angle of the aperture; umbilical callus coiled on the umbilicus wall near the base, leaving the upper part of the umbilicus open.

Height and width, 24 × 18, 40 × 30 mm.

OCCURRENCE: Lower Miocene, Caimito, Santo Domingo, Costa Rica and Chiapas.

HORIZON: Gatun formation.

Genus *POLINICES* Montfort

POLINICES STANISLAS-MEUNIERI Maury

Plate 6, Fig. 48.

Polinices stanislasi-meunieri Maury, Bull. Amer. Paleol., No. 29, 1917, p. 136, pl. 23, figs. 15, 16.

Shell oval, with short and conical spire and large body whorl which make together five and a half rounded whorls; body whorl very slightly concave in front of the suture, others evenly rounded; aperture simicircular; inner lip with a thick posterior callus extending half of the distance from the angle of the aperture to the base, and concealing the upper part of the perforation; the callus is then reduced to half its width by a rectangular truncation.

Height, 36; width, 28 mm.

OCCURRENCE: Lower Miocene, Santo Domingo; Gatun formation, Banana River, Costa Rica.

HORIZON: Gatun formation.

Family *TURRITELLIDÆ* Gray

Genus *TURRITELLA* Lamarck

TURRITELLA GATUNENSIS Conrad

Plate 6, Fig. 49.

Turritella gatunensis Conrad, Pacific R. R. Rep., VI, pl. 5, fig. 20.—Brown and Pilsbry, Proc. Acad. Nat. Sci. Phila., Vol. 63, 1916, p. 358, pl. 27, fig. 4.

Shell turreted, surface sculptured by spiral threads, crossed by bending transverse lines, the upper, surface of each whorl very much excavated. Aperture subcircular. The base smooth.

Height, ?; width, 10 mm.

OCCURRENCE: Ballast Point, Isthmus of Panama.

HORIZON: Gatun formation.

Family *CERITHIIDÆ* Menke

Genus *POTAMIDES* Brogt.

POTAMIDES META n. sp.

Plate 6, Fig. 50.

Shell turreted, with epidermis, aperture with faint canal; surface sculptured by spiral lines and crossed by longitudinal threads, at the intersect-

ing places of the two sets of sculpture, marked by beads; and marked by wide separated, strong, ridges.

This species is related to *P. sacrala* Gld., but differs from it in its less acute spire and its thickened outer lip.

Height, 32; length, 9 mm.

HORIZON: Probably Recent.

Family COLUMBELLIDÆ Troschel

Genus STROMBINA Mörch

STROMBINA LAEVISTRIATA n. sp.

Plate 6, Fig. 51.

Shell fusiform, solid, with slender, conical spire, a little attenuated above, elsewhere smooth in outlines; whorls eight, nearly flat; surface sculptured by fine, close, spiral, and longitudinal ribs, with an impleased spiral groove just below the suture. On the body whorl there are longitudinal wrinkles, denticulated within. Aperture narrow and rather short; varix prominent. Anteriorly there are spiral grooves.

This species is related to *S. cyphonotus* Pilsbry and Johnson, but differs in size and ornamentation.

Height, 25; width, 10 mm.

HORIZON: Probably Gatun formation.

STROMBINA ELEGANS n. sp.

Plate 6, Fig. 52.

Shell fusiform, with slender, conical spire; surface smooth, with longitudinal wrinkle on the surface of the outer lip, a small, strong varix present. At the base there are spiral grooves. Surface ornamented by beautiful, purple, wavy streaks.

This species is characterized by its slender form and its purple, wavy streaks.

HORIZON: Recent.

Family NYCTILOCHIDÆ Dall

Genus TRITON Montf.

TRITON cf. BARTHELEMYI BERNARDI

Plate 7, Figs. 53, 53A.

Triton barthelemyi Bernardi, Journ. Conch., VI, 1857, p. 54.—Martini and Chemnitz, Sys. Conch. Cabinet, 1888, p. 222. pl. 62, fig. I.

Shell fusiform, spire moderate, high shoulder angle rather sharp; inner lip thickened internally and notched, outerlip expanded; whorl 7; protoconch smooth. Surface sculptured by 5-7 uneven, spiral bands with many lower, longitudinal riblets.

Height, 74; width, 44 mm.

HORIZON: Recent.

Genus *DISTORTRIX* Link.

DISTORTRIX GATUNENSIS Toulà

Plate 7, Fig. 54.

Distortrix gatunensis Toulà, Jahrbuch der Geol. Reich., 1909, p. 700, pl. 23 (1) fig. 10.

Shell fusiform, spire moderately high, aperture with thickened outer lip and open, slightly bent canal. Operculum horny with marginal nucleus, varix present. Surface sculptured by spirals and longitudinal ribs, with beads at the intersecting places of the two sets of sculpture. At the base, there are spiral grooves.

Height, 52; width, 24 mm.

OCCURRENCE: Gatun formation, Panama Canal.

HORIZON: Gatun formation.

Family *BUCCINIDÆ* Troschel

Genus *PHOS* Montf.

PHOS COSTATUS Gabb.

Plate 7, Figs. 55, 55a.

Phos costatus Gabb, Trans. Amer. Phil. Soc., XV, 1873, p. 212.—Brown and Pilsbry, Proc. Ac. Nat. Sci., Philadelphia, Vol. 73, 1911, p. 349, pl. 22, figs. 10, 14.

Shell bucciniform, turriculate; spire sharp, elevated; aperture wide, short, with open, bending canal. Whorls ornamented with prominent, longitudinal folds, and spiral threads and sulci; denticulated within.

Height, 25; greatest diam., 15 mm.

OCCURRENCE: Lower Miocene, Santo Domingo.

HORIZON: Gatun formation.

Genus *METULA* Adams

METULA CANCELLATA Gabb

Plate 7, Fig. 56.

Metula cancellata Gabb, Trans. Amer. Phil. Soc., Vol. 15, 1873, p. 205.—Brown and Pilsbry, Proc. Ac. Nat. Sci., Philadelphia, Vol. 63, 1911, p. 351.

Shell elongate-oval, with epidermis; spire moderately high, aperture

rather narrow, with short notch. Surface sculptured by many wider, spirals and longitudinal riblets, but less in number than *Metula gabbi* Brown and Pilsbry. The second and the third whorls separated by a deep groove; the protoconch is lost. The spirals pass the longitudinal folds. Under a microscope the secondary longitudinal riblets can be seen.

Height, 38; width, 12 mm.

OCCURRENCE: Lower Miocene, Santo Domingo, Panama Canal Zone, and Costa Rica.

HORIZON: Gatun formation.

Genus MELONGENA Schum.

MELONGENA (PUGILINA) MENGEANA Dall

Plate 7, Fig. 57.

Solenostira mengiana Dall, Wagner Free Inst. Sci., Vol. 3, p. 122, pl. 9, Fig. 1.

Melongena mengiana Böse, Bol. Ins. Geol. Mex., 1906, p. 40, pl. IV, Fig. 1.

Shell fusiform, small, bulbous nucleus lost, only six sculptured whorls remained, the last whorl enlarged very much, with transverse folds on the surface, 12 on the last whorl, beginning near the suture and continuing over the periphery, becoming obsolete on the base of the whorl; the incremental lines are also somewhat alternated in strength and quite distinct; the spiral ridges, sharp, even, crossed the folds and descend into the interspaces, again with two spiral threads on each side of the ridges, the ridges being weaker on the canal. Aperture elongated; the throat strongly lirate.

Height, 29; diam., 18 mm.

Geological range: This species was only described from the Pliocene beds of Florida and other localities.

HORIZON: Gatun formation.

Family VOLULIDÆ Gray

Genus MARGINELLA Lamarck

MARGINELLA EVAX n. sp.

Plate 7, Fig. 58.

Shell small, oblong, widest at the upper third of the length. Spire conical, short, and so enveloped that the suture is blended. The outer lip is broad, straight, thickest outside, incurved and not denticulated, and dilated near the lower end. Columella bears four folds.

This species is related to *M. galunensis* Brown and Pilsbry, and *M. leander* Brown and Pilsbry, and differs from both in its proportion of dimensions and from the former by its lack of dentation on the inner side of the outer lip.

Height, 27; diam., 13 mm.

HORIZON: Probably Gatun formation.

MARGINELLA cf CINERACEA QUADRIPLICATA Böse

Plate 7, Fig. 59.

Marginella cineracea quadriplicata Böse, Bol. Inst. Geol. Mex., No 22, 1906, p 42, pl. 5, fig. 1.

Shell small, oblong, spire conical, short, and so enveloped that the sutures blend. The outer lip thin, without any thickened part; the inner lip bears four folds. Aperture open, somewhat straight, abruptly but slightly dilated at the lower end.

Height, 20; width, 8 mm.

HORIZON: Probably Gatun formation.

Family OLIVIDÆ d'Orbigny

Genus OLIVA Martyn

OLIVA cf. LITTERATA Lamarck

Plate 7, Fig. 60.

Oliva litterata Lamarck, Ann. du Mus. XVI, p. 315.—Martini and Chemnitz, Sys. Concho Cabinet, V, 1888, p. 64, pl. 15, Fig. 1-8.

Shell rather small, elongate, beautifully ornamented by zigzag brown streaks, widest at the upper half of the length. Spire conical, short; with a narrow canaliculate suture. The outer lip broad. The inner has sixteen implications. Aperture narrow and long, with an outwardly reflected callus anteriorly. Canal short.

Height, 26; width, 7 mm.

HORIZON: Recent.

OLIVA CALLOSA n. sp.

Plate 7, Fig. 61.

Shell solid; spire very low, with a narrow canaliculate suture; surface ornamented by zigzag reddish-brown streaks and with growth lines. The

outer lip broad, the inner has about 16 implications. Aperture open and long, with an outwardly reflected callus anteriorly. Canal short.

This species differs from *O. mariae* Durrois in its low spire.

Height, 28; width, 19 mm.

HORIZON: Recent.

Family CANCELLARIIDÆ Adams

Genus CANCELLARIA Lamarck

CANCELLARIA HARRISI Maury

Plate 7, Fig. 62.

Cancellaria harrisi Maury, Bull. Amer. Paleol., No. 29, 1917, p. 64, pl. 10, figs. 9, 10.

Shell fusiform, 8 whorls, the first two smooth, on the third ribs and spirals appear; the latter increase from striae to flat narrow bands, on the last one alternating with finer secondary and tertiary spirals; on crossing the ribs, at the shoulder are nodulose, on the body whorl ribs 14, on the earlier whorls the ribs are more numerous. Columella triplicate, the lower fold bordering the anterior canal. Aperture open; sharp keel on the base.

Height, 34; diam., 29 mm.

OCCURRENCE: Lower Miocene, Caimito, Santo Domingo.

HORIZON: Gatun formation.

CANCELLARIA LAEVESCENS Guppy

Plate 8, Fig. 63.

Cancellaria laevescens Guppy, Quart. Jour. Geol. Soc. London, Vol. 22, 1868, p. 287; pl. 17, fig. 12.—Maury, Bull. Amer. Paleol., No. 29, 1917, p. 64, pl. 10, fig. 6.

Shell thick, ovate, spire cancellated by numerous equidistant ribs and close spiral ridges, the ribs broader and highly elevated; whorls 6 in the present specimen, the body whorl slightly more than two-thirds of the height of the shell, nearly smooth except with growth-lines, decussated by low distinct ridges, the latter becoming quite obsolete near the aperture except the upper part. Columella strongly folded with two very prominent plaits; callus thick spreading; outer lip denticulated within; canal short and twisted.

Height, 30; width, 17 mm.

OCCURRENCE: Lower Miocene, Santo Domingo.

HORIZON: Gatun formation.

Family TEREBRIDÆ Adams

Genus TEREBRA Lamarck

TEREBRA GAUSAPATA LAEVIFASCIOLA Maury

Plate 8, Fig. 64.

Terebra gausapata laevifasciola Maury, Bull. Amer. Paleol., No. 29, 1917, p. 27, pl. 3, fig. 19.

Shell small, very slender, elongate. Each whorl sculptured by a subsutural band about a quarter the length of the whorl, a deep sulcus beneath the subsutural fasciole, beneath which there are 6 to 7 spiral, low bands crossed by higher, longitudinal wider-separated riblets.

Height, 44; greatest diam., 10 mm.

OCCURRENCE: Lower Miocene, Cercado de Mao, Santo Domingo

HORIZON: Gatun formation.

TEREBRA GATUNENSIS Maury

Plate 8, Fig. 65.

Terebra gatunensis Maury, Bull. Amer. Paleol., No. 29, 1917, p. 31, pl. 4, fig. 5

Shell turreted, slender, with an acute spire. Each whorl sculptured by a subsutural band about a quarter the width of the whorl, marked off by a furrow, and beneath which five or six spiral cords; and with many fine, longitudinal growth-lines which bend a little at the furrow. Columella twisted, with sharp keel at the back.

Height, 44; width, 9 mm.

OCCURRENCE: Lower Miocene, Cercado de Mao, Santo Domingo.

HORIZON: Gatun formation.

TEREBRA MACROSPIRA n. sp.

Plate 8, Fig. 66.

Shell long, slender; whorl 17 (this specimen is a decollated one); surface sculptured by arcuate, longitudinal riblets, very low at the last six whorls, and passing into sharp defined arcuate riblets upward. Collumella not plicated, but a sharp keel at the base.

This species differs from *T. sulcifera* Sowerby in its ornamentation.

Height, 91; diam., 18 mm.

HORIZON: Gatun formation.

TEREBRA CRACILENTA n. sp.

Plate 8, Fig. 67.

Shell slender, with acute spire, ornamented by subsutural band about a quarter of the width of the whorl marked off by a furrow, beneath which four stronger spirals and two weaker spirals which intersecting with radial longitudinal riblets, rises into very prominent beads on the subsutural band and the four upper spirals, and especially prominent on the fourth spiral.

This species is related to *T. gatunensis* Maury, but differs in ornamentation.

Height, 45; diam., 10 mm.

HORIZON: Gatun formation.

TEREBRA TENUIS n. sp.

Plate 8, Fig. 68.

Shell slender, with acute spire, ornamented by a subsutural band about a quarter of the width of the whorl, marked off by a furrow, beneath which are four spiral bands, which intersecting with radial longitudinal riblets, rises into prominent beades; below the four bands are one to two faint bands.

This species differs from *T. gausapata laefasciola* Maury in its ornamentation and more radial riblets.

Height, 46; width, 10 mm.

HORIZON: Gatun formation.

Family TURRITIDÆ Adams

Genus DRILLIA Gray

DRILLIA LIMONETTA Olsson

Plate 8, Fig. 69

Drillia limonetta Olsson, Bull. Amer. Paleo., No. 39, 1922, p. 70, pl. 5, Fig. 10.

Shell small, solid, whorls from eight to nine; surface sculptured by moderate strong ribs which on the spiral whorls pass from suture to suture but are only slightly flexed near the upper suture; on the body whorl, ribs 11, which are much enlarged and outer lip thickened; the ribs do not reach the canal; and marked by a few spiral threads, and covered by fine, irregular threads which are nearly obsolete on the upper portions of the whorls but

are strong on the base and the canal; aperture subelliptical with a short, bended canal, denticulated within the outer lip.

Height, 31; width, 10 mm.

OCCURRENCE: Gatun Stage, Port Limon, Costa Rica.

HORIZON: Gatun formation.

DRILLIA ZOOKI Brown and Pilsbry

Plate 8, Fig. 70.

Drillia zooki Brown and Pilsbry, Proc. Ac. Nat. Sci. Philadelphia, Vol. 63, 1911, p. 345, pl. 23, Fig. 8.

Shell small, with long and arcuate spire, aperture narrow and short. Surface sculptured by prominent longitudinal folds, 11 on the last whorl, below the fasciole below the suture; on the folds crossed by spiral lines. On the body whorl, the folds gradually die out, only spiral lines ornamented with canal at the base.

Height, 27; greatest diam., 7 mm.

OCCURRENCE: Gatun formation, Isthmus of Panama.

HORIZON: Gatun formation.

DRILLIA INAEQUISTRIATA n. sp.

Plate 8, Fig. 71.

Shell slender and long, the last whorl occupying over half the height of the shell, aperture narrow and rather long, with canal at the base. Beneath the fasciole below the suture. surface ornamented by prominent folds, rather irregular, and crossed by spirals.

This species is characterized by its slender form and close folds.

Height, 55; width, 9 mm.

HORIZON: Probably Recent.

Family CONIDÆ Adams

Genus CONUS Linné

CONUS IMITATOR Brown and Pilsbry

Plate 8, Figs. 72, 72a.

Conus imitator Brown and Pilsbry, Bull. Amer. Paleo., No. 39, 1922, p. 45, pl. 3, Fig. 39.

Shell conical, moderate high spire, rather flat; aperture narrow and long; shoulder angle rather sharp, whorls slightly concave between the sutures; surface sculptured by 3 or more faint raised spirals and strongly arcuate

growth-lines; the last whorl with faint spirals above and with about 14 spiral grooves at the base.

Height, 17; width, 11 mm.

OCCURRENCE: Gatun Stage, Costa Rica.

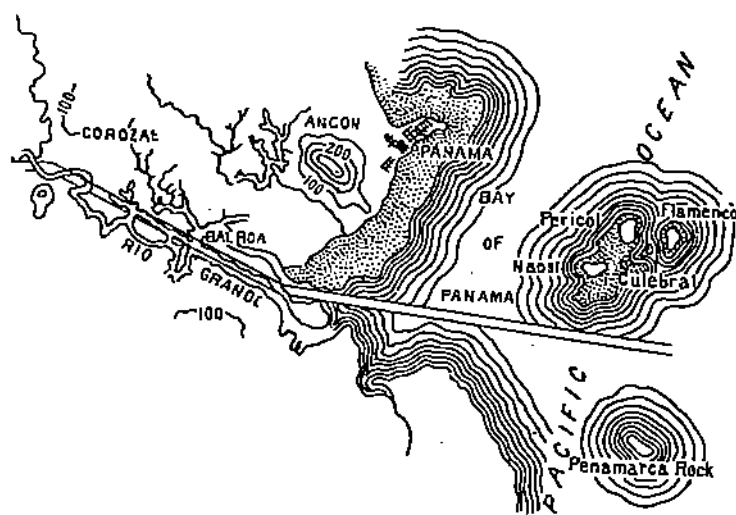
HORIZON: Gatun formation.

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Map of the

Panama Bay

*From map issued by the
Isthmian Canal Commission*

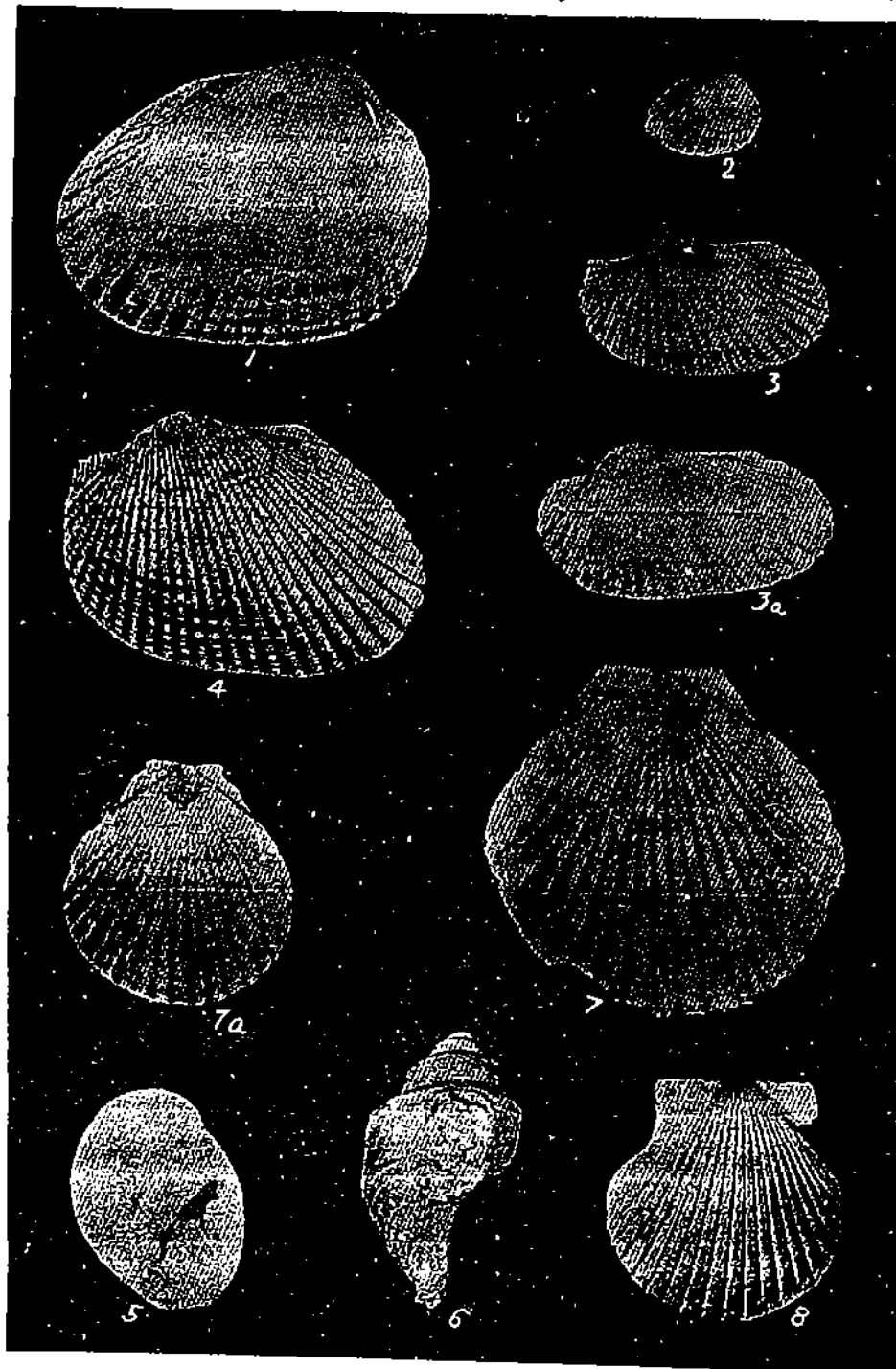
S.C. Li

May 1924

**Explanation of
Plate I**

Plate I

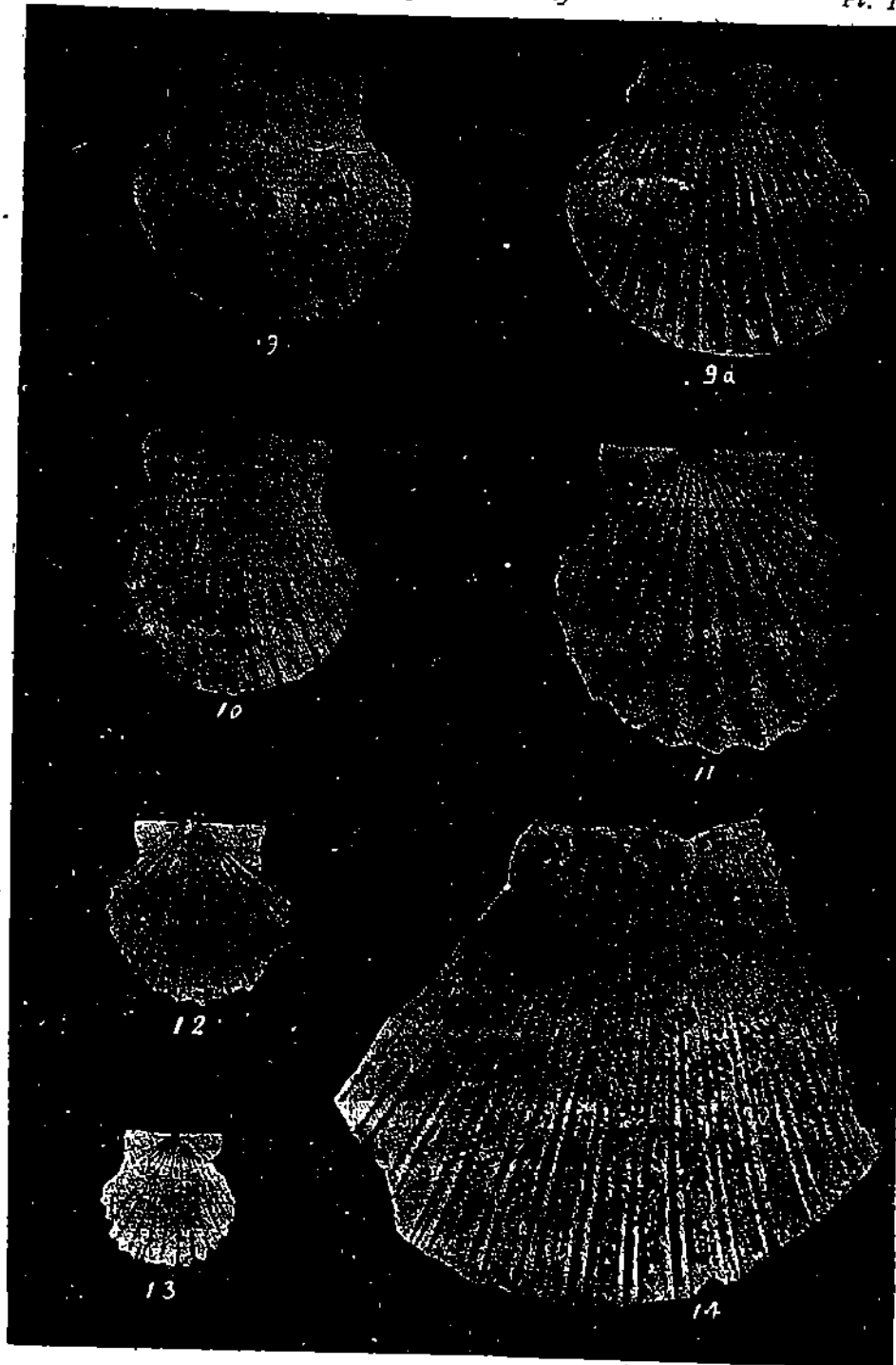
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**Explanation of
Plate II**

Plate II

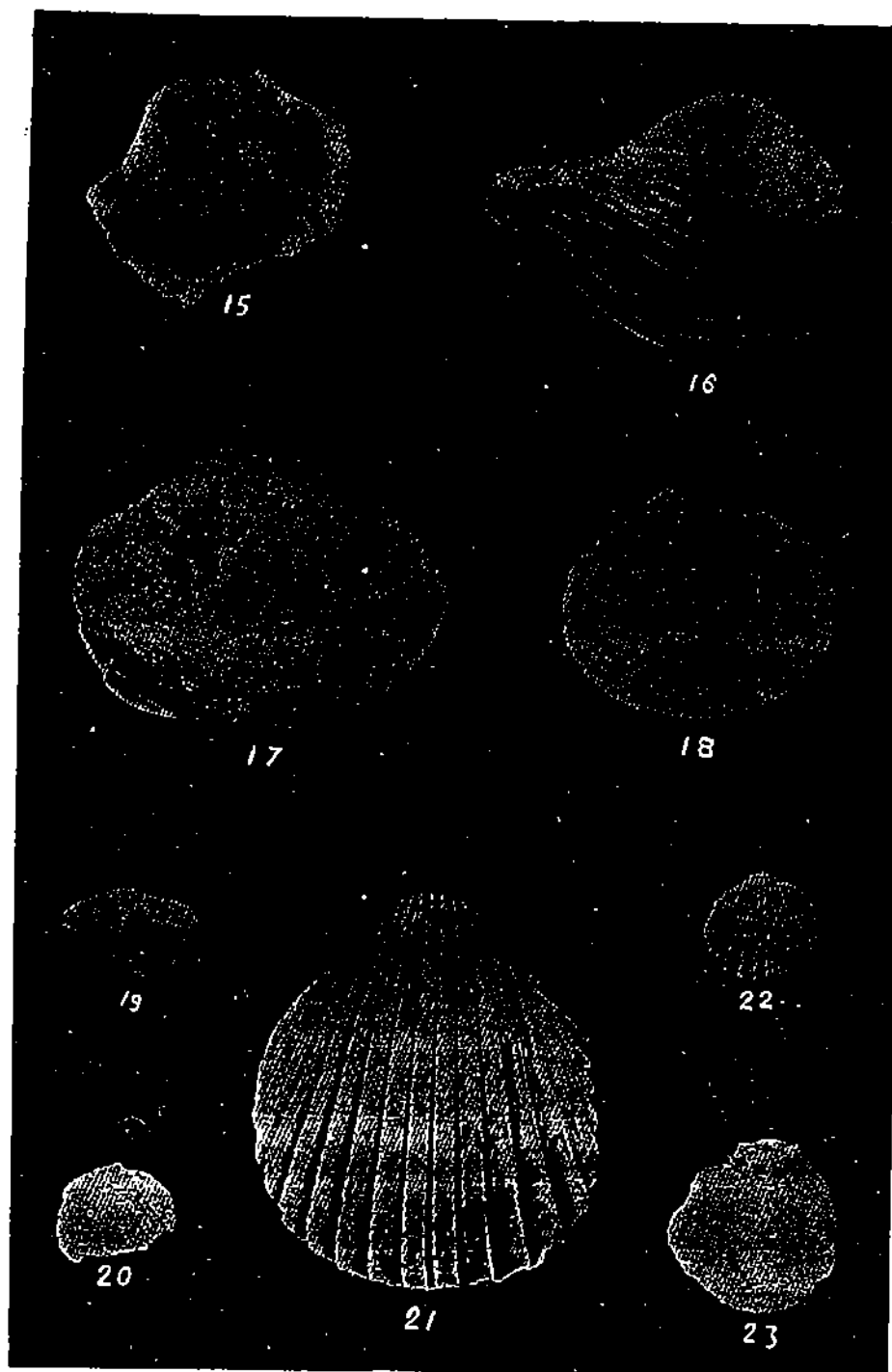
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**Explanation of
Plate III**

Plate III

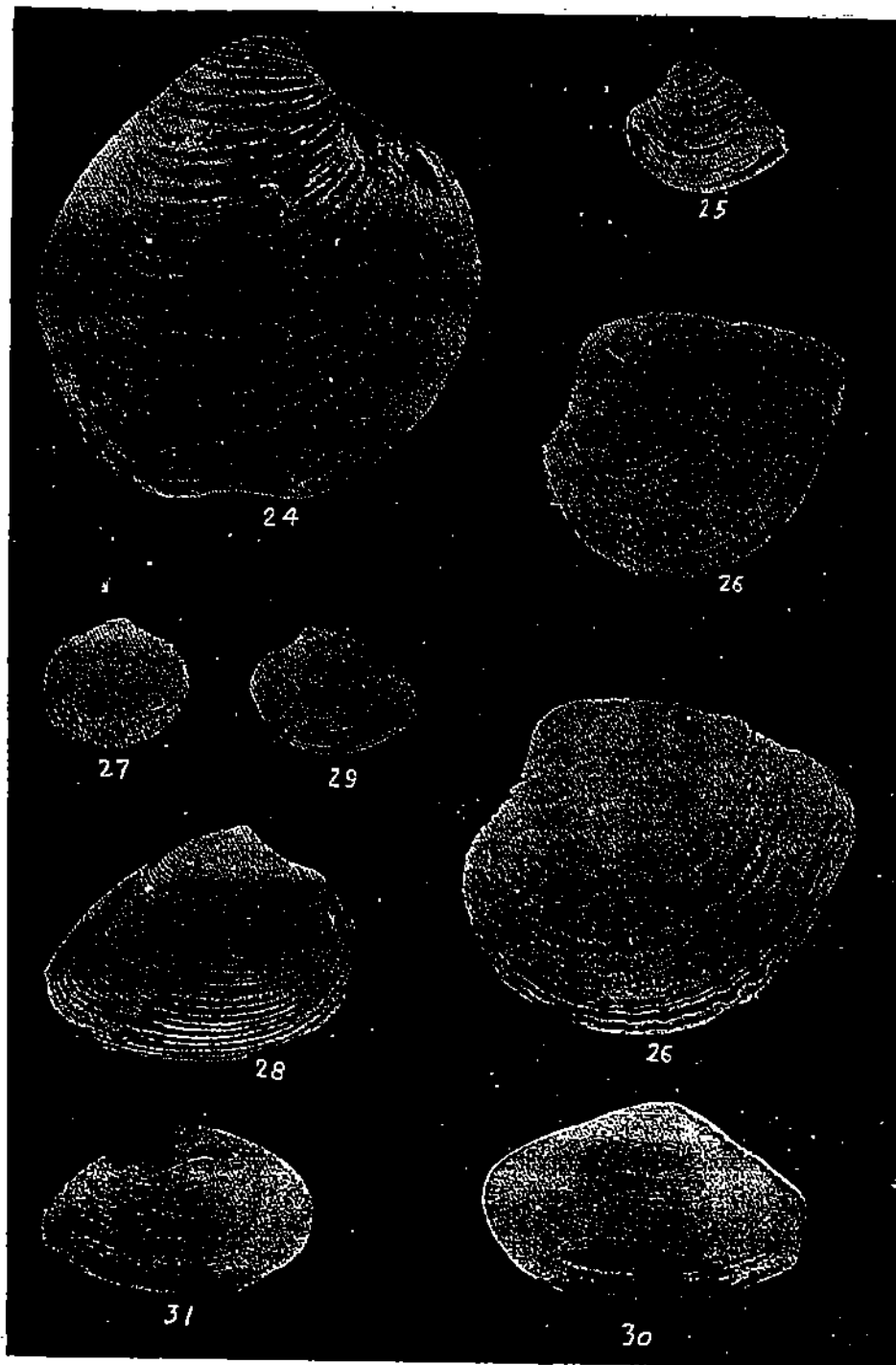
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**Explanation of
Plate IV**

Plate IV

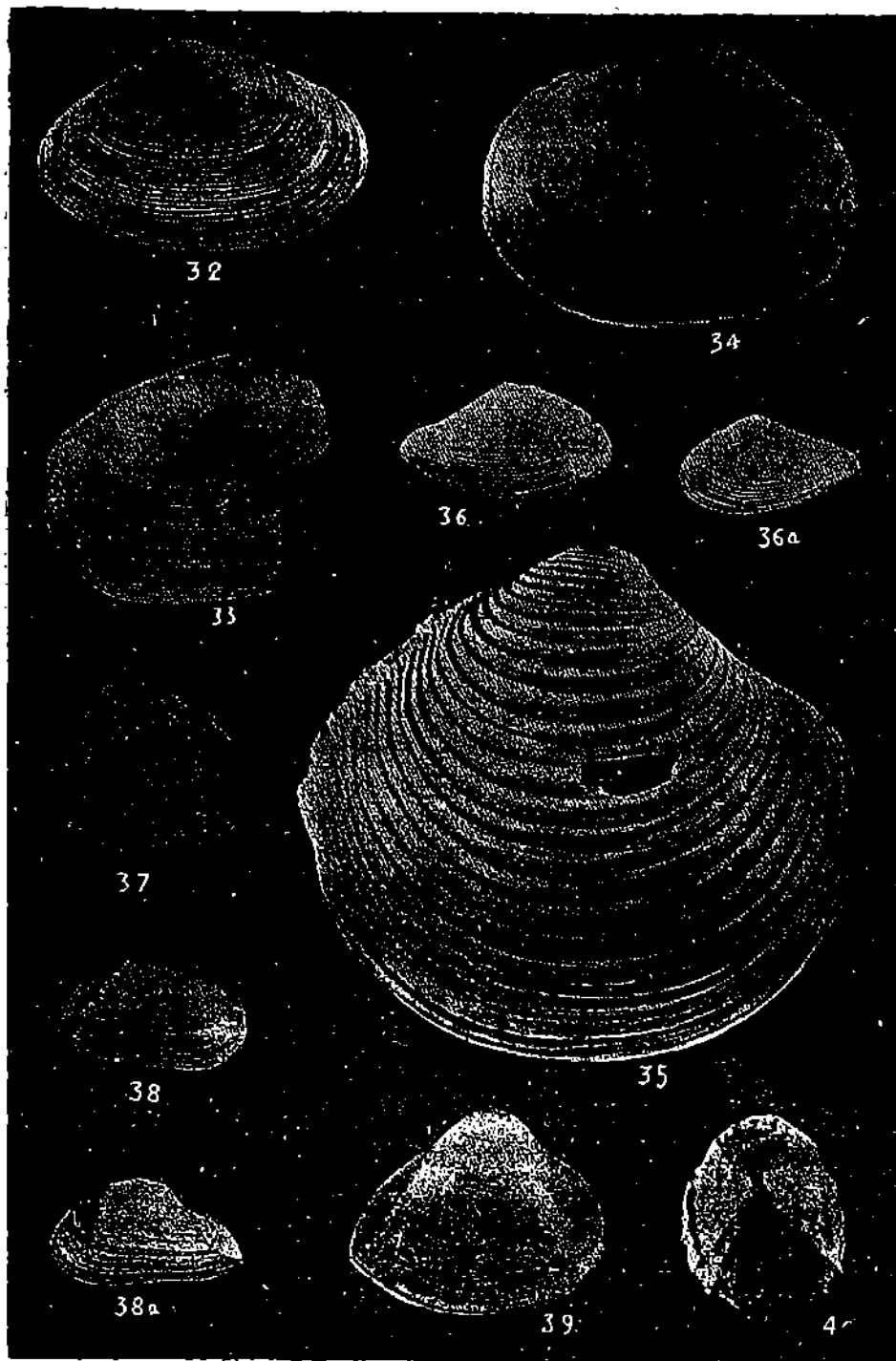
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**Explanation of
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Plate V

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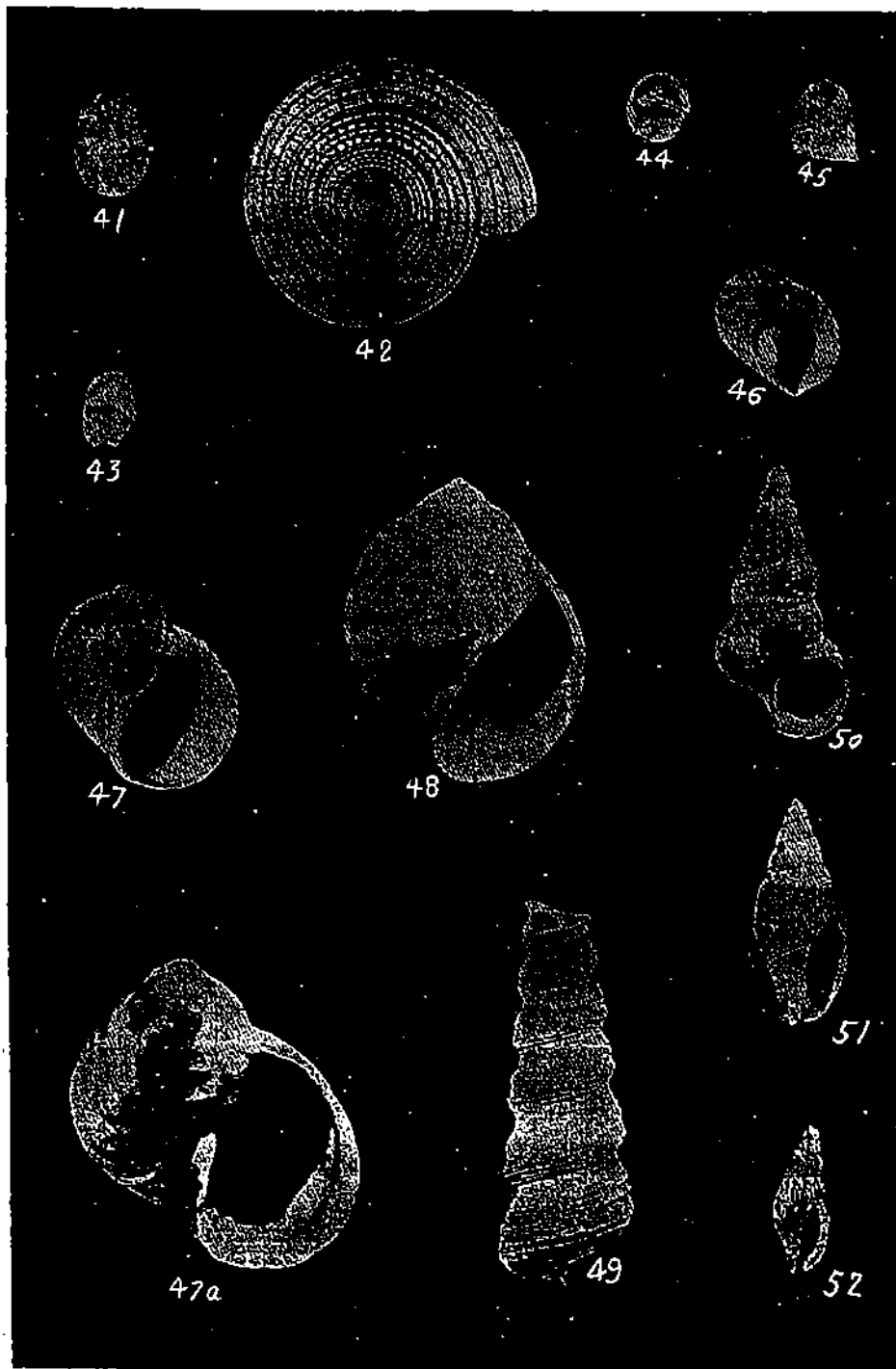
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**Explanation of
Plate VI**

Plate VI

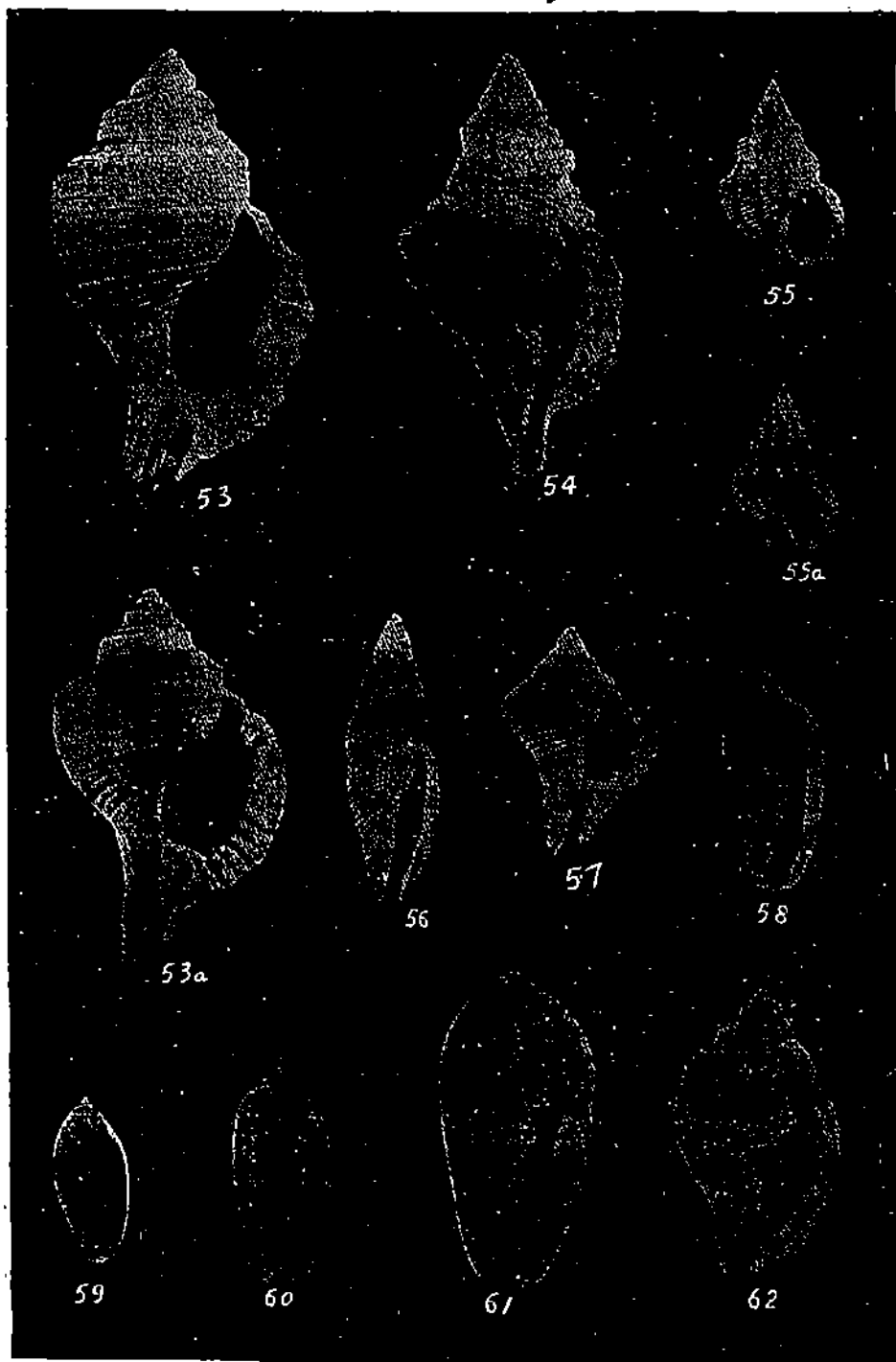
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**Explanation of
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**Explanation of
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