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Contributions to the Tertiary Paleontology of Northern Peru: Part 3, Eocene Mollusca

By A. A. Olsson

December 25, 1930

Harris Co.,

Ithaca, N. Y.

U. S. A.

Prefatory Note

This paper is Part 3 of the Contributions to the Tertiary Paleontology of Northern Peru and of which Parts 1 and 2 have already appeared in these Bulletins. A reclassification of the Peruvian Upper Eocene rocks into two stages, representing two distinct marine transgressions has been found necessary and the Introduction is devoted to a discussion of the Paleontology and Stratigraphy of these formations. In addition to the description of several new species of Eocene mollusks, the following new genera and subgenera are proposed.

Yasila Type. **Yasila paytensis,** n. sp.
Chiralithes (Subgenus of **Clavilithes**). Type: **Clavilithes cynosuris,** n. sp.
Perulithes (Subgenus of **Clavilithes**). Type: **Clavilithes peruvianus** Woods.
Nerinatica (Subgenus of **Natica**). Type: **Natica paytensis,** n. sp.

Gloversville, N. Y.
Nov. 24, 1930.

INTRODUCTION

The series of sedimentary deposits consisting chiefly of conglomerates, sandstones and shales which form the Peruvian Eocene, was briefly described in 1928 in Part 1, of these Contributions[1] as an aid in recording the occurrence and stratigraphic range of the fossil species of mollusca. Stratigraphically these rocks were divided into 6 formations from early to late Eocene age.

Since the publication of our sections in 1928, a great deal of new information has been secured of a faunal and stratigraphic nature and certain changes affecting the classification of the Upper Eocene rocks are necessary. Following the opinion generally held at that time, the Upper Eocene was believed to constitute a single stratigraphic unit and beds containing an Upper Eocene fauna were assigned to a single formation named the Saman. This interpretation can no longer be maintained and two formations of early and late Upper Eocene age respectively and representing two distinct marine transgressions across the littoral region of northern Peru must be recognized. The twofold division of the European Upper Eocene deposits into the Bartonian and Ludian stages, heretofore not separated in America, seems to find a parallel in northern South America.

In the new or revised classification, the Verdun grits of the Negritos region, formerly referred to the Lower Oligocene, are correlated directly with the typical Saman formation of the Chira Valley. The beds formerly referred to the Saman in the Negritos and coastal region are now known to belong to an older formation which may be called the Talara formation, a name first used by Grzybowski[2]. The outcrops which may be selected as typical for the Talara formation, are the shales and sandstones lying above the Upper Eocene unconformity or beginning with the *Discocyclina peruviana* zone as exposed along the east side of the Talara Golf course and extending east and then north along the tablazo escarpments.

[1]Olsson, 1928, Bulls. Amer. Pal., vol. 14, no. 52.
[2]Grzybowski, 1899, Neues Jahrb, fur Min., etc., BB. bd. 12, p.

THE SAMAN FORMATION

The type exposures of the Saman formation are the fossiliferous yellow sandstones of Casa Saman near Tangara in the Chira valley and extending northeast as a series of strike hills past Sullana and Quercotilla to Sojo. They have a thickness of about 1000 feet and consist chiefly of sandstones and conglomerates becoming more argillaceous and fine-grained towards the top. In this region, they rest directly upon the Cretaceous (Copa Sombrero formation) or on the Amotape slates and granites along the south side of the Amotape Mountains. The typical Saman sandstones are also found at Paita, representing coastal rocks resting on slates and mica-schists. Small exposures of Saman sandstones are found around the borders of the Cerros de Illescas resting upon metamorphics and igneous rocks. The largest exposures are found at Nonura bay, the basal bed being usually a beach limestone filled with *Lepidocyclinæ*.

Fossils principally mollusks are common in the Saman sandstones throughout the Chira valley. Many species such as *Aturia alabamensis* var. *peruviana*, the *Pseudolivæ*, *Venericardia planicosta* var. *samanensis* and *Amotapus arbolensis* are unusually large and represent the highest stage attained in the evolution of these forms. The following species have been collected in the Saman sandstones at Casa Saman.

†*Arca* (*Argina*) *sullanensis* Woods
†*Arca* (*Argina*) *samanensis* Olsson
***Pteria* sp.
Mytilus sp.
†*Ostrea samanensis* Olsson
†*Amotapus arbolensis* Woods
†*Venericardia planicosta* var. *samanensis* Olsson
**Cardium samanicum* Olsson
**Phacoides* (*Miltha*) *paytensis* Woods
†‡*Clementia peruviana* Olsson
**Macrocallista inca* Olsson
**Pitaria* (*Lamelliconcha*) *samanensis* Olsson
†*Spisula* (*Oxyperas*) *callistoides* Olsson
Tellina sp.
Solen sp.
**Corbula tangara* Olsson

†‡*Architectonica sullana* Olsson
†‡*Architectonica chira* Olsson
**Polinices* (*Neverita*) *samanensis* Olsson
†*Ampullina ortoni* Gabb
†*Ampullina gabbi* Woods
**Claytræa saxosa* Olsson
Crepidula sp.
†‡*Turritella samanensis* Olsson
†‡*Turritella chira* Olsson
**Turritella boughtoni* Olsson
†*Cerithium* (*Iddingsia*) *læviusculum* Gabb
**Lagunitus peruvianus* Woods
**Lagunitus samanicus* Olsson
†*Ectinochilus gaudichaudi* d'Orb.
†*Peruficus lagunitensis* Olsson
†‡*Pseudoliva parinæensis* var. *samanica* Olsson
†*Pseudoliva coronaria*, n. sp.
**Tritonidea staufti* Olsson
†*Dorsanum lagunitensis* Woods
†*Melongena* (*Cornulina*) *lævifusoides* Olsson
**Melongena* (*Pugilina*) *œdicnema* Olsson
‡*Mancorus grabaui*, n. sp.
†‡*Voluta* (*Peruluta*) *mancorensis* Olsson
†*Agaronia inca*, n. sp.
†‡*Conus chiræensis* Olsson
†‡*Xancus peruvianus* Olsson
†‡*Aturia alabamensis*, var. *peruviana* Olsson

†Also in Talara form.
* Restricted to Saman sandstones.
‡Also in Chira or higher Oligocene formations.

The above list records 43 species. The majority or approximately 60% are species which have ascended from the older rocks and of which nearly 44% are forms first appearing in the Lower Upper Eocene or basal Talara formation. About 26% are long ranging forms passing into the overlying Oligocene and having no particular significance. Only 13 species or 30% seem to be restricted to Saman rocks. The above tabulation is somewhat inaccurate as certain species recorded both from the Talara and Oligocene formations have not been collected in the

Saman sandstones but their addition would not greatly change the relationship already indicated. The very close affinities of the Saman fauna with that of the Lower Upper Eocene or Talara formation is very evident.

The typical Saman sandstones do not occur in the coastal region north of the Chira valley but become replaced by shales and white to yellowish gritty sandstones showing great lateral variation and in thickness ranging from 1500 to 3000 feet. In some localities small *Lepidocyclinæ* and *Nummulites* (the Verdun grits) are common but other fossils are very rare or generally too fragmentary for specific identification. North of Mancora, the Verdun rocks become coarse conglomerates passing into mudflows in the Canoas and Caleto Mero region. Since they are the surface rocks in the Verdun field, they were named the Verdun formation.

An unconformity of regional character marks the base of the Verdun formation. This unconformity varies according to local structure but in general increases in magnitude to the north indicating that the Verdun transgression came from the southwest. At Caleto Sal, an erosional interval preceding the deposition of the Orbitoidal conglomerates is indicated in the abundance of rolled fossils such as *Pseudoglauconia lissonii* of Restin origin, showing that these older beds were exposed to erosion. In the Negritos region, the Verdun unconformity is an important factor in the producing districts and drilling wells frequently find a large part of the normal section missing. The more complete sections generally exposed in synclinal areas or in down-faulted blocks have the Verdun grits resting upon a variable thickness of Pozo shales belonging to the upper part of the Talara formation.

The correlation of the Verdun grits with the Saman sandstones of the Chira valley has been complicated from the lack of exposures in the intermediate region since these formations lie deeply buried beneath Oligocene and Pleistocene deposits. The most conclusive evidence of the equivalence of these rocks is furnished by the Lagunitas sandstones of Lagunitas. They are coarse, gritty sandstones similar to those of the Verdun and contain many Nummulites and some *Lepidocyclina* and at Triangulation Station 40 in Lagunitas numerous mollusks similar to those of the Saman sandstones. They are directly overlain by the Chira shales and according to well sections form the upper part of an Orbitoidal section of grits and arenaceous shales about 600 feet in thickness which clearly belongs to the Verdun formation. Beneath these Orbitoidal beds, drilling wells pass into the Talara formation, easily recognized by its fauna of *Discocyclina peruviana* and other special fossils. The Lagunitas sandstone therefore must belong to the Upper part of the Verdun formation or to the Second and Third grits of the Jabonillal region.

1. ‡†*Arca samanensis* Olsson
2. *Glycymeris*, sp.
3. ‡†*Ostrea samanensis* Olsson
4. ‡**†*Venericardia planicosta*, var. *samanensis* Olsson
5. ‡*Pitaria samanensis* Olsson
6. ‡†§*Conus chiræensis*, n. sp.
7. *Scobinella*, sp.
8. **Olivancillaria peruviana* Woods
9. †*Plejona* (*Volutocorbis*) *sula*, n. sp.
10. *Melongena*, sp.
11. ‡†*Dorsanum lagunitensis* Woods
12. ‡†*Pseudoliva samanica* Olsson
13. ‡†*Sconsia? samanica* Olsson
14. §*Morum peruvianum*, n. sp.
15. ‡†*Ectinochilus gaudichaudi* d'Orb.
16. *Cerithium*, sp.
17. ‡†*Cerithium* (*Iddigsia*) *lævisculum* Gabb
18. ‡†*Turritella chira* Olsson
19. ‡†*Turritella samanensis* Olsson
20. ‡†*Ampullina ortoni* Gabb
21. **Tympanotomus lagunitensis* Woods
22. *Faunus ? lagunitensis* Woods
23. **Lagunitas peruvianus* Woods
24. ‡†*Lagunitas samanicus* Olsson
25. ‡†§*Architectonica sullana* Olsson
26. ‡†§*Architectonia chira* Olsson
27. **Terebra*, sp.

** Also pre-Talara.
† In Talara formation.
‡ In Saman sandstones.
§ In Oligocene.
* Restricted to Lagunitas sandstones.

The Talara Formation

The distribution of the Talara formation is restricted to a narrow coastal belt beginning at Yasila and Jaquay Cunas a few miles south of Paita and extending north to the Tumbez river. In Ecuador, the shales which immediately lie beneath the clay-pebble bed of Baldry and Sheppard more than likely belongs to the Talara formation although its typical fauna has not been recognized.

In most places, a three-fold division of the Talara formation is recognized, a middle sandstone member (the Talara sandstones) between underlying and overlying shales. In a complete section, the Talara formation has an average thickness of about 2800 feet and has been divided as follows:

	Revised	*Old*
Talara	Pozo Shales	Pozo Shales
formation	Talara Sandstones	Saman Sandstones
	Talara Shales	Saman Shales

The Talara sandstones show great lateral variation from massive, hard, blue sandstones with cannon-ball concretions (Talara and Lobitos) to heavy-bedded flagstones and platty sandstones or to thin-bedded papery sandstones and shales. The sandstone layers are frequently ripple marked or covered with fucoidal markings indicating deposition in very shallow waters or tidal flats. Towards the top, the Talara sandstones pass into the Pozo shales laid down in somewhat deeper waters. The Pozo shales and the Talara sandstones are convenient lithological units in areal mapping but since they contain no fossils aside from foraminifera, need not be further considered in this paper.

The lower division or the Talara shales are principally dark-colored or gray shales, sometimes passing into sandstones or even conglomerates at their base. In some cases these sandy basal layers may reach a thickness of 400 feet or more, becoming a very important oil horizon known as the Lomitos conglomerate. It is principally from these lower beds that the bulk of the Talara molluscan faunas has been obtained. Mr. Willard Berry[3]

[3]Willard Berry, 1928, Eclogae geologicae Helvetiae, vol. 21, pp. 390 to 405.

has described the foraminiferal fauna of the Talara shales.

In the entire coastal region, an unconformity marks the base of the Talara formation. This unconformity is beautifully exposed at Yasila[4] and Jaquay Cunas where the basal Talara rocks consisting of yellow sandstones containing an abundant fauna, rest either on slates or on small remnants of the Salina beds (Lower Middle Eocene) preserved in small down-faulted blocks amongst the older slates and granite. The Pale Gredas, Parinas and Restin formations appear to be entirely absent in this region. West of Lagunitas, the Talara unconformity is exposed along the east side of the Keswick Hills as a zone of coarse, black, quartzitic cobbles in arenaceous shales resting upon eroded Restin shales. From this point, this unconformity may be traced in surface exposures north of the Great Fault of Bosworth through numerous fault blocks nearly to Talara. It is well exposed in the shale cliffs on the east side of the Talara Golf Course, as a sandy zone containing *Discocyclina peruviana* and *Nummulites speciosus* lying on somewhat more steeply dipping Restin shales. North of Mancora, the basal Talara formation contains lenses or reefs of Lithothamnium limestones.

The importance of the Talara unconformity marking the base of the Upper Eocene in Peru, has been emphasized in our former writings. It is unquestionably the most important stratigraphic break in the entire Tertiary history of this region, indicating vast changes in the tectonic development of northern and western South America. Master faults were formed at this time in the Negritos region which strike generally north and south or parallel to the major foldings of the Andean Geosyncline. Since the Upper Eocene, structural development has followed along other lines with trends usually parallel to the present coast-line.

As previously stated, the bulk of the Talara fauna has been obtained from the basal sandy or conglomeritic layers, the horizon of the Lomitos conglomerate or the *Liothyrina peruviana* -- *Discocyclina peruviana* zone. A few fossils have also been collected from certain gritty layers of local development near the top of the Talara shales but these are relatively unimportant. The

[4]Yasila and Jaquay Cunas. These are two localities lying about 8 to 11 kilometers respectively southwest of Piata along the coast between Punta Nermete and Isla de Foca. They are shown on the Paita sheet of the Peruvian Servicio Geográphica del Ejercito 1925,

best fossil localities are the following:

Y. Yasila and Jaquay Cunas southwest of Paita.
N. Salina area at the southwest ent of the Negritos Golf Course, Negritos.
L. About 2 to 3 miles northwest of Lagunitas.
G. North side of Great Fault ½ mile northeast of Section 23, Negritos, zone of **Operculina** and other fossils.
T. Talara Golf Course and near southeast corner of Talara tank farm.
Lo. Lobitos.
B. Cabo Blanco, banks of Que. Siches.
C. Caleto Sal.

The following lists includes all the fossil species except the smaller foraminifera and the undetermited crustacea, corals and echinoids known from the Talara formation. The capital letters following the species refer to the localities tabulated above. The prefixes * † ** § indicates the stratigraphic range of the species as follows:

* Restricted to the Talara formation
† Ascending from the Restin or older beds
** Continuing into the Saman formation
§ Passing into the Oligocene

Pelecypoda

1. **Leda,* sp., Y
2. **Leda* (*Adrana*), sp. Y, T
3. ***Arca* (*Argina*) *sullanensis* Woods, T
4. ***Arca* (*Argina*) *samanensis* Olsson, T
5. **Glycymeris peruvianus,* n. sp., Y
6. ***Ostrea samanensis* Olsson, Y etc.
7. **Anomia,* sp., N
8. **Mytilus,* sp., N
9. **Atrina talarensis* Olsson, T
10. **†*Amotapus arbolensis* Woods, N, Y, C
11. **Venericardia,* sp., L
12. **Venericardia simillina,* n. sp., Y
13. **†*Venericardia planicosta* var. *samanensis* Olsson
14. **Cardium,* sp., L
15. **Cardium junceum,* n. sp., Y
16. **Phacoides* (*Here*) *andersoni,* n. sp., Y
17. §*Phacoides* (*Miltha*) *woodi,* n. sp., Y
18. §**†*Clementia peruviana,* n. sp., Y, N, C, T, etc.
19. **Pitaria* (*Pitaria*) *yasila,* n. sp., Y

20. **Pitaria* (*Lamelliconcha*) *salsola* Olsson, N, Y
21. **Pitaria* (*Lamelliconcha*) *baldryi,* n. sp., Y
22. **Macoma* (*Psammacoma*) *talarensis* Olsson, T
23. **Corbis,* sp., B
24. **Spisula* (*Spisula*) *caleta* Olsson, C
25. **Spisula* (*Spisula*) *hualtaca* Olsson, C
26. **Spisula* (*Oxyperas*) *deserta* Olsson, Y, C
27. **Mactra ?,* sp., N, Y
28. **Corbula,* sp., Y
29. **Corbula boggsi* Olsson, N
30. **Corbula salina* Olsson, N
31. **Ensis,* sp., N
32. **Verticordia,* sp., L
33. **Martesia,* sp., N

Gasteropoda

1. **Conus peruvianus,* n. sp., Y
2. §***Conus chiræensis,* n. sp., Y
3. **Drillia parina* Olsson, N
4. **Daphnella salina* Olsson, N
5. **Eopleurotoma paytensis,* n. sp., Y
6. **Eopleurotoma wiedeyi,* n. sp., Y
7. **Hemipleurotoma arenosa,* n. sp., Y
8. **Moniliopsis peruviana,* n. sp., Y
9. **Moniliopsis ? paytensis,* n. sp., Y
10. **Crassispira woodringi,* n. sp., Y
11. **Crassispira capella,* n. sp., Y
12. **Turricula* (*Pleurofusia*) *eolavinia,* n. sp., Y
13. **Fusiturricula yasila,* n. sp., Y
14. §*Genotia peruviana,* n. sp., Y
15. **Scobinella* (*Mitratoma*) *bartschi,* n. sp., Y
16. **Terebra negritensis,* n. sp., Y, N
17. **Terebra,* sp., Y
18. **Cancellaria* (*Admete*) *paytensis,* n. sp., Y
19. **Oliva* (*Oliva*) *misti,* n. sp., Y
20. **Agaronia saxosa* Olsson, L
21. ***Agaronia inca,* n. sp., N, Y
22. **Ancillarina pananga,* n. sp., N, Y
23. **Voluta paytanica,* n. sp., Y

24. †*Peruluta peruviana,* var. *samanica* Olsson, N
25. **§*Peruluta mancorensis* Olsson, Y
26. **Plejona* (*Volutocorbis*) *sula,* n. sp., Y
27. **Lyria sabulosa* Olsson, N, G, L
28. †*Lyria busera,* n. sp., Y
29. **Mitra* (*Tiara*) *yasila,* n. sp., Y
30. **Eoxancus talarensis,* n. sp., Y, T
31. **Eoxancus paytensis,* n. sp., Y
32. **†§*Xancus peruvianus* Olsson, C
33. **Clavilithes woodringi* Olsson, L
34. **Clavilithes lagunitensis* Olsson, L
35. **Perulithes yasila,* n. sp., Y
36. §*Chiralithes cynosuris,* n. sp., Y
37. **Chiralithes pozoensis* Olsson, L
38. ***Peruficus lagunitensis* Olsson, Y
39. †*Levifusus mallacus* Olsson, L
40. **Typhis* (*Levityphis*) *thagus,* n. sp., Y
41. **Murex scorpionius,* n. sp., Y
42. **Yasila paytensis,* n. sp., Y
43. **Siphonalia* (*Pseudoneptunea*) *nuntia,* n. sp., Y
44. **Terebrifusus placitus,* n. sp., Y
45. **Terebrifusus lepus,* n. sp., Y
46. **†*Melongena* (*Cornulina*) *levifusoides* Olsson, Y
47. ***Dorsanum lagunitensis* Woods, N, Y
48. **Tritiaria salina* Olsson, N
49. **Tritiaria terebratula* Olsson, N
50. **Pollia sillapaytensis,* n. sp., Y
51. **Pollia* (*Endopachychilus*) *purpuroides,* n. sp., Y
52. **Pseudoliva,* sp., Y
53. ***Pseudoliva samanica* Olsson, N, Y, L
54. **Pseudoliva modesta* Olsson, N
55. ***Pseudoliva coronaria,* n. sp., Y
56. **Bursa chira,* var. *yasila,* n. var., Y
57. **Sassia,* sp., Y
58. **Plesiotriton paytensis,* n. sp., Y
59. * *Ficus otaria* Olsson, N, Y
60. ***Sconsia ? samanica* Olsson, N, Y
61. **Morum* (*Herculea*) *maccormacki* Olsson, L
62. **Amphiperas bullen-newtoni,* n. sp., Y

63. **Amphiperas negritensis* Olsson, N
64. **Cypræa boggsi* Olsson, L
65. *Cypræedea,* sp., Y
66. **Ectinochilus gaudichaudi,* var. *alauda* Olsson, N, Y
67. ***Cerithium (Iddingsia) læevisculum* Gabb
68. *†Harrisianella peruviana* Olsson, C
69. *§**Turritella chira* Olsson, N, Y
70. *§**Turritella samanensis* Olsson, N, Y
71. **Turbo,* sp., Y
72. *†Natica (Natica) peruviana* Olsson, N, Y
73. **Natica (Nerinatica) paytensis,* n. sp., Y
74. **Polinices (Polinices) woodi* Olsson, N
75. ***Ampullina ortoni* Gabb, Y
76. **Tuba peruviana,* n. sp., L, Y
77. *§Liotia,* sp., Y
78. *§**Architectonica sullana* Olsson, Y, N, etc.
79. *§**Architectonica chira* Olsson, Y, N, etc.
80. **Epitonium (Acrilla) peruvianum* Olsson, N, Y, L
81. **Epitonium (Acrilla) paytens,* n. sp., Y, L

Cephalopoda

1. *§**Aturia alabamensis,* var. *peruviana* Olsson, N

Scaphopoda

1. **Cadulus,* sp., Y
2. **Dentalium samanicum* Berry, L
3. **Dentalium boggsi* Berry, L
4. **Dentalium yasilum,* n. sp., Y

Brachiopoda

1. **Liothyrina peruviana* Olsson, L, N, Lo, C. B
2. **Argyrotheca berryi* Olsson, C
3. **Argyrotheca chica* Berry, C

Foraminifera

1. **Discocyclina peruviana* Cushman, L, T, Lo, B, C
2. **Discocyclina salensis* Berry, C
3. **Asteriacites caleta* Berry, C
4. **Asterodicocyclina stewarti* Berry C

Most of the species recorded above, were collected near Negritos, Lagunitas or Yasila. Although maintaining a general faunal characteristic, even nearby localities will show certain variations so that each station has its individual elements. At Yasila, the most common fossil is *Turritella chira* while a mile to the north, the same layers contain a pelecypod fauna with *Amotapus arbolensis* Woods and *Spisula deserta* as outstanding members. The same variations are found through the Negritos and Talara regions with even more striking differences. Near Lagunitas, the lower Talara shales contain zones filled with *Liothyrina peruviana* and *Discocyclina peruviana* and a rich molluscan fauna of *Clavilithes, Morum,* a small *Venericardia* and *Verticordia.* Just north of the Great Fault near Section 23, are sandy layers filled with *Operculina* and a small *Lepidocyclina* while molluscs are quite rare. Between this station and the Talara Golf course, the beds are nearly unfossiliferous consisting principally of shales but at the Talara Golf course, the rocks become filled with *Discocyclina peruviana* and *Nummulites speciosa.* Somewhat higher, a molluscan fauna with *Clementia peruviana, Atrina talarensis* and *Eoxancus talarensis* occurs in thin sandstone layers near the southeast corner of the Talara tank farm. At Caleto Sal, the basal Talara is a soft, gritty sandstone with small brachiopods (*Argyrotheca*) and stellate *Orthophragmina.* In this same region we also find lenses or reef-like masses of Lithothamnium limestones which seem to reach their greatest development in Quebrada Conchudo. The varied ecological conditions brought into being by the Talara or early Upper Eocene transgression were therefore extremely favorable to the rapid evolution and expansion of a new fauna and additions to this fauna may be expected as new fossil localities are found, embracing a larger range of ecological stations.

About 119 species of mollusks have been collected from the basal Talara formation. The majority or about 72% are known only from this horizon. A few of these species may be discovered in the Saman rocks but the larger number will probably remain strictly Talara forms. Only 9% have come up from the older beds, a few highly specialized species as *Peruluta peruviana,* var. *samanica* seem to have survived but for a short time, while others as *Amotapus arbolensis* and *Venericardia planicosta* var. *samanensis* are longer ranging forms which pass into the Saman formation while *Clementia peruviana* and *Xancus peruvianus* although beginning in the upper Restin belong to more modern types and pass into the Middle and possibly the Upper Oligocene. About 19% represent species which pass into the Saman formation, a percentage which will probably be increased as additions are made to the Saman fauna. About 11% continue into the Oligocene most of which begin in the Talara formation. The slight affinities of the Talara fauna with the older Peruvian Eocene should be noted. It is particularly striking in the entire absence (except as rolled or reworked fossils) of several important groups of mollusks, such as the large Cerithoids (*Pseudoglauconia lissoni, Perucerithium*) the Melanatrias, Carolias, etc.

The evidence of the other fossil invertebrates as far as these have been studied, is even more conclusive in proving the slight affinities of the Talara fauna with the older Eocene. Three or four species of brachiopods occur in the basal Talara, the only representatives of this class in the Peruvian Tertiaries. The larger foraminifera including 2 species of *Discocyclina,* 1 species of *Asterodiscocyclina,* 1 or more species of *Helicolepidina,* numerous *Lepidocyclina, Operculina and Nummulites,* all commence in the basal Talara while these genera are entirely absent from the underlying Eocene. The Crustacea, Echinoids and Corals have not been studied but they all appear distinct from pre-Talaran forms.

The relations of the Talara fauna with that of the Saman is close. About 19% of the Talaran mollusks recorded above, occur in the Saman, a proportion which could be increased by including a few species ranging into the Oligocene but not definitely known from the Saman. Of the Saman fauna itself, about 44% belong to Talara species.

The Talara fauna is distinguished from the Saman by its large number of special species. It includes several species of *Clavilithes* whose affinities are with the older beds. *Epitonium peruvianum* and *paytensis, Lyria sabulosa, Natica paytensis* and *Phacoides andersoni* are but a few species of mollusk which seem to be restricted to this formation. The brachiopods are entirely confined to this formation while no species of *Orthophragmina* has been identified from the Saman or younger formations.

CORRELATION

In 1922, Cushman[5] in his discussion of the larger foraminifera of the Bosworth collection, referred the zone of *Discocyclina peruviana* definitely to the Upper Eocene. This correlation is supported by the evidence of the mollusks and other groups of fossil invertebrates. The zone of *Discocyclina peruviana* lies near or at the base of the Talara formation and above a major unconformity. It marks the commencement of a new fauna quite distinct from the older Peruvian Eocene which continues to the top of the Saman sandstones.

It has been shown that the Talara and Saman rocks belong to distinct formations separated stratigraphically by a regional unconformity and by certain differences in fauna. They are both referred to the Upper Eocene and in terms of the European section, to the Bartonian and Ludian.

DESCRIPTION OF SPECIES

Class PELECYPODA

Order PRIONODESMACEA

Superfamily NUCULACEA

Family NUCULIDAE Adams

Genus NUCULA Lamarck

Nucula catalina, n. sp. Plate 1, fig. 2.

Shell small to medium size, solid, subtrigonal; outline like most Nuculas is subtruncate posteriorly with the beaks near the posterior 1/4th; ventral margin curved with its greatest convexity nearly below the umbos; beaks small and inconspicuous; surface sculpture variable, usually appearing nearly smooth to the unaided eye but on slight magnification a submicroscopic sculp-

[5] Cushman, 1922, In Bosworth's Geology of North-West Peru, p. 136.

ture is seen, consisting of quite regular concentric wrinkles, heaviest on the umbos and along the anterior portion of the valves; the spaces between these concentric wrinkles is crossed by regular, elevated radial threads; along the umbonal ridge, the concentric wrinkles may be finely divided into small broken threads; the anterior and posterior submargins are nearly smooth; interior concealed.

Height 8mm.; length 9.5mm.

Height 10.5mm.; length 12mm.

Remarks.—This species is recognized by its elegant submicroscopic sculpture. It is somewhat variable in this character, some shells being nearly smooth while on others it is persistant and strong. The species occurs with *Dentalium mancorense Leda barranca,* fragments of *Aturia peruviana* in certain hard, cherty layers in the Lower Talara shales of Que. Barrancas.

Locality and Geologic Occurrence.—Talara formation, Que. Barrancas.

Family LEDIDAE Adams

Genus LEDA Schumacher

Subgenus LEDINA Dall

Leda (Ledina) barranca, n. sp. Plate 1, figs. 3, 6, 7.

Shell large, solid, corbuloid to *Yoldia*-form; umbos small ending in the small scarcely curved beaks; valves nearly equilateral, the posterior side slightly more sloping or contracted than the anterior; valves moderately convex, the greatest inflation being a short distance above the middle and frequently the surface appears slightly impressed just below the middle; lunule narrow, lanceolate, nearly as long as the anterior-dorsal margin and defined by being sunk or slightly depressed below the general surface level; escutcheon not well exposed on any of our specimens; anterior extremity well rounded; posterior side slightly constricted behind the beaks, bluntly pointed and emarginated at the extremity and weakly arcuate just in front and below; ventral margin straight in the middle, rounded on the sides; surface is smooth, except for the irregularly spaced growth-lines and occasional resting marks and more rarely submicroscopic radial wrinkles; hinge taxodont but not well enough exposed for detailed description.

Length 26mm.; height 17mm.; semidiameter 5.5mm.

Length 23mm.; height 14.25mm.; semidiameter 4mm.

Remarks.—The subgenus *Ledina* Dall with *Leda smirna* Dall[6] (*L. eborea* Conrad 1860, not 1846) as type, includes certain Eocene species characterized by their solid shell, *Yoldia*-like form with both ends evenly rounded. A recently described species of this group is the *Leda jonesi* Gardner[7] from Sumter Co., Alabama. In *L. barranca,* the shell is quite thick and solid and peculiarly corbuloid in shape. The anterior side appears to be slightly longer than the posterior but this may not be actually the case, as the posterior side is usually more or less broken. There is a weak emargination of the posterior ventral side. The surface is polished, smoothish except for irregular growth lines. The hinge is seldom seen and always poorly exposed. In one specimen there are about 17 high taxodont teeth along the posterior-dorsal margin.

Locality and Geologic Occurrence.—Talara formation, Que. Barrancas.

Superfamily ARCAEA

Family ARCIDAE Dall

Genus GLYCYMERIS da Costa

Glycymeris peruvianus, n. sp. Plate 1, fig. 4.

Shell small, subcircular, widest about the middle with an evenly rounded ventral margin; anterior and posterior submargins straight so that the dorsal portion of the shell appears trigonal to subpointed; shell is moderately convex, greatest just above the middle; umbos not prominent, with low, scarsely pointed beaks; surface smoothish, with numerous, subregular, low ribs or cords, separated by wider interspaces; resting marks present, showing deep, distant, concentric rings particularly on the umbos and earlier part of the shell; hinge normal with a narrow cardinal area; posterior set of taxodent teeth 8 to 11, and generally with 2 or 3 more on the anterior side; ventral margin crenulated ex-

[6]Dall, 1898, Trans. Wagner Free Inst., vol. 3, pt. 4, p. 580.
[7]Gardner 1929, Journ, Wash. Acad. of Sci., vol. 19, pp. 425-428, fig. 1.

cept along the posterior and anterior sides.

Height 14.5mm.; width 14.5mm.; semidiameter 4mm.

Locality and Geologic Occurrence.—Talara formation Yasila.

Order TELEODESMACEA

Superfamily CARDITACEA

Family CARDITIDAE Gill

Genus VENERICARDIA Lamarck

Subgenus VENERICARDIA s. s.

Venericardia planicosta var. **samanensis** Olsson Plate 1, fig. 1.

Venericardia planicosta var. **samanensis** Olsson, 1928, Bulls. Amer. Pal., vol. 14, No. 52, p. 28, pl. 5, figs. 4, 5, pl. 6, fig. 6.

This species is refigured from a very perfect specimen collected by Mr. Oscar Haught in the basal Talara beds of Yasila.

Locality and Geologic Occurrence.—Talara formation: Negritos, Lagnitus, Yasila, etc. Saman formation: Lagunitus, Saman, Paita, Bayovar.

Venericardia simillina, n. sp. Plate 2, fig. 3.

Shell small, thin, subcircular to sub-ovate, moderately convex; in older shells the beaks become more inequilateral and in the type specimen is situated near the anterior ¼th; umbos full, prominent with the greatest convexity of the shell slightly posterior and above the middle of the disk; there is a broad, posterior umbonal angle above which the surface is somewhat depressed or excavated; sculpture consists of about 20, narrow, knife-like, generally tuberculated ribs separated by wider and deeper interspaces; except the first 4 anterior ribs and the 5 posterior ones on the posterior-dorsal slope, the ribs are terraced on each side or stand on a broad, square basal platform above which rises the narrow central rib; the top of the central rib is usually cord-like and finely ornamented with widely spaced, small but elevated beads or tubercles; these beads seem to have been present on all the ribs but are easily destroyed by weathering,

Length 18mm.; height 16mm.; semidiameter 5.5mm.

Remarks.—This species is a member of the group of *V. alticostata* Conrad. According to Harris's figures the nearest approach is found amongst the Claibornian forms, especially the variety designated *transversa* by Lea. *Alticostata* differs from *simillina* in having a greater number of ribs, the beading is coarser and less distant and in the sculptural details along the sides of the ribs. Associated with the type are several smaller *Venericardia* which may be the young of this species. They are more circular in form and their sculpture is less elegant.

Locality and Geologic Occurrence.—Talara formation, Yasila.

Superfamily LUCINACEA

Family LUCINIDAE Fleming

Genus PHACOIDES Blainville

Subgenus PSEUDOMILTHA Fischer

Phacoides (Pseudomiltha ?), sp. Plate 1, fig. 5.

Shell large, subcircular, subequilateral, moderately convex; umbos low, wide; posterior-dorsal area distinct, depressed and moderately wide; dorsal or hinge-margin straight with the rest of the valve margin forming part of a nearly perfect circle; sculpture of fine, concentric growth-lines; interior concealed.

Height 93mm.; length 91mm.; semidiameter 25mm.

Remarks.—Only a single, much weathered specimen of this large lucinoid is known. Since the interior is concealed so that the presence or absence of hinge teeth is not known, it is referred to *Pseudomiltha* principally on account of its large size. The posterior-dorsal area is deeper and more strongly defined than on most members of this group. It resembles *P. giganteus* Deshayes[8] of the Parisian Eocene by its subcircular outlines but the umbos are higher and fuller. *P. haitensis* Woodring and Mansfield[9] from the Plaisance limestones of Haiti is longer, more depressed and with flatter umbos. *P. megameris* Dall[10] from the Yellow limestones of Jamaica is a much larger species reaching a length of 235 millimeters but only known in the form of casts. Trechmann[11] in his interesting and valuable paper on the Mollusks of the Yellow limestones of Jamaica records 3

[8]Deshayes 1824, Coq. Fos. env. de Paris, i., p. 91, pl. 15, figs. 11, 12.

[9]Woodring and Mansfield 1924, Appendix 2, Geol. of Republic of Haiti., p. 612, pl. 10, fig. 1, (p. 106).

[10]Dall 1901, Nautilus vol. 15; Proc. U. S. Nat. Mus., vol. 23, pl. 42, fig. 1.

[11]Trechmann 1923, Geol. Mag., vol. 60, pp. 347, 360, 361, pl. 14, fig. 5, pl. 17, fig. 6.

other Pseudomilthas which he compares with European species.

Locality and Geologic Occurrence.—Clavilithes series, coastal phase rocks of the Clavilithes series along the base of the Amotape Mountains near Monte Grande, Que. Parinas.

Subgenus MILTHA Adams

Phacoides (Miltha) woodi, n. sp. Plate 2, figs. 9, 12.

Shell elevated, with the height about equal to the length, rather compressed; beaks small, pointed, curved slightly forward over the minute and almost obsolete lunule; basal margin forming more than ¾ths of a circle in outline, except that the anterior part is straighter; anterior-dorsal area short, and defined by being depressed below the general surface of the disk; posterior-dorsal area wider, defined by a narrow sulcus and with a wide median fold from the beak to the margin and bordered above by a second sulcus; sculpture consists of very fine, concentric lines, interrupted by heavier, resting marks; this sculpture is somewhat coarser on the dorsal margin; hinge with well developed cardinal teeth.

Height 32mm.; length 32.5mm.; semidiameter 2.5mm.

Remarks.—This species is a true *Miltha* belonging to the group exemplified by *P. (M.) childreni* Gray of the Brazilian coast, *P. xantusi* Dall of the Gulf of California and several fossil species. Commencing in the basal Talara beds, this species continues through the Saman into the Chira and Mancora formations. The Saman sandstone specimens in our collection are usually smaller, heavier and slightly more convex than the forms from the basal Talara and Mancora rocks. The Middle Oligocene shells from the Mirador sandstones of the Chira valley are very similar to the typical form from the basal Talara. Other species of *Miltha* in the Peruvian Eocene are *Lucina paytensis* Woods[12] and *Phacoides conventus* Olsson[13]. *L. paytensis* differs in being more quadrate, less circular in form, the ventral margin is straighter and the beaks are lower and less pointed. *Miltha iheringiana* Doella-Jurado[14] from the Enterriene formation of

[12]Woods, 1922, p. 70, pl. 4, figs. 5a, 5b.
[13]Olsson, 1929, Bulls. Amer. Pal., No. 57, p. 9, pl. 3, fig. 3.
[14]M. Doello-Jurado, 1919, Physis (Rev. de la Soc. Arg. de Ciencias Naturales), t. 4, pp. 558-562, figure.

Argentine differs principally in being larger.

Locality and Geologic Occurrence.—Mancora formation, Que. Charanal; Saman formation, Casa Saman; Talara formation, Yasila

Subgenus HERE Gabb

Phacoides (Here) andersoni, n. sp. Plate 2, figs. 5, 6, 7.

Shell small, solid, moderately convex; the shape of the shell is generally subcircular with the beaks slightly anterior of the middle; anterior-dorsal side straight with a very small, sunken lunule; posterior-dorsal area wide, depressed, wing-like and defined by a deep sulcus or groove; sculpture of wide, heavy, rounded, concentric ribs (recalling those of *Lirophora*) and separated by deep, wide grooves; they are usually about 8 in number and continue across the posterior-dorsal submargins to the ventral margin; interior of the shell deep, with the ventral margin appearing smooth or weakly crenulated; hinge with strong cardinal and lateral teeth.

Length 7.75mm.; height 8.25mm.; semidiameter 3mm.

Length 9.25mm.; height 9mm.; semidiameter 3.5mm.

Length 8mm.; height 8mm.; diameter 7mm.

Remarks.—When first collected, this shell was believed to belong to the genus *Volupia* of Defranc. *Volupia* is described as having a large lunule, 3 cardinal teeth and its figure shows a strongly trigonal shell and no differentiated posterior-dorsal submargin. Fischer[15] believed *Volupia* to belong to the *Veneridæ* and placed it near *Anaitis* and the Chiones. Dall[16] followed Fischer in placing *Volupia* with the *Veneridæ* as a section of *Chione* but with misgivings that the shell was really a lucinoid and related to *Here.* The lucinoid affinites of *Volupia* was finally fully established by Cossmann and Pissaro with *Gradilucina* Cossmann based on *Lucina tabulata* Defr. of the Parisien Eocene falling as a direct synonym[17].

Anderson's *V. bolivarensis*[18] from the Eocene of Colombia may be a true *Volupia* but it is said to have a small lunule and a

[15]Fischer, 1887, Manuel de Conchyliologie, p. 1084.
[16]Dall, 1903, Trans. Wagner Free Inst., vol. 3, pt. 6, p. 1288.
[17]Cossmann and Pissaro, 1904-06, Icon, complete des Coq. de l'Eocene de Paris, pl. 27, fig. 82-1 and footnote.
[18]Anderson, 1928, Proc. Calif. Acad. of Sciences, vol. 17, p. 22, pl. 1, figs. 7, 8.

flange-like projection on the posterior side descending from the shell which suggests a differentiated posterior-dorsal area. The *Lucina dolabra* Conrad[19] from the Claiborne sands of Alabama may be a true *Volupia*. In this shell, the lunule is deep, the posterior-dorsal area is very narrow but defined by a deep groove and the external sculpture consists of coarse, broad, irregular concentric ribs.

Broken specimens of *andersoni* may resemble Anderson's figure of *Volupia bolivarensis* but perfect shells differ by their more circular form, apparently more numerous ribs and stronger posterior-dorsal area.

Locality and Geologic Occurrence.—Talara formation, Yaslia.

Phacoides (Here) nonurensis, n. sp. Plate 2, fig. 8.

Shell of medium size, coarse, inequilateral, plump; outlines subcircular to subquadrate with the small, pointed beaks near the anterior 1/3rd; posterior-dorsal areas defined by being depressed below the general surface level but not delimited by any evident line or sulcus; lunule large, broadly lanceolate; surface sculpture consists primarily of coarse, elevated, thick concentric ridges between wide, flat interspaces; the ribs on the holotpye have an average spacing of 1 1/2 millimeters on the middle of the disk but become much closer and crowded on the dorsal areas; lunule large, lanceolate pouting in the middle, coarsely sculptured by the ends of the concentric ribs; interior concealed.

Height 20mm.; length 20.5mm.; diameter 13.5mm.

Locality and Geologic Occurrence.—Saman formation, Nonura Bay Sechura. Talara formation, Caleta Sal.

Superfamily CARDIACEA

Family CARDIIDAE Fischer

Genus CARDIUM Linné

Cardium junceum, n. sp. Plate 2, figs. 4, 10.

Shell small, thin, convex, subquadrate to subcircular truncate behind; umbos high, prominent and full with the greatest inflation of the shell about the center of the disk; basal and anterior margin evenly rounded, the posterior straight or slightly curved;

[19]Conrad, 1833, Amer. Journ. Sci., vol. 23, p. 343, Harris, 1919, Bulls. Amer. Pal., vol. 6, p. 111, pl. 37, figs. 17-21.

the posterior-umbonal slope is slightly angled or rounded, feebly defining the posterior-dorsal submargins from the rest of the surface; posterior-dorsal submargins flattened to slightly concave; sculpture consists of strong, ornamented ribs and interspaces, strongest on the medial portion of the shell, smaller on sides; the ribs number about 27 with 19 ribs anterior of the umbonal angle; the ribs are square in section, separated by deep, wide, flat interspaces; the summit of the ribs are generally exfoliated but when perfect are ornamented with a line of fairly large, closely spaced beads or tubercles; the flat interspaces and sides of the ribs are scalloped or cross-striated by evenly spaced incised lines; hinge of left valve with 2 cardinal teeth, the anterior one much the larger and 2 deep, lateral sockets.

Height 16.5mm. (imperf.); length 16mm.; semidiameter 6mm.
Height 15mm.; length 14mm.; semidiameter 5.5mm.
Height 18mm.; length 17.5mm.; semidiameter 4.5mm.

Remarks.—From *C. samanicum,* this species differs by its constantly smaller size, thinner shell and more numerous ribs. The *Fragum* or *Trigoniocardium*-like form is not so well delevoped as in that species.

Locality and Geologic Occurrence.—Talara formation, Yasila.

Superfamily VENERACEA

Family VENERIDAE Leach

Genus PITARIA Römer

Subgenus PITARIA s. s.

Pitaria (Pitaria) yasila, n. sp. Plate 2, fig. 11.

Shell of medium size, oblong or subquadrate, convex; basal or ventral margin rounded in the anterior portion, becoming nearly straight towards the posterior side; dorsal side arcuate; anterior extremity more narrow, rounded, produced beyond the tip of the beaks which are situated near the anterior ¼th; the shell is moderately convex, greatest about the center with a fairly prominent but rounded posterior-dorsal, umbonal slope; a shallow dorsal-anterior slope is present on the opposite or anterior side of the beaks, between which the umbos or center of the shell disk appears flattened or slightly impressed; surface smooth, with the growth lines somewhat stronger along the posterior-dorsal edge; anterior adductor muscle scar deep; hinge unknown.

Length 45.5mm.; height 30.5mm.; diameter 23mm. (mold).

Remarks.—In outlines, this species resembles the *Meretrix angelinæ* Harris[20] from the Eocene of Angelina County, Texas. The Peruvian species is smaller, more convex, with larger and more prominent umbos and shorter, more pointed anterior extremity. Although several specimens are known, they are all poorly preserved with all or only a part of the external shell remaining.

Locality and Geologic Occurrence.—Talara formation, Yasila.

Subgenus LAMELLICONCHA Dall

Pitaria (Lamelliconcha) baldryi, n. sp. Plate 2, figs. 1, 2.

Shell small, thin, delicate, ovate-elliptical, inequilateral; umbos high, full with prominent beaks situated near the anterior 1/3rd; lunule small, deeply impressed or excavated, smooth; anterior side below the lunule is evenly rounded; posterior end blunt; ventral margin evenly rounded; posterior-dorsal side straight or slightly arcuate; surface sculpture consists of narrow, thin, elevated and distantly spaced lamellae which on the middle of the shell disk are approximately 2mm. apart, but become much closer near the ventral margin; they are lacking from a narrow zone bordering the posterior-dorsal margin and from the lunule; the flat intespaces are further marked with weak, subobsolete striæ; interior of the shell moderately deep; ventral margin smooth.

Length 20.5mm.; height 15.5mm.; semidiameter 4.5mm.

Remarks.—In type of sculpture, this species is nearest *P. parinensis* Olsson but differs by its thinner and more delicate shell, higher umbos and beaks and more pointed posterior extremity. The concentric lamellæ are also more delicate and widely spaced.

The species is named for Mr. R. A. Baldry, Geologist of the Lobitos Oilfield, Ltd., at Lobitos.

Locality and Geologic Occurrence.—Talara formation, Yasila.

[20]Harris, 1919, Bulls. Amer. Pal., vol. 8, p. 17, pl. 2, figs. 12, 13. Palmer, 1927, Pal. Americana, vol. 1, no. 5, p. 225, pl. 4, figs. 16, 19.

Class GASTROPODA

Subclass STREPTONEURA

Order CTENOBRANCHIATA

Superfamily TOXOGLOSSA

Family TEREBRIDAE Adams

Genus TEREBRA Bruguière

Subgenus STRIOTEREBRUM Sacco

Terebra (Strioterebrum) negritensis, n. sp. Plate 5, figs. 5, 8, 16.

Shell small slender, solid, porcellaneous and generally whitish in color; nucleus small of about 2 whorls with submerged tip; subsequent whorls 10, straight or slightly convex with a slow, even taper; sutures linear, close and slightly appressed; body-whorl of medium size and about 1/3rd the length of the whole shell; a sutural band present on all except the nuclear whorls bordered below by a weak, broad groove; axial ribs on spire-whorls are quite strong, become low, obsolete and irregular on the later; on the spire-whorls, the sutural band is weakly nodulated by the ends of the ribs, partially disjointed by the sutural groove and then continued as narrow, straight or slightly curved ribs to the lower suture; on the penultimate and last whorl, the ribs below the sutural are quite irregular and often nearly absent; surface generally appears nearly smooth and poreclaneous but close examination of perfect shells show very fine spiral striæ; anterior canal of moderate length, straight; columellar probably smooth, unarmed.

Length 16mm.; diameter 3mm.

Remarks.—All of our specimens have the aperture filled with matrix wholly or partly concealing the columella from view but as far as can be determined the pillar appears to be smooth and unarmed. On most shells the surface is smoothish, porcellaneous and white, with the axial sculpture fading and becoming irregular on the penultimate and body-whorl. When perfectly preserved however, the entire surface on magnification is seen to be covered with fine spiral threads.

Another *Strioterebrum* is found at Yasila. It is a small, subulate species with a persistant sutural band defined by a deep, spiral groove. It is sculptured with numerous, narrow and equal axial riblets and persistent spiral threads. The specimens are however too poorly preserved for naming and further characterization.

Locality and Geologic Occurrence.—Talara formation, Salina near Negritos, Yasila.

Family CANCELLARIIDAE Adams

Gensus ADMETE Kroyer

Subgenus ADMETE Kroyer

Section BONELLITIA Jousseaume

Admete (Bonellitia) paytensis, n. sp. Plate 11, fig. 5.

Shell small, delicate, high-spired; protoconch small, smooth, eroded; subsequent whorls about 4, strongly convex between deep and slightly grooved sutures; last whorl large, moderately convex near or just above the middle with a sloping base ending in a pointed anterior canal, narrowly umbilicate; sculpture strongly reticulate on the spire-whorls with 5 or 6 spiral cords and nearly equal, small longitudinal riblets; on the last whorl of mature shells, the spirals are generally stronger than the riblets and alternate in strength; varices or hump-like shoulders occur on the last whorl approximately 180 degrees apart; aperture subtrigonal with the outer lip internally crenate; columella with 2 strong plications.

Height 15mm.; diameter 10mm.; aperture 10mm.

Remarks.—This species resembles *Admete luffa* Olsson from the Restin of Jabonillal but has a finer and more irregular sculpture.

Location and Geologic Occurrence.—Talara formation, Yasila.

Family TURRIDAE

Genus EOPLEUROTOMA Cossmann

Eopleurotoma paytensis, n. sp. Plate 3, figs. 11, 16, 17.

Shell small or medium size with the spire much longer than the aperture; nucleus small, bulimoid of 3 smooth whorls; post-nuclear whorls 6 or 7 forming a rather long, moderately tapering spire; spire whorls straight to slightly convex in profile between straight linear sutures; fasciole feeble bordered above and next to the suture by a heavy, keel-like cord; sculpture of ribs and spirals, the ribs generally disappearing from the last whorl and only the spirals remaining; the ribs number about 11 to a turn, they are low and extend from the fasciole to the lower suture; spiral sculpture consists of closely spaced, even spiral cords which on the spire whorls number 8 or 9 and 21 or 22 on the last whorl; anal sinus is *Turris*-like, deep, broad and situated just below the feeble anal fasciole; aperture short, subelliptical with a short, stubby anterior canal; inner lip smooth or armed internally with several long, irregular liræ.

Length 16mm.; diameter 4.50mm.; aperture 5.75mm.

Remarks.—*Eopleurotoma* cf. *bicatena* Lam. has been recorder by Trechmann[21] from the Scotland beds of Barbados.

Locality and Geologic Occurrence.—Talara formation, Yasila.

Eopleurotoma wiedeyi, n. sp. Plate 4, figs. 5, 10, 11.

Shell much resembling *paytensis* but larger with a more contracted body-whorl and longer anterior canal; whorls 9 with a feeble, anal fasciole situated near the middle of the upper half of the spire-whorls so that their profile appears to be slightly concave; above the fasciole, the suture is bordered by a ribbon-like fold; sculpture consists of 8 low ribs on the middle of each whorl, lacking from the base of the body-whorl; the whole surface is crossed by spiral threads; on the last whorl, the primary spirals number about 24, with 16 from the shoulder to the tip of the anterior canal; they are fairly widely spaced, with 3 or 4 very fine spirals in the interspaces; growth-lines closely crowded, forming a finely cancellated submicroscopic sculpture; anal sinus wide, situated as in *Turris* on the middle of the whorl; anterior canal of moderate length, slightly curved.

Length 21mm.; diameter 6mm.; aperture 9mm.

Remarks.—This species may be mistaken for the young of *Crassispira woodringi* but the ribbing is quite different. It is

[21]Trechmann 1925, Geol. Mag., vol. 62, p. 497, pl. 24, f. 24.

named for Dr. Lionel Wiedey of the Geological Department at Negritos.

Locality and Geologic Occurrence.—Talara formation, Yasila.

Genus HEMIPLEUROTOMA Cossman

Hemipleurotoma arenosa, n. sp. Plate 3, figs. 4, 5, 6.

Shell small, fusiform with the spire more than twice the length of the aperture; nucleus very small, eroded; subsequent whorls 6 or 7, convex or shouldered about the middle with a concave or constricted zone on each side of the suture; fasciole broad, concave or sloping, bordered next to the suture by a spiral cord which is much heavier on the earlier whorls; last whorls larger and more convex with a short, slender, pointed anterior canal; shoulder of whorls with numerous, low, bead-like ribs lacking from the rest of the shell; these ribs are strongest on the spire-whorls and may become absent or obsolete on the body-whorl; the surface is further sculptured by fine and coarse spiral threads arranged as follows: a sutural cord already mentioned, generally 1 or 2 primary spirals on the shoulder crossing the bead-like ribs, a set of 3 or more irregular primary threads on the middle and base of body-whorl passing into closely spaced but smaller threads on the anterior canal, fine secondaries in the fasciole and on the interspaces between the larger spirals; aperture subelliptical with a short but slender anterior canal; anal sinus deep, situated *Turris*-fashion on the shoulder.

Length 17mm.; diameter 6.25mm.; aperture 7.5mm.

Length 19.25mm.; diameter 7mm.; aperture 8mm.

Remarks.—This shell is probably correctly referred to Cossmann's genus *Hemipleurotoma.* Cossmann at first considered *Pl. archimedis* Bell. as genotype, later changing to *Pl. denticula* Bast. Several species of *Hemipleurotoma* grouped about *Pl. childreni* Lea occur in the Claiborne sands.

Locality and Geologic Occurrence.—Talara formation, Yasila.

Genus MONILIOPSIS Conrad

Moniliopsis peruviana, n. sp. Plate 3, figs. 7, 12, 18, 19.

Shell small or medium size, with a long, slender spire and shorter aperture; whorls 8 or more, those of the spire straight to slightly convex so that the profile of the spire is nearly straight; sutures straight, slightly excavated; sutural fasciole absent or very feeble; body whorl not quite half the length of the shell and generally somewhat more convex than the spire whorls; aperture subelliptical with a straight, stout, stubby anterior canal; the inner lip is somewhat callused and usually with a narrow umbilical chink at the tip of the anterior canal; sculpture consists principally of coarse, closely spaced, regular spirals separated by deep grooves; the spirals number 9 on the spire whorls and 19 or 20 on the last whorl; the earliest spire-whorls have a few low ribs but most of them have only a spiral sculpturing; anal sinus is *Turris*-like, deep, wide and situated on the middle of the whorls; outer lip with long, narrow, internal liræ.

Length 21mm.; diameter 5.5mm.; aperture 7.25mm.

Remarks.—*Pleurotoma elaborata* Conrad[22] the type of the genus *Moniliopsis*[23] is a beautiful *Scobinella*-like shell but with a straight, smooth pillar. The sculpture consists principally of coarse, rope-like spiral cords. but which can hardly be called cancellate as described by Conrad. The present species although not agreeing entirely with *Moniliopsis* is nearest that genus in general form and type of sculpturing. Dall has described several species of Pleurotomoids from the recent Pacific fauna which he refers to *Moniliopsis.*

Locality and Geologic Occurrence.—Talara formation, Yasila.

Moniliopsis ? paytensis, n. sp. Plate 3, figs. 8, 14, 15.

Shell small, slender with a long, tapering, acute spire and relatively short, sub-elliptical aperture; nucleus eroded, very small; subsequent whorls 9, sculptured with strong, acute spiral cords separated by deep, concave interspaces; sutures close, indistinct; the sculpture is *Mitra*-like consisting of sharp, elevated, spiral threads between wide, deep, concave interspaces; the spirals number about 3 on the spire-whorls, 6 on the middle and base of last whorl; on the anterior canal, the spirals are more irregular and crowded; the grooved interspaces may have one or more secondary threads and further sculptured with close-set, raised threads parallel to the growth-lines; aperture subelliptical with a short anterior canal; pillar straight smooth; anal sinus when

[22]Conrad 1832, Foss. Shells Tert. Form., 1, p. 52, pl. 17, fig. 19.
[23]Conrad 1865, Amer. Journ. Conch., vol. 1, p. 143.

discernible is situated *Turris*-like on the shoulder or just above the middle of the whorl; inner lip moderately heavy and often bearing one or more internal liræ.

Length 18mm.; (imperf.); diameter 5mm.; aperture 5mm.

Length 14.5mm.; diameter 4mm.; aperture 5mm.

Locality and Geologic Occurrence.—Talara formation, Yasila.

Genus CRASSISPIRA Swainson

Crassispira woodringi, n. sp. Plate 3, fig. 1.

Shell of medium size, solid; whorls about 9; nucleus absent; spire whorls slightly convex between close, indistinct sutures with a sloping, broad but scarsely constricted anal fasciole and in which the anal sinus lies in the lower half and just above the shoulder of the whorl; the whorls are feebly shouldered, this shoulder bearing on the last turn about 8 low, knob-like ribs which become nearly obsolete on the back of the body-whorl; the ribs are absent from the fasciolar band; the spiral sculpture is quite weak and consists of primary, secondary and tertiary threads; the spirals of primary strength consists of a single thread a short distance below the upper suture, 2 or 3 threads on the spire whorl between the shoulder and the lower suture and 15 or more on the last whorl between the shoulder and the tip of the canal; the primary spirals are subregular in size and spacing with fairly wide interspaces; secondary threads occur mainly in the fasciolar area and are irregular in size and spacing; the whole surface is further overrun by very fine secondaries; growth lines strong, crowded on the last whorl; the anal sinus is deep, narrow and situated just above the shoulder angle; anterior canal moderately long, strongly twisted, often developing a pronounced fold at the tip.

Length 30mm.; diameter 9.5mm.; aperture 13mm.

Length 34mm.; diameter 9mm.; aperture 13.5mm.

Remarks.—The anterior canal is moderately long, stout and strongly twisted near the tip but shorter than in the forms generally grouped near or with *Turricula.* The anal fasciole is sloping, scarsely constricted, with the deep anal sinus situated just above the shoulder and some distance below the upper suture. It is more slender than typical *Crassispira.* It is possibly distantly related to *Turris* (*Surcula*) *resina* Dall[24] recent in the Gulf of Panama and to Woodring's[25] *Crassispira aegis* from Bowden.

Locality and Geologic Occurrence.—Talara formation, Yasila.

Crassispira capella, n. sp. Plate 4, figs. 3, 4.

Shell small or medium size, solid, biconic with the spire somewhat longer than the aperture and anterior canal; nucleus (eroded) small, pointed, followed by 7 or 8 subsequent whorls; sutures close, indistinct, bordered by a cord or keel between it and the fasciole; fasciole wide and concave, but not sharply delimited from the rest of the shell surface; the fasciole occupies nearly 2/3rds of the surface of each spire-whorl; sculpture consists of heavy, distant ribs and spirals; the ribs number about 6 on the last whorl; they are strong and knob-like on the lower half of each spire-whorl; the spiral sculpture consists of strong, raised primary cords on the lower half of each spire whorl or below the fasciole; the spirals overrun the top of the axial ribs; on the last whorl there are 6 or 7 threads on the middle and base with 12 or more on the anterior canal; secondaries and fine spiral threadlets occur in the wide interspaces between the primaries and over the fasciole; growth-lines closely crowded, with the anal sinus lying in the center of the sutural fasciole; anterior canal of moderate length, stout, straight.

Length 20mm.; diameter 6.5mm.; aperture 9mm.

Remarks.—This species seems correctly referred to *Crassispira* as that genus is commonly used at present. It resembles Dall's figure[26] of *Crassispira bacchia* of the recent Lower Californian fauna.

Locality and Geologic Occurrence.—Talara formation, Yasila.

Genus TURRICULA Schumacher

Subgenus PLEUROFUSIA Gregorio

Turricula (Pleurofusia) eolavinia, n. sp. Plate 3, figs. 2, 9, 10.

Shell small, moderately slender and coarsely sculptured; nuc-

[24]Dall 1908, Bull. Mus. Comp. Zool., vol. 43, no. 6, p. 264, also Dall 1919, Proc. U. S. Nat. Mus., vol. 56, p. 16, pl. 2, fig. 4.

[25]Woodring 1928, Constr. to the Geology and Paleontology of the West Indies, Carnegie Institution of Washington, No. 385, p. 151, pl. 4, fig. 12.

[26]Dall 1919, Proc. U. S. Nat. Mus., vol. 56, p. 25, pl. 6, fig. 1.

leus small pointed; post-nuclear whorls about 8 or 9 according to the size and maturity of the shell, sculptured with low ribs and coarse spirals; upper half of the spire-whorls deeply constricted to form the anal fasciole which is nearly smooth except for very fine, submicroscopic threadlets and usually a single, large spiral thread just below the suture; the longitudinal or axial sculpture is formed on the spire-whorls by 4 or 5, low ribs which occur only on the middle of the whorls and are lacking from the anal fasciole; on the last whorl they generally become irregular or subobsolete and do not extend far below the shoulder; the spiral sculpture is uniformily coarse and harsh; on the spire-whorls there are generally 4 threads between the anal fasciole and the lower suture, increasing to 15 or 16 on the body-whorl; they are spaced subregularly between much wider, band-like interspaces; on the center of the whorl, the interspaces have a central, larger secondary thread, or a variable number of much smaller tertiary threads; anterior canal long and very slender.

Length 29mm.; diameter 9.5mm.; aperture 13mm.

Remarks.—Along with several other groups which begin in the basal Talara beds, this species is the first of a phylogenetic series with representative species in the Oligocene, Miocene and recent faunas. In the Peruvian Oligocene, this group is represented by a new species, *Turricula piura.* The Miocene species include the *Turricula lavinoides* Olsson from Costa Rica, and *Turricula jacquensis* Sowerby from Santa Domingo. The recent species is *Turricula lavinia* Dall from the West Coast of Mexico.

Locality and Geologic Occurrence.—Talara formation, Yasila.

Genus FUSITURRICULA Woodring

Fusiturricula yasila, n. sp. Plate 3, fig. 3.

Shell small, slender, the spire somewhat longer than the aperture and anterior canal; whorls 8 or 9, the first 2 or 3 nuclear whorls appearing to be smooth while the others are sculptured with fairly large, distant ribs crossed by fine spiral threads; the ribs number 5 to each turn; they are nearly in line on adjacent whorls except on the spire where they may be irregularly spaced; on the last whorl, the ribs are quite heavy on the upper and middle portion of the whorl but lacking from the anterior canal; the sutural area is constricted and ornamented with a strong sutural cord; fine spiral threads overrun the whole surface of the shell, the summit of the ribs and their interspaces; anal sinus deep, lying in the sutural fasciole; anterior canal fusoid, long, slender and straight; pillar or columella straight.

Length 21mm. (imperf.); diameter 6.50mm.

Length 20.5mm.; diameter 7.50mm.

Remarks.—This is a *Fusus*-like species and small shells not showing the anal sinus might easily be mistaken for members of the *Fusidae.* The anterior canal is long, slender and nearly straight. Sculpture consists of heavy but not prominent, distant ribs which are lacking from the smoothish sutural fasciole and from the base of the last whorl.

Locality and Geologic Occurrence.—Talara formation, Yasila.

Genus GENOTIA, H. and A. Adams

Genotia peruviana, n. sp., Plate 4, figs. 1, 2.

Shell small to medium size, thin with strongly coronated whorls and high scalar spire; nucleus rather large of 3 convex turns, the first quite small, the other 2 large and nearly equal in size; post-nuclear whorls 3 or 4, strongly shouldered about the upper 1/3rd, this shoulder angle bearing a series of weak knobs or tubercles, sometimes without; above, the shoulder is flat, sloping or barely concave, while below the sides of the whorl is straight to the lower suture; sutures distinct bordered on the anterior side by a simple or beaded spiral; last whorl large, slowly contracting to the anterior tip; sculpture of moderately strong, regular spirals covering the whole shell but sometimes more crowded on the shoulder angle which also may have faint knobs or tubercles; posterior sinus wide, the center lying along the shoulder angle; inner lip crenulated.

Height 14.5mm.; diameter 6mm.; Yasila

18mm. (broken tip and canal, 3 whorls) diameter 9.5mm
22mm. (estimated length)

18mm. (4 whorls, broken tip and canal); diameter 8.5mm.
20mm. (estimated length)

Remarks.—This species although well represented in our collection by numerous specimens, is usually poorly preserved and it has been necessary to select for the Holotype, a small but nearly perfect specimen from Yasila. The protoconch as described above, is fairly large and composed of 3 or 4 convex, smooth whorls.

In the basal Talara beds, our largest specimen has a length of about 17mm. The Oligocene specimens are larger and heavier and represent shells which may have reached a length of 25mm. or more when perfect. These later shells do not differ in any important degree from the Eocene examples.

The genus *Genotia* has not been generally recognized in the American Tertiaries, but probably several species will be separated after a critical study of the described forms of *Turridae*. The *Conus pulcherrimus* Heilprin[27], as may be seen by the excellent figure of Aldrich[28] belongs to this genus. Fossil species of *Genotia* are well-known in the European and Indian Tertiaries and the living species *mitraeformis* Kiener is found along the west coast of Africa.

Genotia peruviana resembles Cossmann's[29] figure of *Clathurella Milleti* (Desm.), from the Miocene of Peluoa but the sinus is *Turris*-like or situated on the shoulder. They also resemble the *Genotia pulcherrima* Heilprin already referred to and *Genotia birmanica* Vredenburg[30] from the Miocene of India.

Genus SCOBINELLA Conrad

Subgenus MITRATOMA, n. subg.

Type. Scobinella (Mitratoma) bartschi, n. sp.

The following is a description of the subgenus *Mitratoma*.

Shell small or medium-sized, *Mitra*-like but with a shorter anterior canal and a deep sutural fasciole; nucleus unknown; spire about 1.5 times the length of the aperture; the anal fasciole is quite deep, bordered above by a strong, sutural cord and below by the angled shoulder of the whorl; sculpture is *Mitra*-like consisting principally of deep, spiral grooves forming broad, flat

[27]Heilprin, 1879. Proc. Acad. Nat. Sci. Phila., p. 213, pl. 13, fig. 8.
[28]Aldrich, 1897, Bulls. Amer. Pal., vol. 2, p. 173, pl. 5, fig. 7.
[29]Cossmann, 1896, Pal. comp., vol. 2, pl. 6, figs. 36, 37.
[30]Vredenburg, 1922, Records Geol. Sur. of India, vol. 53, p. 132, pl. 15, figs. 4, 5.

spiral bands; shoulder or anterior side of anal fasciole feebly ribbed or noded; anal sinus small, lying in the center of the sutural fasciole; columella straight provided with 4 *Scobinella* or *Mitra*-like, low folds; outer lip strongly lirated within.

Remarks.—*Mitratoma* is obviously related to *Scobinella* of Conrad but differs by its still more *Mitra*-like form and sculpture. In *Scobinella*, the whole surface including the fasciole is covered with close and beautifully beaded spiral cords. Both have the interior of the outer lip strongly lirated.

Scobinella (Mitratoma) bartshi, n. sp. Plate 4, figs. 6, 7, 8, 9.

Shell small or medium-size, Mitra-form, stout; nucleus small, pointed but not well-preserved on any of our specimens; post-nuclear whorls 7 or more, forming an evenly tapering spire about 1.5 times the length of the aperture; sutural fasciole pronounced deep and occupying slightly more than 1/3rd the width of the spire-whorls; it is bordered on the posterior side by a strong sutural cord and on the anterior side by a sharply angled shoulder; the spire-whorls have the shoulder sharply noded by strong, oblique riblets which usually fade out on the penultimate and last whorl; the more pronounced sculpture of the body-whorl is strong spiral bands, very wide in the middle and next to the shoulder, narrower and more cord-like on the anterior canal; anterior canal stout, short; columella straight with 3 or 4 *Scobinella*-like folds, stronger above; interior of outer lip strongly and closely lirated.

Height 16.25mm.; diameter 5.5mm.; aperture 7mm.

Remarks.—The appearance of this species is strongly *Mitra*-like and its pleurotomoid affinities would be doubted, were it not for its deep, pronounced sutural fasciole and small but typical anal sinus. The columella is provided with 3, 4 or more *Scobinella*-like folds which become lower and weaker towards the anterior side. It is quite common in the Lower Talara shales of Yasila.

Locality and Geologic Occurrence.—Talara formation, Yasila.

[31]Conrad 1848, Journ. Acad. Nat. Sci. Phila., ser. 2, vol. 1, p. 120.

Family CONIDAE Adams

Genus CONUS Linné

Conus chiraensis, n. sp. Plate 5, figs. 1, 2, 4, 10.

Shell small or medium-size; in porportions the height approximately twice the diameter; the spire is flat to slightly elevated or conic; shells with a flat spire, have a higher, projecting tip, formed of the nuclear and early post-nuclear whorls; in the higher spired forms, the outline of the spire is low, conic with a higher, projecting nuclear tip; sides of last whorl straight; shoulder of the body-whorl is sharply angled, below which the upper face of the whorl is usually feebly rounded or beveled; post-nuclear whorls about 8, with concave spire faces, lying between the high, ridge-like, peripheral edge of the whorl and the inner sutures; this concave zone sculptured with about 4 low, broad spirals and finer transverse (radial) lines; surface of the whorl below the shoulder is smooth, polished except for growth lines and feeble, irregular spirals on the anterior canal, the growth lines are straight below, curving above to the right and deeply retracted at the shoulder; anterior canal with 12 or more feeble, irregular spiral threads; aperture long, narrow.

Height	39mm. (broken);	diameter 31mm.
	45mm.;	28mm.
	32mm. (broken);	20mm.

Remarks.—The distinguishing characteristics of this Cone are the straight smooth sides, feebly sculptured with revolving spirals about the anterior canal; the spirally-sculptured spire whorls; and strongly retracted growth lines at the sharp shoulder angle. The flat spired shells illustrated by figure 2 is selected as the typical form. This is the dominant form in the older beds first appearing in the basal Talara of Yasila and Cunas de Jaquey near Paita. The higher spired form illustrated by figure 1 is the common Oligocene variety, but all gradations occur between it and the flat-spired form.

This species resembles the *Conus planiceps* Heilprin from the Tampa Silex beds of Florida as figured by Dall[32] and the two species have probably a common ancestor. The *Conus sauridens* Conrad from the Jackson Eocene and *C. alveatus* Conrad from Vicksburg belong to the same group, but both species have the spire-whorls more concave.

Locality and Geologic Occurrence.—Talara formation, Yasila and Jaquey de Cunas. Saman formation, Lagunitas, Casa Saman. Chira formation, near Casa Saman, Quercotilla. Mancora formation, Que. Charanal.

Conus peruvianus, n. sp. Plate 5, figs. 13, 14, 15.

Shell small with moderately high spire, straight sides and generally noded shoulder angle; whorls 8 or more, forming a moderately high, conic spire whose height is approximately ¼th the full length; sutures close, distinct, situated slightly below the edge of the spire-whorls; the upper surface of the spire-whorls is flat to slightly concave, sculptured simply by the strongly curved growth-lines; the shoulder of the last whorl is strongly angled smooth or noded; the spire-whorls are coarsely noded, just above the lower suture, there being on an average about 16 nodes to a volution of a later turn; upper 2/3rds of the surface of last whorl smooth, with 8 or 9 wide spiral bands on the anterior canal.

Height 21mm.; diameter 9.5mm.; aperture 15mm.

Remarks.—The noding of the shoulder angle is a variable feature some shells remaining coarsely noded throughout life while in others the shoulder angle becomes sharp and smooth on the later turns. There are several small, noded Cones which distantly resemble *peruvianus, Conus remondi* Gabb from the Tejon Eocene of California, according to Stewart's[33] figure is a smaller species with more numerous (22) shoulder nodes. *Conus parvus* Lea from the Claiborne sands differs in having the upper surface of the spire-whorls finely spirally sculptured. In the Parisian Eocene, *peruvianus* finds its closest parallel with *Conus parisiensis* Desh.

Locality and Geologic Occurrence.—Talara formation, Yasila.

Superfamily RACHIGLOSSA

Family OLIVIDAE d'Orbigny

Genus OLIVA Martyn

Subgenus OLIVA, s. s.

Oliva misti, n. sp., Plate 6, figs. 2, 6, 8, 11, 12.

Shell small, stout; nucleus pointed; subsequent whorls 5 or 6,

[32]Dall, 1915, Bull. 90, U. S. Nat. Museum, p. 37, pl. 61, figs. 1, 2.
[33]Stewart 1926, Proc. Acad. Nat. Sci. Phila., vol. 78, p. 414, pl. 29, fig. 15.

forming a medium-height, pointed conic spire; sutures grooved or channelled; last whorl large about 5/6th the full length of the shell, medium convex, its greatest inflation opposite the posterior end of the aperture; aperture linear, widest below but not emarginate; columella straight, flat, covered by a callused band merging above with the parietal callus and extending to the posterior end of the aperture; this band of callus is finely lirated nearly its full length (except for a short distance at its posterior end); the anterior end of the callus band is somewhat wider and heavier, and bearing a very weak, internal fold separated by a groove from the lirations above; this fold is but little stronger than the columellar lirations; the anterior external side of callus band is separated from the body-whorl by a deep groove so that its edges appear shelf-like or ribbed; outer lip thin, straight.

Length 18mm.; diameter 7.5mm.; aperture 11mm.
Length 17.5mm.; diameter 7.25mm.; aperture 10.25mm.
Length 17.25mm.; diameted 6.50mm.; aperture 10.50mm.

Remarks.—This species is represented by a large number of specimens from Yasila. Because of its small size and relatively long, sharp spire, it would at first be classed as an *Olivella.* The inner lip and columellar side are straight and finely transversely lirate throughout most of its length as in the true Olivas. The anterior part of the columellar callus is somewhat wider, encircling the tip of the base on the anterior side of the siphonal fasciole. The most anterior plait may continue across this band as a very faint, external fold.

The genus *Oliva,* although so abundant in the later Tertiary and recent faunas, has not heretofore been recorded from rocks older than the Miocene. This species although small, seems to be quite typical except that the anterior lirations are not quite so strong as in most Olivas.

Locality and Geologic Occurrence.—Talara formation, Yasila, Talara shales of Caleto Sal.

Genus ANCILLA Lamarck

Subgenus ANCILLARINA Bellardi

Ancilla (Ancillarina) pananga, n. sp. Plate 6, fig. 9, 10.

Shell small or medium size, cylindrical with a spire of moderate length; aperture about ¾ths the length of the whole shell; whorls about 4, those of the spire nearly straight or slightly convex in profile; sutures distinct but usually with a thin wash of callus on the anterior side but spreading across the suture between the last and penultimate whorls; body-whorl large, cylindrical, widest about the middle; aperture long, gradually narrowing above, wider below and obliquely truncate; surface smoothish but under a lens showing fine spiral striations; columellar area mostly concealed with the anterior portion bearing 2 or 3, oblique plaits.

Height 21mm.; greater diameter 7mm.

Remarks.—This species is related to the common *A. canalifera* Lamarck of the Parisian Eocene. In the French species, the spire is generally scalar with shouldered whorls formed by the upper edge of the wider, thicker callus band. The spire and penultimate whorls are longer in the Peruvian shell and hence the aperture is shorter and less effuse.

Cossmann[34] placed *A. canalifera* in the subgenus *Tortoliva* of Conrad[35] with *Ancillarina* Bellardi[36] as synonym. Conrad's[37] figure of *O. texana,* the type of *Tortoliva* is very poor and depicts a small, broken and probably immature shell. It appears probable that *texana* is nothing more than a young, worn shell of the common *A. staminea* which would make *Tortoliva* a strict synonym of Conrad's earlier *Olivula.* Tryon[38] placed *Tortoliva* as a synonym of *Agaronia* Gray. Professor Harris tells me that the type of *texana* which should be in the Academies collection at Philadelphia is apparently lost or misplaced. Since so much uncertainty exists regarding the status of *Tortoliva* it seems wisest to use Bellardi's subgenus *Ancillarina* the type of which is *A. suturalis* Bon., a Lower and Middle Miocene species of France and the Italian Piedmonte. Five European species are listed by Cossmann from the Eocene, Oligocene and Miocene terranes.

Locality and Geologic Occurrence.—Talara formation, Yasila. Salinas near Negritos.

[34]Cossmann 1899, Essais de Pal. comp., vol. 3, p. 67.
[35]Conrad 1865, Amer. Journ. Conch., vol. 1, p. 22.
[36]Bellardi 1882, Memoria delle Scienze di Torino, vol. 34, p. 419, 433.
[37]Conrad, 1865, idem, p. 143.
[38]Tryon, 1883, Manual of Conch., vol. 5, p. 60.

Genus OLIVANCILLARIA d'Orbigny

Subgenus AGARONIA Gray

Olivancillaria (Agaronia) inca, n. sp. Plate 6, fig. 5.

Shell of medium size, solid; spire elevated, pointed, the penultimate and spire-whorls together about ¼th the length of the shell; sutures slightly grooved; body-whorl narrow elliptical, its greatest convexity just above the middle; aperture elongate, pointed at the posterior end, broader anteriorly, subemarginate and obliquely truncate; columella straight with a thin, parietal callus above passing into a heavier callus and on the anterior half with 5 or 6, strongly oblique plaits.

Length 25mm.;diameter 10mm.; aperture 17mm.

Length 30mm.; diameter 13mm.; aperture 19mm.

Remarks.—The *O. peruviana* Woods from the Lagunitas sandstones I have not seen. It differs according to Woods figure by its smaller size, broader more stubby spire and by its wider shell. *O. saxosa* Olsson is a much larger, more slender shell with deeply grooved sutures.

Locality and Geologic Occurrence.—Talara formation, Lomitos conglomerate near Negritos, Yasila. Saman formation, Casa Saman.

Family MITRIDAE

Genus MITRA Martyn

Subgenus TIARA Swainson

Mitra (Tiara) yasila, n. sp. Plate 10, figs. 1, 2.

Shell small to medium size with spire and anterior canal of nearly equal length; whorls 8 or more, with straight or slightly convex profile; body-whorl fairly large and forming about 2/3rds of the whole shell; sculpture of low, slightly elevated spiral cords or ribbons, separated by deep, irregular grooves; on the spire whorls there are usually 4 or 5 spiral cords increasing to 22 or more on the last whorl and anterior canal; aperture subelliptical; anterior canal slightly twisted or curved; columella provided with 3 folds of which the upper 2 are much larger than the lower.

Length 25mm.; diameter 8.25mm.; aperture 13mm.

Length 19mm.; diameter 6.75mm.; aperture 11.5mm.

Length 37mm. (imperf.).

Remarks.—In form and sculpture, this species resembles the *Mitra Almagrensis* var. *coralliophilla* Olsson of the Costa Rican Miocene. The Peruvian species is larger with the spire and anterior canal of more nearly equal length.

Locality and Geologic Occurrence.—Talara formation, Yasila.

Family VOLUTIDAE Gray

Genus VOLUTA Linné

Voluta paytanica, n. sp. Plate 6, figs. 1, 4.

Shell of medium size, solid, pyriform; spire rather low, elevated with the penultimate and last whorl strongly shouldered; nucleus as in *Voluta musica* is bulbous and fairly large, composed of 4 convex, smooth whorls; post-nuclear whorls 2 or more, rapidly increasing in size and becoming strongly shouldered about the upper third; this shoulder is armed with stout, pointed or spine-like ribs which number 9 or 10 on the last turn; the ribs extend but a short distance anteriorly across the face of the whorl and barely discernible from the shoulder across to the upper suture; spaces between the ribs are much wider; in addition the shoulder or sutural area is marked with numerous deep or radial cuts or grooves with narrow ridges between; there are generally 3 such ridges to each major rib and to each interspace; the secondary ridges end at the point of the ribs but extend a short distance below the ribs on the adjoining interspaces; general texture of shell is heavy, porcelaneous; aperture and columellar area unknown.

Height 31mm.; greater diameter 21mm.; aperture 20mm.

Remarks.—The only specimen of this species is a fragmentary shell from which the last whorl has been broken away for nearly a half turn. This condition is indicated by a heavy callus deposit of the inner lip which effectually conceals most of the surface sculpture. The anterior canal is rather short and encircled near the base by 3 ribs, the central one being narrow and keel-like. The nucleus or protoconch is well preserved. It is large, bulbous, composed of 4, smooth convex whorls. It agrees closely with Dall's[39] figure of the nucleus of *Voluta musica.*

[39]Dall 1890, Trans, Wagner Free Institute, vol. 3, pt. 1, p. 77, pl. 6, fig. 8.

Until more perfect specimens are available, showing the features of the columellar region, this species is tentatively referred to the genus *Voluta*.

Locality and Geologic Occurrence.—Talara formation, Yasila.

Genus PLEJONA Bolton

Subgenus VOLUTOCORBIS Dall

Plejona (Volutocorbis) sula, n. sp. Plate 11, figs. 6, 13.

Shell small, subfusiform or biconic with the spire and anterior canal of about equal length; whorls 5 or more (nucleus destroyed on our specimens); spire of moderate length, pointed, with the spire-whorls slightly convex between distinct and slightly channelled sutures; body-whorl moderately inflated, widest about the upper one-third and sub-elliptical in general profile; sculpture subreticulate but with the spiral cords predominating over the axial ribs; on the spire-whorls there are 13 or 14 narrow ribs; on the penultimate whorls they are crossed by 4 strong, equal spiral cords and 2 smaller ones in the lower suture; on the last whorl of the type specimen, the axial ribs become larger and more irregular; on still larger specimens, the ribs may become obsolete and disappear; the spiral cords increase to 20 on the last whorl; aperture subelliptical with a thickened outer lip crenulated a short distance back from the edge by 12 or 13, narrow denticles or liræ; columella or pillar somewhat excavated in the middle and bearing 3, oblique, revolving plaits; siphonal sinus or canal shallow.

Length 16mm.; diameter 8.5mm.; aperture 11mm.; (Holotype)
23.5mm.
29mm. (2 whorls); 15mm.

Remarks.—Most of our specimens are broken or crushed and it has been necessary to select a small example as the holotype having a length of about 16mm., but the average size of the species seems to be between 22 to 24mm. There are also 2 large, immature specimens which may belong to a related species. Their sculpture is less harsh, ribs obsolete and the spiral cords are more irregular in strength. *V. sula* resembles *V. limopsis* Conrad[40] of the Midway Eocene and type of Dall's subgenus *Volutocorbis*

[40]Harris, 1896, Bulls, Amer. Pal., col. 1, p. 198, pl. 8, fig. 3.

but has a higher and more pointed spire, coarser and less tubercular sculpture. A striking feature of the species, is the thickened, crenulated outer lip.

Locality and Geologic Occurrence.—Talara formation, Yasila.

Genus LYRIA Gray

Lyria busera, n. sp. Plate 8, figs. 3, 5.

Shell of medium size, solid with coronated or shouldered whorls; whorls 4 or more (the tip of the spire with the protoconch missing), solid, coronated with 8 or 9, fairly strong ribs or knobs; these ribs are strong and persistant on the spire whorls and cross from suture to suture; they become irregular and obsolete on the lower half of the body whorl and on large shells the lower part of this whorl may be smooth; the surface is smooth, porcelaneous and aside from the ribs, sculptured simply with crowded growth lines; anterior canal slightly twisted with a deep, siphonal sinus at its tip; aperture destroyed in our specimens; columella straight with 5 plaits or liræ.

Length 33mm.; diameter 19mm.; (4 whorls)
35mm.; 23mm.

Remarks.—The type specimens of this species come from the Restin shales north of Negritos. We have also a single crushed shell from the lower Talara shales of Yasila. The species resembles *Lyria turgidula* Deshayes of the Parisien Eocene but has less numerous and less persistant ribs. It also resembles the *Voluta quinqueplicata* Bayan of the Lutetien of Beynes.

In typical *Lyria* as exemplified by its genotype *Lyria nucleus* Lamarck there are but 3 plicæ situated on the columella of the very short anterior canal. The parietal callus is thin or lacking and the outer lip is not greatly thickened. Most of the fossil species credited to *Lyria* differ by having a greater number of plaits which continue upward across the heavier parietal callus. *Lyria lyriformis* Broderip recent of Australia agrees in these characters best with the fossil forms. The parietal callus is heavy and besides the 2 strong folds on the columella there are 12 or more, smaller, regular plaits along the parietal wall. The outer lip is thickened or rib-like. The protoconch of *lyriformis* is large while it is very small in *nucleus.*

Locality and Geologic Occurrence.—Restin formation, north of Negritos; Talara formation, Salina near Negritos, Yaslia.

Family XANCIDAE

Genus XANCUS ("Bolten") Roeding

Subgenus EOXANCUS, n. subg.

The following is a description of the Subgenus *Eoxancus.*

Type **Xancus (Eoxancus) talarensis**, n. sp.

Shell of medium size, subfusiform, solid; spire high of moderate taper, equalled or slightly exceeded by the anterior canal; nucleus unknown; early post-nuclear whorls strongly sculptured with ribs and spirals, this sculpture becoming obsolete leaving the last 3 turns smooth; sutures canaliculate or channeled; last whorl not contracted about the base; anterior canal, long, with an even taper, pointed at its tip and with a slight fold or bulge about the middle; columella with 2 sharp, keel-like folds.

Remarks.—This group is evidently related to *Xancus* but with sufficient differences that subgeneric separation is desirable. In form, the shell is slender, *Aurinia* or *Scaphella*-like, the sutures are deeply channelled with the superior edge of the whorl not truly shouldered and more ofter rounded or beveled. The columella has only 2 instead of 3 or 4 plications.

The genus *Xancus* is represented in the Peruvian Eocene by a typical species (*X. peruvianus* Olsson[41]) related to *X. wilsoni* Conrad[42] of the Vicksburg Oligocene of Mississippi. Its stratigraphic range begins in the Restin sandstones of Cabo Blanco and continues through the Saman, Chira and Mancora formations. It would appear that *Xancus* although apparently not represented in the recent and later Tertiary faunas of the West Coast, probably arose through a *Clavilithes* ancestry in the Eastern Pacific during the Middle Eocene. From this center, it spread during Oligocene and Miocene times through the Caribbean region, to Europe and as far east as India and Java. Recent species are found in the Caribbean region, along the coast of Brazil and in the Indian Ocean.

Xancus (Eoxancus) talarensis, n. sp. Plate 7, figs. 2, 3, 5.

Shell of medium size, slender with the spire and anterior canal

[41]Olsson, A. A., 1928, Bulls. Amer. Pal., vol. 14, p. 89, pl. 21, fig. 5.
[42]Conrad, T., 1848, Journ. Acad. Nat. Sci. Phila., 2nd series, vol. 1, p. 120, pl. 12, fig. 12.

of nearly equal length and size; protoconch missing; the first 3 turns preserved on our specimens are strongly sculptured with ribs and spirals; this sculpture soon becomes obsolete leaving the 3 last turns practically smooth; on the early spire-whorls, the ribs generally number about 6 to each turn; they are crossed by 6, elevated spiral threads, the lower being more widely spaced; sutures canaliculate or deeply channelled; profile of spire-whorls straight below, rounded or bevelled next to the channelled sutures; last whorl quite large but not inflated, and about three-fourths the length of the whole shell; aperture narrowly subelliptical, more narrowed and pointed at the anterior end; anterior canal long, straight with a slight but noticeable bulge in the middle; columella with 2 sharp, keel-like folds.

Height 65mm.; diameter 26.5mm.; aperture 37mm.

Remarks.—This species is represented by 4 specimens, 3 from Yasila and 1 from Talara. Although closely related to the next species, *paytensis,* it is clearly distinct, differing by its more slender form, more rounded and less shouldered whorls and narrower, less canaliculated sutures.

Locality and Geologic Occurrence—Talara formation, Talara, Yasila.

Xancus (Eoxancus) paytensis, n. sp. Plate 7, figs. 1, 4, 6.

Shell of medium size, solid; spire and aperture of about equal length; nucleus unknown; post-nuclear whorls probably 8 or 9 in perfect specimens, with straight or weakly convex sides and separated by wide, deep, excavated sutures so that the whorls appear to be narrowly shouldered; the earlier whorls are strongly sculptured with ribs and spiral threads; there are usually 6 ribs to each turn, more or less in line across the sutures; the ribs and their interspaces are crossed by 5 spiral threads, the upper one bordering the excavated suture being largest; on the 5th or 6th whorl, the sculpture begins to fade out and on the later turns, the surface is nearly smooth; anterior canal of moderate length, straight, stout; aperture narrow, the outer lip strongly thickened at its junction with the body-whorl; columella with 2 strong plications.

Height 80mm.; diameter 38mm.; aperture 41mm.

Remarks.—In our collection, this species is represented by 6 specimens, all from the basal Talara beds of Yasila. Four of the specimens are young shells with strongly sculptured spire-whorls while the other two specimens represent the full-grown and mature form. The sutures lie in a deep, wide channel as in *Busycon canaliculatum* Linné of the recent East American fauna In this species as in *talarensis,* the columella has only two folds, instead of three or four as in typical *Xancus.*

Locality and Geologic Occurrence.—Talara formation, Yasila.

Genus EOVASUM Douville

Eovasum douvillei, n. sp. Plate 8, figs. 4, 6.

Shell moderately large, solid volutiform; nucleus not preserved; subsequent whorls 4½ or more, forming a medium height, conic spire; last whorl rather large, shouldered, the shoulder angle armed with strong, spine-like ribs; on the last turn, there are 8 primary ribs with 3 smaller ones of erratic occurrences in certain interspaces; on the penultimate whorl, the spiny ribs are partly concealed by the close, overlapping sutures and lacking entirely from the earliest spire-whorls, but which are closely ribbed from suture to suture; on the body-whorl, there is a medial line of small, knob-like ribs emerging at the upper junction of the aperture and corresponding in their axial position to the stronger ribs above; the siphonal sinus is apparently quite deep and wide, giving rise to an encircling band about the anterior canal and bordered on the posterior side by a low rib or keel; columella straight with 4 folds, the upper 2 much the strongest; outer lip broken.

Height 58mm.; diameter 39mm.; aperture 38mm.

Remarks.—This species based on a single imperfect specimen lacking a part of the outer lip, was collected from the basal Restin shales in the vicinity of the Great Fault north of Negritos The shoulder of the last whorl is sharp and armed with a row of stout, spine-like ribs which lie partly submerged and covered by the earlier sutures. Midway between the shoulder and the siphonal fasciole is a row of much smaller node-like ribs. There are 4 strong, columella plications.

The genus *Eovasum* Douville[43] is based on *Turbinella frequens* Mayer-Eymar of the Egyptian Eocene. The shell is short, stout

[43]Douville, 1921, Journ. de Conchyliologie, vol. 66, pp. 1-4, pl. 1, figs. 1a, 1b, 2.

and strongly shouldered. The spire is low and flat. A strong melongenoid cord encircles the base and the columella is provided with 4 strong folds. The Peruvian fossil differs by its higher spire and the basal cord is less melongenoid and situated more posteriorly and more than half way between the tip of the canal and the shoulder.

Trechmann[44] has recorded *Turbinella* (*Eovasum*) sp. from the Yellow limestones of Jamaica but his specimens are casts and do not show the columella folds and the melongenoid basal cord. *E. indicum* Douville[45] occurs in the *Cardita beaumonti* beds of India. It has a higher spire than *frequens* but lower than that of the Peruvian species.

Locality and Geologic Occurrence.—Restin formation, just north of Negritos.

Family FASCIOLARIIDAE

Genus CLAVILITHES Swainson

Subgenus CHIRALITHES, n. subg.

Type **Clavilithes cynosuris**, n. sp.

The following is a description of the subgeuns *Chiralithes.*

Shell elongate-fusoid, massive, the spire about half the total length; whorls convex, the earlier ones with *Fusus*-like ribs and spirals, the later turns (generally the last 3 whorls) smooth; the sutures are distinct, linear and bordered by an apressed band; anterior canal stout, moderately long, slightly twisted or curved backwards and moderately thickened about the middle; aperture subcircular to subelliptical above, produced and narrowed below into the long, narrow anterior canal; outer lip often thickened in gerontic individuals; inner lip callused, the inner edge of the callus free; growth lines sinuated, forming a broad, concave curve across the upper face of the whorl and between the sutures.

Remarks—*Chiralithes* should probably be considered as a subgenus distinct from *Perulithes* except that *C. pozoensis* Olsson of the basal Talara seems to be a possible transitional form between the two groups. The shell is elongate-fusoid in form,

[44]Trechmann, 1923, The Geol, Mag., vol. 60, p. 355, pl. 17, fig. 7.
[45]Douville, 1929, Pal. Indica n. ser., vol. 10, Mem. No. 3, p. 39, pl. 7, figs. 12, 13, 14, and 15.

massive, the early whorls sculptured after the fashion of *Fusus* with ribs and spirals. The last 3 turns are generally smooth except for growth lines. The whorls are strongly convex, with an appressed sutural band. The anterior canal is moderately long, stout, thickened about the middle but without the ribs or cord of *Streptochetus*. The growth lines are sinuous, with a wide sinal curve across the main face of the whorl. In mature specimens, the inner and outer lip are thickened.

Clavilithes (Chiralithes) cynosuris, n. sp. Plate 9, figs. 2, 3, 4, 5.

Shell of medium size, solid, fusoid with a long, heavy anterior canal; whorls numerous, slightly convex at first sculptured with about 8 strong longitudinal ribs crossed by regular spiral cords; on the later whorls, the ribs and spirals become obsolete with the shell becoming smooth; protoconch and early nepionic whorls not known; the sculptured whorls are at first evenly convex but soon develop a contracted band or zone just below the upper suture; this sutural band becomes more pronounced on the last whorls where it is quite deep and narrow; body-whorl and the 2 or 3 preceding turns are smooth except for faint spirals, these spirals persisting longest on the sutural zone; anterior canal moderately long, solid and twisted just below the middle and slightly recurved or bent to the right at its tip; aperture obovate to subelliptical above but narrowed and canal-like anteriorly; outer lip simple, thickening in gerontic specimens; inner lip callused, the outer edge free or shelf-like.

Length	58mm.;	diameter 27mm.;	(2¼ whorls)
	55mm.;	19.5mm.;	(5 whorls)
	59mm.;	21mm.;	(4 whorls)
	40mm.;	16.5mm.;	(4 whorls)
	40mm.;	17mm.;	(5 whorls)

Remarks.—The Chira shales specimens of this species are accepted as the typical form. When perfect, the shell probably reached a length of 80 to 90 mm.; and when mature had a strongly thickened inner and outer lip. Shells from the lower Talara are consistently smaller and the largest specimen in our collection does not exceed 45mm. The spire whorls for 5 or 6 turns are strongly sculptured with ribs and spirals but shortly afterwards become smooth except for faint spirals persisting on the anterior canal.

Subgenus PERULITHES, n. subg.

Type **Clavilithes peruvianus** Woods — Plate 9, fig. 6.

The following is a description of the Subgenus *Perulithes*.

Shell fusiform, with the spire equal to or much longer than the anterior canal; protoconch unknown; spire whorls rounded or convex, in some species with a shallow sutural zone about the upper edge of the whorl; last whorl convex, rounding into the base; sculpture of ribs and spirals on the early post-nuclear whorls, becoming smooth on the later turns or simply sculptured with spiral threads; anterior canal fusoid, straight to slightly twisted; outer lip thin, probably with a shallow sinal inflexion near the middle; growth lines sinuated with a broad, shallow sinus opposite the middle of the aperture; columella smooth.

Remarks.—In form and sculpture, this group seems intermediate between *Streptochetus* and the true *Clavilithes*. The shell is typical fusoid with a long, often very slender spire and anterior canal. There is a strong sculpture of ribs and spirals on the early post-nuclear whorls, the later turns however become smooth or simply marked with fine spirals. The growth lines show a shallow sinal inflexion opposite the middle of the aperture. From true *Clavilithes* it differs by its rounded not contracted or angulated body whorl so that the shape of the shell is more typically *Fusus*-like.

Perulithes is a very characteristic group of the Peruvian Eocene and besides the typical species *peruvianus* Woods from the basal *Clavilithes* series the following species may be referred to it, *C. Harrisi* Woods (*Clavilithes* series), *C. pozoensis* Olsson and *C. yasilus*, n. sp. from the basal Talara.

Clavilithes (Perulithes) yasilus, n. sp. — Plate 9, figs. 1, 7.

Shell subfusiform, the spire of about equal length to the aperture and anterior canal; whorls 7 or more, those of the spire slightly convex on the lower half, slightly concave or depressed on the upper half, thus forming a shallow sutural band; suture grooved; the earlier spire-whorls are sculptured with about 7 wave-like ribs which soon become obsolete and are lacking from the last 3 or 4 turns; the last turns when well-preserved have a fine sculpture of revolving, scabrous threads, strongest on the sutural zone and anterior canal, usually lacking on the middle of the last whorl; growth lines somewhat sinuous, with a shallow, sinus-like inflection on the shoulder or middle of the last whorl; anterior canal straight with a narrow aperture; columella straight, smooth.

Length 45mm.; diameter 17mm.; aperture 21mm.; (broken)

Remarks.—From *C. pozoensis* Olsson which this species resembles, it will be distinguished by its more robust form, less slender spire and shallow sutural zone. It also resembles *C. kennedyanus* Harris[46] but that species has the angulated body whorl of true *Clavilithes.*

Locality and Geologic Occurrence.—Talara formation, Yasila.

Family BUCCINIDAE Troschel

Genus POLLIA Sowerby

Pollia sillapaytensis, n. sp. Plate 11, figs. 7, 8, 12.

Shell small, moderately slender, recalling a small *Phos* in general form and sculpture; spire rather long, slender nearly 2/3rds the length of the shell; nucleus small, pointed, of about 3 whorls but other characters unknown; post-nuclear whorls about 6; last whorl somewhat convex about the upper one-half, contracted about the base and produced to form a narrow, twisted canal; aperture rather wide, subovate but contracted or emarginate into the twisted, recurved siphonal canal; outer lip slightly thickened and bearing on the columella 4, curving lirae; sculpture consists of *Phos*-like ribs and spirals; on the last whorl there are 7 ribs or axial undulations, strong and heavy on the middle of the whorl but fade out on the base; on the spire-whorls they pass from suture to suture; spiral sculpture consists of fairly coarse primary cords separated by wider interspaces; there are generally 4 primary cords on the spire-whorls and 13 or 14 on the last whorl; one or more finer secondaries are usually present in the spiral

[46]Harris 1895, Proc. Acad. Nat. Sci. Phila., p. 53, pl. 7, fig. 8. Grabau 1904, Smith. Misc. Coll., p. 131, fig. 17.

bands between the primaries.

Length 12.75mm.; diameter 8mm.; aperture 8.5mm.

Length 18.25mm.; diameter 8mm.

Remarks.—This is a small *Phos*-like species sculptured with strong ribs and spiral cords. It recalls the *Tritonidea neglecta* Deshayes of the Parisian Eocene (Cossmann and Pissarro, Iconagraphie, pl. 37, figs. 179-7) but is larger and has a more slender and pointed spire.

Locality and Geologic Occurrence.—Talara formation, Yasila.

Subgenus ENDOPACHYCHILUS Cossmann

Pollia (Endopachychilus) purpuroides, n. sp. Plate 11, figs. 1, 2, 9.

Shell small, stout, biconic with a pointed spire about half the length of the whorl shell; spire whorls 5+, with straight or slightly concave sides between close, appressed sutures; nuclear whorls unknown; the last whorl is moderately shouldered or angled, above which the surface of the whorl is noticeably depressed or concave; sculpture consists of 9 to 11, low ribs on the shoulder of the last whorl but lacking from the rest of the shell and a spiral sculpture of irregular incised lines forming spiral bands or ribbons of variable width; these bands are quite wide on the anterior half of the shell, close and finer on the sutural area above the shoulder of the last whorl; aperture subelliptical, more or less pointed at the anterior and posterior ends; outer lip thickened, with 4 or 5, heavy denticles; inner lip thickened and bearing 6 or 7, elongated, low denticles; siphonal fasciole narrow, slightly recurved; anal fasciole present at the posterior end of the aperture.

Length 18mm.; diameter 11mm.; aperture 11.5mm.

Remarks.—Associated with this species at Yasila, is a larger form which probably belongs to a different species, but our specimens are so badly weathered or crushed that they are not suitable for the erection of another new species. They differ by their larger size, more *Thais*-like in form, wider subovate aperture, finer spiral sculpturing and entire lack of axial ribs.

Locality and Geologic Occurrence.—Talara formation, Yasila.

Genus TEREBRIFUSUS Conrad

Terebrifusus ? placitus, n. sp. Plate 4, figs. 17, 18.

Shell small, subulate, with a long spire and shorter aperture; protoconch unknown; post-nuclear whorls 4 or more, straight or slightly convex with the sutures close and indistinct; sculpture is rough and coarse with about 6, distant, low ribs and quite coarse, distant, primary spiral cords; the ribs are nearly in line across the spire-whorls; the spiral sculpture is coarse, *Mitra*-like; on the spire-whorls there are 5 primary cords between wide interspaces; on the last whorl the spirals increase to 10 or more, being closely spaced on the base and anterior canal; there is a single central secondary which is bordered on each side by a finer tertiary thread in each spiral interspace; the surface is covered with close growth-lines so that the resulting sculpture is scabrous; aperture subelliptical; columella and anterior canal short, encircled by a constricted zone and bordered below by a broad, but not too prominent fold arising through the close crowding of the curved growth-lines; columella armed with 5 or more, weak, revolving plaits which are continued as spiral threads around the anterior canal; a moderately deep, siphonal canal.

Length 13mm.; (tip imperfect) diameter 4.25mm.

Length 12mm.; diameter 3.5mm.

Length 11mm.; diameter 3.5mm.

Remarks.—This species is referred with much doubt to Conrad's genus *Terebrifusus* of the Gulf Coast Eocene. In *Buccimitra amoena* Conrad (as *Terebra gracilis* Lea and *multiplicata* H. C. Lea), the type of *Terebrifusus,* the shell is small, *Phos*-like with numerous, small and regular columellar plaits. *F? placitus* from Peru resembles *amoena* in general characters but is more *Mitra*-like and the suture is bordered by a strong, spiral cord.

Locality and Geologic Occurrence.—Talara formation, Yasila.

Terebrifusus ? lepus, n. sp. Plate 11, figs. 14, 15.

Shell small, *Phos*-like in form and sculpture; protoconch unknown, post-nuclear whorls 4 or more, convex in profile between close, indistinct sutures; whorls sculptured with strong, acute, distant ribs crossed by fine spiral threads; the ribs number about 6, are strong, narrow and separated by much wider interspaces;

the ribs are continuous and in line across the sutures, very slightly oblique to the axis of the shell; on the last whorl they pass across the face of the whorl to the contracted zone or sulcus encircling the beak; the spiral sculpture is formed of fairly regular, distant threads; there are 6 spirals on the whorls of the spire, the uppermost 2 being much smaller and closer together; on the last whorl there are 12 or more spirals; the spiral interspaces are wider than the spiral threads and carrying 2, 3 or more fine secondaries; anterior canal of medium length, twisted with the columella armed with 5 plaits of which the upper ones are much stronger.

Length 12.5mm.; diameter 4.5mm.

Length 10mm. (imperf.); diameter 5mm.

Locality and Geologic Occurrence.—Talara formation, Yasila.

Genus SIPHONALIA A, Adams

Subgenus PSEUDONEPTUNEA Kobelt

Siphonalia (Pseudoneptunea) nuntia, n. sp. Plate 10, figs. 14, 15.

Shell small, broad with a high, acute spire; protoconch bulimoid, composed of 3 high, convex, smooth whorls; subsequent whorls 5 in number are strongly convex becoming shouldered on the penultimate and last whorl; sutures close, waved by the ends of the axial ribs; sculpture consists of low, curved, narrow ribs separated by much wider interspaces; these ribs number 9 to 11 on the last turn, are sinuous or convex backwards opposite the middle of the aperture; the ribs begin at the upper suture and extend to the base of the last whorl but not along the anterior canal; the ribs and their interspaces are further sculptured with raised, subregular spiral threads between wider interspaces; there are about 8 threads on the spire-whorls, 13 on the main part of the body whorl with smaller ones on the anterior canal; anterior canal moderately long, curved and twisted; aperture semi-circular, extended forward into the anterior canal.

Height 12.5mm.; diameter 7.5mm.

Height 13mm.; diameter 8.25mm.

Height 15mm.; diameter 7.5mm.; aperaure 8.25mm.

Remarks.—Compared with the Siphonalias figured by Cossmann and Pissarro from the Parisian Eocene, this species is nearest *S*. (*Pseudoneptunea*) *angusticostata* Mellw from the

Cuisien.

Locality and Geologic Occurrence.—Talara formation, Yasila.

Genus PSEUDOLIVA Swainson

Pseudoliva coronaria, n. sp. Plate 6, figs. 3, 7.

Shell medium-sized to large, solid; whorls about 5, forming a moderately elevated, globose spire; spire at tip, elevated, pointed; last whorl is sharply shouldered but not ribbed and bordered immediately above by a deep, channelled or grooved suture; the penultimate and spire whorls are strongly convex, callused, turbaned-shaped, between the deep, grooved sutures; surface of body-whorl smooth or marked simply by the longitudinal growth-lines; the *Pseudoliva* groove about the base deep and situated near the anterior one-third; siphonal fasciolar band prominent, narrow and bordered on the posterior side by a keel-like ridge; aperture subovate, outer lip unknown; inner lip with a moderately heavy, parietal callus at its posterior end.

Height 56mm.; diameter 28mm.; aperture 30mm. (Yaslia).

Remarks.—The material representing this species, consists of the Holotype from the basal Talara beds of Yasila and three large specimens thickly encrusted with rock matrix from the Saman sandstones of Casa Saman.

In its channelled sutures and callused, turbaned whorls, this shell resembles the members of the *mutabilis* group of the older Peruvian Eocene. It differs constantly by its more elevated spire, absence of ribs on its earlier spire-whorls, narrower body-whorl and shorter aperture. The general effect produced, is that of a more slender shell with the aperture about one-half the total length. *P. mutabilis* var. *douvillei* of the Restin and Parinas, the end member of the *mutabilis* group is a strongly senile or gerontic form developing a very heavy shell and a thick, irregular callus growth over its penultimate and spire whorls.

The Saman specimens are much larger than the measurements given above for the Holotype from Yasila. They are unfortunately thickly encrusted with matrix which forbids their being figured. The two specimens measure as follows:

Height 65mm.; diameter 53mm.; aperture 40mm. (approx.)
Height 75mm.; diameter 65mm.; aperture 50mm. (approx.)

Locality and Geologic Occurrence.—Talara formation, Yasila. Saman formation, Casa Saman.

Family MURICIDAE Tryon

Genus MUREX Linné

Murex scorpionius, n. sp. Plate 11, figs. 3, 4, 10.

Shell small, fusiform with the spire somewhat longer than the outer lip and anterior canal; protoconch (eroded) seems to be small, pointed; post-nuclear whorls 5 or more, roughly subtrigonal in section due to 3 major ribs to each turn; anterior canal of moderate length, straight, with an open canal throughout; sculpture consists of strong ribs of which there are 3 major ones to each turn which on the later turns develop almost into true varices; the major ribs are partly continuous and in line across the sutures; between the primary ribs there is usually a smaller one which unlike the others is quite short and does not extend far along the anterior canal; there are 2 central spiral cords on each spire whorl and a 3rd usually showing in the lower suture; on the body-whorl there are 4 central cords and several irregular ones on the base of the whorl and anterior canal; aperture subelliptical to subovate, narrowed and produced into the anterior canal; outer lip heavily thickened by the last ribs which sometimes carries one or more small spines.

Length 16.5mm.; diameter 8.25mm.

Remarks.—This species resembles *M. contabulatus* Lamarck of the Paris Basin but our shells have no true varices but simple ribs not quite continuous across the sutures. The spaces between the ribs have each a smaller riblet which is not found on *contabulatus.*

Locality and Geologic Occurrence.—Talara formation, Yasila.

Genus TYPHIS Montfort

Subgenus LEVITYPHIS Cossmann

Typhis (Levityphis) thagus, n. sp. Plate 12, fig. 6.

Shell small, solid; nucleus unknown; post-nuclear whorls 4 or more, strongly shouldered, each bearing 4 strong, rib-like varices and tubular spines; last whorl of moderate size, strongly convex about the upper 1/2, contracted below about the base; on the last whorl, the varices are heavy, rib-like, rounded and continue from the shoulder angle anterior across the face of the whorl to the tip of the anterior canal; the interspaces are wide with a tubular spine on the shoulder not exactly intermediate in position but adjacent to the varix just in front; surface smooth; mouth circular with the last varix forming the outer lip; anterior canal closed.

Length 12mm. (imperfect); diameter 8.5mm.

Remarks.—Our only specimen is fragmentary lacking the tip of the anterior canal and nucleus. It resembles *Typhis coronarius* Deshayes of the Parisian Eocene which species was selected by Cossmann as the type of his subgenus *Levityphis. Typhis alternatus* Lea from Claiborne is larger and has a longer spire.

Locality and Geologic Occurrence.—Talara formation, Yasila.

Genus YASILA, n. gen.

Type. Yasila paytensis, n. sp.

The following is a description of the genus *Yasila.*

Shell small, muriciform; spire short, elevated, acute; nucleus of medium size, Bulimiform composed of 3 smooth turns; body-whorl large, inflated and strongly contracted about the base and produced forward into the anterior canal; anterior canal long, narrow, straight and continuously open, with a single columellar plication about the middle; sculpture of strong ribs and spiral threads; aperture sub-circular, narrowed and continued through the anterior canal; outer lip thickened by the last rib, finely denticulated within.

Remarks.—This group represented by two species, *paytensis* from the basal Talara beds of Yasila and *chiræensis* from the Chira shales near Casa Saman, is characterized by its long, straight, anterior canal bearing a single columellar plication about the middle. The axial ribs number, 7, 9 or more to each turn but do not develop into true varices. On some specimens of *paytensis,* the ribs as they cross the shoulder become pointed or even develop into small, sharp spines.

Possessing a columellar plication, *Yasila* would seem to find its relations with *Muricopsis* but in the absence of other characters too much stress cannot be attributed to this feature. *Odontopolys* Gabb based on *O. compsorhytis* Gabb a rare Claiborne species of Texas and Alabama has a higher spire, 3 varices and 2 columellar plications. *Peruficus* Olsson is characterized by its *Ficus*-like form and sculpture and 2 columellar plications.

Yasila paytensis, n. sp. Plate 11, figs. 11, 16, 17, 18.

Shell small with a short but acute spire and shouldered whorls; nucleus as described above; post-nuclear whorls 4 to 4 1/2, sharply shouldered, sculptured with 7 - 9 narrow, but strong axial ribs to each turn which extend from the upper suture and across the base of the last whorl but not along the anterior canal; the spirals consists of primary, secondary and tertiary threads; this sculpture is as follows: a primary cord about the suture, 5 threads of secondary strength on the shoulder area, 14 primary threads from the shoulder angle across face of the whorl to tip of anterior canal and separated by wide interspaces each of which carries a central secondary and 1 or 2 tertiary threads on the sides; the ribs as they cross the shoulder angle sometimes become pointed and spine-like; aperture subovate; the outer lip greatly thickened by the last rib; a single *Strepsidura*-like columellar fold; outer lip denticulate within.

Length 13.5mm.; diameter 9mm.; aperture 10mm.

Remarks.—This species is very abundant at Yasila, our collection containing 50 to 75 specimens.

Locality and Geologic Occurrence.—Talara formation, Yasila.

Superfamily TAENIOGLOSSA

Family NYCTILOCHIDAE Dall

Genus PLESIOTRITON Fischer

Plesiotriton paytensis, n. sp. Plate 10, figs. 8, 10, 11.

Shell small or medium size with a high spire, large body-whorl and a cancellated beaded sculpture; protoconch eroded, small; post-nuclear whorls 6 or 7, together forming a high, rapidly tapering spire; spire-whorls roughly convex, appearing slightly shouldered next to the suture; body-whorl moderately large, ovate, nearly 2/3rds the length of the whole shell; heavy rib-like varices generally spaced about 120 degrees apart; aside from the varices, the general sculpture of the whorls is subcancellate;

axial sculpture of small, numerous, closely spaced riblets which become noded or finely beaded by the crossing or intersection of the spiral cords; there are generally 4 primary spirals on the penultimate whorls, 16 or more on the last whorl; the primary spirals are separated by wider interspaces which carry 2 or 3 smaller spiral threads; aperture narrow elliptical, somewhat contracted and pointed above, continued forward into a short, truncate anterior canal; outer lip heavy, crenulated within; columella straight with 3 or 4 *Cancellaria*-like folds.

Length 13.5mm.; diameter 6.25.; aperture 6.5mm. Yasila.
Length 17.5mm. imperfect.
Length 18mm. (2 last whorls); diameter 11mm.
aperture 11.5mm., Salina

Remarks.—The collection from Yasila contains 15 specimens, the largest which is somewhat imperfect measures 18 millimeters in height. We have also a single specimen from near Negritos of which only the last 2 whorls are preserved. When perfect, this shell must have been about 23 to 24 millimeters in length. The columella is provided with 3 *Cancellaria*-like plications with a smaller 4th just visible below.

Principally on account of its columellar plications, *paytensis* is provisionally referred to the genus *Plesiotriton* of Fisher (type *Cancellaria volutella* Lamarck of the Parisian Eocene) although it does not fully agree with that genus in the position of the varices on the penultimate and spire-whorls. Auinger's genus *Hilda* based on *Triton transylvanicum* from the Miocene of Austria-Hungary is also similarly provided with columellar folds but has only a single labial varix.

The Parisian *P. volutella* has more evenly tapering whorls, its sculpture is smoother, less *Triton*-like and the inner lip is strongly callused. *Eutritonium* (*Plesiotriton*) *Hillegondae* Martin[47] from the Upper Eocene of Java is very similar to *volutella.* R. Bullen Newton[48] has described *Hilda turriculata* from the Nigerian Eocene.

Locality and Geologic Occurrence.—Talara formation, Yasila. Salinas near Negritos.

[47]Martin 1914, Samml. des geol. Reichs Mus. in Leiden, p. 150, pl. 10, figs. 111, 111a.

[48]R. Bullen Newton 1922, Bull. 3, Geol. Survey of Nigeria, p. 29, pl. 4, figs. 24, 25.

Genus BURSA ("Bolten") Roeding

Bursa chira, n. sp. Plate 10, figs. 5, 6, 7, 13.

Shell somewhat flattened dorso-ventrally and with 2 varices continuous across the 3 last spire-whorls towards the apex; whorls about 6; protoconch unknown; earliest post-nuclear whorls without varices, convex and sculptured with about 4, nodulated spiral cords and finer secondaries; on the later turns, heavy varices are found about 180 degrees apart and these are almost in line from one whorl to the next; between the varices, the whorls are moderately humped or angulated forming a sort of shoulder, this shoulder carrying 4 or 5 low knobs; the surface is further sculptured with undulated spiral cords; base of last whorl deeply contracted and with a medium length anterior canal or beak slightly recurved backwards; aperture subcircular to subelliptical, nearly three-fourths the length of the shell and with a deep, groove-like anal sinus at the posterior end; outer lip heavily thickened by the last varix, the actual edge of the lip, thinner, elevated but not deeply fluted by the spiral sculpture; anterior canal narrow and of medium length.

Height 26mm.; greater diameter 21.25mm.; lesser diameter 13.5mm.

Remarks.—Although this is an Oligocene species of the Chira Shales, it is described in this place for comparison with *yasila.* of the basal Talara. Comparing with recent species, *chira* resembles most closely *B. neglecta* Sowerby[49] (*margaritula* Desh.) of the Indo-Pacific region. The *margaritula* as figured by Martin[50] from the Javanese Miocene is somewhat higher, the varices are less heavy and the beak or anterior canal is much wider. *Bursa caelata* Broderip[51] of the Panama recent fauna but a very rare shell on the Peruvian beaches differs by its heavier spiral sculpture and deeply fluted or frilled outer lip.

Locality and Geologic Occurrence.—Chira formation, Quercotilla.

[49]Sowerby, Conch. Illus. **Renella** fig. 22.

[50]K. Martin, 1899, Die Fossilien von Java, Samml. des Geol. Reichs. Museum in Leiden, Bd. 1, p. 146, pl. 23, figs. 337, 337a, 338, 339.

[51]Broderip, 1832, Proc. Zool. Soc., p. 178. Sowerby, Conch. Illus., p. 92, fig. 16.

Bursa chira var **yasila** n. var. Plate 10, figs. 3, 4.

Shell small or medium-sized; protoconch helicoid of 3 smooth, rapidly enlarging convex whorls; the last 1/2 turn of the first post-nuclear whorl is ornamented with 3 or 4, somewhat beaded, widely spaced, primary spirals and much finer spiral threadlets; this stage is brought to a close by the formation of a thickened rib or varix; the succeeding whorls are bursoid, each turn provided with two varices; in some shells these varices are placed 180 degrees apart, resulting in a strongly flattened shell, while in others the varices are weaker, slightly spiral in their arrangement and the dorso-ventral flattening of the shell is less pronounced; each whorl is shouldered or humped and armed with 4 or 5 low knobs between each set of varices; above and below this shoulder, the surface is sculptured with finer beaded spirals; aperture subelliptical with a deep vertically directed anal sinus at its posterior end and a medium length anterior canal; outer lip strongly thickened and crenulated with 7 or 8 denticles within; columella with 5 or 6 plait-like denticels.

Height 18.25mm.; greater diameter 12mm.; lesser diameter 9mm.

Remarks.—In its more usual form, this shell appears to be perfectly distinct from *Chira,* differing by its smaller size, proportionately higher spire and longer anterior canal, weaker varices and consequent less strongly flattened dorso-ventrally and weaker spiral sculpturing. With these shells there is however represented in our collection, a number of small specimens which in all essentials seem to be the young of true *chira.* Until larger collections are available for study, it cannot be decided whether one or more species or varieties of *Bursa* occur at Yasila.

Locality and Geologic Occurrence.—Talara formation, Yasila.

Family AMPHIPERASIDAE

Genus AMPHIPERAS Gronovius

Amphiperas bullen-newtoni, n. sp. Plate 5, figs. 17, 18.

Shell very small with the anterior and posterior extremities contracted and produced; dorsal side moderately convex (our shell somewhat crushed) ; ventral side flattened with the aperture extending lengthwise through the middle; the left or outer lip side widely and evenly rounded; right side strongly rounded in the middle, contracted and produced at the anterior and posterior extremities; surface sculpture with transverse, regular threads of nearly equal size separated by wider interspaces; they are strong on the ventral surface much weaker on the dorsal (this side somewhat weathered); the transverse ribs or threads number 21 to 22 on the outer lip; aperture straight, except at the posterior extremity where it curves slightly to the right, narrow, linear in form; outer lip widely thickened, internally crenulated by the ends of the external sculpture.

Length 10mm.; height 4mm.; diameter 6mm.

Remarks.—A similar species (*nigeriensis* Bullen Newton[52]) occurring in the Nigerian Eocene is referred by Bullen Newton to *Amphiperas* Gronovius (=*Ovula* Bruguiere, genotype *Bulla ovum* Linnaeus) on account of the absence of any external evidence of a spire, the possession of short, broadly canaliculated extremities and the elongately oval contour of the columellar region. The Peruvian species of which the Holotype is the only specimen known, is only about half as large as the African shell, the aperture is straighter more *Cypraea*-like and the posterior and anterior canals are narrower. In external ornamentation, *nigeriensis* and *bullen-newtoni* agree with *Cypraedia* Swainson and *Cypraeovula* Gray. A strongly sculptured *Ovula* has been described by Dall[53] as *Ovula* (*Transovula?*) *multicarinata* from the Ocala limestones.

Locality and Geologic Occurrence.—Talara formation, Yasila.

Genus GISORTIA Jousseaume

Gisortia thomasi, n. sp. Plate 8, figs. 1, 2, 7.

Shell large, very heavy, ovoid-pyramidal with a strongly flattened ventral surface and a high central dorsal hump; the spire is entirely concealed in the adult by callus, this region of the shell is flattened but locally depressed immediately over the spire and on the right and left sides of the posterior canal; when viewed from below, the outline of the base appears broadly elliptical with the right margin more strongly curved or convex than the left, and with the anterior end narrowed, pointed while

[52]Bullen Newton 1922, Eocene Mollusca from Nigeria, Bull. 3, Geol. Sur. of Nigeria. p. 18, pl. 3, figs. 14, 15.
[53]Dall 1890, Trans. Wag. Free Inst. vol. 3, pt. 1, p. 164, pl. 10, figs. 10, 11.

the posterior 1/4th is quite broad; the right side is not angled as in *G. tuberculosa* and instead carries a broad depression which extends feebly upward onto the dorsal surface; aperture narrow and not much wider at the anterior end; viewed from above, the dorsal surface is pear-shaped with a high, central and very prominent hump; the posterior-dorsal area is flattened, locally impressed, rounding on the sides; the dorsal hump is very high, narrow, prominent and exactly central in position; there is a broad depressed band on each side beginning on the ventral surface and extending upward onto the dorsal; the one on the right is much wider and is partly responsible in the development of a pronounced marginal ridge on the posterior dorsal-ventral margin; this depression extends but a short distance onto the dorsal surface so that the left side of the shell in this region is strongly convex; the left depressed band is narrower but continues quite to the base of the dorsal hump; posterior canal is very deep, ridged on the sides; anterior canal about a quarter as deep as the posterior and curved to the left; columella, inner and outer lip concealed.

Length 118mm.; diameter of base 82mm.; height 70mm.

Remarks.—The discovery of a species of *Gisortia* in the Peruvian Eocene is of particular interest and importance and I am indebted for the priviledge of describing the fossil to the generosity of Mr. W. Thomas, Geologist of the Lobitos Oil Fields, who collected the type specimen. It was found together with another but badly broken specimen in the so-called *Venericardia* bed which stratigraphically lies about 1000 feet below the base of the Cabo Blanco or Parinas sandstones at Cabo Blanco. In terms of the Negritos section, this horizon would lie near the middle of the Pale Gredas.

In 1927, there appeared in the Memoirs of the Geological Survey of India, the excellent and exhaustive monograph of the genus *Gisortia* by Vredenburg[54] which greatly simplifies the study of these curious and valuable guide fossils. Vredenburg recognized three subdivisions of the genus; *Gisortia sensu stricto* (type *Ovula gisortiana* Passy= *Gisortia gigantea* Munster), its section *Palliocypraea* Cossmann (type *Cypraea gastroplax* McCoy) confined to the Australian Eocene, and the subge-

[54]Vredenburg 1927, A review of the Genus **Gisortia** with description of several species. Mem. Geol. Survey of India, Pal. Indica, New Series, Vol. 7, Mem. No. 3.

nus *Vicetia* Fabiani (type *Gisortia Hantkeni* H. and M. Ch.) geographically restricted to the old Tethys or Mesogeé seas during the Middle and Upper Eocene. Vredenburg enumerates 36 species distributed through the European, Indian and Australian region. Trechmann[55] has recorded *Gisortia* cf. *murchisoni* and *postalensis* Oppenheim from the Yellow limestones of Jamaica, associated with a fauna of *Clavilithes, Carolia* and large Cerithiums. The above description of *thomasi* from Peru, is the first record of the occurrence of this genus on the mainland of South America. In spite of their large and ponderous shells, these mollusks enjoyed a world-wide distribution in the equatorial and subequatorial region during the Eocene period. A single species, *Cypraea umbilicata* Sowerby has survived to the present day, living with the relic *Trigonia* in waters of moderate depth off the coast of Australia.

In true *Gisortia,* as best exemplified by *gisortiana,* the shell combines to a remarkable degree the external features of *Cypræa* and *Ovula.* The shell is very broad across the posterior portion, contracted and pointed at the anterior, with a high, deep, curved posterior canal. The dorsal surface is simply convex or as in *G. tuberculosa* Duclos with tubercles or nodes situated on the posterior side of the middle. *Vicetia* is more truly *Cypraea*-like, the base subovate, and less narrowed or pointed at the anterior end, the dorsal surface has two transverse ridges separated by a medial, transverse depressed zone.

The Peruvian fossil seems nearest related to *Gisortia tuberculosa* of the Lower Eocene of France, Spain and India. Compared with the excellent figure of Cossmann and Pissaro[56], the Peruvian fossil, differs as follows: the base is less trigonal and longer, the right and left margins being less angulated; the aperture is straighter, less expanded at the anterior end; the dorsal area has a single very prominent hump, instead of scattered nodes and this dorsal hump is exactly central in position.

In *Vicetia,* a transverse impressed zone crosses the dorsal surface and gives rise to two transverse ridges. In *murchisoni*

[55]Trechmann 1923, The Yellow Limestones of Jamaica, Geol. Mag., Vol. 60, pp. 355, 356.

[56]Cossmann and Pissarro 1910-1913, Icon. comp. des Coquilles Fossiles des Environs de Paris. pl. 32, fig. 161-1.

d'Archiac (*douvillei* Cossmann) these ridges are quite far apart. They are much closer in *G. Jamesi* Vredenburg[57] so that the two together (as seen in Vredenburg's figure c, pl. 24) are nearly central in position. In *thomasi* there is a shallow transverse groove beginning on the right and left ventral side and extending upward over the dorsal surface. The right one is very short, but the left continues at least to the base of the dorsal hump. In these features as well as the central dorsal hump and straight narrow aperture, the Peruvian fossil seems to occupy a position intermediate between the Gisortias of the type of *tuberculosa* and the subgenus *Vicetia*. It further suggests that *tuberculosa* is phylogenetically closely related to the ancestral form which gave rise to *Vicetia* in the Mid-Eocene

The aperture is completely filled with matrix so that the features of the columella, and the absence or presence of denticles or plications on the inner and outer lip cannot be determined. The dorsal hump is also somewhat broken.

Locality and Geologic Occurrence.—Pale Greda formation, Cabo Blanco.

Family TURRITELLIDAE Gray

Genus TURRITELLA Lamarck

Turritella chira Olsson Plate 12, figs. 1, 2, 3, 4.

Turritella samanensis and *chira* are both common in the basal Talara beds. In a large collection of these fossils from this horizon, the 2 species often appear to intergrade. In general *T. samanensis* is more slender, the whorls are evenly convex and sculptured with numerous, subequal but not sharp spirals. The nepionic sculpture consists of 3, subequal spiral threads which is soon followed by the mature sculpture of numerous fine spirals. In *T. chira,* the taper is more rapid so that the shell is shorter and more stubby, the whorls are subangular, widest about the anterior half, sloping or excavated towards the upper suture. The sculpture is coarser, with 2 primary spirals about the anterior half, often with a 3rd but smaller spiral just above and much finer spirals on the sutural zone.

Locality and Geologic Occurrence.—Talara formation, Yasila.

[57]Vredenburg 1927, idem., p. 69, pls. 23-25.

Family NATICIDAE Forbes

Genus NATICA Scopoli

Subgenus NERINATICA n. subg.

Type. Natica (Nerinatica) paytensis, n. sp.

The following is a description of the subgenus *Nerinatica.*

Shell small, solid with a large, inflated body-whorl and a low, flat spire; sutures distinct; aperture semicircular, the columellar side straight; umbilicus wide with a low, broad internal rib in the upper part bordered in the lower part by a broad groove or sinus; the internal rib or funiculus emerges near the top of the umbilicus as a broad, thick callus which spreads upward and joins with the parietal callus; sculpture of subregular spiral bands formed by incised spiral lines; operculum unknown.

Remarks.—In its flat spire and banded spiral sculpturing, this group resembles *Sinum* (*Sigaretus*) but differs widely from that genus by its heavier shell and wide, deep umbilicus. In these later characters, *Nerinatica* approaches the true Naticas or its related subgenera. In *Natica* Scopoli and its subgenera *Naticarius* Dumeril[58] (with *N. canrena* Linné as type) and *Stigmaulax* Mörch (type *N. sulcata* Born,) the umbilicus is wide, deep with the internal or funicular rib emerging near the base of the umbilicus and separated from the umbilical wall by a deep groove. In *Nerinatica,* the funicle is much smaller, usually showing simply as a wide, internal fold, occupying the upper part of the umbilicus and bordered below by a broad groove or sinus which forms most of the lower half of the umbilicus. It emerges near the upper end of the umbilicus as a thick callus growth which is continuous above with the parietal callus. The operculum is unknown.

Natica (Nerinatica) paytensis, n. sp. Plate 5, figs. 3, 6, 7, 9, 11, 12.

Shell small, solid with a flat spire, partially concealed by the large rapidly expanding body-whorl; whorls about 3 1/2 to 4, the spire-whorls being very small and nearly concealed by the later turns; suture distinct, incised; sculpture consists of banded spi-

[58]Woodring 1928, Miocene Mollusks from Bowden, Jamaica Pt. 2, Carnegie Institution, p. 378.

rals formed between incised spiral lines or grooves; these spiral bands number about 22 on the last whorl from the umbilical edge to the upper suture; on the penultimate whorl just above its union with the outer lip, there are 6 spiral bands; the spiral bands are fairly regular and on a mature shell are generally about 1/2mm in width on the back of the body-whorl; usually the spiral band on the lower side of the suture is somewhat larger than the others; umbilicus wide, deep as previously described; aperture semicircular, oblique, the columellar side nearly straight.

Height 11mm.; greater diameter 12mm.

Remarks.—This species is very common in the basal Talara shales at Yasila and Jaquey Cunas. *Sigaretus* (*Eunaticina*) *aratulus* Cossmann from the Pliocene of Karikal may be related species but Cossmann's[59] figures are poor and do not show the spire and umbilical area clearly.

Locality and Geologic Occurrence.—Talara formation, Yasila and Jaquey Cunas.

Family FOSSARIDAE

Genus TUBA Lea

Tuba peruviana, n. sp. Plate 12, figs. 9, 10.

Shell small, turbinate with a moderately high spire; protoconch unknown; post-nuclear whorls 6 or more, strongly convex, often becoming shouldered or flattened above; last whorl rather large, convex with a circular or cyclostomous aperture and continuous peristome; sculpture of numerous, elevated and finely beaded spiral cords, usually alternating in strength on the last whorl; the spiral cords are finely beaded by the crowded growth lines.

Height 10.25mm.; diameter 7mm.

Remarks.—Two specimens from the basal Talara beds near Lagunitas are accepted as the types for this species. Another specimen from Yasila badly crushed may possibly belong to a different species. The Lagunitas shells have strongly shouldered whorls with a coarser and more irregular sculpture.

[59]Cossmann, Essais de Paleoconch. comparee, vol. 13, p. 149, pl. 3, figs. 16, 17.

Locality and Geologic Occurrence.—Talara formation, Lagunitas, Yasila?

Superfamily PTENOGLOSSA

Family EPITONIIDAE Dall

Genus EPITONIUM Bolten

Subgenus ACRILLA H. Adams

Epitonium (Acrilla) peruvianum Olsson Plate 4, figs. 12, 13.

Epitonium (Acrilla) peruvianum Olsson, 1928, Bulls. Amer. Pal., vol 14, p. 54, pl. 12, figs. 10, 12.

E. peruvianum and the following *paytense* are very characteristic of the basal Talara or horizon of the Lomitos conglomerate. Being very long and slender, the fossils are usually broken in being removed from their matrix if the rock is at all hard. *E. peruvianum* is refigured here from more perfect specimens than were available at the time the species was described. The shell figured by Bullen Newton[60] from the Nigerian Eocene as *Acrilla* cf. *affinis* (Deshayes) bears much resemblance to this species.

Epitonium (Acrilla) paytense, n. sp. Plate 4, figs. 14, 15, 16.

Shell small, slender with numerous coronated whorls; the taper of the shell is more rapid than *peruvianum* and with the upper 1/3rd of the whorl strongly coronated or flattened above; sutures close, distinct; varices numerous, small, there being about 19 to the average-size whorl; they are generally oblique to the axis of the shell; on well-preserved specimens, the varices appear to be divided by a medial line; intervarical spaces are much wider and coarsely sculptured by strong spiral cords there being about 6 or 7 below the coronated shoulder; a basal disc is present; aperture not fully preserved.

Length 16mm.; diameter 4.5mm. (8 whorls)

Length 17.5mm.; diameter 6mm. (8 whorls broken)

Remarks.—Associated with *E. peruvianum,* this species is always less abundant and easily recognized by its strongly coronated whorls.

Locality and Geologic Occurrence.—Talara formation, Yasila, Lagunitas.

[60]Bullen Newton 1922, Bull. 3, Geol. Sur. of Nigeria p. 50, pl. 3, figs. 10-12.

Class SCAPHOPODA

Family DENTALIIDAE Gray

Genus DENTALIUM Linné

Dentalium mancorens, n. sp. Plate 12, figs. 12, 13.

Shell of medium size to large, solid, finely ribbed on the posterior portion becoming smooth and polished on the anterior half; the shell is moderately curved with an even taper; apical characters not known; the posterior part of the shell is finely ribbed, the ribs being nearly even, elevated ridges with much wider, concave spaces between; the ribs gradually become obsolete and most of the anterior portion of the shell is smooth and polished; growth-lines evident, oblique in plane to the axis of the shell.

Length 57mm.; greater diameter 7mm. (Holotype).
Length 55mm.; greater diameter 6.5mm.
Length 44mm.; greater diameter 7mm.
Length 43mm.; greater diameter 6.25mm.

Remarks.—The above measurements are all based on fragmentary specimens. Some basal sections are nearly 9mm. in diameter so that a mature shell was probably more than 70 mm. in length. Its posterior portion has a diameter of about 1.5mm. It is sculptured with stronger, primary ribs which it is estimated number about 18. When the shell has attained a diameter of 2.5mm., secondary ribs appear in the interspaces which rapidly increase so that on the later portion of the test, the ribs are all subequal in size. On the posterior portion, the interspaces are finely etched by the closely spaced lines of growth.

This *Dentalium* was found in great abundance in a hard, flinty concretionary rock lying loose in Que. Barrancas, a south tributary of Que. Mancora near Catalinas. The geological formations in this area belong mainly to the Lower Talara shales and sandstones. Besides this species of *Dentalium*, there are fragments of several gastropods, *Aturia alabamensis* var. *peruviana*, *Nucula catalina* and *Leda barranca*. The rock matrix being so very hard and splintery, most of the specimens are broken or destroyed before they can be extracted.

Locality and Geologic Occurrence.—Talara formation, Que. Barranca.

Dentalium yasilum, n. sp. Plate 12, figs. 14, 15, 16, 17, 18, 19, 20.

The shell is moderately to strongly curved and that chiefly in the posterior portion; taper of the shell in the apical region is quite rapid until it has attained a diameter of about 3mm., after which the taper is much slower and more uniform; apical section strongly hexagonal which is maintained until the shell has reached a diameter of 2mm., after which the section becomes circular; on the apical portion there are 6 primary ribs between which smaller and finer ribs are gradually introduced; on the mature portion of the shell, the ribs have become very numerous, quite fine; between the primaries there may be 1 or more secondary ribs; on well preserved shells the space between the ribs is very finely etched by growth lines.

Length 30mm. (imperf.); basal diameter 5mm. (somewhat flattened.

Remarks.—Two species of *Dentalium* have been described from the basal Talara or Lomitos conglomerate by Willard Berry[61] as *D. samanicum* and *D. Boggsi.* Both species are based on fragmentary specimens or tips collected in a trench section through the Lower Talara shales near Lagunitas. *D. Boggsi,* an apical portion, has a fairly rapid taper and curved shell. Its cross-section is circular and not hexagonal as in *yasilum,* with 16 nearly equal, regular ribs or costae. In *D. samanicum* the ribs number about 30 and alternate in strength. The type specimen of *samanicum* is a small shell with a maximum diameter of 2.2mm. Specimens of *yasilum* of that size have a much more rapid taper.

D. yasilum is very abundant in the basal Talara beds at Yasila and should be easily recognized by its hexagonal tip and fine ribbing. The ribbing although becoming very fine, is persistent through the entire life history. *D mississippiense* Conrad[62] from Vicksburg in its mature form resembles *yasilum* but its apical

[61]E. Willard Berry 1926, Nautilus, vol. 40, p. 19, 20.
[62]Conrad 1848, Journ. Acad. Nat. Sci. Phila., 2nd series, vol. 1, p. 112, pl. 11, figs. 1.

taper is more gradual and has 12 instead of 6 primary ribs.

Locality and Geologic Occurrence.—Talara formation, Yasila.

ADDITIONAL SPECIES

Tornatellaea ? sp. Plate 12, fig. 11

Figured specimen from Yasila. Also occurs in the Chira shales but all our specimens are filled with matrix, concealing the internal features of the outer lip and the columella.

Tritonium (Sassia) sp. Plate 10, fig. 9

This species seems to be a true species of *Sassia,* resembling Cossmann's figure of *T.* (*Sassia*) *apenninicum* Sassi. It also resembles *T. antiquum* Deshayes from the Thanetian. The figured specimen from Yasila.

Peruficus lagunitensis Olsson Plate 12, figs. 5, 7, 8.

Peruficus lagunitensis Olsson, 1929, Bulls. Amer. Pal., vol. 15, No. 57, p. 26, pl. 8, fig. 11.

Refigured from Yasila specimens. Figure 8 shows the two columellar folds.

EXPLANATION OF PLATE 1

Figure — Page

1. **Venericardia planicosta** var. **samanensis** Olsson 21
   Length 89 mm.
   Yasila.
2. **Nucula catalina,** n. sp. 18
   Holotype, length 12 mm.
   Que. Barranca.
3. **Leda (Ledina) barranca,** n. sp. 19
   Cotype, length 17 mm.
   Posterior extremity of right valve.
   Que. Barranca.
4. **Glycymeris peruviana,** n. sp. 20
   Holotype, height 13.5 mm.
   Yasila.
5. **Phacoides (Pseudomiltha ?),** sp. 22
   Height 93 mm.
   Que. Monte Grande.
6. **Leda (Ledina) barranca,** n. sp. 19
   Holotype, length 26 mm.
   Que. Barranca.
7. **Leda (Ledina) barranca,** n. sp. 19
   Cotype, length 23 mm.
   Que. Barranca.

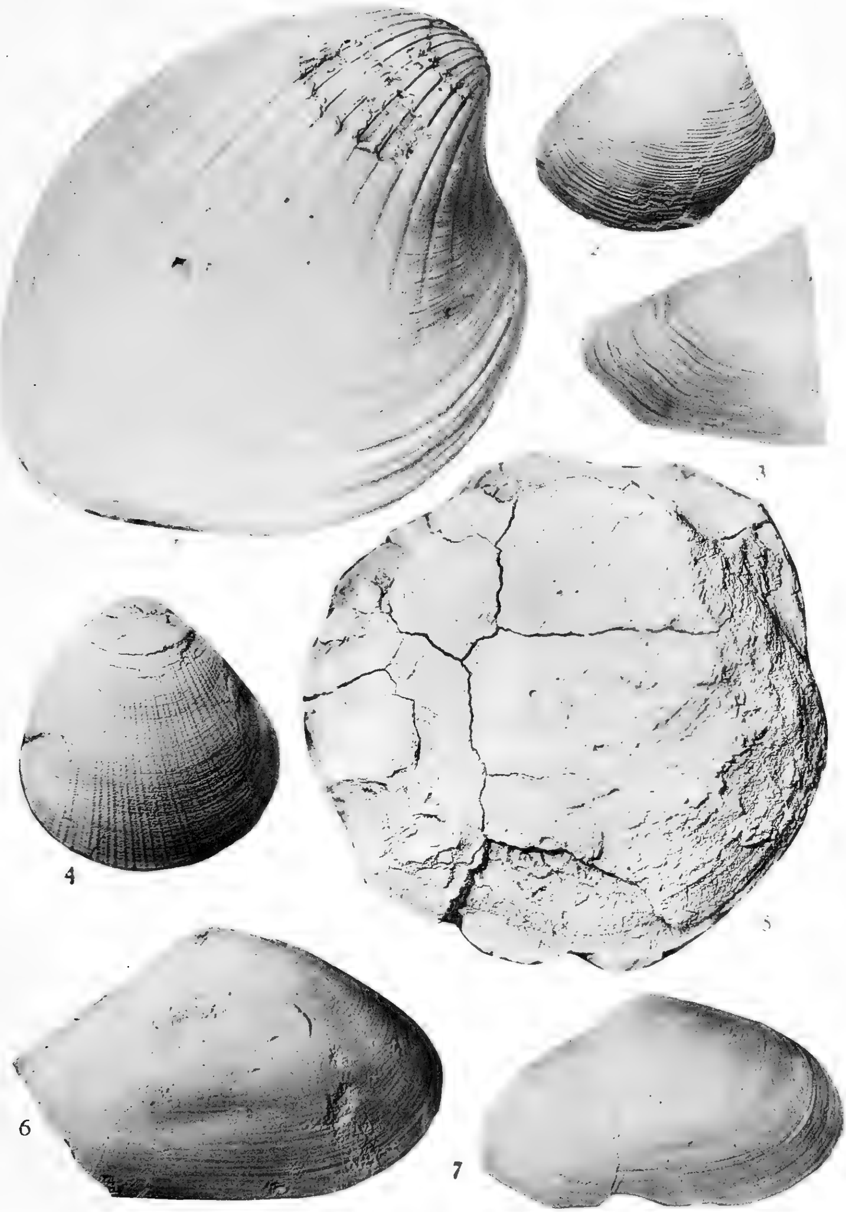
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PLATE 2

EXPLANATION OF PLATE 2

Figure		Page
1.	**Pitaria baldryi,** n. sp. Holotype, length 20.5 mm. Yasila.	27
2.	**Pitaria baldryi,** n. sp. Cotype, length 16.5 mm.	27
3.	**Venericardia simillina,** n. sp. Holotype, length 18 mm. Yasila.	21
4.	**Cardium junceum,** n. sp. Holotype, length 15.5 mm. Yasila.	25
5.	**Phacoides (Here) andersoni,** n. sp. Cotype, height 8.25 mm. Yasila.	24
6.	**Phacoides (Here) andersoni,** n. sp. Holotype, height 8.25 mm. Yasila.	24
7.	**Phacoides (Here) andersoni,** n. sp. Cotype, height 7.50 mm. Yasila.	24
8.	**Phacoides (Here) nonurensis,** n. sp. Holotype, length 20.5 mm. Nonura Bay.	25
9.	**Phacoides (Miltha) woodi,** n. sp. Cotype, length 27 mm. Yasila.	23
10.	**Cardium junceum,** n. sp. Cotype, height 15 mm.	25
11.	**Pitaria yasila,** n. sp. Holotype, length 45.5 mm.	26
12.	**Phacoides (Miltha) woodi,** n. sp. Holotype, length 32.5 mm. Yasila.	23

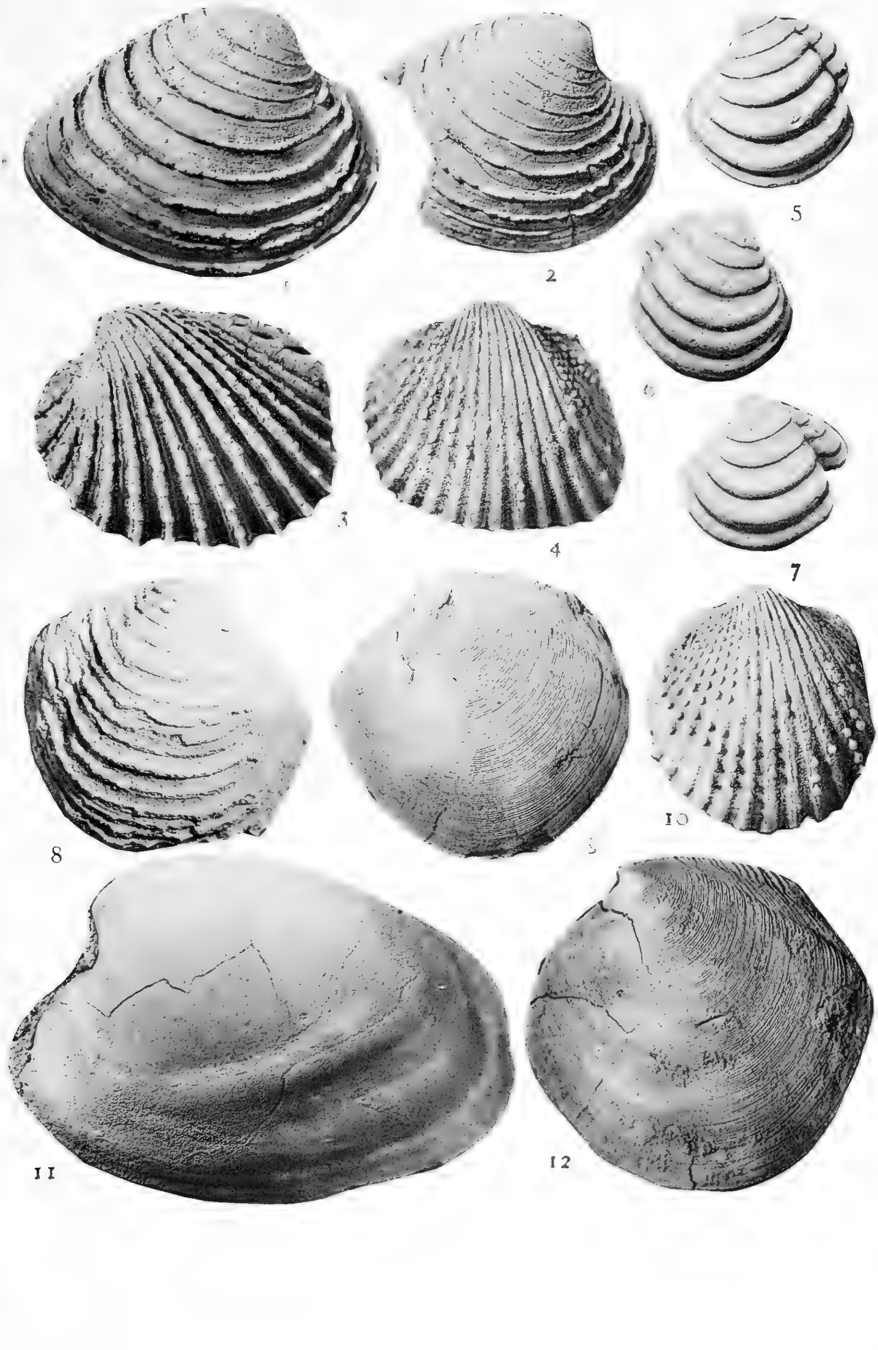
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PLATE 3

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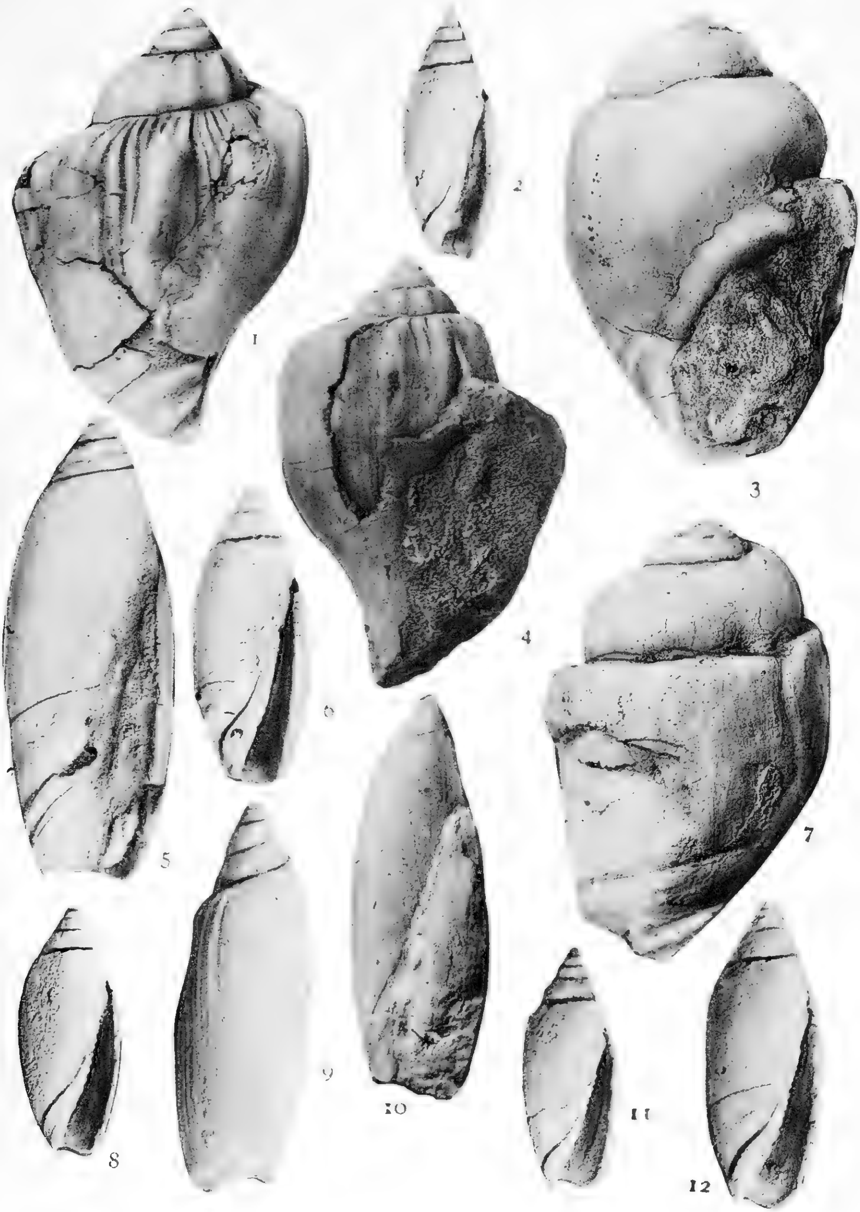
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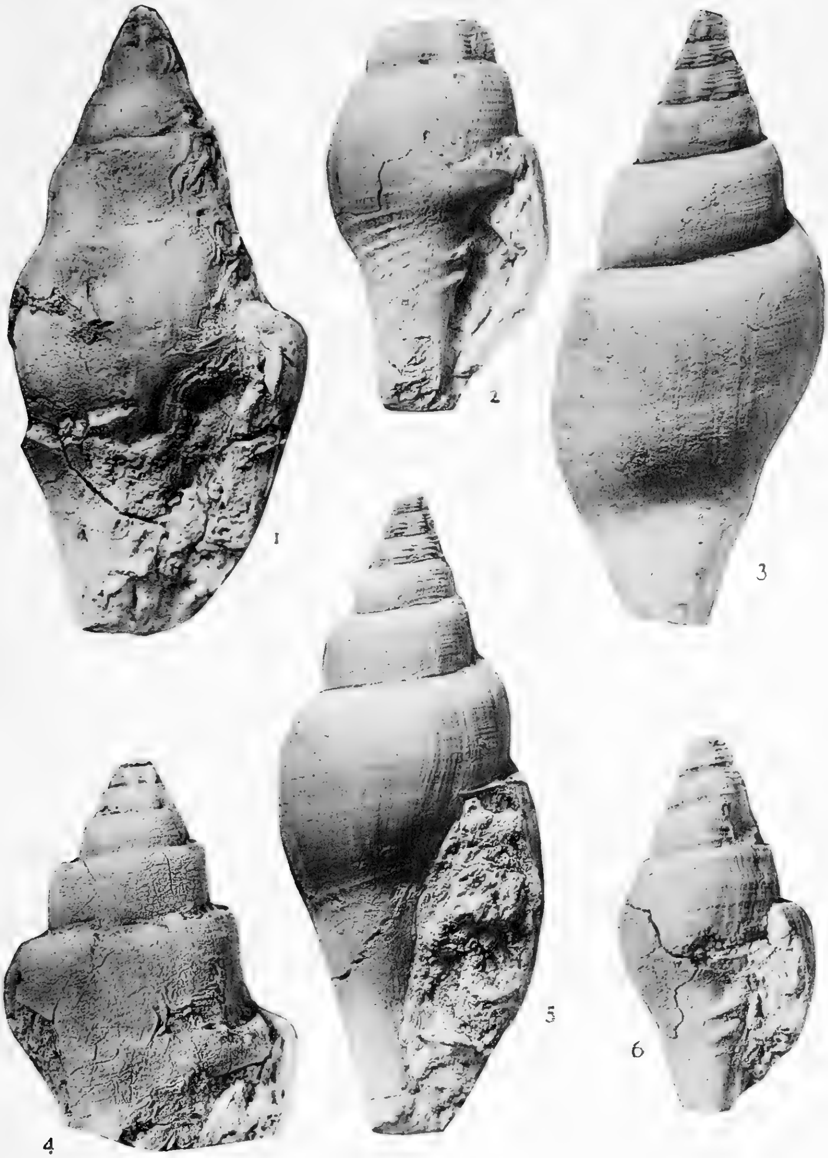
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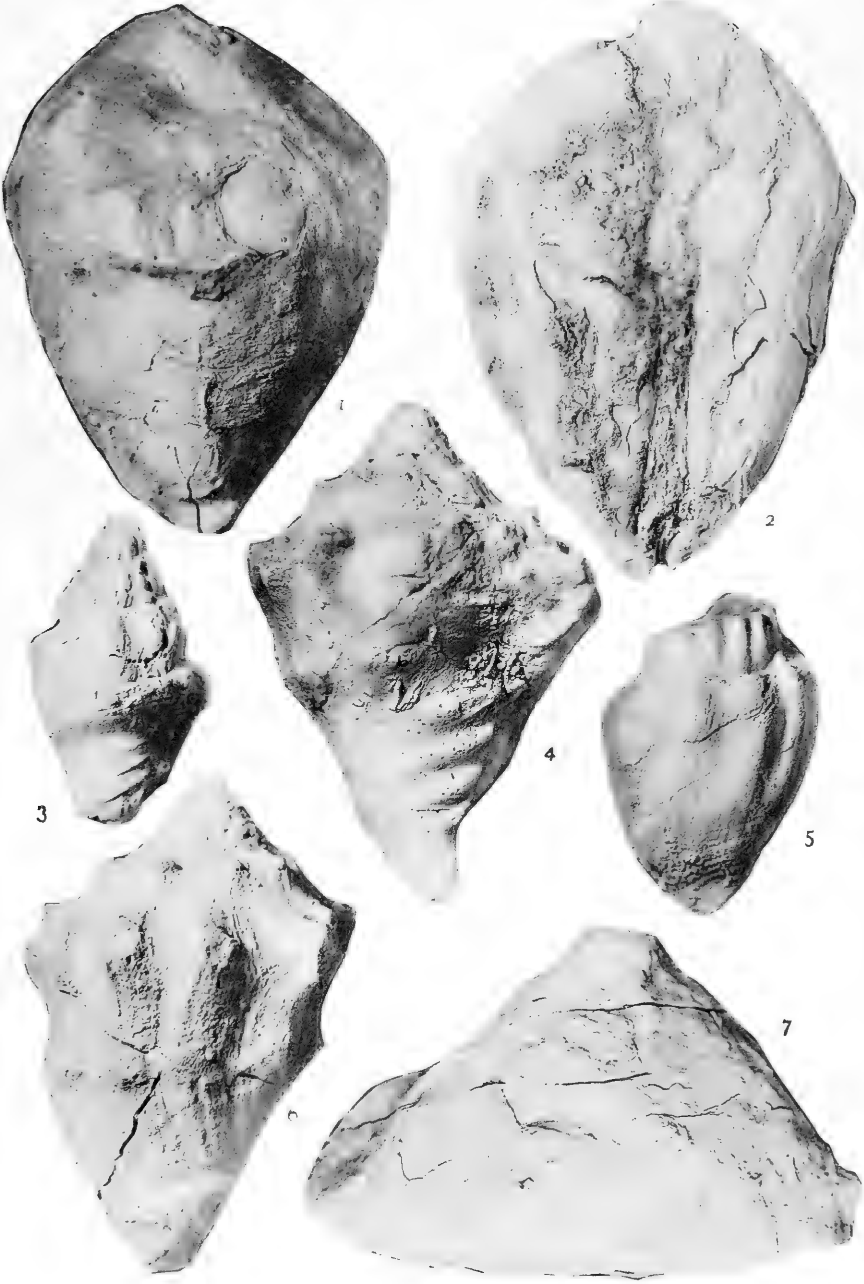
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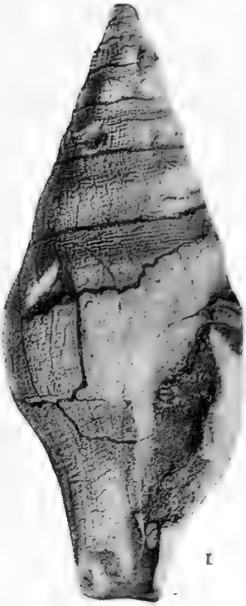
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VOL. XVII

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June 5, 1931

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No. 63

Contributions to the Tertiary Paleontology of Northern Peru: Part 4, The Peruvian Oligocene

By A. A. Olsson

June 5, 1931

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Ithaca, N. Y.
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Prefatory Note

This paper, Part 4 of the Contributions to the Tertiary Paleontology of Northern Peru, is devoted to a description of the Peruvian Oligocene and its fossils. The following Oligocene species which also occur in the underlying Eocene formations have been described in the earlier Bulletins of this series:

Phacoides (*Miltha*) *woodi* Olsson, Pt. 3, p. 23.
Clementia (*Clementia*) *peruviana* Olsson, Pt. 1, p. 33.
Conus chiraensis Olsson, Pt. 3, p. 51.
Architectonica sullana Olsson, Pt. 1, p. 55.
Architectonica chiraensis Olsson, Pt. 1, p. 57.
Turritella samanensis Olsson, Pt. 1, p. 65.
Turritella chira Olsson, Pt. 1, p. 66, Pt. 3, p. 67.
Ectinochilus gaudichaudi d'Orbigny, Pt. 1, p. 71.
Bursa chira Olsson, Pt. 3, p. 62.
Voluta (*Peruluta*) *mancorensis* Olsson, Pt. 1, p. 92.
Xancus peruvianus Olsson, Pt. 1, p. 89.
Clavilithes (*Chiralithes*) *cynosuris* Olsson, Pt. 3, p. 51.
Pseudoliva parinasensis var. *mancorensis* Olsson, Pt. 1, p. 78.
Aturia alabamensis var. *peruviana* Olsson, Pt. 1, p. 99.

In this paper, the following new genera and subgenera are proposed.

Anconia. Type: *Anconia elenensis,* n. sp.
Pseudofaunus. (Subgenus of *Faunus*). Type: *Faunus bravoensis,* n. sp.
Hannatoma. Type: *Melanatria gesteri* Hanna and Israelsky.
Mancorus. Type: *Mancorus grabaui,* n. sp.
Chiraluta. Type: *Chiraluta inca,* n. sp.

Gloversville, N. Y.
January 1st, 1931.

THE PERUVIAN OLIGOCENE*

INTRODUCTION

In America, it is customary to accept the range of *Venericardia planicosta* or its related species, as a guide to the stratigraphic limits of our Eocene deposits and in the southern states, this species occurs from the basal Midwayan to the top of the Jackson formation. In Peru, the group of *Venericardia planicosta* ranges through more than 15,000 feet of section, first beginning in the lower Negritos and continuing through to the summit of the Saman. The last member found in the fossiliferous Saman sandstones represents the climax in *Venericardia* evolution. It is a large, solid shell with a coarse, heavy hinge and nearly obsolete sculpture. The top of the Saman sandstones or their equivalent rocks the Verdun grits, are therefore believed to mark the upper limit of the Eocene system in northern Peru. This interpretation is supported by the stratigraphy and by additional paleontological evidences which deal more particularly with the correlation of certain overlying and underlying beds.

The closing part of the Peruvian Eocene witnessed principally the deposition of thick beds of sandstones (The Saman sandstones) or thick grits and arenaceous shales (poorly fossiliferous except in *Lepidocyclinae* "The Verdun grits", grading into coarse conglomerates and mud-flowers north of Quebrada Mancora. The late upper Eocene or close of Saman times was therefore principally a period of shallow, regressive seas with extensive emergence and uplift increasing towards the north.

Another group of rocks, whose age has been definitely established are the Miocene sandstones, conglomerates and shales of the Zorritos region. They begin in the coast sections near Piedra Redonda and extend northward past Zorritos and Tumbez into southern Ecuador. The paleontology of these formations has been described by Nelson, Grzybowski, Berry, Woods and more fully

* This, and the previous papers on Peruvian Paleontology, have been published with the kind permission of Dr. O. B. Hopkins, Chief Geologist for the International Petroleum Co., Toronto. I am also happy to acknowledge my appreciation for the facilities extended to me during visits to the Philadelphia Academy and National Museum for the purpose of examining type material, to Drs. H. A. Pilsbry, P. Bartsch, C. W. Cooke, and E. G. Vanatta.

monographed by Spieker. The lower part of the Peruvian Miocene or the rocks to which Grzybowski applied the name of Zorritos formation, belong to the lower Miocene or to the Burdigalian as maintained by both Grzybowski and Spieker[1].

The Zorritos formation, chiefly composed of sandstones, conglomerates and varicolored, often lignitic shales, was deposited in very shallow, coastal and even lagoonal waters. In parts of the Boca Pan valley, the basal Zorritos sandstones appear to be transitional with the underlying Heath shales but in most cases there is an evident unconformity between the two formations. In the Tumbez valley, the Miocene rocks progressively overlap the older formations until at Rica Playa, they are found resting on the Saman and Restin Eocene or even on granite. The early Miocene in Peru was a period of expanding or transgressive seas, faunally characterized by numerous species of Arks, Venerids and large Turritellas of quite modern affinities.

[1]While accepting the Burdigalian or lower Miocene age of the typical Zorritos formation, it is important to correct certain errors regarding the composition of the Zorritos fauna as presented by Spieker in his monograph. This criticism however, is no reflection upon the general high standards of Spieker's work. The geology of the Zorritos region is extremely difficult and only through the most painstaking, detailed studies over the entire Miocene region of northern Peru, has it been possible to work out the true stratigraphic sequence. In 1928, the Peruvian Miocene was divided by Iddings and Olsson (Bull. Amer. Assoc. Petro. Geologist, vol. 12, p. 25) into 3 parts, namely the Zorritos (including in one formation, the lower Zorritos, the Variegated beds and the upper Zorritos of Spieker), the Cardalitos and Tumbez formations. Part of the fossils described by Nelson in 1870, such as **Arca Larkinii, Dosinia grandis** and **Turritella plana** (the **alturana** of Spieker) belong to the Tumbez formation of probable upper Miocene age. Small patches or narrow strips of fossiliferous Tumbez sandstones occur at Zorritos and along the coast to the east, lying in downfaulted blocks against the Cardalitos shales and the true Zorritos sandstones. Grzybowski's species are principally from the true Zorritos formation characterized by such forms as the following: **Turritella inca, infracarinata, prenuncia, Arca toroensis, Anomia berryi, Chione propinqua** and **Tellina zapotalensis.** The 14 species listed by Grzybowski as from the upper part of the Heath shales of Grau, were believed by Spieker to belong to the Variegated beds but subsequent studies have shown that these forms are actually from the upper part of the Cardalitos shales or even the basal Tumbez. Spieker's monograph figures and describes all the species then known from the Zorritos region as belonging to the fauna of the Zorritos formation. Woodring in his discussion of the Bowden gasteropods (p. 86) considers the Zorritos fauna as Middle Miocene and hence equivalent to the Gatun of Panama and Costa Rica. If the fauna is considered as a unit this is a natural conclusion but eliminating the Tumbez and Cardalitos species, the remaining group is clearly lower Miocene in its affinities.

Circumscribed between the upper Eocene Saman sandstones and the Zorritos rocks of lower Miocene age, is a third series of sedimentary formations, frequently exceeding 10,000 feet in thickness and partly of marine, brackish and fresh-water origin. These intermediate rocks constitute the principal surface formations south of Lagunitas and through the Chira valley. They have a still greater distribution north of Cabo Blanco and underlie most of the region between Cerro Organo and the southern limits of the Zorritos Miocene at Piedra Redonda. Formations of equvalent age and character occur on the Santa Elena peninsula of western Ecuador and occupy a similar outcrop area between late Eocene and Miocene rocks. It is evident that these intermediate formations must be assigned to the Oligocene system.

In 1928, the Peruvian Oligocene was divided by Iddings and Olsson[2] into 3 parts or formations as follows.

Upper Oligocene	Heath formation.
Middle Oligocene	Mancora formation.
	(Punta Bravo grits)
Lower Oligocene	Chira formation.
	(Bavovar formation)

The Verdun grits were formerly considered as belonging to the lower part of the Chira formation. They are now known to be simply an Orbitoidal and gritty facies of the Saman sandstones developed in the coast sections of Negritos and Lobitos, and therefore belong to the upper Eocene. No other changes in classification are necessary and the formations as listed above, will be adopted in this paper.

In Bosworth's classification, the Peruvian Tertiaries are divided into the Negritos, Lobitos and Zorritos formations. These formations are based principally on local lithology and in separate regions cover rocks of different ages. The Lobitos formation includes most of the rocks referred to the upper Eocene and lower Oligocene and in the Chira valley beds of middle and upper Oligocene age. In the Caleta Sal region, the Punta Bravo grits of the Mancoro formation were referred to the Zorritos formation by Bosworth.

[2]Iddings and Olsson, 1928, Bull. Amer. Assoc. of Petro. Geologists, vol. 12, p. 20.

LOWER OLIGOCENE

THE CHIRA FORMATION

In the Chira valley, the Saman sandstones are overlain by black, bituminous shales which have been named the Chira formation. On exposure to weathering, they assume a chocolate or dull-brown color and break down into a soft, powdery soil. Bands of white or yellowish volcanic ash are found in many localities, usually associated with thin seams of hard, plastery sandstones. At Paita, the Chira shales may be seen lying in fault contact against the Saman sandstones or the Amotape slates and to the east form the high cliffs which extend for several miles along the bay front. The Chira shales are exposed over a large region in the Mancora valley and extend southward into upper Quebrada Pozo Cabo Blanco. They also occur at Caleto Sal underlying the Punta Bravo grits where they are quite sandy or limy and filled with *Nummulites*. (The Sal Chica facies).

Small foraminifera are common in the Chira shales and zones rich in small *Nummulites* and more rarely *Lepidocyclina* are a characteristic feature of these lower Oligocene shales in many places. Mollusks are usually rare and of local occurrence, the best localities being found in the Chira valley. The species given in the following list have been principally collected at two localities in the Chira valley, the first about 3 to 4 miles north of Casa Saman, the other in the lower Chira shales near Quercotilla. The Sal Chica beds of the Caleto Sal region are very rich in *Nummulites* and the thickly crowded tests of these fossils often form a large part of the rock. Mollusks are also fairly common in the Sal Chica beds but they have not been thoroughly studied. The following species are known from the Chira formation.

Leda sp.
**Barbatia* sp.
**Glycymeris* small species
**Spondylus mimus*, n. sp.
M *Crassatellites neorhynchus*, n. sp.
**Venericardia* sp. small species
**Cardita* (*Carditamera*) sp.

*_Lucina_ (_Lucina_) _inca,_ n. sp.

*_Protocardia_ sp.

Cardium sp.

*_Pitaria_ (_Pitarella_) _chiraensis,_ n. sp.

*_Pitaria_ (_Lamelliconcha_) _ayabaca,_ n. sp.

*_Antigona_ (_Artena_)

T-M _Clementia peruviana_ Olsson

M _Nerita_ sp.

T-M _Architectonica sullana_ Olsson

T-M _Architectonica chiraensis_ Olsson

*_Polinices_ (_Neverita_) _subreclusiana,_ n. sp.

M _Polinices_ (_Neverita_) _quirosana_ Hodson

*_Polinices_ (_Lunatia_) _chulucana,_ n. sp.

Ampullina sp.

TS _Turritella samanensis_ Olsson

TS _Turritella chira_ Olsson

*_Turritella salchica_ Olsson

* _Turritella gilbertharrisi_ Hodson

M _Faunus_ (_Pseudofaunus_) _chiraensis,_ n. sp.

*_Potamides chira,_ n. sp.

T-M _Ectinochilus gaudichaudi_ d'Orbigny

*_Rimella peruviana,_ n. sp.

M _Peruchilus culberti,_ n. sp.

*_Strombus chiraensis,_ n. sp.

M _Cypraea_ (_Cypraedea_) _chira,_ n. sp.

*_Cypraea_ 3 species

M _Peruficus lagunitensis_ var. _charanalensis_ n. var.

*_Morum_ (_Oniscidea_) _peruviana,_ n. sp.

*_Morum_ (_Oniscidea_) _chiraensis,_ n. sp.

*_Ficus chiraensis,_ n. sp.

*_Tritiaria chira,_ n. sp.

*_Tritiaria sullana,_ n. sp.

*_Cyrtochetus_ ? _chiraensis,_ n. sp.

*_Metula peruviana,_ n. sp.

*_Latirus quercotillaensis,_ n. sp.

MH _Pseudoliva parinasensis_ var. _mancorensis_ Olsson

M _Bursa chira_ Olsson

	**Yasila chiraensis*, n. sp.
T S M	*Clavilithes* (*Chiralithes*) *cynosuris* Olsson
M	*Mancorus grabaui*, n. sp.
R T S	*Xancus peruvianus* Olsson
	**Lyria peruviana*, n. sp.
	**Chiraluta inca*, n. sp.
T S M H	*Peruluta mancorensis* Olsson
	**Strigatella peruviana*, n. sp.
	**Mitra* sp.
	**Harpa myria*, n. sp.
	**Scobinella meloda*, n. sp.
	**Turricula* (*Surcula*) *piura*, n. sp.
	**Turricula* (*Surcula*) *sullana*, n. sp.
	**Turricula* (*Knefastia*) *chira*, n. sp.
	**Borsonia peruviana*, n. sp.
	**Clathrodrillia mira*, n. sp.
T S	*Tuba* sp.
T	*Tornatellaea* ? sp.
	**Haminea* large species.
T S M H	*Aturia alabamensis* var. *peruviana* Olsson

The foregoing list enumerates 66 species of mollusks. Several species which are too fragmentary to describe or illustrate are included for completeness and listed generically. The species preceded by an asterisk are restricted as far as known to the Chira formation or about 58%. Twelve species or about 19% occur in the underlying Eocene while sixteen species or 25% pass into the overlying Mancora. More complete collecting may change these figures by extending the stratigraphic range of many forms but such extensions will probably be more than balanced by new additions to the Chira fauna.

THE MIDDLE OLIGOCENE

THE MANCORA FORMATION

Shale deposition was the dominant form of sedimentation during the Chira or lower Oligocene, indicating quiet seas and em-

* Restricted to the Chira formation.
R also in Restin formation
T also in Talara formation
M also in Mancora formation
H also in Heath formation.
S also in Saman formation

bayments and general low relief of shore lands. In direct contrast to the Chira shales the rocks of the succeeding Mancora formation are usually sandy, often rapidly changing to coarse conglomerates or to shales and as shown by their fossils, are partly marine or non-marine origin. These coarse, clastic rocks prove the proximity of coastal lands of high relief and rapid erosion. An erosional interval or disconformity marks the base of the Mancora formation. In the Chira valley, this unconformity is often indicated by sandstone dikes which originating in the basal Mirador sandstones, extend downward into the Chira shales or by rolled fossils from the earlier formations. In the Mancora valley and northward, the Mancora unconformity is seen in the gradual overlap of the Mancora rocks on the older beds to the north so that in the Boca Pan valley and beyond, the Mancora formation rests upon the Restin and Talara Eocene. The quiet deposition of lower Oligocene times was evidently terminated by major earth movements which resulted in general uplift and probably a large part of the Tertiary region of northern Peru was raised above sea-level. The increased elevation of the permanent land areas to the east, became reflected in the sudden change in rock deposition from dominantly shale formation to one of sandstones and conglomerates. It was accompanied in some regions by an increase in volcanism which did not fully subside until the late Oligocene. Thick beds of volcanic ash and tuffs form a large part of the middle Oligocene rocks of Ecuador and probably some of the igneous dikes intruded into the lower Tertiaries of the Santa Elena region may date from this period.

The Mancora formation is typically exposed in the lower part of Quebrada Mancora and Quebrada Pozo Cabo Blanco and westward along the coast past the fishing hamlets of Mancora Grande and Mancora Chica. The rocks consists chiefly of yellow, brown or reddish sandstones with interbedded chocolate and brown shales and seams of black conglomerates. They are sparingly fossiliferous, the best fossil horizons occurring near or at the top of the formation. Fossils collected from the top of the Mancora sandstones near Mancora Narrows are very similar to the fauna from the base of the Caleto Mero shales or top of the Punta Bravo grits at Caleto Mero. Species from this locality include the following.

* *Nucula mancorensis,* n. sp.
* *Pitaria (Agriopoma) mancorensis,* n. sp.
SC *Clementia peruviana* Olsson
C *Crassatellites neorhynchus,* n. sp.
* *Macoma meroensis,* n. sp.
C *Mancorus burtii* Hanna and Israelsky
* *Acanthina (Chorus) meroensis,* n. sp.
C *Pseudoliva parinasensis* var. *mancorensis* Olsson
* *Surcula ? mayi* Hanna and Israelsky
SC *Peruluta mancorensis* Olsson
* *Turritella conquistadorana* Hanna and Israelsky

The species preceded by an asterisk are restricted to this horizon. The capitals S or C indicates that the species also occurs in the Saman or Chira formations.

To the north, the Mancora formation again appears in the coast section between Punta Bravo and Caleto Mero and continues eastward as a series of high strikes ridges nearly to the Tumbez valley. In this region, the rocks are chiefly coarse, white grits, colored or variegated shales and coarse conglomerates. They are usually less marine than the typical Mancora sandstones with zones of large oysters and a peculiar fauna of large, fresh and brackish water gasteropods. Since they differ so greatly both in fauna and lithology from the more typical Mancora sandstones, they are usually referred to here as the Punta Bravo grits. Incursions of marine waters during the deposition of the grits is shown by certain zones rich in marine fossils. The following species have been collected from various horizons in the Punta Bravo grits at Caleto Sal.

CS *Ostrea miradorensis,* n. sp.
**Arca bravoensis,* n. sp.
Barbatia sp.
CS *Clementia peruviana,* n. sp.
Pitaria sp.
**Cyrena (Polymesoda) bravoensis,* n. sp.
**Spisula (Oxyperas) steinmanni,* n. sp. also Que. Charanal
**Macoma lissonii,* n. sp.
Phos sp.
Bursa

**Morum* (*Oniscidia*) n. sp. Que. Charanal
**Cymia berryi*, n. sp.
C *Polinices* (*Neverita*) *quirosana* F. Hodson
**Ampullina bravoensis*, n. sp.
CS *Peruluta mancorensis* Olsson
**Hannatoma gesteri* Hanna and Israelsky
**Hannatoma tumbezi*, n. sp.
**Pseudofaunus bravoensis*, n. sp.

Beyond Caleto Sal, the Punta Bravo grits extend inland and form the high hills of Cerro Tunal, Cerro Conchudo and Cerro Verde. They cross the Boca Pan valley just north of Trigal but disappear beneath the Miocene overlap before reaching the Tumbez. In this region the rocks are principally non-marine with zones of *Mytilopsis, Pachychilus* and ornate *Hemisinus*-like gasteropods. They become more marine towards the top and pass through a narrow transitional zone into the entirely marine Heath shales. Along the north side of Cerro Verde, 1 to 2 miles east of Quebrada Culebra, the upper Punta Bravo grits contain *Ampullinopsis spenceri* and *Sanguinolaria tumbezana*. The fauna of the Punta Bravo grits in this region, is as follows.

Upper Quebrada Canoas.
**Leda* (*Adrana*) sp.
**Tagelus* sp.
**Callista* (*Costacallista*) *canoasensis*, n. sp.
·*Pitaria* (*Lamelliconcha*) *wolfi*, n. sp.
**Donax petersoni*, n. sp.
**Angulus* sp.
**Mactrella tumbezia*, n. sp.
**Mytilus canoasensis*, n. sp.
**Hemisinus terebriformis*, n. sp.
**Pachychilus*, sp.
**Ampullinopsis spenceri* Cooke
North side of Cerro Verde
**Ampullinopsis spenceri* Cooke
**Sanguinolaria tumbezana*, n. sp.
Trigal, Boca Pan valley.
**Mytilopsis trigalensis*, n. sp.
**Cyrena* (*Polymesoda*) *trigalensis*, n. sp.
**Pachychilus* sp.

The Mancora formation covers a large part of the Chira valley, extending from near Quercotilla westward to the mouth of the Chira river and north to Lagunitas. In the southwestern part of this region near Mirador and Vichayal, the rocks are principally coarse, black conglomerates (The Mirador conglomerates) which gradually pass into soft sandstones and thinner conglomerates towards the east and into sandy, gypsiferous shales to the north. Near Sullana and Quercotilla, the sandstones contain much volcanic ash and form prominent white banded hills (The Bowl sandstones) which parallel the outcrop of the Saman sandstones but are separated by the intervening Chira shales.

In the typical Mirador conglomerates, fossils are very rare, fragmentary or belong to species derived from the older beds. Rounded boulders of fossiliferous Saman sandstones and of Nummulitic concretions from the Chira shales have been found in the coarse conglomerates of Mirador and indicate that these older rocks were being eroded in the neighborhood. In the sandy zones which accompany the Mirador conglomerates near Tamarindo, the following typical Mancora species have been found.

**Ampullina bravoensis,* n. sp.
**Ampullinopsis spenceri,* n. sp.
**Hannatoma emendorferi,* n. sp.
SC *Aturia alabamensis* var. *peruviana* Olsson, very large.

An interesting fossil locality was discovered by Messers Boughton and Emendorfer in the lower Mirador sandstones of Quebrada Charanal. Although the fossils are abundant, they are extremely local or patchy in their occurrence and are best collected from the weathered outcrop. The source of these fossils has been traced to erratic masses of fossiliferous sandstones in a conglomeratic zone interbedded amongst softer sandstone and sandy shales. Several species are common Chira shale forms which have not been found elsewhere in the Mancora formation and it is possible that they may be derived fossils from a sandy horizon in the upper Chira shales and which was largely eroded away during early or pre-Mancora times. On the other hand, certain species are typical Mancora forms such as *Mancorus burtti, Morum dolioides* and *Mactra steinmanni* while many others as *Morum charanalensis, Melongena charanalensis* and

Venericardia charanalensis etc., are not known from any other locality. Since so much of the Mancora rocks are of non-marine origin, our knowledge of the contemporaneous marine faunas is necessarily limited and consequently I am inclined to accept these species as belonging to an early Mancora fauna. In these rocks, abundant fish remains, large whale vertebrae, fossil woods and the curious, double-pointed, gypsum arrow-heads so characteristic of the Lagunitas shales have also been found. The following species of mollusks are known from this locality.

	Nucula sp.	
	**Leda* (*Saccella*) *miradorana,* n. sp.	
	**Leda* (*Saccella*) *charanica,* n. sp.	
	**Venericardia charanalensis,* n. sp.	
	Chama sp.	
	**Codakia* (*Jagonia*) *peruviana,* n. sp.	
T	*Phacoides* (*Miltha*) *woodi,* n. sp.	
T C M	*Clementia peruviana* Olsson	
	**Pitaria* (*Lamelliconcha*) *charanica,* n. sp.	
	Tagelus sp.	
M	*Spisula* (*Oxyperas*) *steinmanni,* n. sp.	
	Corbula sp.	
	**Verticordia* sp.	
	Haminea sp.	
	**Polystira* sp.	
M	*Surcula* ? *mayi* Hanna and Israelsky	
T S C	*Conus chiraensis* Olsson	
	Cancellaria sp.	
	**Olivella* (*Lamprodoma*) *illesca,* n. sp.	
	**Melongena charanalensis,* n. sp.	
M	*Mancora burtti* Hanna and Israelsky	
S C	*Mancorus grabaui,* n. sp.	
T S C	*Chiralithes cynosuris,* n. sp.	
C M	*Pseudoliva parinasensis* var. *mancorensis* Olsson	very large
T.S.C.M	*Peruluta mancorensis* Olsson	very large
C	*Lagunitus lagunitensis* var. ***charanalensis,* n. var.**	
M	*Morum* (*Oniscidea*) *dolioides,* n. sp.	
	**Morum* (*Herculea*) *charanalensis,* n. sp.	
M	*Turritella hubbardi* Hodson	smooth variety

	**Turritella galvesia*, n. sp.
	Turritella sp.
T S C M	*Architectonica sullana* Olsson
C M	*Polinices (Neverita) quirosana* Hodson
	Nerita sp.
	Dentalium sp.

In the Lagunitas district, the Mancora formation followed by the Heath shales form the surface rocks along the south flank of the Negritos - La Brea structure as well as the borders and center of the Lagunitas syncline. Through this large region, the middle Oligocene or Mancora rocks are principally gypsiferous shales with thin seams of brown or gray sandstones and black, pebble conglomerates. A characteristic feature of the Lagunitas shales are curious, double-pointed, arrow-shaped bodies composed of gypsum. Fossils are rare in the Lagunitas shales and always entirely replaced by gypsum. They include principally the following species: *Peruluta mancorensis* Olsson, *Pseudoliva parinasensis* var. *mancorensis* Olsson, *Pseudofaunus bravoensis*, n. sp. and *Aturia alabamensis* var. *peruviana* Olsson.

At Belen, a few miles south of Lagunitas, and along the axis of the Lagunitas syncline, coarse conglomerates and sandstones very similar to the Mirador conglomerates occur in the Lagunitas shales. Zones containing plant remains, principally fossil fruits and seeds occur at this locality. These plant fossils have been described by Professor Berry[3] who recorded 31 species from this locality. According to Professor Berry, "they belong to forms of the humid, lowland tropics and they are not represented at the present time at all, or by closely allied forms in the semi-desert country such as northwestern Peru has been since the elevation of the Andes to their present day heights." The following species have been described by Berry from this locality.

Palmocarpon bravoi Berry
Palmocarpon belensis Berry
Palmocarpon cocoides Berry

[3]Berry, 1924, American Journal of Science, vol. 8, pp. 123-126.
1927, The Pan-American Geologist, vol. 47, pp. 128-132.
1929, Early Tertiary fruits and seeds from Belen Peru, The Johns Hopkins Univ. Studies in Geology, no. 10, pp. 139-172 pls. 1-3.

Ficus sphericus Berry
Virola tertiaria Berry
Anona peruviana Berry
Leguminosites belensis Berry
Leguminosites mucunoides Berry
Fagara piurana Berry
Jatropha tertiaria Berry
Saccoglottis cipaconensis Berry
Vantanea compressiformis Berry
Matayba belensis Berry
Sapinoides peruvianus Berry
Cupanoides peruvianus Berry
Anacardium peruvianus Berry
Ampelocissus bravoi Berry
Cissus willardi Berry
Malvacarpus octolocolus Berry
Tetracera belensis Berry
Lithospermites glabrum Berry
Uragoga tertiaria Berry
Psychotria eogenica Berry
Cucurbites compressus Berry
Carpolithes belensis Berry
Carpolithes inusitatus Berry
Carpolithes dicellaformis Berry
Carpolithes cissiformis Berry
Carpolithes olssoni Berry
Carpolithes rutoides Berry
Carpolithes peruvianus Berry

These rocks are certainly not Eocene in age as Professor Berry seems disposed to consider them but belong to the Mirador and Lagunitas facies of the Mancora formation. It is true that no marine fossils have been found directly associated with these plant remains but marine mollusks of Mancora and Heath age do occur in beds in every way similar to those of Belen, a short distance east of this locality. Belen is part of a general synclinal region, not greatly disturbed by excessive faulting and occupied by the youngest Tertiary rocks of the Negritos and Lagunitas region. The nearest outcrops of Eocene strata are the Talara and Saman shales of upper Eocene age at Lagunitas about 4 miles north of Belen. They occur along or near the general axis of the Negritos - Lagunitas - La Brea anticlinal structure while to the southward they rapidly dip beneath the younger formations of the Lagunitas syncline.

ECUADOR

Rocks equivalent in age to the Mancora formation are widespread on the Santa Elena peninsula of western Ecuador. They consist principally of sandstones and conglomerates and locally of thick beds of volcanic ash. Along the north coast, the massive sandstones and volcanic tuffs of Punta Centinella, although unfossiliferous, are probably of middle Oligocene age. Further north, the sandstones of Punta Montanita near Manglaralto contain *Thyasira montanita* and a large *Epitonium* allied to *antiguense* Brown from the middle Oligocene of Antigua. On the south side of the peninsula, middle Oligocene sandstones form the headlands of Ancon Point and Mambri Point. The Ancon Point sandstones have been described in detail by Sheppard in his account of the geology of the Ancon region. He has shown that these rocks belong to a single formational unit to which he has given the name of Ancon Point stage. They are downfaulted and consequently younger than the Seca and Socorro shale stages (which contain upper Eocene fossils) on the east and upfaulted side. Except in the so-called gasteropod zone, fossils are quite rare in the Ancon Point sandstones. In the gasteropod zone best developed on the northwest side of Ancon Point, the dominant fossil is a large, slender gasteropod, usually quite fragmentary, the *Anconia elenensis*, n. sp., associated with *Leda stewarti*, n. sp., *Barbatia* sp., *Thyasira* sp. and *Polinices* sp.

Sandstones probably equivalent to those of Ancon Point, occur at Mambri Point, east of Ancon. They contain scanty remains of marine fossils such as *Pseudoliva mancorensis*, *Siphonalia* and shark vertebrae. To the eastward, they pass beneath the Mambri shales of late Oligocene age. Mid-Oligocene sandstones are exposed in the railroad cuts near Zapotal, lying above the upper Eocene shales and Orbitoidal sandstones and beneath the Mambri shales on the east. The Zapotal sandstones are quite fossiliferous, several species being equivalent to forms from the Mancora formation in Peru. Significant species in the Zapotal fauna are the following: *Sanguinolaria tumbezana*, n. sp. *Mactrella tumbezia*, n. sp., *Leda* (*Adrana*) sp., *Tagelus* sp., *Donax* sp., *Macoma* sp., and *Corbula* sp.

[4]Sheppard, George 1928, Journ. of Geology, vol. 36, pp. 120-128.

The largest and most interesting Oligocene fauna known from Ecuador comes from Posorja near the southeast extremity of the Santa Elena peninsula. The outcrops consists of small sandstone exposures along the banks of the Guayas river, rising a few feet above tide level. Most geologists who have visited this locality, have classed these rocks with the Miocene, although the fauna shows practically no affinities with the Miocene faunas of Amen and Zorritos. Of the 22 species known from this locality, *Ampullinopsis spenceri* occurs in the upper Punta Bravo grits, while 8 species are common to the basal Heath shales of Caleto Mero. Such species as *Sinum multilineatum* var. *peruvianum*, *Acanthina* (*Chorus*) *sula*, *Turritella meroensis*, *Chione posorjensis*, *Macoma meroensis* and *Arca meroensis* show the close affinities of this fauna with that of the basal Heath or Caleto Mero shales of Caleto Mero and probably more extensive collecting at both localities, will show many more species in common. There is no hesitation in placing the Posorja sandstones near the top of the middle Oligocene and equivalent to the transitional beds between the Punta Bravo grits and the Heath shales. The following list records the species at present known from Posorja.

Arca (*Scapharca*) *meroensis*, n. sp.
Pitaria (*Lamelliconcha*) *wolfi*, n. sp.
Chione posorjensis, n. sp.
Clementia peruviana, n. sp.
Tellina (*Angulus*) sp.
Macoma meroensis, n. sp.
Ampullinopsis spenceri Cooke
Sinum multilineatum var. *peruvianum*, n. var.
Crepidula sp.
Turritella meroensis, n. sp.
Cerithium sp.
Siphonalia sp.
Acanthina (*Chorus*) *sula*, n. sp.
Pseudoliva parinasensis var. *mancorensis* Olsson
Phos sp.
Olivancillaria (*Olivancillaria*) *aequatorialis*, n. sp.
Olivancillaria (*Agaronia*) *cotapaxi*, n. sp.
Olivancillaria (*Agaronia*) *antisana*, n. sp.
Oliva (*Oliva*) *pichincha*, n. sp.

Olivella (*Lamprodoma*) sp.
Terebra sp.
Epitonium, sp.

UPPER OLIGOCENE

THE HEATH FORMATION

A return to normal marine conditions at the close of Mancora or middle Oligocene times permitted the renewal of shale deposition on a large scale and the formation of the Heath shales. These rocks like those of the Chira formation, are principally black, bituminous, clay shales, usually barren of fossil remains except in a few localities and of a thickness variously estimated from 3,000 to 5,000 feet. In some regions, a characteristic feature of the Heath shales, are large, concretionary masses of yellow, cherty limestones while in the Cone Hill facies in the Lagunitas syncline, thin beds of yellow limestones are quite frequent.

The term, the Heath shales or Heath formation since Grzybowski's studies in the Zorritos region, has been in general use to designate the black shales which lie beneath the fossiliferous Zorritos sandstones. Grzybowski[5] defined his "Heath stufe" in this sense and the name Heath would indicate that he regarded the extensive shale outcrop of the middle and upper Quebrada Heath as typical of this formation. However a part of the rocks which Grzybowski believed to be Heath, belong to a higher formation or to the Cardalitos shales of Iddings and Olsson[6]. The exposures at Grau and from which Grzybowski listed 15 species are not Heath but belong to the upper Cardalitos shales of probable middle Miocene age and lie beneath the Tumbez sandstones of Mal Paso[7].

Southwest of Zorritos, shales belonging to the Heath formation, occupy the broad area between the Punta Bravo grits of

[5]Grzybowski 1899, Die Tertiarablagerungen des nordlichen Peru und ihre Molluskenfauna. Neues Jahrib., Beilage Band **12**, pt. 3, p. 657.

[6]Iddings and Olsson, 1928, Bull. Amer. Assoc. Petro. Geols., vol. 12, p. 25, 26.

[7]These species were considered by Spieker to belong to the Variegated beds, since they occur with oyster beds, thin lignites and plant-bearing shales. The upper Cardalitos shales become lignitic as they pass into the sparingly fossiliferous Tumbez sandstones which form the cliffs of Mal Paso.

Cerro Verde and the Miocene sandstones of Piedra Redonda and Zapotal. They pass downward through a narrow transitional zone of thin sandstones and shales into the Punta Bravo grits. They are overlain by the yellow sandstones of the Lower Zorritos Miocene.

The transitional beds between the Punta Bravo grits and the Heath shales are well displayed at Caleto Mero and along the north side of the Cerro Verde ridge. These rocks are generally fossiliferous, the species belonging to a small fauna of shallow-water affinities which followed near the advancing shore line of the early Heath sea. The first appearance of species of *Chione* and *Dosinia* show the affinities of this fauna with the succeeding Miocene while such forms as *Peruluta mancorensis*, *Pseudoliva parinasensis* var. *mancorensis*, *Architectonica sullana* and *Clementia peruviana* are old types which have persisted from the late Eocene and in this region at least, are not known above this horizon. The following species belong to this zone of the basal Heath or Caleto Mero shales.

Leda (Adrana) sp
Barbatia sp.
P *Arca (Scapharca) meroensis,* n. sp.
Tagelus sp.
MZP *Mactra (Mactrella) tumbezia,* n. sp.
P *Chione posorjensis,* n. sp.
Callista (Costacallista) mancorensis, n. sp.
T-M *Clementia peruviaia,* n. sp.
Dosinia (Dosinidia) palmeriae, n. sp.
P *Macoma meroensis,* n. sp.
P *Sinum multilineatum* var. *peruvianum,* n. var.
P *Turritella meroensis,* n. sp.
Turritella Caleta, n. sp.
Turritella conquistadorana Hanna and Israelsky
M *Turritella hubbardi* Hodson
T-M *Architectonica sullana* Olsson
Crepidula sp.
Ficus woodringi, n. sp.
Bursa sp.
Acanthina (Chorus) meroensis, n. sp.
P *Acanthina (Chorus) sula,* n. sp.

CM *Pseudoliva parinasensis* var. *mancorensis* Olsson
T-M *Voluta (Peruluta) mancorensis* Olsson

* Restricted to this horizon.
T-M Talara to Mancora.
C Chira, Z Zapotal Ecuador, P Posorja Ecuador.

Of the 23 species in the above list, about 17 or 70% are restricted to this horizon. Some of these forms as *Chione posorjensis, Macoma meroensis, Turritella meroensis* and *Chorus sula* are also known from Posorja Ecuador and the top of the Mancora sandstones at Mancora, two localities which apparently represent the same general horizon.

The shales which occupy the area between Mancora and Punta Bravo belong to the Heath formation. At Mancora Narrows, they are seen resting on the Mancora sandstones and contain the small fauna listed on page 11. Along Quebrada Seca-Bravo, the shales contain large concretions from which the following species have been collected.

Pleurophopsis peruviana, n. sp., also at Belen and Pajarabobo
Pleurophopsis lithophagoides, n. sp. at Belen and Pajarabobo
Myrtaea ? cooki, n. sp. Belen

This general horizon belongs to the *Pleurophopsis* zone.

In southern Lagunitas and in the Chira valley, the Heath shales (The Cone Hill facies) occupy general synclinal areas and are the youngest Tertiary rocks found in those regions. They are usually black or gray shales, contain much surface gypsum and in some localities thin seams of yellow, cherty limestones. Towards the base, they are transitional with the less marine rocks of the Mancora formation.

Near Belen and Pajarabobo, a few miles south of Lagunitas, the Heath shales occupy the central part of the Lagunitas syncline. The shales are usually limy and often contain wide belts of thin-bedded, yellow limestones. Fossils may occur in these limy beds but they are usually rare and require deligent search. Shark teeth and vertebrae are more common and several large skeletons of toothed whales, the bones completely replaced by gypsum, have been found.

The fossil species of mollusks which are known from these beds form a small but very characteristic faunal group which may be called the *Pleurophopsis* fauna or the horizon which they characterize as the *Pleurophopsis* zone from its most outstanding member. The following species have been collected from this horizon near Belen and Pajarabobo (Tri. sta. 157).

**Nucula* (*Nucula*) *paboensis,* n. sp. Pa.
**Acila paita,* n. sp. Pa.
**Acila piura,* n. sp. Pa.
**Solemya* (*Acharax*) *belenensis,* n. sp. Be.
**Pleurophopsis peruviana,* n. sp. Ma., Pa., Be., Cu.
**Pleurophopsis lithophagoides,* n. sp. Ma., Pa., Be., Cu.
**Vesicomya tscudi,* n. sp. Be.
**Vesicomya ramondi,* n. sp. Be.
**Thyasira tessaria,* n. sp. Pa., Be.
**Myrtaea* ? *cookei,* n. sp. Ma., Pa., Be., Ecuador.
**Nerita* sp. Pa.
**Austrofusus* ? *belenensis,* n. sp. Pa., Be.
**Siphonalia* ? *belenensis,* n. sp. Pa., Be.
**Siphonalia* ? *tessaria,* n. sp. Pa., Be.
Aturia alabamensis var. *peruviana* Olsson Pa.

Of the 15 species listed from this fauna but 1, *Aturia alabamensis* var. *peruviana,* is known from other rocks. *Pleurophopsis peruviana* and *lithophagoides* and *Myrtaea* ? *cookei* are known from the Heath shales of Quebrada Seca-Bravo north of Mancora and from the Heath shales just east of Quebrada Culebra. *Myrtaea* ? *cookei* is also known from the Mambri shales of Ecuador near Manglaralto.

THE LOMITOS CHERTS

There remains to describe a curious occurrence of cherty limestones in lower Lomitos (Sq. Mi. 1, N. 7.), whose exact age and stratigraphic position is still uncertain. It is an isolated exposure, concretionary like in form, and composed of hard, yellow, cherty limestones. The surrounding outcrops are the lower Talara shales and wells drilled in the vicinity, encounter a normal lower Talara section until they pass through the unconformity at the base of the Talara formation. The nearest Oligocene strata are the sandstones, shales and their intercalated pebble beds, belonging to the Lagunitas facies of the Mancora formation about one mile to the south. The apparent field relations of the Lomitos cherts would seem to show that they belong to the lower Talara formation and somewhat similar but unfossiliferous cherts occur in the lower Talara shales north of Negritos (Sq. Mi. 4, N. 4).

The fauna of the Lomitos cherts is as follows.

Aturia alabamensis var. *peruviana* Olsson a small form, like those from the Cone Hill shales.

Thyasira peruviana, n. sp. common.

Thyasira staufti n. sp. common.

Pleurophopsis peruviana, n. sp. quite common.

Myrtaea ? very small specimens.

Vesicomya ? of *tscudi,* n. sp.

Cytherea ?

A large *Cyprina-Isocardia* like shell 190mm. in length.

Solemya lomitensis, n. sp.

Ampullina or *Polinices* internal casts.

Nerita ?

Thyasira peruviana and *staufti* are the commonest species and occur in great numbers. It is significant to note that no Talara or even essentially Eocene species are found in this fauna or have any of the Lomitos species been found elsewhere associated with Eocene forms. On the other hand, *Pleurophopsis, Solemya* as well as the lithological aspect of the rocks resemble the cherty limestones of the upper Oligocene, or Heath shales. Were it not for their close association with Eocene rocks and their remoteness from Oligocene strata, this fauna would without hesitation, be classed as Oligocene. I am inclined to accept the paleontological resemblance of greater significances than the apparent field relations and believe that the Lomitos cherts are Oligocene in age. If the Lomitos cherts are actually Oligocene, their isolated occurrence in the midst of Eocene outcrop, is best explained as an erosional remnant which has been left after the removal of a once continuous but unconformable cover of Oligocene beds. It is hoped that the Lomitos fauna will eventually be discovered in rocks whose stratigraphic relations can be satisfactorily determined.

ECUADOR

Upper Oligocene rocks, equivalent to the Heath shales are well represented in Ecuador on the Santa Elena peninsula. They form the shale belt between the middle Oligocene sandstones of Zapotal and the Miocene fossiliferous sandstones of Aguada and Amen and extend southward along the east side of the Chanduy hills. Being soft in nature and easily weathered, these shales are generally poorly exposed and give rise to wide, grass-covered areas of low relief. Good exposures occur around Estero Mambri on the south coast where they rest upon the sandstones of Punta Mambri. They also form the high cliffs south of Manglaralto north of Colonche. The following species have been collected from a large limestone concretion in these shale cliffs of Manglaralto.

Myrtaea ? cookei, n. sp. Heath shales of Peru.
Solemya sp. Heath shales of Peru.
Pleurophopsis sp. Heath shales of Peru.
Thyasira sp. Heath shales of Peru.
Siphonalia a very large species.
Dentalium sp. Probably same species in Cone Hill of Peru.

Correlation

In the following diagram an attempt has been made to show graphically, the oscillations in sea-level or the major migrations of the strand line in northern Peru during the Oligocene epoch. It reveals two complete diastrophic cycles or two distinct periods of sea-transgression, each beginning and ending with partial or complete emergence of a large part of the coastal region. The Peruvian Oligocene is therefore broadly divisable into two rock groups which correspond to two periods of general and widespread marine invasion.

The Saman Eocene as previously noted, came to a close with general emergence and sea-retreat. This period of uplift was probably of short duration and was soon followed by renewed subsidence producing the Chira transgression. The Chira formation is closely related faunally and stratigraphically to the underlying Saman Eocene and consequently is correlated with the lower Oligocene or the Vickburgian of the Gulf States and the Lattorfian of Europe.

During the period of uplift between Chira and Mancora times,

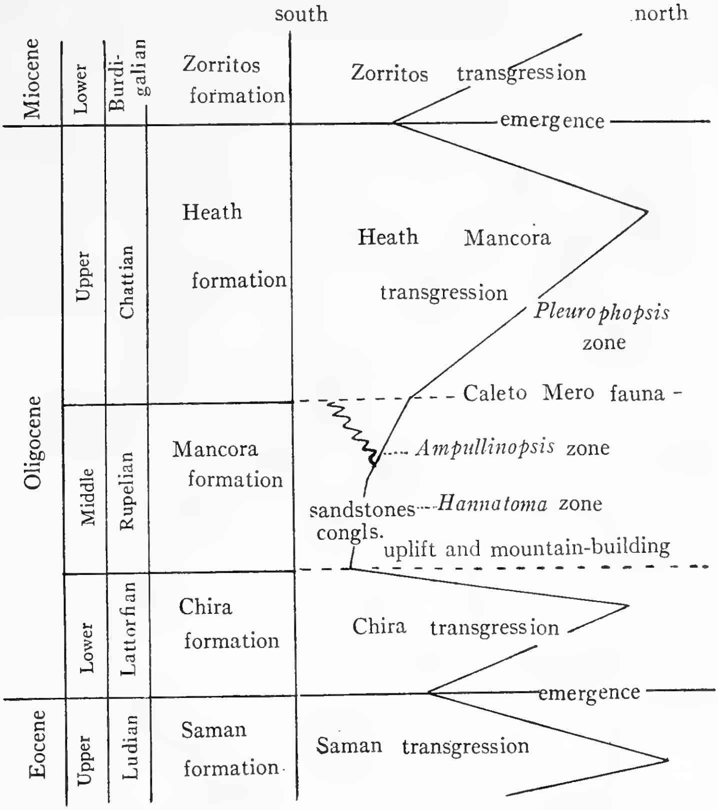

Diagram illustrating the migration of the strand-line in northern Peru during the Oligocene epoch

mountain building seems to have been actively at work, the adjacent lands were greatly elevated and large quantities of coarse terrigenous material were deposited by the rejuvenated streams along the sea-front. It seems quite certain that this condition of high relief was general over a large part of northern South America. In Peru, Ecuador and northern Colombia, the middle Oligocene rocks consists chiefly of sandstones, conglomerates and volcanic tuffs, usually of fresh-water origin and frequently of great thickness. This period of mountain building which preceded the deposition of the Mancora rocks in northern Peru, is the most important event of Oligocene times in northern South

America.

Although the Mancora rocks are usually of fresh or brackish-water origin, they represent the initial stage of a second marine invasion which culminated in the deposition of the entirely marine Heath shales. A curious mixture of fresh-water shells with strictly marine species is a marked feature of the Mancora fauna. Most of the Mancora species are distinct from those of the Chira shales although certain forms such as *Aturia alabamensis* var. *peruviana, Peruluta mancorensis* and *Clementia peruviana* have persisted from early Talara times. About 71 species have been recorded from the Mancora formation proper with 21% in common with the Chira shales.

From the standpoint of faunal correlation, *Ampullinopsis spenceri* originally described by Cooke[8] from Willoughby Bay Antigua, is the most important species in the Mancora rocks. In Peru, this species is restricted to the upper part of the Mancora formation. At Posorja Ecuador, this fossil somewhat smaller in size, seems to occur at a slightly higher horizon. *Ampull.nopsis spenceri* has also been collected in northern Colombia associated with a typical Punta Bravo fauna of *Hannatoma* and *Pseudofaunus*. The same series of rocks contain coal beds and marine limestones filled with large *Lepidocyclinae*.

Vaughan[9] who has critically studied the fossil corals of Antigua, has repeatedly emphasized the middle Oligocene (Rupelian) affinities of the Antiquan formation and regards it as the key horizon and key formation in the correlation of our Tertiary deposits with those of Europe. The stratigraphic occurrence of *Ampullinopsis spenceri* in Peru and Ecuador, would indicate that the Antiguan formation is approximately equivalent to the upper part of the Mancora formation. This correlation of the Mancora formation with the middle Oligocene or Rupelian-Stampian of Europe, agrees with the natural stratigraphic division and the correlation of the Chira shales with the Lattorfian or lower Oligocene.

[8]Cooke, 1919, Contribution to the Geology and Paleontology of the West Indies, Carnegie Institution of Washington, No. 291, p. 123, pl. 5, figs. 1-3.

[9]Vaughan, 1919, Bull. 103, U. S. Nat. Mus., pp. 202, 203, 582., Pan-Pacific Scientific Conference, p. 832.

As submergence progressed, marine conditions became established over a larger region with the Mancora rocks grading into a thick series of overlying shales which have been called the Heath formation. In the Mancora and Caleto Mero districts, the transitional beds consisting of thin sandstones and shales are quite fossiliferous and contain the special fauna listed on page 20. This fauna has also been collected in southeastern Ecuador at Posorja. The persistance of certain old species as *Pseudoliva parinasensis* var. *mancorensis, Peruluta mancorensis, Architectonica sullana* and *Clementia peruviana* indicate that this fauna is still Oligocene in age and closely related to the underlying formations but early Miocene influence is seen in the first appearance of species of *Chione* and *Dosinia,* two genera which assume a very important role in the later Tertiary faunas.

The typical Heath shale fauna or the fossils of the *Pleuropopsis* zone have been listed on page 22. It is a peculiar group of mollusks which combine to a marked degree, the aspect of fresh-water and deep-sea forms and species of *Pleuropopsis* were first described or noted by Cooke and Maury as Unios. Later Palmer (Van Winkle) showed that these *Unio*-like fossils from Trinidad belonged to marine forms whose dentition and deep muscle scars suggested descent from the pre-Tertiary genus *Pleurophorus.* This fauna is known from many localities in northern Peru, from the Mambri shales of Ecuador and from northern Colombia (Rio Sinu). The small group of species described by Cooke from the Asphalt beds of Bejucal Cuba as well as the Godineau horizon of Trinidad is equivalent. The intimate stratigraphic relations of the Heath shales to the underlying Mancora beds of middle Oligocene age, as well as their position directly beneath the Zorritos formation of lower Miocene or Burdigalian age, indicates that the Heath shales belong to the upper Oligocene or Chattian. They are thus equivalent to the Anguilla formation of the Lesser Antilles.

The overlying Zorritos Miocene is usually uncomformable on the Heath shales, indicating uplift and erosion at the close of Oligocene times. This was followed by a general Miocene transgression which reached its culmination during the Helvetian - Tortonian.

It is not the purpose of this paper to discuss questions of general correlation unless they directly affect the interpretation of the Peruvian section or the limitation of the Oligocene system. In the West Indian and Caribbean region, the pre-Miocene faunas, aside from the larger foraminifera and the corals, are not well known. Vaughan's critical studies of the corals and in more recent years of the larger foraminifera, have been very important in correlating these rocks with their corresponding stages in Europe

Vaughan's most recent views on the age of the upper Culebra beds and the Emperador limestones of the Canal Zone, as well as the Anguilla formation of the Lesser Antilles, is that these deposits belong to the lower Miocene. This view is accepted by Woodring in his Bowden gasteropods (see correlation chart opposite p. 41). In this paper, I have preferred to follow Vaughan's older correlations (1919) in which these formations are assigned to the upper Oligocene as this arrangement seems more in accord with the diastrophic history of the region, as well as the closer stratigraphic and faunal affinities which these rocks bear to formations of undoubted middle Oligocene age. The typical Culebra beds as formerly exposed at their type locality in Gaillard cut, are unique or exceptional amongst the Tertiary formations of Panama. They represent principally rather shallow-water deposits accumulated in a narrow, isthmian strait which for a short time connected Pacific waters with those of the Caribbean (see Vaughan, Bull. 103, U. S. Nat. Mus., p. 211) during a period of maximum sea-transgression. The Caimito formation (see MacDonald, Bull. 103, p. 531) which lies directly above the Emperador limestone are non-marine rocks indicating uplift with complete and final withdrawal of marine waters from the interior of Panama in the isthmian region. In the thicker Tertiary sections of southern Panama, northern Costa Rica, the Darien region and northern Colombia, the only beds which can be compared with the Culebra rocks are the massive, usually Orbitoidal limestones which in many places form the basal or lower part of the Tertiary section and are partly late Eocene and middle Oligocene age.

The mollusks of the Culebra beds and Emperador limestones have not been completely described. The larger foraminifera and corals are more fully known. Vaughan's analyses of the corals of the upper Culebra beds is as follows (Vaughan, Bull. 103, p. 208) "Of the 6 species in the Culebra formation, 2 also occur in the Emperador limestone; 4 also occur in the Antigua formation; and 4 also occur in the Anguilla formation. There is only one species *Astreopora antiquensis,* that is elsewhere known only from the Antigua horizon; while 2 species are at present known elsewhere only from the Anguilla horizon." From the Tonosi limestones of southern Panama which Vaughan correlates with the lower Culebra formation, he lists 5 species of corals, 4 of which occur at Antigua.

The coral fauna of the Emperador limestone show the close affinities of these rocks with the Culebra and Antigua. According to Vaughan (*op. cit.* p. 209) "Of the 26 species from the Emperador limestone, 6 have been identified in the Antigua formation and 9 in the Anguilla formation, but it is probable that the number of species common to the Emperador limestone and the Anguilla formation will be somewhat increased." The corals from both the upper Culebra and Emperador limestone show close relationship with the Oligocene coral faunas from Antigua but not a single species is known elsewhere in rocks of undoubted Miocene age.

For a description of the Culebra beds and Emperador limestone, as well as the other formations in the Canal zone, the reader is referred to the carefully measured sections of MacDonald (Bull. 103, pp. 533-545) made during the digging of the Canal and from cuts along the relocated Panama railroad. These exposures are now largely covered by the waters of the Canal or overgrown with vegetation. On bases of fauna and lithology, the Culebra beds have been divided into a lower and upper member. The lower member consists of dark, well-laminated beds of soft shales, marls and carbonaceous clays, with some pebbly, sandy and tuffaceous layers. There are also a few thin beds of lignitic shale. The upper member is more calcareous in character with lenses of sandy limestones and calcareous sandstones separated by carbonaceous clays and thin-bedded tuffs. There is no evidence of any stratigraphic break between these two zones and together, they doubtless represent a continuous deposit. The change in fauna and lithology between the lower and upper member is probably not of very great importance. The gradual cessation of argillaceous sedimentation and consequent clearing of water led to limestone formation and an environment more favorable to the growth of corals.

The Bohio conglomerates, the Culebra beds, the Emperador limestone and the Caimito formation, represent a complete depositional cycle. The Bohio rocks are principally non-marine, composed of thick, coarse conglomerates of water-worn boulders and cobbles, eroded from steep slopes and recently uplifted mountains. With continued subsidence, flooding of marine waters occurred over a larger area, until finally a strait was formed connecting the Pacific with the Caribbean. Complete marine sedimentation is indicated by the calcareous deposits of the upper Culebra and the Emperador limestones, rich in corals. The Caimito formation, principally non-marine sandstones and tuffs, is the closing stages of this cycle and indicate renewed uplift and general sea-retreat. Compared with the diastrophic cycles as recently determined for Peru, a close correspondence is found with the middle - upper Oligocene or Heath - Mancora transgression. The Bohio conglomerates, the direct results of recent mountain building, corresponds to the non-marine portion of the lower Mancora or Punta Bravo grits. The lower Culebra is equivalent to the more marine portion of the upper Mancora. The upper Culebra represents the transitional zone between the Mancora and Heath, while the Emperador limestone is equivalent to the typically marine part of the lower Heath. The Caimito formation correspond to the recessive part of the very late Oligocene sea or possibly to a transitional period between the late Oligocene and early Miocene. A correlation of the Caimito formation with the Aquitanian of Europe is suggested. It may be mentioned that the European Aquitanian is the beginning (and not the end) of a marine transgression which was continued and further expanded during the Burdigalian.

DESCRIPTION OF SPECIES

Class PELECYPODA

Order PRIONODESMACEA

Family SOLEMYACIDAE

Genus SOLEMYA Lamarck

Subgenus SOLEMYA s. s.

Solemya (Solemya) lomitensis, n. sp. Plate 3, fig. 5.

Shell *Tagelus*-like, the height about one-third the total length; posterior side short, somewhat contracted or deeply impressed along the dorsal margins; anterior side more than twice the length of the posterior with the dorsal and ventral margins straight and parallel; dorsal side somewhat longer than the ventral so that the anterior side, although straight, appears to be obliquely truncated; surface of the internal molds is nearly smooth and polished but showing faint radial bands on the anterior one-third; umbos low, wide with scarcely differentiated beaks.

Length 60mm.; (broken, est. 70mm.) height 28mm.; diameter 6mm?

Remarks.—The type specimen is an impression of the interior of two spreading valves belonging to the same individual. The short posterior side has been broken away so that the full length of the valves must be estimated. The surface is smooth and polished but shows at the anterior end faint impressions of 6 radial bands. These radial bands were continued beyond the edge of the valves as digitate processes of the epidermal layer, remains of which are found on the anterior edge of the right valve.

Locality and Geological Occurrence.—Lomitos.

Subgenus ACHARAX Dall

Solemya (Acharax) belenensis, n. sp. Plate 3, fig. 7.

Shell elongate, *Tagelus*-like in form; anterior-dorsal side straight with the low, wide beaks at the posterior one-quarter; ventral side straight and with the anterior side appearing sharply truncate; posterior side is narrowed and contracted, its dorsal edge erect, plate-like in form and probably carried a large external ligament; surface smooth or showing only faint traces of radial groovings along a zone from the beaks to the ventral-anterior extremity; epidermis extended beyond the ventral periphery of the valves as a wide band, simple in the middle, digitate at the anterior and posterior extremities.

Length 84mm.; height 25mm.; semidiameter 9mm.

Remarks.—The above dimensions are of the valves proper and do not include the epidermal extensions along the ventral margin. The shell is nearly smooth or with faint, radial grooves across the umbos to the anterior-ventral margin. The general form of the valves without the epidermal covering is similar to *Tagelus,* except that the anterior and posterior ends of the shell are reversed.

The type specimen includes both valves, but the right valve is broken and partly buried in the matrix filling the cavity of the other. Along the ventral margin there are remains of the digitate extensions of the epidermal covering. They are best preserved on the anterior-ventral margin where three and the base of a fourth of these fringes may be seen. They are quite large, measuring about 6 to 7mm across the base and more than 15mm long (tip broken). The collection also contains 3 specimens from Pajarabobo. On one of these, the extensions of the epidermal layer has been well preserved as a broad ribbon-like band, 11 to 12mm wide, along most of the ventral margin. It is simple, nearly smooth in the medial portion, becoming deeply digitate along the anterior side and probably less so along the posterior side.

Locality and Geologic Occurrence.—Heath formation, Lobos, Pajarabobo.

Superfamily NUCULACEA

Family NUCULIDAE Adams

Genus NUCULA Lamarck

Subgenus NUCULA s. s.

Nucula (Nucula) paboensis, n. sp. Plate 2, fig. 7.

Shell of medium size, inequilateral, moderately convex, ovate-subtrigonal in outline; beaks small, pointed, with the greatest convexity of the valves a short distance above and anterior of the middle; the general outline of the shell is subelliptical with a well-rounded basal margin, a slightly rounded posterior-dorsal margin but with the anterior side appearing obliquely subtruncate by the large, straight, lunular edge; surface marked with fine, concentric lines or wrinkles which are slightly heavier towards the anterior side; they are crossed by minute, radial lines thus producing a fine reticulate or mesh-like sculpture; weathering of the surficial layer reveals an internal shell structure of strong, radial riblets; lunule large, subelliptical, the center slightly elevated or pouting, and encircled by a submarginal, depressed zone; lunule smooth or nearly free from any sculpture; interior concealed.

Length 21mm.; height 16mm.; diameter 10mm.

Remarks.—This is typical *Nucula* distinguished by its fine sculpture of minute radial lines and concentric wrinkles.

Locality and Geologic Occurrence.—Heath formation, Pabo.

Nucula mancorensis, n. sp. **Plate 2, fig. 8.**

Shell rather large, moderately heavy and transversely subovate or subelliptical in outlines; beaks are small and inconspicuous, situated near the posterior one-fourth and passing into the full but not prominent umbos; the shell is but moderately convex and the surface sculptured with rather coarse, irregular growth lines; there is no evidence of any radial lines so generally found on many species of *Nucula,* and the ventral margin is smooth; the outline of the valves is subelliptical, inequilateral, with a broadly rounded basal or ventral margin, sometimes slightly arcuated near the middle; a slightly rounded anterior-dorsal margin and the anterior and posterior extremities narrowly rounded or crudely pointed; there is a slightly depressed or sunken escutcheon just beneath or in back of the small beaks.

Length 26mm.; height 19mm.; diameter 12.5mm.

Remarks.—Most recent and Tertiary species of *Nucula* are quite small, unusually with a fine, radial internal shell structure which gives rise to a crenulated ventral margin. A few species such as *N. taphria* Dall of the Duplin Miocene and certain recent forms, may lack this internal shell structure and the ventral margins are consequently smooth. From external appearance alone, this species might be thought to belong to the *Veneridæ* but by breaking away the shell along the dorsal margin, the characteristic taxodont teeth are revealed. In size, *mancorensis* resembles certain Cretaceous species of the United States, namely *N. percrassa* Conrad and *slackiana* Gabb of the Atlantic Coastal Plain and the recently described *N. larimerensis* Reeside of Colorado. From all of these, it differs by its outlines, absence of radial shell structure and simple ventral margins. *N. lebuensis* Philippi of Chile differs by its more elliptical outline while *valdiviana* Philippi also from Chile is still larger than *mancorensis*. *N. mirifica* Dall, a recent Japanese species, according to Dall, is probably the largest smooth recent *Nucula* known and reaches a length of 36mm., but is surpassed in size by the Japanese species of *Acila*.

Locality and Geologic Occurrence.—Mancora formation, top of the Mancora sandstones at Boca de Mancora.

Genus ACILA Adams

Acila paita, n. sp. Plate 2, figs. 11, 13.

Shell generally larger than the next species, usually from 17 to 22mm. in length; the general outline is subelliptical with a well-rounded ventral margin, straight or slightly arcuated dorsal margin and with the posterior side pronouncedly truncated and flattened; beaks small, inconspicuous, situated close to the posterior side of the valves; valves moderately convex, the greatest inflation being about the middle; escutcheon broadly elliptical with an inner or central sculptured ridge or cresentic fold between bordering sinuses or depressions: lunule narrow, elliptical; external surface sculptured with typical *Acila*-markings or ribs; in younger specimens and on the umbos of larger ones, the ribs form a single divaricate set on each side of the ventral sinus; this simple sculpture may persist or the ribs close to the ventral margin may begin to zigzag about two or three short sinuses; near the dorsal margin, the end of the ribs may bifurcate into short branches.

Length 17.25mm.;	height 12.75mm.;	diameter 8.25mm.
17mm.;	13mm.;	8.25mm.

Remarks.—Differs from *piura,* by its larger size and coarser sculpture.

Locality and Geologic Occurrence.—Heath formation, Lagunitas shales south of Negritos.

Acila piura, n. sp. Plate 2, figs. 9, 10, 14.

Shell small or medium size, solid, transversely subtrigonal; beaks small, inconspicuous with high, full umbos, situated in young shells about the posterior one-third but becoming more posterior with age; the ventral margin is smoothly rounded, passing into the narrowly rounded anterior extremity; anterior-dorsal margin somewhat arcuate or convex, the posterior-dorsal margin straight, subtruncate and ending in a subpointed posterior-ventral extremity; the outline is quite variable, young specimens being generally nearly as high as long, while older specimens may remain moderately high and subtrigonal or become elongate and much longer than high; internal molds usually show two folds extending across the umbos to the posterior half of the ventral margin and a broad, subobsolete, depression or sinus between; escutcheon wide and shallow, and marked only by a change in sculpture; surface sculptured with the usual divaricate markings of *Acila,* is fine or medium strength as illustrated by the figures; on the anterior-dorsal submargins and on the lunular area, the ends of the ribs fork or become further divided into simple, short branches.

Length 14.5mm.; height 11mm.; diameter 8mm.
12mm.; 9.5mm.; 6mm.

Remarks.—From the preceding species, *piura* differs by its smaller size and finer sculpture as illustrated by the figures.

Fossil Acilas first appear in the Cretaceous of Europe and West America, and continue through the Tertiary to the present time. In the recent fauna, the genus is confined to the Pacific region, species occurring along the Japanese and Chinese coast and one species *A. castrensis* Hinds along the Californian coast. In the Atlantic region, the group is known only as fossil in the Tertiary rocks of the Antillean area as well as a single species in the Pliocene of England. Several fossil forms are found in the Tertiaries of the West Coast in Eocene and Miocene beds.

Locality and Geologic Occurrence.—Heath formation, Lagunitas and Cone Hill shales south of Lagunitas.

Family LEDIDAE Adams

Genus LEDA Schumacher

Section LEDA s. s.

Leda (Leda) stewardi, n. sp. Plate 2, fig. 12.

about 25mm; valves moderately convex, moderately heavy and
Shell of medium size, the largest individual with a length of the surface finely sculptured with close concentric lines; the outline of the valves is sub-yoldiform, sublenticular and with the beaks and umbos slightly anterior of the middle, the greatest height is about the umbonal region, with the anterior side evenly rounded, the posterior produced, narrowed and slightly flexed from the beaks towards the posterior extremity; rostral area sublenticular, outlined by a deep, marginal groove and somewhat arched along the valve margin, sculpture of close, elevated, concentric ridges or threads, strong and regular on the umbos and center of disk, but becoming subobsolete towards the base and on the rostral sides, leaving these areas smooth.

Length 18mm.; height 10mm.; diameter 6.25mm. (type)
25.5mm.; 9mm.; 12mm.

Remarks.—This species is found in the lacustrine Ancon Point sandstones associated with *Anconia elenensis*. It is a large shell for the genus, reaching a length of about 25mm. The beaks and umbos are not quite central with the posterior side contracted and pointed at the end. The sculpture consists of fine, regular, concentric raised threads absent near the posterior and anterior dorsal margin.

Locality and Geologic Occurrence.—Ancon Point formation, Ancon Point, Ecuador.

Section SACCELLA Woodring

Leda (Saccella) miradorana, n. sp. Plate 1, figs. 4, 6, 10, 11.

Average length of shell about 14mm; subelliptical in outlines, pointed, cuneiform behind; beaks small, inconspicuous and situated slightly anterior of the middle of the valves; convexity of the valves is moderate; basal margin widely and evenly rounded, the anterior extremity generally narrowly rounded while the posterior extremity is pointed; lunule very narrow, sunken and defined by an obtuse angulation of the valves and lack of concentric sculpture; escutcheon narrowly lanceolate or lenticular in outlines and strongly sculptured with ridges paralleling the hinge margin; rostral angle sharp and ridge-like; sculpture consists of moderately coarse, regular concentric ridges or elevated threads; there is usually present a faint fold and sinus across the anterior portion of the valve meeting the ventral margin just back of the anterior extremity; hinge concealed.

Length 14.25mm.; height 9mm.; semi-diameter 2.50mm.

Remarks.—From the members of the *Leda acuta* group, this species differs by its porportionately longer and more evenly lenticular shell.

Locality and Geologic Occurrence.—Mancora formation, Mirador sandstones and shales of Que. Charanal.

Leda (Saccella) charanica, n. sp. Plate 1, figs. 5, 7.

Shell small, depressed or but slightly convex, strongly sculptured with elevated, concentric ridges; beaks small, situated at an equal distance from the anterior and posterior extremities; ventral margin broadly rounded; the posterior-dorsal margin straight or slightly concave, ending in the bluntly pointed posterior extremity; rostrum lanceolate to subelliptical, defined by a heavy angle or fold, and strongly sculptured with ridges parallel to the hinge margin; the sculpture consists of strong, elevated, concentric ridges separated by deep grooves, and marked with fine, radial lines or threads, producing a sculpture as seen on certain Semeles; there is usually a fold and sinus across the anterior portion of the shell; hinge features unknown.

Length 11mm.; height 6.25mm.; diameter 1.75mm.

Remarks.—This is a rare species represented only by 6 valves in our collection. The large valves are quite flat or depressed. In general outlines and coarse sculpturing they may be compared with the *Leda dodona* Dall of the Lower Miocene of Florida. The smaller valves are higher and slightly more convex. On low magnification, the tops of the concentric ridges are seen to be smooth but with the intervening grooves marked with fine, radiating threads.

Locality and Geologic Occurrence.—Mancora formation, Mirador sandstones of Que. Charanal.

Section ADRANA H. and A. Adams

Leda (Adrana) sp. Plate 2, figs. 15, 16.

Shell of medium size, flattened to slightly convex, elliptical; beaks slightly posterior of the middle with a shorter, pointed posterior end; anterior side wide, reaching its greatest height near the anterior one-third rounded at the end but meeting the dorsal side to form a right angle corner; there is usually a weak furrow from the beaks to the anterior-posterior extremity; valves flattened to slightly convex and sculptured with small, regular concentric threads, smoothish on parts of the surface and generally coarse near the ventral margin and on the anterior-dorsal slope; escutcheon long, narrow, lenticular impressed; lunule very narrow, linear; hinge not exposed.

Length 28mm.; height 10mm.
26mm.; 11.25mm.

Remarks.—The valves are but little convex with the surface marked with medium strength concentric threads strongest near the ventral and dorsal margins. Although quite common at Canoas, most of the specimens in our collection are internal casts, the external shell having broken away in course of collecting. It will be distinguished by its plain valves and lack of a sculptured posterior ridge. Specimens from Zapotal, Ecuador, are larger than those of Peru and have a length of about 33 millimeters. A second species of *Adrana* occurs at Caleto Mero distinguished in having the posterior dorsal side strongly carinated as in *A. crenifera* Sowerby recent along the Ecuadorian and Peruvian coast.

Locality and Geologic Occurrence.—Mancora formation, Que. Canoas. Middle Oligocene sandtones of Zapotal, Ecuador.

Superfamily ARCAEA

Family ARCIDAE Dall

Genus ARCA Lamarck

Subgenus ARGINA Gray

Arca (Argina) puntabravoensis, n. sp. Plate 2, figs. 1, 4.

Shell small, typical about 22mm in length, strongly convex or inflated with high, prominent umbos and subovate to subrhomboidal outlines; beaks small, prosogyrate, situated near the anterior one-third; umbos prominent and inflated; greatest convexity of the valves just anterior of the middle, usually with a low, wide, depressed zone, extending from the beaks in front of the umbonal ridge to the posterior half of the ventral margin; umbonal slope or ridge is rounded, with the posterior-dorsal submargins sharply contracted or impressed; hinge-line straight, with an extremity narrow, cardinal area; sculpture consists of 22 or 23, low, flat ribs, of which 15 to 17 are anterior of the umbonal slope; they are divided by flat, interspaces of the same width as the ribs themselves; the ribs and interspaces may be weakly beaded or crenulated by concentric, growth lines; a feeble interstitial thread is usually present between the ribs on the posterior submargins and between the 1st, 3 and 4 ribs on the anterior; interior and hinge concealed.

Length 22mm.;	height 19mm.;	semidiameter 6mm.	left valve.
20.5mm.;	18mm.;	8mm.	right valve.

Remarks.—From *A. samanensis* from the Saman sandstones, this species differs in shape being strongly convex with higher and fuller umbos and a more flexuous or contracted ventral margin.

Locality and Geologic Occurrence.—Mancora formation, Punta Bravo grits of Punta Bravo.

Subgenus SCAPHARCA Gray

Arca (Scapharca) meroensis, n. sp. Plate 2, figs. 2, 3, 5, 6.

Shell small, generally between 17 to 23 mm. in length, subrectangular in outlines and moderately convex; umbos are wide, full but not prominent with low, small, prosogyrate beaks; the umbonal slope is rounded or subangulated, with depressed and slightly concave posterior-dorsal submargins; ventral margin straight and parallel with the cardinal margin, becoming rounded on the anterior side; posterior side straight or slightly rounded, meeting with the basal margin at an angle slightly less than 90 degrees; sculpture consists of about 30 double ribs separated by wide, flat interspaces; on the umbos, the ribs are simple and finely beaded, but become divided distally by a deep, mesial groove; on the umbonal slope and posterior-dorsal submargins, the distal ends of the ribs may become still further divided by additional grooves into three or four, subsidiary riblets; interspaces are wide, flat and crossed by irregular concentric growth-lines; hinge straight, the cardinal area of medium width, the posterior side with fine, transversely-oblique grooves.

Length 22mm.; height 14.5mm.; semidiameter 7mm.
17mm.; 12mm.; 4mm.

Remarks.—This is a small *Scapharca* resembling *Arca lesueuri* Dall from the *Arca* bed at Vicksburg in form and size but with wider and fuller umbos and less pointed beaks. Of still greater importance, the ribs are double or bifid on both valves of *meroensis* while they are usually simple across the middle of the disk on the right valve of *lesueuri*.

Locality and Geologic Occurrence.—Heath formation, base of the Heath shales at Caleto Mero. Posorja, Ecuador.

Superfamily OSTRACEA

Family OSTREIDAE Lamarck

Genus OSTREA Linné

Subgenus OSTREA s. s.

Ostrea miradorensis, n. sp. Plate 1, figs. 1, 2.

Shell large, elongate, becoming thick and heavy with age; left valve shallow to moderately deep; attachment scar is large, elongate usually lying on the posterior side; the anterior side is free and in old shells becomes greatly thickened and roughened by the coarse edges of the lamellar layers; the left valve is sculptured with numerous, subregular, coarse, simple or bifurcating riblets; cardinal area of lower valve is wide and high with the ligamental area fairly long, erect, straight or slightly curved at the tip; lateral margin of valves non-dentate.

Height 130mm.; diameter 64mm.; (Cotype) Mirador
113mm.; 49mm.
187mm.; 105mm. (Holotype) Mirador

Remarks.—In the Verdun grits of the Negritos region, abundant oyster remains are found which probably belong to this species. Some of these fragments indicate oysters of large size, exceeding 400mm in length. In these large specimens, the shell has become greatly thickened along the anterior side and the ligament pit is vertical or slightly twisted. Large oysters are common in the Mirador conglomerates of the Chira valley and in zones in the Mancora and Punta Bravo grits north of Que. Mancora. These large shells have usually an elongate or racoon-oyster shape with a wide, high ligamental area and heavily thickened anterior side. The external surface is strongly ribbed in young shells but usually become smooth with maturity.

Locality and Geologic Occurrence.—Saman formation, Verdun grits of Jabonillal, Quemado, Lobitos and Verdun. Mancora formation, Mirador conglomerates of Mirador and near Tamarindo. Mancora sandstones of Mancora. Punta Bravo grits of Punta Bravo and Caleto Sal.

Superfamily PECTINACEA

Family SPONDYLIDAE Fleming

Genus SPONDYLUS Linné

Spondylus mimus, n. sp. Plate 3, fig. 2.

Right valve of medium size (height about 52mm), heavy, moderately convex or inflated; outline is pectinoid but apparently with the posterior side slightly produced and longer than the anterior; umbo high, full and prominent and showing a small attachment area; cardinal area is high, triangular, its base or length more than twice the height; ears small; sculpture consists of a series of low, radial ribs or cords, simple on the umbo but becoming mesially divided ventrally particularly on the anterior-ventral submargins; there are no spines; spaces between the ribs, generally wide and trough-like but narrower and more groove-like on the umbos; dorsal submargins smooth.

Length 49mm; height 52mm; semidiameter 17mm, (right valve)

Remarks.—Only the lower or right valve is known. It may be distinguished by its small, numerous spineless ribs.

Locality and Geologic Occurrence.—Chira formation, Chira valley near Casa Saman.

Family MYTILIDAE Ferussac

Genus MYTILUS (L) Bolten

Mytilus canoasensis, n. sp. Plate 1, fig. 12.

Shell mytiliform, subtrigonal, oblique, smooth except for fine to irregular lines of growth; beaks at the very anterior end with the anterior side below the beaks flattened, impressed; dorsal side straight; posterior side widely rounded; ventral margin more narrowly rounded between the anterior and posterior sides; a small byssal fold or sinus just below the beaks; internal characters unknown.

Height 25mm.; length 24.5mm.; oblique length 32mm.

Remarks.—The hinge and the interior are concealed on the Holotype so that when these are known, the species may prove to belong to *Mytilopsis.* The external appearance of the shell is however that of *Mytilus* which its association with a marine beach fauna of *Chione, Mactrella, Tagelus, Donax, Leda* and *Nucula* would also indicate. It differs from *Mytilopsis trigalensis* by its larger, thinner and flatter shell.

Locality and Geologic Occurrence.—Mancora formation, Punta Bravo grits, west branch of Que. Canoas 4 miles inland.

Family DREISSENIIDAE Gray

Genus MYTILOPSIS Conrad

Mytilopsis trigalensis, n. sp. Plate 1, figs. 3, 8, 9.

Shell small, oblique, strongly inflated or vaulted, mytiliform; beaks at the extreme anterior end; anterior side immediately below the beaks flattened or impressed so that the anterior portion of the shell appears strongly contracted; dorsal side straight and fairly long; posterior side straight meeting with the posterior-ventral extremity as a narrow curve; surface smooth or marked simply with fine to irregular lines of growth; hinge and interior unknown.

Length 12mm.; height 10mm.; oblique length 15mm.

Remarks.—This species is fairly common in the lower part of the Punta Bravo grits in Que. Boca Pan just north of the village of Trigal. Here it occurs along with a fresh or brackish water fauna of *Corbicula*, *Hemisinus* and *Pachychilus.* Most of the specimens occur imbedded in rock so that the hinge and interior are concealed from view. In a few specimens, principally internal casts, the poorly preserved hinge shows the large, wide chondrophore characteristic of *Mytilopsis.*

Locality and Geologic Occurrence.—Mancora formation, Punta Bravo grits of Trigal valley of Que. Boca Pan.

Order TELEODESMACEA

Superfamily CYPRICARDIACEA

Family Pleurophoridae Dall

Genus PLEUROPHOPSIS Van Winkle

Pleurophopsis peruviana, n. sp. Plate 4, figs. 1, 4.

Shell of medium size, coarse, elongate and *Unio*-like; posterior dorsal margin is quite straight, the ventral margin is parallel but with a wide, deep sinus in the middle; posterior side rounded, the anterior side contracted and rounded at the end; umbos prominent, merging posteriorly into the wide, arcuated umbonal slope and with the greatest inflation of the valves slightly posterior of the middle; beaks small and pointed; sculpture is coarse, consisting of strong, crowded growth-lines; ligament external; internal molds preserve the form of the valves except that the anterior end is more contracted, compressed and pointed; the anterior adductor muscle scars, high and conspicuous on the internal casts.

Length	70mm.; height	44mm.; diameter	39mm.
	76mm.;	40mm.;	32mm.
	47mm.;	24mm.;	23mm.

Remarks.—The genus *Pleurophopsis* with *P. unioides* Van Winkle as genotype, was described by Dr. Palmer[10] (formerly Miss VanWinkle) from the Godineau beds of Trinidad. It differs from *Unio* which the larger specimens resemble externally, in possessing true hinge teeth, there being two cardinal teeth in each valve. Together with large *Myrtaea*-like bivalves, *Thyasira, Vesicomya, Solemya,* certain marine gastropods (*Siphonalia*) and with an occasional *Aturia,* they form a faunal assemblage, very characteristic of the Peruvian Upper Oligocene, and this fauna in whole or in part, is now known from western Ecuador, northern Colombia, Trinidad and certain of the West Indian islands.

Compared with the type species *uniodes* and its variety *fernandensis* from Trinidad, *peruviana* is still more *Unio*-like with a strong umbonal ridge. *Unio bitumen* Cooke[11] from the asphalt

[10]Van Winkle, 1919, Bulls. Amer. Pal., vol. 8, p. 23.

[11]Cooke, 1919, Contr. to the Geology and Paleontology of the West Indies, Carnegie Institution of Washington, No. 291, p. 130, pl. 9, figs. 3 a-c.

beds of Bejucal, Cuba probably belongs to *Pleurophopsis*.

Locality and Geologic Occurrence.—Heath formation, Cone Hill shales of Belen and Pajarabobo south of Lagunitas. Mancora shales of Que. Conchudo-Bravo, north of Que. Seca. Lomitos.

Pleurophopsis lithophagoides, n. sp. Plate 4, figs. 2, 5, 7, 9.

Shell small, thin, elongate and *Lithophaga*-like, but the beaks less anterior in position and the valves more compressed; dorsal and ventral margins straight and parallel or with the dorsal side somewhat descending to form a subpointed or obliquely rounded posterior extremity; umbos small, inconspicuous with low, scarcely curved beaks near the anterior one-fifth; anterior side somewhat contracted and rounded at its extremity; the valves are slightly convex without an evident umbonal slope; surface with fine and irregular growth lines; internal molds show a fairly deep but not large anterior muscle scar and irregularly spaced concentric lines, which are the impressions of the deeper growth lines.

Length 39mm.;	height 14mm.;	diameter 8.5mm.
32mm.;	11.5mm.;	7mm.

Remarks.—These *Lithophaga*-like forms are often very common in certain cherty limestone concretion found in black foraminiferal shales of probable late Oligocene age. Since they occur principally as internal molds or tightly closed valves, the features of the hinge are not known. They resemble the smaller specimens of *P? unioides* from Trinidad but differ by their constantly smaller size, more regular *Lithophaga*-like outlines and less pronounced muscle scars.

Locality and Geologic Occurrence.—Heath formation, Cone Hill shales of Belen south of Lagunitas. Mancora shales of Que-Conchudo-Bravo, north of Que. Seca.

Superfamily ASTARTACEA

Family CRASSATELLITIDAE Dall

Genus CRASSATELLITES Krueger

Subgenus CRASSATELLITES s. s.

Crassatellites neorhynchus, n. sp. Plate 7, figs. 8, 10.

Shell of medium size, heavy, inequilateral, moderately convex;

posterior side obliquely truncated with the extremity slightly emarginate; posterior-dorsal margin straight, the basal or ventral margin slightly rounded and with a narrowly rounded anterior extremity; greatest convexity of the valves, a short distance above the center with the posterior-dorsal submargins somewhat concave or depressed; beaks small, pointed with the umbos strongly sculptured but not noticeably flattened; lunule subelliptical, deeply excavated; surface is mainly smooth, except for a narrow area on the umbo, which has 6 to 8 low concentric ribs or undulations which rapidly fade out ventrally; hinge not well exposed in any of our specimens.

Length 36mm. (broken); height 36mm.; semidiameter 6mm.

Remarks.—Our specimens are fragmentary with the posterior side broken so that the true outlines of the shell is best gained from impressions and the curve of the growth-line of earlier nepionic stages. The perfect shell appears to be broadly subovate, the ventral margin evenly curved and without any inflexion near the posterior end. The umbos near the beaks are sculptured with few, deep, concentric ribs or waves but are not noticeably flattened. The species sometimes becomes twice as large as indicated by the above measurements but all our specimens are fragmentary. The Mancora specimens are badly crushed.

Locality and Geologic Occurrence.—Chira formation, Chira valley near Casa Saman. Mancora formation, top of Mancora sandstones near Boca de Mancora.

Superfamily CYRENACEA

Family CYRENIDAE Gray

Genus CYRENA Lamarck

Section POLYMESODA Rafinesque

Cyrena (Polymesoda) bravoensis, n. sp. Plate 7, figs. 4, 9.

Shell small or medium size, subtrigonal with high prominent but narrow umbos and small, pointed and slightly curved beaks; small shells are longer and more subovate in outlines, when larger becoming trigonal with the ventral margin nearly straight and narrowly rounded anterior and posterior sides; anterior and posterior dorsal sides descending with narrowed, pointed, erect to slightly curved beaks so that the outline of the shell is strongly trigonal and hatchet-shaped; the valves are moderately convex and coarsely sculptured with even concentric ridges spaced about .6 of a millimeter apart on a shell 20mm. in height; there is no lunule but the area immediately below or in front of the beaks deeply impressed or concave; posterior-dorsal or area of escutcheon also deeply impressed or furrowed; internal molds show a deep, wide pallial sinus reaching forward from the lower side of the posterior muscle scar a short distance past the middle; hinge unknown.

Length 27mm.; height 24.5mm.; diameter 16mm.

Remarks.—The valves are somewhat variable in form with young shells ovate, veneroid but becoming high, trigonal and hatchet-shaped with maturity. Most of our specimens are internal molds but show patches of the original surface sculptured with coarse, even concentric ridges or ribs. *C. trigalensis,* from the Punta Bravo grits of Que. Boca Pan will be easily distinguished by its smoother sculpture.

Locality and Geologic Occurrence.—Mancora formation, Caleta Sal.

Cyrena (Polymesoda) trigalensis, n. sp. Plate 7, figs. 3, 6, 11.

Shell small, thin, inequilateral and moderately convex; umbos full but not prominent ending in the small, slightly curved beaks at the anterior one-third; anterior side much shorter than the posterior, impressed in front and just below the beaks but no lunule; posterior extremity narrowly rounded; there is usually a faint but evident posterior umbonal inflexion so that the posterior-ventral margin is slightly flexuous or sinuated; posterior slope flattened; surface marked with fine and irregular, concentric growth-lines; hinge not exposed but internal molds show the presence of two strong lateral teeth, the anterior one just below and in front of the beaks and the posterior more distant and near the posterior extremity of the hinge; pallial sinus small, distinct.

Length 19mm.; height 18.25mm.; semidiameter 5.5mm.

Length 18mm.; height 16mm.; semidiameter 4.75mm.

Locality and Geologic Occurrence.—Mancora formation, Punta Bravo grits at Trigal.

Superfamily CARDITACEA

Family CARDITIDAE Gill

Genus VENERICARDIA Lamarck

Subgenus VENERICARDIA s. s.

Venericardia (Venericardia) charanalensis, n. sp. Plate 3, fig. 6.

Shell subcircular, moderately convex; beaks small, adjacent, situated near the anterior one-fifth, with wide but not prominent umbos; greatest convexity of the valves just posterior of the center with a feebly angled umbonal ridge; outline of shell subcircular to nearly square, the height about equal to the length; basal margin little rounded, the posterior side straight with the 2 meeting to form an angle slightly less than 90 degrees; anterior side rounded; sculpture of about 22 V-shaped ribs separated by deep, rounded grooves; the anterior set of 11 ribs are coarsely beaded, the next 4 to the umbonal angle are unbeaded but terraced on each side; the ribs on the posterior dorsal slope are nearly concealed but appear to be finely beaded near the dorsal margin; lunule very small.

Length 34mm.; height 33mm.; semidiameter 12mm.

Remarks.—*Venericardia charanalensis* is a member of the *alticostata* group. It differs from typical *alticostata* by its more circular valves, heavier and less elevated ribs.

Locality and Geologic Occurrence.—Mancora formation, Mirador sandstones of Que. Charanal.

Superfamily LUCINACEA

Family LUCINIDAE Fleming

Genus LUCINA Lamarck

Subgenus LUCINA s. s.

Lucina (Lucina) inca, n. sp. Plate 5, fig. 7.

Shell orbicular, plump, slightly inequilateral; beaks small, slightly curved forward with wide full umbos passing into the general convexity of the shell; lunule concealed in our specimens; posterior-dorsal hinge margin straight, below with a well-defined posterior-dorsal area; basal margin well rounded, the posterior side straighter and appearing almost subtruncate; surface with fine and generally irregular growth-lines and the whole overrun with very fine, indistinct radial striae; interior concealed

Length 36mm.; height 33mm.; semidiameter 8.25mm.

Remarks.—This species is almost an exact diminutive of the recent *Lucina chrysostoma* (Meuschen) Philippi of the Antillean region and its representative species, *L. edentuloides* Verrill of the West Coast. It differs from *chrysostoma* by its more central beaks, in which feature the shell approaches more nearly *edentuloides.*

Locality and Geologic Occurrence.—Chira formation, near Casa Saman.

Lucina ? lomitensis, n. sp. Plate 5, figs. 1, 4.

Shell large, subcircular to subovate in form and strongly convex; umbos low, wide with very small, closely adjacent and slightly curved beaks; dorsal or hinge margin straight with a long, narrow ligament; sculpture of very fine growth lines, more widely spaced on the beaks and umbos; on internal molds, the cavity of the small beaks is scarcely evident; there is usually a faint groove or depression (corresponding to a ridge inside the valve), extending across the umbos to the posterior-ventral margin of the valves; there is a similar but fainter groove on the anterior side.

Length 120mm.; height 90mm. (broken); diameter 50mm.
height 110mm. (estimated)
Length 132mm.; height 80mm. (broken); diameter 57mm.
height 105mm. (estimated)

Remarks.—The above description is based on several large, internal casts and some smaller specimens which still retain part of the external shell. The hinge is not known and the impressions of the muscle scars are scarcely discernible, but the shape of the valves and small, closely adjacent beaks are features which seem to relate the fossils to the *Lucinidae.* They may be related to the Pseudomilthas of the European Eocene typified by *Phacoides giganteus* Deshayes.

Among the European Pseudomilthas, *lomitensis* bears the closest resemblance to *Lucina postalensis* Oppenheim[12] in that the

[12]Oppenheim 1896, Die Eocaenfauna des Monte Postale bei Bolca im Veronesischen, Paleontographica, Band 43, p. 155, taf. XII, fig. 4.

posterior side is longer than the anterior as well as by its low, scarcely pointed beaks. Several American species of *Pseudomiltha* have been described or recorded from the Yellow limestones of Jamaica and Haiti by Dall, Woodring and Trechmann but they do not resemble the present species. The interior of these large American Lucinas are not well known and it is possible that they may belong to a group distinct from the European *Pseudomiltha.*

Locality and Geologic Occurrence.—Lomitos cherts.

Genus PHACOIDES Blainville

Subgenus LUCINOMA Dall

Phacoides (Lucinoma) zapotalensis, n. sp. Plate 5, figs. 2, 5.

Shell of medium size, solid, suborbicular and moderately convex; outline of shell is nearly circular with the posterior side subquadrate, the greatest height of the valves along a line slightly anterior of the middle; beaks rather low, turned forward over the narrow, lunular area; dorsal area scarcely defined; ligament partly immersed in the hinge-plate; hinge not well exposed but judging from impressions with 2 cardinal teeth in each valve and a small anterior lateral in the right; a small posterior adductor near the dorsal corner and a long, narrow anterior adductor at the opposite side; pallial line entire, following near the ventral margin; interior of shell rugose and pustulate; surface sculpture is annulated with distant concentric thread-like ridges and numerous, crowded, coarse threads.

Length 47mm.; height 43mm.; diameter 19.5mm.

Length 37.5mm.; height 37mm.; diameter 20mm.

Remarks.—Our specimens are mainly internal molds with only patches of the external shell still remaining. The posterior-dorsal submargins are scarcely defined. The shell is quite heavy and internally coarsely rugose or pustulated as in the recent West Indian *Phacoides pectinata.* The surface is generally coarsely sculptured with crowded concentric threads but on better preserved species, this sculpture is seen to be annulated as in *filosus* Stimpson and *annulatus* Reeve.

Genus MYRTAEA Turton

Myrtaea (?) cookei, n. sp. Plate 3, fig. 3.

Shell large, thin, broadly elliptical, inequilateral, moderately convex; umbos low, wide, ending in the small, inconspicuous, curved pointed beaks situated at the anterior one-third; the valves are moderately convex, the greatest inflation being slightly anterior and above the middle; dorsal and ventral margins nearly parallel with the posterior side becoming widely rounded; anterior side contracted; surface is coarsely sculptured with close, crowded growth lines and sometimes faint indications of radial ribs on the posterior submargins; lunule appears to be absent or very small; hinge with a long, narrow posterior ligament.

Length 87mm. (broken); height 64mm.; diameter 15mm.

Remarks.—Our fossils are probably related to the shell identified by Cooke[13] with his *Myrtaea* (?) *asphaltica* from Bejucal Cuba and represented by figure 1 of his Plate 14. (by mistake called *Semele?* sp. from Willoughby Bay, Antigua which is figure 2). Cooke's specimen is more coarsely sculptured and the umbo appears to be higher and fuller.

The hinge and interior are not exposed on our specimens and consequently their generic relations remain uncertain. They probably belong to the *Lucinidae* but differ from most members of that famliy by their elongated form and absence of dorsal areas. As Cooke notes they differ from most American species of *Myrtaea* by their much larger size. In external form, thin shell, the fossils bear close resemblance to the fresh-water *Anodontinae* but occur associated with a truly marine fauna. This fauna has a wide distribution in northern Peru and western Ecuador and fossils from the same general horizons are in our collections from Colombia. It is therefore probable that the Bejucal asphalt locality of Cuba is closely equivalent in age to the Heath formation or to the late Oligocene of Peru and Ecuador.

Locality and Geologic Occurrence.—Heath formation, Cone Hill shales of Pajarabobo and Belen south of Lagunitas. Mancora shales of Que. Conchudo-bravo, about 6 miles inland from

[13]Cooke, 1919, Contributions to the Geology and Paleontology of the West Indies, Carnegie Institution of Washington, No. 291, p. 117, pl. 11, fig. 1.

Punta Bravo. Caleto Mero or Heath Shales inland from Que. Culebra and Piedra Redonda. Mambri shales of San Pedro near Mangalaralto, Ecuador.

Genus CODAKIA Scopoli
Section JAGONIA Récluz

Codakia (Jagonia) peruviana, n. sp. Plate 5, figs. 3, 6.

Shell small, suborbicular, moderately convex; lunule small, deeply impressed; in outlines, the anterior and posterior sides are nearly straight, with the basal or ventral margin strongly rounded at its middle point; beaks small, pointed, curving forward over the small lunule; dorsal areas poorly defined, principally by being slightly depressed and by a difference in sculpture; sculpture is elegant, consisting of rather widely-spaced concentric threadlets and much finer, closer-spaced radial riblets; on the anterior and posterior sides, the radial riblets are coarser, more irregular and cord-like; the dorsal areas are nearly free from radials and with the concentric threads more crowded; interior nearly concealed but the partly exposed hinge has the widely spaced laterals of *Jagonia.*

Height 9mm.; length 10mm.; semidiameter 2mm.
Height 7.5mm.; length 7.5mm.; semidameter 2mm.
Height 8mm.; length 8.5mm.; semidameter 2.75mm.

Remarks.—All of our specimens are imbedded in rock and with their surface more or less encrusted with a film or fine sand. The sculpture is subreticulate but with the radial riblets much finer than the concentric threadlets on the center of the shell disk. The hinge, only partly exposed, has the widely spaced laterals characteristic of the section *Jagonia.*

Previously, the earliest known American species of *Codakia,* were Miocene in age. In Europe however, *Codakia* s. s. is known from the Eocene of the Paris Basin, while *Jagonia,* represented by the *Lucina squamosa* Lamarck first appears in the Stampien of the same basin.

Locality and Geologic Occurrence.—Mancora formation, Que. Charanal.

Family THYASIRIDAE Dall

Genus THYASIRA (Leach) Lamarck

Thyasira staufti, n. sp. Plate 6, figs. 1, 2, 4, 13, Shell of medium size, broadly ovate, inequilateral, moderately to strongly convex; beaks and umbos fairly prominent, the former situated near the anterior one-third; the posterior-dorsal submargin is strongly defined by a heavy ridge extending from the beaks to the posterior extremities; this ridge is bordered above by a deep groove or sinus which is also deeply impressed on the internal casts; between this groove or sinus and the dorsal margin is a wide band, generally flat or faintly furrowed; the anterior-dorsal area defined by a deeply sunk cordate or nearly circular lunule; the ventral margins generally curved or rounded, but noticeably angled just back of the middle by a broad but faint fold extending ventrally from the beaks and bordered behind by a faint, shallow sinus; surface smooth or simply ornamented by more or less, irregular growth lines and the ridges and furrows of the dorsal areas; hinge unknown; interior of shell lucinoid.

Length 42mm.; height 34mm.; diameter 24mm.

Length 38mm.; height 32.5mm.; diameter 26mm.

Remarks.—Possibly this fossil should be referred to *Phacoides* rather than *Thyasira.* The strong dorsal areas (equally impressed upon the casts) and its evident close relationship with the next species with which it occurs in great abundance, leads me to believe that the species belongs to the genus *Thyasira.* The hinge is not preserved on any of our specimens but natural internal molds formed through the solution of the external shell show no impression of hinge teeth.

From the next species, *staufti* will be easily separated by its longer shell, the general absence of a medial ridge on its posterior-dorsal area and by its low beaks and umbos.

Locality and Geologic Occurrence.—Lomitos cherts.

Thyasira peruviana, n. sp. Plate 6, figs. 3, 5, 7, 8, 9, 12

Shell of moderate size, elevated, subovate, with high and prominent umbos and smaller prosogyrate coiled beaks; dorsal areas well defined, the posterior limited from the rest of the shell by a strong ridge along the umbonal angle; the posterior-dorsal area is elliptical in shape with a central or medial ridge bordered on each side by a flat or concave band; lunule cordate and deeply impressed; young shells are generally more rounded and smoothly convex; with age the shell becomes higher and angled along a line passing through the center of the umbos to the basal margin; basal margin rounded and generally somewhat angled midway; anterior extremity somewhat produced and angled at the end; the posterior extremity more rounded; surface smooth or marked with irregular growth lines; interior lucinoid and furrowed or ridged on the dorsal areas.

Length 32mm.; height 35mm.; diameter 28mm.
Length 25mm.; height 25mm.; diameter 19mm.

Remarks.—Young shells are nearly circular in form. With growth, the umbos become elevated and very prominent and the shell assumes a typical thyasiroid outline. The posterior-dorsal area is strong in each valve and carries mesially a sharp ridge or keel, lying between two excavated or concave furrows. These ridges and channels are continued through the substance of the shell and become impressed on the internal molds.

In form, the shell recalls the *Thyasira bisecta* Conrad from the Alaskan and Oregon coast. The more elevated forms are like *Axinus Schweinfurthi* Oppenheim[14] from the Eocene of Egypt, but our shells have the umbos still more prominent.

Thyasira tessaria n. sp. Plate 6, figs. 10, 14.

Shell like the preceding species but generally larger and more convex or inflated; the outline of the shell is subcircular, the greatest inflation located slightly above the middle of the valves; the basal or ventral margin is well rounded, the posterior side straight, slightly sinuated or subtruncate; anterior-dorsal or lunular area of moderate size, shallow, broadly elliptical or cordate in form; posterior-dorsal area quite large, moderately impressed and its surface appearing vaulted or slightly convex in the middle but without a distinct medial rib; surface roughly sculptured with coarse, irregular, crowded growth lines; hinge not exposed.

Length 31mm.; height 31mm.; diameter 21mm.

[14]Oppenheim, 1903, Zur Kenntnis alttertiarer Faunen in Agypten, Palaeontographic Bd. 30, taf. 13, fig. 8.

Remarks.—As noted in the above description, this species differs from *montanita* in being generally larger and more convex. There are no impressions of hinge-teeth along the partly exposed internal molds of the hinge margin.

Locality and Geologic Occurrence.—Heath formation, Cone Hill shales, Pajarabobo, near Belen south of Lagunitas.

Thyasira montanita, n. sp. Plate 6, figs. 6, 11.

Shell of medium size, subcircular to subovate in outlines, inequilateral, moderately convex; anterior-dorsal area not well-defined, it carries the small, shallow lunule in the center, below which the sides of the shell are often feebly impressed and in mature shells develop a shallow, impressed zone or sinus, slightly emarginating the anterior end or edge of the valves; posterior-dorsal area strong, deeply impressed and with a weak medial fold; umbos wide, full but not prominent, ending in the small inconspicuous and slightly curved beaks; surface somewhat chalky with rather coarse, uneven concentric growth-lines; hinge unknown but from the internal molds appear to be edentulous.

Length 22.5mm.; height 26.25mm.; diameter 14.5mm.

Length 33mm.; height 28mm.; diameter 18mm.

Remarks.—The dorsal areas are not quite as sharply defined as in most species of *Thyasira* and they may belong to *Phacoides*. However the hinge appears to be edentulous as the impressions of the hinge-line found on certain internal molds, show no evidence of hinge teeth.

Locality and Geologic Occurrence.—Punta Montanita, near Marglaralto, Ecuador.

Superfamily ISOCARDIACEA

Family VESICOMYACIDAE Dall
Genus VESICOMYA Dall

Vesicomya tschudi n. sp. Plate 4, figs. 6, 8

Shell Veneroid or broadly subelliptical to elongate subovate, moderately convex; umbos prominent, wide, ending in pointed, recurved and adjacent beaks situated near the anterior one-fifth; anterior-dorsal margin arched, somewhat descending; anterior and posterior submargins rounded; valves moderately convex, the greatest inflation slightly above and anterior of the middle;

surface chalky and sculptured with only concentric growth-lines; interior shows an indistinct, wavy but entire pallial line and a deep, anterior muscle scar; impression of the posterior adductor faint; hinge concealed (in some internal molds, the hinge-line shows impressions of at least two cardinal teeth in each valve).

Length 48mm.; height 35mm.; semidiameter 12mm.

Remarks.—Internal casts and the closed valves of *Callocardia*-like bivalves are common fossils in certain cherty limestone and concretionary layers south of Lagunitas. Impressions of the hinge-line show two cardinal teeth in each valve and no laterals. The pallial line is entire, connecting a deep anterior muscle scar with usually a very faint posterior scar. From *Meiocardia* H. and A. Adams, they differ in lacking a strong posterior-umbonal angulation and probably should be referred to the genus *Vesicomya* of Dall.

The recent species of *Vesicomya* are inhabitants of the abyssal depths. Most of the known forms are small, the largest species, *V.* (*Archivesica*) *gigas* Dall having a length of 115mm.

Locality and Geologic Occurrence.—Heath formation, near Belen.

Vesicomya ramondi, n. sp. Plate 4, fig. 3.

Shell transversely elliptical, moderately convex; umbos wide ending in the small, curved and adjacent beaks situated near the anterior one-fifth; anterior-dorsal margin straight, slightly descending; ventral margin straight to slightly rounded across the middle and anterior portion, becoming well rounded on the posterior side and ending in a widely expanded but pointed posterior extremity; anterior side, short, contracted, rounded; surface smooth or sculptured simply with concentric growth-lines; interior (from molds) smooth, with a deep but comparatively small anterior muscle scar and a very faint posterior scar close to the dorsal margin; an indistinguishable pallial line.

Length 44mm.; height 26mm.; diameter 19.5mm.

Remarks.—This species resembles *Vesicomya* (*Callogonia*) *angulata* Dall of the recent Pacific fauna, especially in the form of its posterior extremity, except that the beaks are more anterior in positon. *Callogonia* differs from true *Vesicomya* in having a small pallial sinus but the pallial line is not discernible on our fossils.

Locality and Geologic Occurrence.—Heath formation, Cone Hill shales near Belen south of Lagunitus.

Superfamily VENERACEA

Family VENERIDAE Leach

Genus PITARIA Römer

Subgenus AGRIOPOMA Dall

Pitaria (Agriopoma) mancorensis, n. sp. Plate 7, figs. 2, 5.

Shell moderately large, thin, cordate, convex or inflated; beaks small, closely adjacent and situated approximately near the anterior one-fifth; umbos prominent passing gradually into the full convexity of the valves which is near the middle of the shell; lunule widely cordate and feebly defined by an incised line; in young specimens, the outline of the valves is subcircular but becoming with growth subovate with the anterior and posterior extremities narrowly rounded; posterior-dorsal submargins arched or slightly convex, with a deep, lenticular, ligamental area, bordered by the raised margins of the valves; anterior-dorsal or lunular margins straight; surface white, smooth and marked with irregular growth lines; internal characters concealed.

Length 44.5mm.; height 36.5mm.; diameter 27mm.

Remarks.—In its straight lunular margins and high umbos this species seems nearer the *P. sayana* Conrad and *P. morrhuana* Linsley of the East Coast Miocene and recent faunas, than to the *P. gatunensis* Dall of the Panama Canal zone. The species is quite variable, young shells (fig. 5) may resemble Gabb's[15] figure of *sapotensis* from Costa Rica.

Locality and Geologic Occurrence.—Mancora formation, top of the Mancora sandstones near Boca de Mancora.

Subgenus PITARELLA Palmer

Pitaria (Pitarella) chiraensis, n. sp. Plate 7, fig. 7.

Shell of moderate size, thin, subovate, inflated; basal margin nearly straight but soon passing into the well-rounded curves forming the anterior and posterior extremites; posterior-dorsal

[15]Gabb, 1881, Journ. Acad. Nat. Sci. Phila., vol. 8, p. 343 (as **Meretrix**) pl. 44, fig. 15.

slopes convex with the margins nearly straight and sloping downwards towards the posterior extremity; beaks small, situated near the anterior one-sixth to one-seventh, incurved over the feebly defined lunule; greatest convexity of the valves about the middle and through the general umbonal region; sculpture appearing smooth or simple marked with fine and somewhat irregular, concentric growth lines; interior concealed.

Length 40mm.; height 30mm.; semidiameter 7.5mm.

Remarks.—In form, this species recalls a convex *Macrocallista* but the surface is not polished or porcellaneous. It is proportionately longer than *gatunensis* of the Canal Zone.

Locality and Geologic Occurrence.—Chira formation, Chira valley near Casa Saman.

Subgenus LAMELLICONCHA Dall

Pitaria (Lamelliconcha) wolfi, n. sp. Plate 8, figs. 7, 8, 9, 12.

Shell with an average length of about 29mm. subovate, inequilateral; beaks small near the anterior one-fourth and with the umbos wide, full but not conspicuous; shell is moderately convex, greatest at a point slightly anterior of the middle and ofter with a faintly impressed area just behind and continued downward from the beaks towards the posterior side of the ventral margin; the outlines of the valves is subovate to subelliptical with a well rounded curve to the basal margin and with a slightly rounded to straight posterior-dorsal margin; the anterior and posterior extremities narrowly rounded, the latter often appearing as if pointed and subtruncate; sculpture of fairly heavy, concentric bands, rounded on their superior surface and divided by deep grooves; this sculpture is strongly developed over the whole surface but heaviest on the rounded umbonal angle and anterior submargins; lunule small and very narrow, bordered by the posterior-dorsal margins and less strongly sculptured than the shell disk; hinge of right valve with 3 cardinals, the 2 anterior close together, the 3rd or upper long and feebly bifid and a socket for the left anterior lateral.

Length 29mm.; height 23mm.; semidiameter 9mm.

Remarks.—Differs from *Callista mancorensis* by its smaller size, finer sculpture and less convex valves. The sculpture is strong over the whole surface but through weathering and exfoliation, the umbos usually become smooth exposing the inner layer. Examples from Peru, probably belonging to this species, are smaller and more strongly sculptured. It is smaller, less depressed and with flatter sculpture than *P. samanensis.*

Locality and Geologic Occurrence.—Posorja, Ecuador. In upper part of Punta Bravo grits, Que. Canoas.

Pitaria (Lamelliconcha) charanica, n. sp. Plate 8, figs. 2, 5.

Shell of medium size, elliptical, inequilateral, slightly convex; beaks small, adjacent, near the anterior fourth; basal margin slightly rounded, the posterior extremity evenly rounded and with the posterior-dorsal margin nearly straight but not quite parallel to the ventral margin; lunular area small, excavated and free from strong sculpturing; surface sculpture of strong, even, concentric ridges spaced about .75mm. apart on the ventral part of the shell disk and separated by deep 7-shaped groves; the posterior-dorsal umbonal slope is rounded or with a low fold; left valve with the hinge of *Pitaria* carrying a large anterior lateral.

Length 40mm.; (broken) height 29mm.
Length 43mm.; height 25mm.; semidiameter 8mm.
Length 38mm.; (broken) height 25mm.; semidiameter 6mm.

Remarks.—On most of our specimens, the surface has been eroded so that the concentric bands appear sharp and ridge-like. Where unweathered, they are seen to be of medium thickness, porcellaneous, rounded on top and usually appressed dorsally. The outlines of the shell may be compared with *Pitaria hilli* Dall of the Gatun Miocene.

Locality and Geologic Occurrence.—Mancora formation, Que. Charanal.

Pitaria (Lamelliconcha) ayabaca, n. sp. Plate 10, figs. 8, 9.

Shell of medium size, subelliptical, solid with the beaks at the anterior one-third; basal margin broadly rounded, the dorsal side sloping and the two ends more narrowly rounded; lunule narrowly elliptical; sculpture of even, concentric bands which measure about seven-eighths of a millimeter on the center of the disk, slightly wider along the posterior-ventral slope, and much narrower on the anterior side; these bands are flattened in form but rounded or sloping on the ventral side; they are separated by deep grooves; interior unknown.

Length 35mm.; height 26mm.; semidiameter 5.5mm.
30mm.; 23.5mm.; 6mm.

Remarks.—The sculpture of this shell is like that of *Costacallista* and possibly it should be referred to that subgenus of *Callista* rather than to *Lamelliconcha.* It will be distinguished from *Pitaria charanica* by its shorter shell and by its sculpture of broader, flatter and more even, concentric bands.

Locality and Geologic Occurrence.—Chira formation, Chira shales near Casa Saman.

Genus DOSINIA Scopoli

Section DOSINIDIA Dall

Dosinia (Dosinidia) palmeræ, n. sp. Plate 7, fig. 1

Shell rather small, thin, moderately convex and subcircular in outline; beaks small, curved forward, situated near the anterior one-fifth or one-sixth; the outline of the shell is nearly a perfect circle except for a flattening of the curve along the posterior-dorsal margin and the indentation of the concave lunular area; shell is moderately convex, greatest just above the middle; sculpture consists of fairly coarse, concentric, smooth bands or ribbons, averaging nearly a millimeter wide on the middle of the disk; these concentric bands are rounded or sloping on their inferior side, shelf-life or knifed on the upper edge, and sometimes overlapping on the band above; interior concealed.

Length 34mm.; height 33mm.; semidiameter 9mm.

Remarks.—Since the Tampa silex beds of Florida are now usually considered as Lower Miocene, *Dosinia mathewsoni* Gabb and *whitneyi* Gabb from the San Lorenzo series of Middle California[16] were the only species of *Dosinia,* previously known from the American Oligocene. This discovery of another species in the Peruvian Oligocene, would seem to show, that this group orignated in the Pacific region during the Oligocene epoch and from there spread eastward through the Antillean region and into Europe during the later Tertiaries.

Locality and Geologic Occurrence.—Heath formation, basal Caleto Mero shales of Caleto Mero.

[16]Bruce Clark, 1918, The San Lorenzo series of Middle California, Bull. Dept. Geology, Univ. of Calif., vol. 11, No. 2, p. 141, 143, pl. 7, figs. 1, 6. 9.

Genus CALLISTA Mörch

Subgenus COSTACALLISTA Palmer

Callista (Costacallista) mancorensis, n. sp. Plate 8, figs. 1, 3.

Shell of moderate size, subovate, inequilateral, moderately convex; beaks small, adjacent, near the anterior one-fourth, incurved over the small, concave or excavated lunule; the greatest convexity of the shell lies in a small area, a short distance above and in front of the middle of the disk; from the anterior to the posterior extremities, the basal margin of the shell is evenly rounded; the posterior-dorsal submargin slightly convex or arched and with a well-rounded umbonal slope; the surface is sculptured with broad, flattened, subregular, concentric folds, widest and heaviest about the middle of the valves, somewhat finer on the umbos and subobsolete close to the ventral margin; this sculpture is lacking on the lunule and from the area close to the posterior-dorsal submargins; interior concealed.

Length 43mm.; height 32mm.; semidiameter 11mm.

Remarks.—In most of our specimens, the hinge and internal characters are completely concealed. In a fragmentary right valve, there appear to be three cardinals and a socket for the anterior lateral. In sculpture, the species is similar to the recent *C. erycina* Linnaeus of the Indian Ocean, and its closely related *C. erycinoides* Lamarck from the European Miocene. On *mancorensis,* the concentric folds are finer and less regular and the shell is thinner and slightly more convex. *C. planiveta* Guppy from the Miocene of Jamaica is heavier and more depressed.

Locality and Geologic Occurrence.—Heath formation, basal Caleto Mero Shale, Caleto Mero.

Callista (Costacallista) canoasensis, n. sp. Plate 8, figs. 10, 11, 13.

Shell generally small but occasionally reaching a length of 22mm., subovate, inequilateral; valves are moderately heavy, slightly convex but the general surface appearing flattened or even slightly impressed on the posterior half; beaks small pointed with wide, full but not conspicuous umbos; the outline is subovate to subelliptical, widest just below the beaks and slightly narrowed on the posterior half with a narrowly rounded or slightly pointed posterior extremity; the anterior extremity is broadly rounded, with a straight lunular margin lying just in front of the beaks; lunule small, narrowly cordate; sculpture consists of concentric bands or ribbons, heavy on the anterior submargins and on the rounded posterior-umbonal slope, smooth or subobsolete on the middle of the disk; the sculpture seems to be slightly stronger on the right than on the left valve; posterior-dorsal submargin nearly smooth.

Length 22.25mm.; height 19.5mm.; diameter 10mm. (Holotype

Length 16.50mm.; height 12.5mm.; diameter 7.25mm.

Remarks.—The hinge is not exposed on our specimens. Externally the shell seems to combine the features of *Callista* and those of *Pitaria* (section *Lamelliconcha*). The shell is moderately heavy with appressed concentric bands which are absent from the center of the shell disk.

Locality and Geologic Occurrence.—Mancora formation, Punta Bravo grits, near headwaters of Que. Canoas, Prov. of Tumbez.

Genus ANTIGONA Schumacher

Section ARTENA Conrad

Antigona (Artena) inca, n. sp. Plate 10, figs. 7, 10.

Shell small or medium size, slightly to moderately convex, semi-circular to broadly ovate in form; umbos wide but not prominent with the small, slightly curved and pointed beaks at the anterior one-fourth; lunule subelliptical, defined by an impressed line; escutcheon narrow; surface sculptured with regular, elevated, concentric lamellar ridges which are spaced on the center of the shell disk about .9mm. apart; these concentric lamellæ become more crowded on the anterior and posterior sides; the interlamellar spaces are marked with fine lines of growth; interior concealed; on exfoliation of the outer surface of the shell, a fine sculpture of small, radial threadlets is brought to view as seen on some species of *Chione* and *Venus*.

Length 32mm.; height 30mm.; semidiameter 6.5mm.

Length 34mm.; height 31mm.;

Remarks.—Since the interior is concealed, the reference of this shell to *Antigona* is based principally on its external form and sculpture. On exfoliaton of the surface layer, a fine radial structure is revealed in the inner layer such as is frequently seen on species of *Venus.* This radial structure would indicate that the ventral margin of the shell is crenulated.

Locality and Geologic Occurrence.—Chira formation, Chira shales north of Casa Saman.

Genus CHIONE Megerle von Mühlfeld

Subgenus CHIONE s. s.

Chione (Chione) posorjensis, n. sp. Plate 8. figs 4, 6

Shell small or medium size, subovate, subelliptical to subtrigonal and moderately convex; basal or ventral margin evenly rounded; posterior-dorsal margin descending, straight to slightly vaulted in the middle; escutcheon narrow, smoothish; anterior side about one-half the length of the posterior, rounded at the end and with a deep, depressed cordate lunule; posterior extremity narrowly rounded to pointed; umbos low, broad but not conspicuous ending in the low, adjacent and slightly curved beaks; the convexity of the valves is moderate, greatest just above the middle and usually with the valves showing a weak flexing just below and in front of the posterior extremity; surface sculptured principally *Pitaria* fashion (*circinata*) with numerous, sharp, regularly spaced concentric ridges separated by quite wide, flat interspaces; on well-preserved valves, the radial sculpture is very slight and it may show simply as a waving of the concentric ridges along the ventral margin, that is, the ridge is built up of a series of small, close waves arranged side by side with their concave faces toward the dorsal side; weathered valves on which the surface has been partly eroded or exfoliated, an internal radial structure as in *Venus mercenaria* is revealed; ventral margin coarsely crenulated.

Length 26.5mm.; height 20mm.; semidiameter 6.5mm.

Length 23mm.; height 18mm.; semidiameter 6.5mm.

Remarks.—In outlines, the valves range from subovate or subelliptical like those figured to high, elevated or subtrigonal. The surface sculptured is silimar to certain Pitarias but close examination will usually reveal an underlying radial structure in a waving of the ridges so that they appear to be composed of numerous, closely packed waves with their convex faces towards the ventral side. Slightly weathered valves such as those principally found at Caleto Mero show fine radials in the interspaces over the whole surface. The ventral margin is coarsely crenulated.

Only two rather small species of *Chione* are known from the east coast Oligocene, namely *Chione spenceri* Cooke from Antiqua and *C. bainbridgensis* Dall from Georgia but several large Chiones have been described by Bruce Clark from the San Lorenzo series of Middle California of supposedly Oligocene age.

Locality and Geologic Occurrence.—Posorja Ecuador. Heath formation, base of Caleto Mero shales at Caleto Mero.

Superfamily TELLINACEA

Family TELLINIDAE Deshayes

Genus MACOMA Leach

Macoma meroensis, n. sp. Plate 9, figs. 4, 8.

Shell of medium size (reaching a length of about 47mm.), thin, inequilateral, inequivalve, broadly subelliptical in form; beaks small, low but not recurved, closely adjacent and a short distance posterior of the middle; ventral margin slightly rounded from the posterior extremity to the anterior one-third, there becoming strongly and obliquely rounded to form the anterior side; anterior and posterior dorsal margins straight, sloping down from the beaks, the posterior side more rapid than the other; left valve slightly convex, the greatest inflation lying along a vertical line extending across the umbo to the basal margin; right valve less inflated, with the posterior side strongly flexed along the basal margin; surface smooth with very fine concentric growth lines and very fine radial striations; internal characters concealed.

Length 47mm.; height 34mm.; diameter 16mm.

Remarks.—There are no specimens in the collection with the hinge entirely exposed. In certain right valves, the small cardinal teeth may be seen but without any evidence of laterals. The apparent lack of lateral teeth along with the strong posterior flexing of the valves, would seem to indicate that the species belongs to the genus *Macoma.*

Specimens from the basal Caleto Mero shales are generally quite large and are accepted as the typical form. At Mancora but probable from the same horizon, the shells are usually smaller and average about 35mm. in length. Except for size they do not differ in other characters.

The *Tellina zapotalensis* Spieker[17] from the Lower Miocene is closely related. Spieker's figures are misleading and illustrate a shell of veneroid or even *Iphigena*-like outlines. Direct comparison with a fine series of *zapotalensis* from near Boca Pan, show that the Miocene shell is usually larger (averaging between 65 to 75mm.), somewhat less convex, with lower and less inflated umbos and a larger and wider lunular area. Young shells of *zapotalensis* show a strong posterior twist which becomes less with increase in size.

Locality and Geologic Occurence.—Heath formation, basal Caleto Mero shales at Caleto Mero. Basal Mancora shales at Mancora.

Macoma lissoni, n. sp. Plate 9, figs. 2, 9.

Shell small, thin, delicate, subovate, depressed to slightly convex; right valve with the posterior side shorter than the anterior, more or less flexuous; anterior side nearly twice the length of the posterior, vaulted or convex along the umbonal slope so that the middle of the valve is depressed along a line from the beaks to the basal margin; left valve more convex, more regularly subovate in outline and with the beaks nearer the middle; surface of right valve with widely spaced raised threads so that the sculpture is weakly annulated with smaller, crowded growth-lines in the interspaces; hinge not visible.

Length 26mm.; height 18mm.

Remarks.—Easily distinguished from *Macoma meroensis* by its smaller, more delicate shell, greater posterior flexing of the right valve and by its weakly annulated surface sculpture.

Locality and Geologic Occurrence.—Mancora formation, Punta Bravo grits, west branch of Que. Canoas.

[17]Spieker, 1922, The Paleontology of the Zorritos formation. The John Hopkins University Studies in Geology, No. 3, p. 156, pl. 10, figs. 1, 2.

Family PSAMMOBIIDAE Dall

Genus SANGUINOLARIA Lamarck

Sanguinolaria tumbezana, n. sp. Plate 3, figs. 1, 4

Shell elongate-subelliptcal, thin, equivalve and moderately convex; beaks small, adjacent with wide but not conspicuous umbos; valves are inequilateral with the posterior side longer, and somewhat produced and narrowed; anterior side slightly contracted, well-rounded and only a little more than half as long as the posterior; valves are moderately convex, the fullest inflation along the umbonal slope and just above the middle; surface with very fine growth lines and occasionally heavier, irregular resting marks or deeper folds; hinge and interior of valves unknown.

Length 76mm. (broken); height 50mm.; diameter 29mm.
Length 81mm.; height 46mm. (crushed); semi-diameter 14.5mm.
Length 82mm. (broken); height 54mm.; diameter 29mm.
Length 55mm.; height 21mm.; semidiameter 7mm. (Ecuador)

Remarks.—These fossils are common in the upper Punta Bravo grits along the north side of the Cerro Verde ridge about 3 or 4 miles inland from the shore. They are associated with a semi-marine or brackish-water fauna which includes *Ampullinopsis spenceri* Cooke. The hinge is not exposed on any of our specimens and the internal molds show no impressions of the muscle scar or pallial line. Their reference to the genus *Sanguinolaria* is therefore based principally on their external appearance and more information may show that they actually belong to an entirely different group.

This species has also been collected from certain sandstones near Zapotal (Santa Elena pen.) Ecuador. At this place they occur with a more marine fauna which includes *Leda, Spisula posorjensis, Mactrella tumbezia* and several gasteropods. The Ecuadorian specimens are consistently smaller or dwarfed as compared to the Peruvian. It would seem that the more marine conditions of Zapotal had been less favorable than the brackish-water environment which accompanied the formation of the Punta Bravo grits.

Locality and Geologic Occurrence.—Mancora formation, Punta Bravo grits along the north side of the Cerro Verde ridge, Province of Tumbez. Zapotal sandstones, Zapotal Ecuador.

Family DONACIDAE Deshayes

Genus DONAX Linné

Section PARADONAX Cossmann

Donax (Paradonax) petersoni, n. sp. Plate 9, figs. 6, 7.

Shell small, elongate, moderately thick and porcellaneous; posterior side quite short, sloping, rounded at the extremity and about a fourth of the total length; anterior dorsal margin straight; ventral margin straight and parallel to the anterior dorsal margin in the posterior region, thence curving upward in the anterior portion and meeting the dorsal side in a smooth, even curve; valves slightly convex; surface smooth with very indistinct radial markings except on the posterior-umbonal angle and slope where there are deep concentric ribs and grooves; ventral margin crenulated; interior concealed.

Length 19.25mm.; height 7.5mm.; semidiameter 2.75mm.

Remarks.—This species is similar to *Donax gracilis* Hanley of the Panamic fauna. It differs in being shorter and higher and in its strong sculpture of concentric ribs and grooves on the posterior side.

This species is named for Dr. G. Peterson, Manager of the Zorritos Oil Field at Zorritos.

Locality and Geologic Occurrence.—Mancora formation, Punta Bravo grits west branch of Que. Canoas about 4 miles inland.

Superfamily MACTRACEA

Family MACTRIDAE Gray

Genus MACTRA Linné

Subgenus MACTRELLA Gray

Section MACTRELLA s. s.

Mactra (Mactrella) tumbezia, n. sp. Plate 9, figs. 3, 5.

Shell small to medium size, inequilateral, plump, subtrigonal;

umbos prominent of medium width, narrowing above into the small and nearly central beaks; ventral margin smoothly rounded and forming a quarter segment of a large circle; posterior-umbonal slope slightly convex to flattened, defined by a narrow ridge extending from the beaks; anterior side contracted, narrowed but not impressed or flattened, no lunule; surface smooth or marked simply with fine, closely crowded growth lines; hinge unknown.

Length 38mm.; height 31mm.; semidiameter 9.5mm.

Remarks.—The hinge is partly exposed on one of our specimens from Ecuador and seems to be similar to the hinge of recent species of *Mactrella* from the West Coast. The posterior-umbonal angle is simply feebly ridged and not alated as in the recent *Mactrella alata* Spengler and *clisea* Dall. The specimens from Posorja Ecuador are somewhat larger than those of Peru but are generally crushed or distorted out of shape.

Locality and Geologic Occurrence.—Heath formation, basal Caleto Mero shales at Caleto Mero. Zapotal sandstones of Zapotal Ecuador, Posorja Ecuador.

Genus SPISULA Gray

Section OXYPERAS Mörch

Spisula (Oxyperas) steinmanni, n. sp. Plate 9, fig. 1.

Shell of medium size, nearly equilateral, plump, subtrigonal, the height being about four-fifths the length; beaks slightly anterior of the middle with high full umbos; the ventral margin is broadly rounded with the anterior and posterior extremities bluntly pointed; anterior and posterior dorsal margins straight; the posterior dorsal slope or submargins flattened and defined by a ridge or cord-like umbonal angle; the anterior-dorsal submargins little elevated along the hinge margin and neatly sculptured with even, regular lines; general surface of shell is smooth, but with 3, 4, or 5, strong concentric undulations or folds close to the basal margin.

Length 45mm.; height 36.25mm.; diameter 26mm.

Remarks.—Differs from *S. callistoides* Olsson from the Saman Eocene by its higher and more typical *Spisula*-like form. The surface is quite smooth with the concentric undulations of *Oxyperas* only near the ventral margin.

This species is named for the late Professor G. Steinmann of Bonn, in recognition of his pioneer work on South American geology. His recent book, "Die Geologie von Peru," is a complete summary of our present knowledge of the geology and paleontology of Peru and is indispensable to all students of South American West Coast geology.

Locality and Geologic Occurrence.—Mancora formation, Punta Bravo grits of Caleto Sal. Que Charanal.

Class GASTROPODA

Order CTENOBRANCHIATA

Superfamily TAENIOGLOSSA

Family NATICIDAE Forbes

Genus POLINICES Montford

Subgenus NEVERITA Risso

Polinices (Neverita) subreclusiana, n. sp. Plate 10, figs. 1, 4.

Shell small, solid; spire of medium height and composed of four and one-half whorls; the spire-whorls between close but distinct sutures, are weakly convex; body-whorl large, forming most of the shell, slightly shouldered near the suture, subflattened in the middle then sharply rounded into the base; basal region more or less impressed with a large, thick callus which does not completely fill the umbilical region but leaves a small narrow part near the apertural end open; a small groove cuts across the umbilical callus from the aperture or inner lip to the upper end of the unfilled portion of the umbilicus; surface smooth.

Height 18mm.; greater diameter 21mm.

Remarks.—Of the two species of *Neverita* in the Peruvian Oligocene it is interesting to note that one form, *quirosana* Hodson from the Mancora rocks, seems to be nearest related to the Atlantic *duplicata* of Say, while the other, *subreclusiana* from the Chira shales is probably the early Oligocene percursor of the West Coast *reclusiana* of Deshayes.

Neverita reclusiana and its allies in the recent fauna have been discussed by Pilsbry[18]. The shell is generally higher than in

[18]Pilsbry, 1929, Nautilus, vol. 42, pp. 109-113, pl. 6, figs. 1-9.

duplicata, the callus is larger and generally grooved across the lower, inner side. According to Pilsbry's figures, typical *reclusiana* resembles *subreclusiana* in form, but the callus is larger and more spreading. *Polinices subporcana* Williston[19] from the Venezuelan Miocene, belongs to the *reclusiana* group, differing from *subreclusiana* in being larger, more globose and with the callus of different shape leaving more of the umbilicus open.

Locality and Geologic Occurrence.—Chira formation, Chira shales near Casa Saman.

Polinices (Neverita) quirosana F. Hodson Plate 11, figs. 4, 5. 8.

Polinices paraguanensis quirosana F. Hodson, 1927, Bulls. Amer. Pal., vol. 13, p. 71, pl. 38, figs. 1, 5, 7.

Shell small to medium size ,solid; in shape, the shell recalls *Neverita duplicata* Say but is somewhat higher and the profile of the body-whorl viewed from the front, is subangulated and with a flatter base; the umbilical callus is like that of *duplicata* but larger so that the unfilled area on the side opposite the aperture is somewhat smaller and narrower; aperture semi-lunar, oblique; surface smooth or faintly marked with growth-lines.

Height 20mm.; greater diameter 30mm.

Remarks.—This Naticid seems colsely related to the *Neverita quirosana* of Hodson from the Oligocene - Miocene rocks of Miranda, Venezuela. Hodson considered *quirosana* as a variety of *paraguanensis* but since *quirosana* may be strictly Oligocene in age while *paraguanensis* is late Miocene or Pliocene, I am inclined to believe that the two forms are distinct. *Neverita quirosana* as noted, is the Oligocene representative of the *duplicata* group.

Locality and Geologic Occurrence.—Mancora formation, Punta Bravo, Caleto Sal. Que. Charanal. Chira formation, Sal Chica.

Subgenus LUNATIA Gray

Polinices (Lunatia) chulucana, n. sp. Plate 10, figs. 2, 3.

Shell of medium size, paludiniform with a moderately high spire and large body-whorl; nucleus unknown; whorls 4+, moderately convex, except the body-whorl which is large and very

[19]In Hodson, 1927, Bulls. Amer. Pal., vol., 13, pl. 70, pl. 36, fig. 3, pl. 37, figs. 5, 9, 16,

strongly convex; surface is smooth except for fine lines of growth; sutures simple, close and not bordered by an appressed or flattened band; umbilical region covered on our specimens but probably with a narrow, umbilical chink; aperture semi-lunar, the outer lip thin and slightly oblique; columellar region concealed.

Height 20mm.; greater diameter 19mm.
16mm.; 14mm.

Remarks.—Only two specimens of this species are known, both having the umbilical and columellar region wholly or partly covered by rocky matrix. Consequently their reference to *Lunatia* is provisional and may be subject to change on the discovery of additional material. In form, the shell resembles *Natica Fortunei* Reeve[20] from China but has a wider body-whorl and narrower spire. The shell also bears much resemblance to certain of the fresh-water Paludinas and high-spired Ampullarias but their association with marine species is against this relationship. The high-spired Ampullarinas related to *Amauropsis* Mörch and *Pachycromma* Woodring, have a different shaped aperture and inner lip.

Locality and Geologic Occurrence.—Chira formation, Chira shales north of Casa Saman.

Genus SINUM ("Bolten") Roeding

Sinum multilineatum Gabb var. **peruvianum,** n. var. Plate 10, figs. 5, 6.

Shell small, moderately heavy with a low, but erect, pointed spire; whorls 3 or 4, those of the spire slightly to moderately convex between close, distinct sutures; body-whorl large forming the greater part of the shell, oblique and with the greatest inflation around the anterior one-third; umbilical region deeply excavated, perforated by a narrow umbilical chink; surface ornamented as usual with fine, fairly regular spiral lines or threads; aperture large, nearly semicircular in form with a thin, sharp outer lip; inner lip thickened.

[20]Reeve, 1863, Journ. de Conch., t 9, f. 5. Tryon, 1886, Manual of Conch., vol 8, p. 37, pl. 14, fig. 23.

Height 15mm.; diameter 17mm.
19.5mm.; 21mm.

Remarks.—In form, this species is a diminutive of the recent Peruvian *S. concavum* Lamarck except that in the fossil, the spire is usually a little more elevated, pointed and the umbilical region is more deeply excavated. It is probably closely related to Gabb's[21] *Sigaretus multilineatus* from the Lower Miocene of Sapote, Costa Rica, but unfortunately the type specimen at the Philadelphia Academy could not be located so that direct comparison has not been possible. *S. carolanum* Spieker from the Zorritos Miocene, according to Spieker's figure is more depressed. Belonging to this same group, is *S. mississippiensis* Conrad from the Vicksburgian Oligocene which has a lower, more erect, pointed spire and less convex whorls.

There are several other species of *Sinum* which may be compared with the Peruvian fossil, but their similarities may be more apparent than real. *S. chipolanum* Dall appears to be a member of the *concavum* group but differs in having the profile of the body-whorl more evenly convex so that the greatest convexity of the whorl is near the middle. According to Dall, *chipolanum* is said to resemble *S. declivis* Conrad of the Claibornian Eocene but separated by its closed umbilicus and absence of the emargination of the pillar. *S. obliqum* Gabb of the Tejon Eocene has a lower flatter spire.

Locality and Geologic Occurrence.—Heath formation, base of Caleto Mero shales, Caleto Mero. Posorja, Ecuador.

Family AMPULLARIIDAE Gray

Genus AMPULLINA Lamarck

Subgenus AMPULLINA s. s.

Ampullina (Ampullina) bravoensis, n. sp. Plate 11, figs. 3, 7.

Shell large, heavy, globose; whorls about 5, convex, between deeply grooved sutures; spire of moderate height with a pointed tip; body-whorl large, inflated, the greatest convexity in line with the suture or upper edge of outer lip; surface is marked with faint, subobsolete spiral bands, quite regularly spaced on the

[21] Gabb 1881, Journ. Acad. Nat. Sci. Phila., vol. 8, 2nd series, p. 339, pl. 44, fig. 6.

middle of the whorls, finer and fainter near the sutures; aperture semilunar with a simple, thin outer lip; inner lip callused; base or umbilical region impressed or excavated, often defined by a ridge or an impressed line; umbilicus closed to narrowly opened.

Height 58mm.; diameter 53mm.

Remarks.—This is a large, coarse species, a member of the lacustrine fauna of the Punta Bravo grits. It resembles *A. woodsi* Hanna and Israelsky (*A. gabbi* Woods) of the Saman and Cabo Blanco, but differs by its more shouldered whorls, more pointed spire and by its more impressed or excavated base. Both species have a fairly strong, spiral lining.

Locality and Geologic Occurrence.—Mancora formation, Punta Bravo grits, Punta Bravo, Caleto Sal, etc. Mirador conglomerates, Chira valley.

Subgenus AMPULLINOPSIS Conrad

Ampullina (Ampullinopsis) spenceri Cooke Plate 11, figs. 2, 6.

Ampullina (Ampullinopsis) spenceri Cooke 1919, Contributions to the Geology and Paleontology of the West Indies, Carnegie Institution of Washington, No. 291, p. 123, pl. 5, figs. 1-3.

Ampullinopsis was proposed by Conrad[22] in 1865, with *Natica mississippiensis* Conrad as sole example. Although it was never described, Conrad's name must take precedence over Fisher's[23] *Megatylotus* with *Natica crassatina* Lamarck as its genotype. *Ampullina crassatina* and *misssissippiensis* are very closely related and Dall[24] in 1892, considered *mississippiensis* as but a variety of the European fossil.

Amupllina spenceri was described by Cooke from the Antiguan Oligocene. According to Cooke, *spenceri* resembles *amphora* Heilprin[25] of the Tampa silex beds, differing principally by its less elevated spire. In *mississippiensis,* the umbilicus is completely filled with callus, the base is less flattened, rounded on the edge and not limited by a groove or ridge as in *spenceri.* The *Natica* (*Ampullina*) *collazoensis* of Bela Hubbard[26] from the

22Conrad 1865, Amer. Journ. Conch., vol. 1, p. 27.

23Fisher 1885, Manuel de Conchyliologie, p. 766.

24Dall 1892, Trans. Wagner Free Inst., vol. 3, p. 375.

25Heilprin 1887, Trans. Wagner Free Inst., vol. 1, pp. 112, 120, pl. 16, fig. 50, also Dall 1915, Bull. 90, U. S. Nat. Mus., p. 108, pl. 11, fig. 5.

26Bela Hubbard 1920, N. Y., Acad. of Sci., vol. 3, pt. 2, p. 135, pl. 21, figs. 11, 12.

San Sebastian shales of Porto Rico is probably a synomym of *spenceri* as suggested by Woodring.

Examples of the Peruvian fossil have been compared with Cooke's types of *spenceri* in Washington. They show a greater variation in the elevation of the spire, the width and impression of the flattened base, the carination of the body-whorl and in other characters. The extremes of these variations may be seen from the figures.

In *spenceri,* the sutures are deeply channelled so that the summit of each whorl appears to be somewhat shouldered or flattened. The flattened or excavated base may be limited by a groove or by a slight ridge. The growth lines are oblique, bend sharply backward at the basal angle and then forming a wide swing, concave forward across the flattened base. Faint revolving lines may be seen on well-preserved specimens. The umbilical area is only half covered by callus.

The stratigraphic range of *Ampullinopsis* is nearly restricted to Oligocene formations. The type occurrence of *mississippiensis* is in the lower Oligocene or Vicksburgian of Mississippi. The Eocene records of this species given by Gregorio from the lower Claiborne of Alabama are probably incorrect. Dall records *mississippiensis* as a variety of *crassatina* from several localities in the Oligocene of Oregon, Washington, California and Alaska. In Europe, *crassatina* is a wide-spread Oligocene species. According to Vredenburg, this species is found at Zudin, Zhor district of Baluchistan in beds of Stampian age. *A. birmanica* Vredenburg[27] from Shinmardaung is a higher spired shell and of Lattorfian age. The Upper Eocene of Nanggulan Java contains *A. clakei* Martin[28], a small, globose species.

Locality and Geologic Occurrence.—Mancora formation, upper part of Punta Bravo grits, north side of Cero Verde ridge; Punta Bravo grits of Que. Canoas; Mirador conglomerates near Tamarindo. Posorja, Ecuador. Murucucu district of Colombia. Antigua formation of Antigua (Cooke, U. S. Nat. Mus.). San Sebastian shales of Porto Rico (Bela Hubbard).

[27]Vredenburg 1922, Records Geol. Survey of India, vol. 53, pt. 4, pp. 359-369, pl. 25-28.

[28]Martin 1914, Samml. des geol. R. Mus in Leiden, n. ser., vol. 2, p. 173, pl. 6, figs. 152-154.

Family TURRITELLIDAE Gray

Genus TURRITELLA Lamarck

Turritella samanensis Olsson

Turritella samanensis Olsson, 1928, Bulls. Amer. Pal., vol. 14, p. 65, pl. 14, figs. 3, 4, 6, 7, 8.

Turritella samanensis in the Talara and Saman formations of the Upper Eocene, is a small or medium-sized shell with a moderate taper, slightly but evenly convex whorls and a subregular sculpture of fine to moderately coarse spirals. The early spire-whorls have 3 strong, primary spirals and a deep, concave zone in the sutural area. Typical *samanensis* continues into the Chira shales but is much larger and more corasely sculptured.

Locality and Geologic Occurrence.—Chira formation, Lower and upper part of the Chira shales north of Casa Saman.

Turritella conquistadorana Hanna and Israelsky Plate 12, figs. 1, 2, 3, 5, 7.

Turritella conquistadorana Hanna and Israelsky, 1925, Proc. Calif. Acad. of Sci., 4th series, vol. 14, no. 2, p. 41, pl. 7, fig. 5.

"Shell acute-conic, with an apical angle of 15°; sutures depressed, with a strong collar-like rib just below; and with minor riblets intercalated.

Alt. 23.7mm. (apex missing); dia. 5.1mm.

Mancora." (Hanna and Israelsky, 1925.)

Shell of medium size, with a fairly rapid taper and strongly sculptured whorls; protoconch unknown; earliest post-nuclear whorls observed, have three, strong, nearly smooth and equal spiral cords, the two lower, adjacent, the upper or posterior separated by a deep, wide concave groove; on the later spire-whorls, the posterior cord increases greatly in strength, developing into a pronounced and heavy keel; it is bordered below by a wide interspace and this in turn by the two anterior cords; on still older specimens, a fourth spiral may appear emerging from the anterior suture; base of the last whorl slightly convex and marked with six or more, low, close spirals; whole surface with very fine submicroscopic spiral lines; growth-lines with a moderately deep sinus, the apex lying in the deep groove between the posterior and anterior cords; sutures close, distinct.

Height 37mm.; diameter 16mm. (4 whorls)
30mm.; 15mm. (5.5 whorls)
33mm.; 13mm. (6.5 whorls)

Remarks.—With the exception of *conquistadorana* and probably the Argentine and Chilian forms grouped about *Turritella Breantina* d'Orbigny the other known species of *Turritella* having sutures bordered by a posterior cord or keel, much stronger than the rest of the sculpture, seem to be restricted to the American Eocene with representive species in both North and South America. The stratigraphic occurrence of *conquistadorana* in the basal Heath shales of early Late Oligocene age is therefore unusual, especially since no trace of this group has yet been found in the Late Eocene and Early Oligocene formations.

For purpose of comparison, the Eocene species may be divided into 2 groups based on the taper of the adult shell. In the first group with *T. precincta* Conrad[29] of the Wilcox Eocene as the typical form, the shell is short and stout with a large apical angle and consequent rapid taper. It also includes the *T. merriami* Dickerson[30] of the Californian Eocene. In the second group, the shells are very long and slender with a slow, gradual taper. Its most striking member is *T. Dickersoni* Woods[31] of the Negritos formation. Other species of the *Dickersoni* group are *T. humerosa* Conrad[32] from the Wilcox Eocene, *T. Hopkinsi*[33] and *Iddingsi*[34] from Peru and *T. soaresana* Hart[35] from the Maria Farinhà Eocene of Brazil. *T. conquistadorana* belongs to the first group.

Locality and Geologic Occurrence.—Heath formation, basal Caleto Mero shales at Caleto Mero. Basal Mancora shales at Boca de Mancora.

[29]**precincta** Conrad 1864, Proc. Acad. Nat. Sci., p. 211. Harris 1899, Bulls. Amer. Pal., vol. 3, p. 76, pl. 10, fig. 8.
[30]**merriami** Dickerson 1913, Univ. of Cal. Pub., vol. 7, p. 284, pl. 13, figs. 6a, 6b, 6c.
[31]**Dickersoni** Woods 1922, p. 79, pl. 8, figs. 6, 7.
[32]**humerosa** Conrad 1835, Trans. Geol. Soc. Penn., vol. 1, p. 340, pl. 13, fig. 3, Harris 1899, Bulls. Amer. Pal., vol. 3, p. 75, pl. 10, figs. 5, 6, 7.
[33]**hopkinsi** Olsson, 1928, Bulls. Amer. Pal., vol. 14, p. 64, pl. 14, fig. 2.
[34]**iddingsi** Olsson 1928, idem., p. 65, pl. 14, fig. 1.
[35]**soaresana** Hart (in White) 1888, Archivos do Museu Nacional, vol. 7, p. 160, pl. 18, figs. 8, 9.

Turritella hubbardi Hodson Plate 12, figs. 4, 6, 8, 10, 13, 14.

Turritella hubbardi Hodson, 1926, Bulls. Amer. Pal., vol. 11, p. 14, pl. 7, figs. 2-5, pl. 8, figs. 1-6, pl. 9, figs. 1, 5, 6.

This species was described by Hodson from the Oligocene-Miocene of Venezuela. There are two strong cords about the lower half of each whorl, the most anterior lying just above the lower suture and forming a strong keel to the last whorl. In young shells or on the earlier whorls, a 3rd cord is present at the posterior one-fourth, with finer threads in the concave zone just below. This is the type of sculpture which characterizes typical *hubbardi* of Venezuela. The Peruvian examples are larger, our fragments representing shells which reached a length of 40mm. or more. On the large, more mature forms from Caleto Mero, the interval between the peripheral or basal cord often have two, subequal primary spirals of which the uppermost represents the weakened third or most posterior cord. Fine secondary and tertiary threads occur in the intervals between the larger spirals. The spiral cords are sometimes obscurely beaded. Variety *weeksi* Hodson from Venezuela is more coarsely sculptured than any of our specimens.

Locality and Geologic Occurrence.—Mancora formation, Mirador sandstones and shales of Que. Charanal. Heath formation, basal Caleto Mero shales at Caleto Mero.

Turritella meroensis, n. sp. Plate 13, figs. 1, 2, 3, 4.

Shell moderately large, *Mesalia*-like with strongly convex whorls sculptured with heavy, spiral cords or ribs; taper of shell as figured is fairly rapid, the spire-whorls strongly convex with deep, concave sutural zone; protoconch unknown; early post-nuclear whorls have 2 subequal spiral ribs, shortly increasing to 3 on the succeeding whorls through the addition of a new spiral on the posterior side; these 3 spirals become nearly equal in size to form 3 primary cords; on older, more fully mature shells, the primary ribs are increased to 4, 5 or more though futher additions on the posteior side or by intercalation between the 1st and 2nd; the spaces between the primary ribs are concave, wide and smooth or with a small secondary threads and finer tertiaries; base slightly convex or little flattened and sculptured with about 6 irregular spirals, coarse near the margin, fine and sub-obsolete close to the pillar; growth-lines sinuous producing a broad, shallow sinus, the axis lying in the posterior one-third, with the basal lobe nearly straight, its apex to the left of the upper lobe.

Height 40mm.; diameter 17mm. (5 whorls)
37mm.; 16.5mm. (5 whorls)
27mm.; 20mm. (1 1/4 whorls)

Remarks.—This species is abundant in the basal Caleto Mero or Heath shales associated with *T. conquistadorana* and *hubbardi.* I have found no Tertiary species with which *meroensis* can be closely compared. In its rapid taper, strongly convex whorls and coarse sculpture, it resembles certain species of *Mesalia* but the aperture and shape of the growth lines are those of *Turritella.* In Guillaume's[36] classification of the growth lines of *Turritella,* this species would be placed between his No. 2 and 3 but the axis or deepest part of the sinus lies in the posterior one-third. The earlier spire whorls have 3 primary cords increasing to 4, 5 or more on the later turns.

Locality and Geologic Occurrence.—Heath formation, Caleto Mero, Posorja Ecuador.

Turritella gilbertharrisi Hodson — Plate 13, figs. 5, 6, 7, 11, 12; Plate 14, fig. 1

Turritella gilbertharrisi Hodson, 1926, Bulls, Amer. Pal., vol. 11, p. 17, pl. 12, figs. 2, 4, 6; pl. 13, figs, 1-6; pl. 14, figs. 1, 4, 7.

Turritella gilbertharrisi and several varieties were described by Hodson from the Oligocene-Miocene rocks of Venezuela. In Peru, this species has been found to be fairly common in the Nummulitic sandy shales of Sal Chica, less common in the Chira shales. Young shells probably of this species, have also been noted in the Saman group. The stratigraphic range of the species in Peru is therefore rare in the Upper Eocene becoming locally common in the Lower Oligocene.

The Peruvian fossils show considerable variation in most characters. They usually differ from the Venezuelan in having a weaker and cruder sculpture and with the basal or anterior cords closer together, often with a tendency for the posterior or upper cord to become much stronger. The periphery of the whorl is less angulated and consequently has a more rounded or less flattened base. Certain specimens from Caleto Sal may

[36]Guillaume 1924, Bull. Geol. Soc. France 4th series, vol. 24, No. 5, p. 285.

have the surface nearly smooth but the common form is weakly sculptured as indicated by figures 5, 6, 11. The whole range of variation is also found in the Chira shales from coarsely sculptured (figure 12.) to others that are nearly smooth.

Locality and Geologic Occurrence.—Chira formation, Chira shales of Casa Saman, Sal Chica shales of Caleto Sal.

Turritella salchia, n. sp. Plate 13, figs. 8, 9, 10, 13, 14

Shell of medium size, with numerous, straight-sided whorls and even taper; sutures close, indistinct; protoconch and early spire-whorls unknown; sculpture consists of a strong, spiral cord about the lower suture and forming a pronounced keel to the periphery of the last whorl; this cord is bordered above by a groove and a second spiral cord usually a little weaker than the first; above the 2 major spirals, the surface of the whorl is lower, flattened to excavated and usually sculptured with 4, subregular, beaded spirals separated by wider intervals; spirals finely beaded by sinuated growth-lines.

Height 27mm. (4 whorls); diameter 12mm.

Remarks.—Our specimens are fragmentary and encrusted with a calcareous sandy coating concealing to a large extent the finer surface features. The periphery of the last whorl is strongly keeled and bordered above by a 2nd but weaker cord. The wide space between the peripheral keel and the upper suture is flattened or excavated and usually sculptured with 4, finer, but regularly beaded spirals. The taper of the shell is quite slow. It will be distinguished from *Turritella gilbertharrisi* by its heavy peripheral cord and generally stronger sculpture and flatter whorls.

Locality and Geologic Occurrence.—Chira formation, Sal Chica Nummulitic beds of Caleta Sal.

Turritella galvesia, n. sp. Plate 14, figs. 2, 3, 4, 5, 6, 7

Shell small or medium-size; whorls numerous, slightly convex in profile but usually somewhat angulated about the lower third so that the grestest diameter of each whorl is in this region; earliest spire-whorls with two primary spirals in the center of the first few whorls; on the succeeding whorls, the primary spirals become more anterior and new secondaries appear on the area adjacent to the upper suture; sutures fine, indistinct, with the bordering areas straight or flattened and covered with numerous spiral threads; on half-grown shells, the secondary spirals become equal to the primary and the whorl interval is covered with 8 to 12, subregular, revolving threads along with a finer interstitial threadlet in each interval; base rounded.

Length 29mm.; diameter 9mm.
30mm.; 8mm.

Remarks.—When full-grown, this *Turritella* resembles *samanensis* Olsson, in its slightly convex whorls and fine sculpture. It is a more delicate and fragile species, and most of my specimens from Que. Charanal are crushed or flattened out of shape. Usually the whorls are somewhat angulated and with slightly coarser spirals about the lower sutures. In shape, the shells vary from forms with a fairly rapid taper as in *samanensis* to types quite slender and aciculate. The earlier nepionic whorls differ considerably from those of *samanensis*, in having 2 instead of 3 primary spirals about the center. With increase in size, the primary spirals become progressively more anterior in position and new secondary threads appear in the area just above. The profile of the spire-whorls are at first nearly straight but along with the forward movement of the primary spirals, they later become more convex and subangulated. With still further growth, the 2 primary spirals lose their prominence and the whole surface of the whorl is covered with numerous, subregular spirals. In very old shells, the spirals may again become irregular through the unequal growth of new secondaries.

Locality and Geologic Occurrence.—Mancora formation, Mirador conglomerates and sandstones of Que. Charanal.

Turritella caleta, n. sp. Plate 12, figs. 9, 11, 12, 15

Shell small or medium size, with a slow taper resulting in a fairly long, slender shell; protoconch not known; early whorls with 2, spiral ridges about the upper and lower sutures and divided by a wide smooth, concave medial zone; these spiral cords are finely crenulated by the growth-lines; on the following whorls the anterior spiral becomes stronger and even keel-like while the posterior ridge diminishes in strength and becomes nearly obsolete on the last whorls; body-whorl with a 3rd spiral emerging from the suture so that the periphery of the whorl carries 2, heavy spiral cords, the upper being the stronger; with exception of the above mentioned spirals, the surface of the shell is smooth or with very fine, submicroscopic spirals and heavier, sinuous growth-lines; the growth-lines show a wide, shallow sinus on the base and a deeper sinus in the medial concave zone.

Length 23mm.; diameter 13mm.; (2 1/2 whorls)
22mm.; 8.25mm. (5 whorls)

Remarks.—This is a rare species represented in our collection only by fragmentary specimens. The nepionic whorls are biangulated, the anterior and posterior cords finely beaded and separated by a wide concave zone. On the subsequent whorls, the anterior cords become much larger, developing a sharp keel. The surface is smoothish or only obsoletely striated in the adult.

Locality and Geologic Occurrence.—Heath formation, base of Caleto Mero shales, Caleto Mero.

Family MELANIIDÆ (Lamarck) Gray

Genus PACHYCHILUS Lea

Pachychilus canoasensis, n. sp. Plate 15, fig. 5

Shell small, solid with a medium length spire and smooth porcellaneous whorls; sutures distinct; whorls 6 or more (tip of spire broken), straight-sided but with a slight edge or coronation just below the upper suture; body-whorl about half the total length, straight-sided above, slightly angled about the periphery or middle and then sloping evenly to the anterior end; aperture subelliptical; the outer lip is broken but it was probably of medium thickness; growth-lines sinuous with a broad, shallow curve or sinus across the middle opposite the outer lip; columella strongly thickened.

Length 17.5mm.; diameter 6.5mm.

Locality and Geologic Occurrence.—Mancora formation, Punta Bravo grits of Que. Canoas.

Genus HANNATOMA n. gen.

Type.—**Melanatria** (?) **gesteri** Hanna and Israelsky

The following is a description of the genus *Hannatoma.*

Shell paludiniform to elongate melaniform, massive with numerous whorls; sutures distinct, somewhat channeled; whorls generally flat-sided, with a heavy sculpture of revolving ribs or cords; the spire whorls have two of these cords nearly equal in size, on the later turns generally the upper cord becomes larger; base of last whorl rounded, with three smaller and stronger cords; aperture unknown, judging from the growth lines, sinuated, concave about the upper half, convex forward below; inner lip and columella heavily callused; anterior canal short, slightly twisted and apparently broadly truncate.

Remarks.—This new genus *Hannatoma* is proposed for a group of three species very characteristic of the Peruvian Middle Oligocene. Judging by the shape of the growth-lines on the base of the body-whorl, the anterior canal appears to have been broadly and obliquely truncated. This feature would suggest a possible relationship with the *Hemisinus* group, widely distributed in the fresh-water streams of South America and the Antillean region. In typical *Hemisinus* Swainson (genotype, *H. lineolatus* Gray) from Jamaica, the outer lip is straight but the species from eastern Brazil (*H. edwardsi* Lea) have a strongly sinuated lip as in *Hannatoma.* The strong spiral cords of *Hannatoma* is paralleled among certain species of the North American *Pleurocera.*

This genus is named for Dr. G. Dallas Hanna of the California Academy of Science, who with Mr. Merle C. Israelsky, described the first species from Peru.

Hannatoma gesteri Hanna and Israelsky Plate 16, figs. 2, 7

Melanatria (?) **gesteri** Hanna and Israelsky, 1925, Proc. Calif, Acad. of Sci., 4th series, vol. 14, no. 2, p. 42, pl. 8, figs. 1-3.

"Shell robust, spire turreted, composed of eight post nuclear whorls; sutures deeply impressed, bordered above and below by an irregular, rounded, spiral ridge; body whorl with these two ridges and three smaller ones below; the uppermost of the three shows above the suture on the penultimate whorl; columella twisted, and apparently heavily calloused in full-grown specimens; these have a decided anal sulcus in the upper angle of the aperture; peristome thin; canal of moderate length only."—*Hanna and Israelsky.*

Length 58mm.; diameter 24.5mm.

Remarks.—This is the commonest species, and distinguished from the next by its shorter and more stubby form. The spiral cords are less strong, flattening out on the later turns. During the Middle Oligocene, this species together with *Pseudofaunus bravoensis* spread northward into northern Colombia.

Locality and Geologic Occurrence.—Mancora formation, Punta Bravo, Caleto Sal, Punta Mero, etc.

Hannatoma tumbezia, n. sp. Plate 15, figs. 1, 2

Shell massive, elongate-turritelloid, with a fairly long, slender spire; whorls numerous (9+), between distinct and slightly channeled sutures; sculpture of spire whorls of 2, heavy spiral cords, the upper or posterior, often being much larger and coarser on the later turns and sometimes forming a distinct shoulder; base of last whorl rounded with 3, additional and much narrower cords; growth lines sinuous; complete aperture not known; inner lip heavily calloused, with a stout, robust columella.

Length 71mm.; diameter 25mm.

Remarks.—This species will be distinguished from *gesteri* by its much larger shell and stronger sculpture. Both *gesteri* and *tumbezia* are common fossils in the typical Punta Bravo grits together with *Ampullina bravoensis* and *Pseudofaunus bravoensis.*

Locality and Geologic Occurrence.—Mancora formation, Punta Bravo grits, Punta Bravo and Caleta Sal. Lagunitas shales of Lagunitas.

Hannatoma emendorferi, n. sp. Plate 15, figs. 3, 8

Shell much smaller than the last two species, elongate, turritelloid, melaniform; whorl 5+; sculpture of spire-whorls of two, strong, spiral cords, the upper one strongest and separated from the lower, by a wide, groove-like interval; base of last whorl sloping and bearing 4, strong cords so that the body-whorl has 6, spiral cords in all; these basal cords are somewhat smaller than the upper 2; aperture broken; growth lines sinuous.

Length 46mm.; diameter 15.5mm.
36.5mm.; 13mm.

Remarks.—This is a much smaller species than *gesteri* and *tumbezia,* and occurs in the Mirador sandstones and conglomerates along the Chira valley.

It is named for Mr. Earl Emendorfer, formerly Geologist and Chemist for the International Petroleum Co., in Peru and Colombia.

Locality and Geologic Occurrence.—Mancora formation, Mirador sandstones and conglomerates, Chira valley.

Genus HEMISINUS Swainson

Hemisinus terebriformis, n. sp. Plate 15, fig. 4

Shell small, slender, *Terebra*-like in sculpture and form; the whorls coronated by a heavy, noded, spiral cord or keel, situated just in front of the upper suture; in addition the sculpture consists of a series of oblique or curved costæ extending more or less continuously from suture to suture on the spire whorls or ending abruptly at the periphery of the body whorl or 1st basal spiral; the noded character of the sutural keel is caused by its intersection with the costæ; the spire whorls may also have 2 or 3 faint, spiral cords which become stronger on the later turns; base of whorl rounded with 5 or 6, heavy spiral cords and wider interspaces; outer lip slightly expanded, with a wide sinus at its upper one-third.

Length 19mm. (3 1/2 whorls); diameter 10mm.

Remarks.—No specimen with a perfect aperture or one fully exposed has been found, although the species is quite common at Canoas. It is therefore referred to the genus *Hemisinus* chiefly on account of its fresh-water or non-marine character. It will be easily recognized by its strong keel or rib which forms the upper edge of each whorl.

Locality and Geologic Occurrence.—Mancora formation, Punta Bravo grits of Que. Canoas.

Genus ANCONIA, n. gen.

Type.—**Anconia elenensis,** n. sp.

The following is a description of the genus *Anconia.*

Shell large, subulate, with numerous, slowly tapering whorls; early spire whorls more slender than the later turns, smooth; the last few whorls have strongly oblique, curved riblets about the upper quarter, the riblets fading out on the lower three-quarters; growth-lines sinuous, retracted at the upper suture, convex across the lower half and then joining in the umbilical region to form a siphonal cord; a narrow, siphonal sinus, developing into a pronounced cord, curving upwards into the umbilical region; aperture subcircular, oblique, inclined forward at the anterior end; outer lip thin; inner lip and columella heavy with a spreading callus.

Remarks.—The relations of this genus is probably with the fresh water South American *Hemisinus,* but the fossil far exceeded any of the known species of that genus in size. Most of our specimens are broken, but judging from fragments, the mature shell often exceeded 150mm. in length. The long slender spire is smooth with the last few turns ornamented with strong, curved or oblique riblets or folds. The aperture is subcircular and inclined forward at the base. Outer lip thin. The columella is stout with a thin spreading callus on the body-wall and a narrow, deep, siphonal sinus at the anterior end followed by a thick cord encircling upwards into the umbilical region.

Anconia elenensis, n. sp. Plate 16, figs. 1, 5, 8, 9, 10

Shell large, subulate, porcellaneous with numerous, slowly tapering whorls; spire usually more slender than the lower half, with smooth whorls about two-thirds their width in height; sutures distinct and strongly inclined; the last and penultimate whorls of large specimens develop a shoulder near the upper one-third which is sculptured with deep, oblique and curved riblets; these riblets beginning about the middle of the whorl, cross the shoulder and become strong, curved riblets or folds in the area bordering the upper suture; the profile of the last whorl is subquadrate with a rounded base usually ornamented with 3 or 4, widely spaced cords or spirals; base excavated with a deep groove or impressed zone lying just behind the pillar or columella; in this excavated zone, there is a strong cord or rib developed by the growth-lines crowding around the end of the anterior sinus; aperture subcircular, oblique, inclined backwards near the upper suture.

Length 119mm.; diameter 35mm. (6 whorls) Holotype.
57mm.; 31mm. (2 whorls) Paratype.
42mm.; 28mm. (1 1/4 whorls)

Remarks.—*Anconia elenensis* occurs with *Leda stewarti*, n. sp. in coarse, soft and somewhat lignitic sandstones at Ancon Point Ecuador. These rocks are principally of fresh or brackish-water origin and are exactly equivalent to the Punta Bravo grits of Peru and therefore of Middle Oligocene age.

Locality and Geologic Occurrence.—Ancon Point stage, Ancon Point Ecuador.

Family MELANOPSIDÆ Bourguignat

Genus FAUNUS Montfort

Subgenus PSEUDOFAUNUS n. subg.

Type.—**Faunus (Pseudofaunus) bravoensis**, n. sp.

The following is a description of the subgenus *Pseudofaunus.*

Shell elongate with numerous whorls, solid, smooth; whorls flat to slightly convex with distinct, linear sutures; the growth lines show a sinal inflexion about the middle of the early spire-whorls, becoming posterior of the middle on the later turns; outer lip unknown but judging from the growth lines, as in *Faunus,* with a deep, posterior sinus a short distance below the upper suture and a deep sinus on the base; the anterior or basal sinus is deep and narrow and gives rise to a heavy basal cord entering the aperture near the middle of the inner lip; inner lip somewhat calloused.

Remarks.—The recent species of *Faunus* (type *Strombus ater* Linnaeus) are mud-loving, fresh-water shells inhabiting the mouths of large rivers in India, Ceylon, Philippines and as far south as New Caledonia. In the French Eocene, there are several gastropods, which on conchological grounds cannot be distinguished from typical *Faunus* and as Cossmann[1] notes, it is strange that no species of true *Faunus* have yet been found in Oligocene, Miocene or Pliocene deposits.

The Punta Bravo fossils are evidently closely related to *Faunus* but differ principally in having a strong basal cord and a larger, heavier shell. The growth lines indicate a strong posterior sinus, a short distance in front of the upper suture. The anterior sinus is deep and narrow and gives birth to a strong basal cord.

[1]Cossmann, 1909, Paléoconch, Comparée, vol. 8, p. 160.

Pseudofaunus is typically a fresh or brackish-water form. Our specimens from Colombia show a brown coloration which is probably an original epidermal covering and the spire whorls are often deeply eroded and pitted as characteristic of fresh water shells in general.

Faunus (Pseudofaunus) bravoensis, n. sp. Plate 15, figs. 9, 11

Shell large, solid with a long, fairly slender spire; whorls numerous (7+), between distinct, linear sutures; whorls of the spire at first flat-sided, the later ones usually being a little convex; surface smooth, except for growth lines and sometimes very fine, indistinct spirals; outer lip not known, but probably as in *Faunus;* the growth lines sinuous with a medial sinus on the early spire whorls, this becoming more posterior on the later turns; a deep, narrow, anterior sinus, followed by a heavy, encircling, basal cord emerging from the upper one-third of the aperture; the growth lines are often crowded together to form, low, faint varices, so that the lip was probably feebly expanded at times.

Height 76mm.; diameter 27mm.

Remarks.—This species along with *Hannatoma, Ampullinopsis spenceri, Ampullina bravoensis* and *Ostrea miradorensis* are common fossils in the Punta Bravo facies of the Mancora formation. The same fauna has also been collected in certain Middle Oligocene sandstones in the Sinu region of northern Colombia where they occur fairly closely associated with interbedded marine limestones containing large *Lepidocyclina.*

Locality and Geologic Occurrence.—Mancora formation, Mirador conglomerates of the Chira valley; Lagunitas shales south of Lagunitas; Punta Bravo grits at Caleto Sal, Punta Mero, etc.; Que. Charura, northern Colombia.

Faunus (Pseudofaunus) chiraensis, n. sp. Plate 16, figs. 4, 6

Shell small or medium size, subulate, with flat, smooth whorls and close sutures; apical angle about 21 degrees; in porportion, the spire-whorls are nearly twice as wide as high, nearly smooth and bounded by close sutures; body-whorl rounded or slightly angled about the middle or periphery, below which the surface is marked with faint to subobsolete, regular spirals and rarely obscure folds; growth-lines sinuous as in *Faunus*, with a deep sinus a short distance below the upper suture and a broad lobe in the middle or peripheral portion; a deep, siphonal sinus seems to have been present, sometimes giving rise to an obscure fold encircling the anterior canal.

Height 45mm.; diameter 23mm. (2 1/2 whorls)
41mm.; 18mm. (4 whorls)

Remarks.—This species differs from *bravoensis*, by its smaller size and sculptured base.

Locality and Geologic Occurrence.—Chira formation, Chira shales near Casa Saman. Mancora formation, Chira valley.

Family CERITHIIDÆ Menke

Genus CERITHIUM Burguiere

Cerithium ? macarum, n. sp. Plate 16, fig. 3

Shell of medium size, solid, melaniform; spire rather long, composed of 7+ whorls; nucleus unknown; the early spire-whorls are sculptured with 3, primary spiral cords, at first beaded by narrow, straight ribblets; the spiral cords become obsolete leaving the last 3 whorls smooth or only faintly marked with growth-lines; base of last whorl rounded and ornamented with alternating spirals; sutures deep, grooved, slightly coronating the upper edges of the whorl; there are faint indications of varices along the two sides of the shell, which lie in the same plane as the outer lip; growth-lines show a shallow but wide sinal curve across the middle of each whorl; aperture broken; anterior canal short and apparently twisted, cerithioid.

Height 53mm.; diameter 20mm.; aperture 15mm.

Remarks.—Our collection contains but a single specimen which is not quite complete, lacking the aperture and the nuclear tip of the spire. The anterior canal, partly broken and encrusted with rocky matrix, appears to be cerithioid and hence the species is provisionally referred to that genus. The shell bears some resemblance to young specimens of *Cerithium* (*Iddingsia*) *læviusculum* Gabb of the Saman sandstones but easily recognized by its rounded base and grooved sutures.

Locality and Geologic Occurrence.—Mancora formation, Chira valley.

Genus POTAMIDES Brongniart

Potamides chira, n. sp. Plate 15, fig. 10

Shell small, stout; spire high with nearly straight sides; sutures indistinct; whorls are sculptured with two, strong spiral cords which border the upper and lower sutures and with a smaller, much finer thread between; the spiral cords are evenly noded by axial riblets which are nearly absent from the space between the primary cords; base of last whorl flattened with the periphery ornamented with two, simple spiral threads; aperture broken.

Height 24.5mm.; diameter 11.5 mm.

Remarks.—Our specimen is fragmentary, having lost the aperture and early spire whorls. Several other species of *Potamides* occur in the Chira shales but the material is too poorly preserved to be described and illustrated.

Locality and Geologic Occurrence.—Chira formation, near Casa Saman.

Potamides hondensis, n. sp. Plate 15, figs. 6, 7

Shell short, stout with a fairly rapid taper; nucleus unknown; post-nucular whorls 8 or 9 with close, linear sutures; sculpture of spire-whorls consists of 2 large, heavily noded spiral cords separated by an interval of the same width as the cords themselves and often carrying a fine interstitial thread; there is usually present a fine spiral in the lower suture; on the last whorl, the posterior or uppermost spiral cord becomes heavier than the lower; periphery of last whorl blunt or rounded with 2 simple and smaller spirals; base strongly flattened, smooth; aperture not preserved.

Height 42mm. (spire broken); greater diameter 30mm.
49mm.; 23mm.

Locality and Geologic Occurrence.—Mancora formation, Upper Que. Honda.

Family APORRHAIDÆ Philippi

Genus ECTINOCHILUS Cossmann

Ectinochilus gaudichaudi d'Orbigny

Rostellaria gaudichaudi d'Orbigny, 1842, Voyage dans l'Amerique meridionale, Paleontologie, p. 116, pl. 14, figs. 6, 7, 8.
Dientomochilus (Ectinochilus) sp. cf. **lacqueata** (Conrad) Woods, 1922, p. 92, pl. 12, figs. 3a, 3b.
Ectinochilus gaudichaudi Olsson, 1928, Bulls. Amer. Pal., vol. 14, p. 71, pl. 16, figs. 3, 4, 5, 7.

Typical *gaudichaudi* of the Saman sandstones is a nearly smooth shell reaching a maximum length of about 30 millimeters. The earlier Talara forms (var. *alauda*) are usually smaller with the spire whorls ornamented with closely spaced, straight riblets continued across the indistinct sutures but lacking from the smooth body whorl. *E. gaudichaudi* is locally common in the Chira shales and in the Mirador. They are usually larger than the average-sized specimens from the Saman sandstones but reverting towards var. *alauda* in their ornamentation, remain coarsely sculptured at all stages. The posterior canal is continued to the tip of the spire and sometimes in a reverse direction down the opposite side.

Locality and Geologic Occurrence.—Mancora formation, Mirador, near Casa Saman; Chira formation, near Casa Saman and Quercotilla.

Genus PERUCHILUS, n. gen.

Type.—**Peruchilus culberti**, n. sp.

The following is a description of the genus *Peruchilus*.

Shell broadly conic with rapid enlarging, straight-sided or keeled whorls; spire-whorls angled or carinated about the middle or just below; body-whorl with a strong, central keel or ridge bordered anteriorly by a peripheral or basal keel so that on internal molds or weathered specimens, this whorl appears broadly biangulated; sutures linear, straight; base flattened, impressed or concave; anterior canal very short; outer lip wing-like adherent only to the lower quarter or half of the penultimate whorl with a long, pointed, posterior extremity and rounded anterior side; a groove or sinus follows along the posterior side of the expanded lip being the continuation of the medial keel.

Remarks.—*Hemichenopus* Steinmann and Wilckens[36] based on *Chenopus araucanus* Philippi from Chile and Patagonia is probably related. Philippi's[37] original figure is very poor and represents a fragmentary specimen with the spire and anterior canal partly missing. It does not agree entirely with the later figure of Steinmann and Wilckens's which is however a restoration from

[36]Steinmann and Wilckens, 1908, Arkiv för Zool., Bd. 4, p. 79, pl. 7, figs. 4a, b.

[37]Philippi, 1887, Die Tert, u. Quart. Verstein. Chiles, p. 35, Tab. 1, fig. 2.

fragmentary specimens collected from a hard, chalky green sandstone near the mouth of Rio Grande Patagonia by the Swedish Magellanian Expedition. In Steinmann and Wilckens's figure, the anterior canal is shown as being very long and slender. The outer lip is similar to *Anchura, Drephanochilus* and *Arrhoges* in having the posterior end very long, slender, pointed and directed backwards or posteriorly. Cossmann[38] in his supplementary notes to the eighth volume of his Essais de Paléoconchologie Comparée, considers *Hemichenopus* as a section of *Perissoptera* Tate, the main differences noted being the longer, curved anterior canal of *Hemichenopus,* the ornamentation of the spire reduced to spiral striæ and thickened columellar border. According to Steinmann and Wilckens's figure, there is a short, separate posterior digitation by means of which the lip is adnate to the lower half of the penultimate whorl. The relations of the Chilean genus *Hemichenopus* is therefore clearly with *Arrhoges* and *Drephanochilus* and not to the Cretaceous *Perissoptera* as advanced by Cossmann.

The Peruvian fossils are internal molds in a very hard sandstone except a single specimen from the Chira shales which has a part of the external shell preserved. The outer lip is expanded and wing-like adherent only to the lower quarter or half of the penultimate whorl. The posterior end of the lip is elongate and directed backwards or posteriorly, while the anterior extremity is simply rounded. The base is flattened, impressed or concave, ending in a very short anterior canal. The form and sculpture of the whorls are similar to *Hemichenopus* and to several species of Cretaceous *Aporrhadiæ* (such as *Pterocerella tippana* Conrad). The flattened, impressed base and very short anterior canal are the main differences between *Peruchilus* and *Hemichenopus.* In *Drepanochilus,* the base is rounded, sloping or attenuated, the anterior canal is longer, the outer lip is less expanded with the anterior side straight and the spire is longer with the whorls sculptured with numerous curved axial riblets.

The *Aporrhaidæ* attained their greater development during the Mesozoic when they were represented by several genera and sections. Only the typical genus *Aporrhais* DaCosta (*Chenopus*

[38]Cossmann, 1909, Paléonconch. Comparée, vol. 8, p. 224, fig. 86.

Philippi) and *Arrhoges* Gabb have continued through the Tertiaries into the recent fauna, their late Tertiary and recent species being principally North Atlantic and European in distribution. The North American Eocene species belong principally to *Drepanochilus* Meek. It is therefore of great interest to find this ancient family represented in the Oligocene rocks of Peru. The exact age of the beds which have yielded *Hemichenopus* in Chile and Patagonia is still uncertain but they probably belong to the late Oligocene or early Miocene.

Peruchilus culberti, n. sp. Plate 14, figs. 8, 12, 13

Shell of medium size, broadly conic, the spire of medium height with rapid, enlarging whorls; nucleus unknown; subsequent whorls 3, 4 or more, those of the spire straight-sided to slightly convex, angled about the middle; sutures linear, straight; body-whorl large and strongly keeled about the middle; the base is angled or carinated, this basal or peripheral carina lying submerged in the sutures of the earlier turns; on the internal molds or partly weathered specimens, the body-whorl is broadly biangulated with a wide flat band or channel between the central keel and the peripheral carina; the slope above the central keel is straight and marked with 8 or 9 spiral threads between which are finer secondaries; the broad area between the central keel and the basal carina carries a single strong central spiral thread and fine, minute spirals on each side; outer lip expanded as described above, slightly adnate to the penultimate whorl and with a produced posterior extremity; anterior side of lip slightly expanded, rounded; base flattened to impressed concave with a short anterior canal.

Height 27mm.; greater diameter 30mm.; vertical length of lip 24mm.

Remarks.—This species is most common as internal molds in certain hard sandstones belonging to the Mancora formation near Sullana. A single specimen collected in the Upper Chira shales north of Casa Saman has retained part of the external shell and on which most of our knowledge of the finer sculptural details of the surface is based. The lip or wing is unfortunately not preserved on this specimen. On the internal molds, the body-whorl is broadly biangulated by 2 equal carinæ or ridges. On the perfect shell, the upper ridge is most pronounced forming a true keel.

The species is named for Mr. V. Culbert, Geologist who collected most of the Bowl sandstone specimens in 1922.

Locality and Geologic Occurrence.—Chira formation, north of Casa Saman. Mancora formation, Bowl sandstones about 2 miles northeast of Sullana.

Family STROMBIDÆ d'Orbigny

Genus STROMBUS Linné

Strombus chiraensis, n. sp. Plate 11, fig. 1

Shell of medium size, stout, coniform; the spire of 6 or more whorls is low and flattened in the peripheral region, but with the tip or apex high and elevated; sutures deep, the last whorl descending; the earliest spire-whorls are ribbed with large varix-like ribs spaced about 120 degrees apart; the following spire-whorls are simply cone-like in form with a simple, sharp shoulder; at or approaching maturity, heavy shoulder knobs are developed on the last whorl spaced about 120 degrees apart; these shoulder knobs mark former resting stages and cover heavy callous growth at the posterior junction of the outer lip with the body-whorl; base of last whorl on full-grown shells with the anterior canal slightly recurved at its tip; surface smooth.

Height 56mm.; aperture 50mm.; diameter 33mm.

Remarks.—There are 3 specimens of this peculiar fossil in our collection. The immature form is strikingly *Conus*-like, the shoulder is simply angled and lacks the large stromboid knobs which appear with maturity. The earliest spire-whorls (very poorly preserved on our specimens), are provided with large ribs or varices which seem to follow about 120 degrees apart. The succeeding spire-whorls are *Cone*-like with a plain, simple shoulder angle. With maturity, a section along the shoulder of the last whorl is trigonal with large knob-like shoulder ribs spaced about 120 degrees apart. They are partly due to excessive growth of callus at the posterior junction of the lip during resting periods. The outer lip is unfortunately broken on the larger and more mature specimen. The tip of the anterior canal is bent upward or backward in a stromboid fashion.

The genus *Oostrombus* Sacco (genotype *S. problematicus* Mich.) to which this species may possibly belong, differs from typical *Strombus* by its straighter beak, less expanded wing and absence or very small stromboid labial sinus.

Locality and Geologic Occurrence.—Chira formation, Chira shales near Casa Saman.

Genus RIMELLA Agassiz

Rimella peruviana, n. sp. Plate 21, fig. 4

Shell of medium size, a spire of moderate length and a sculpture of coarse riblets and finer spirals; nucleus unknown; post-nuclear whorls 4+, the spire-whorls fairly large and about one-half the length of the whole shell; rib-like varices are present on some of the spire-whorls and roughly spaced about 120 degrees apart; on the last whorl, a varical rib is present, not quite opposite the outer lip so that the ventral side of the shell appears slightly depressed and the dorsal side convex to slightly humped; sculpture consists of even, linear riblets which number about 21 on the last turn; the spaces between the riblets are wider, concave and marked with fine spiral lines; anterior canal and anterior side of aperture broken; the posterior canal is continued as in *Rimella fissurella* along a ridge of callus to the tip of the spire.

Length 19mm. (broken); diameter 11mm.

Remarks.—This species is probably a true *Rimella* but until good specimens are found with perfect aperture and anterior canal, its reference to this genus must be tentative. In typical *Rimella,* the sculpture consists of longitudinal riblets with their interspaces covered with finer spirals. Varices are present on the spire-whorls and generally one on the body-whorl opposite the outer lip but in *Rimella fissurella,* the genotype, the last varix is not so large as on *peruviana.* The genus *Cowlitzia* Clark and Palmer[39] is coarsely sculptured with ribs and spirals but has no varices.

Locality and Geologic Occurrence.—Chira formation, Chira shales near Casa Saman.

Family CYPRAEIDÆ Gray

Genus CYPRAEA Linné

Subgenus CYPRAEDIA Swainson

Cypraea (Cypraedia) chira, n. sp. Plate 17, figs. 9, 12

Shell small, pyriform, the anterior end somewhat produced, narrowed, the posterior pointed and extended beyond the con-

[39]Clark and Palmer, 1923, Bull. Dept. Geol., Univ. Calif. Pub., vol. 14, p. 283, pl. 51. (**Cowlitzia,** type **C. washingtonensis** C. and P.)

cealed spire; dorsal side strongly convex, the ventral side of body-whorl narrower and less convex; aperture narrow, curved or subcircular in outline, slightly wider in the columellar region and extended above the spire at its posterior end; outer lip a wide, thickened band, ridged on the dorsal side; surface strongly sculptured with about 34, regular, revolving narrow cords separated by much wider interspaces, each interspace often carrying a small interstitial thread; the revolving cords cross the thickened outer lip and the vetral side of the body-whorl; interior of inner and outer lip concealed.

Height 29.5mm.;	diameter 19.5mm.;	height 16mm.
27mm.;	16.25mm.;	14mm.

Remarks.—In *Cypraedia* Swainson (genotype *C. elegans* Defr. of the Parisian Eocene) the spire is completely concealed. It is visible in *Cypraeovula* Gray based on *C. capensis* Gray of the recent South African fauna. *Sulcocypraea* Conrad and *C. lintea* as type differs only from *Cypraedia* in having the outer lip strongly thickened.

Several coarsely sculptured Cypraeas have been described from the American Tertiaries. The largest and most elegant is the *C. fenestralis* Conrad from the Vicksburgian. It is a strongly convex or globose shell, with a coarse cancellated sculpture. *C. lintea* Conrad, *dalli* Aldrich and *subcancellata* Johnson are known from the Gulf Coast Eocene. The *Ovula* (*Transovula* ?) *multicarinata* Dall from the Ocala limestones of Florida is strikingly like *Cypraedia* in its style of ornamentation. *C. subelegans* was described by Trechmann from the Yellow limestones of Jamaica. From the same horizon, Trechmann also records a second species at *C. cf. elegans* Defrance.

Cypraedia chira is fairly common in the Chira shales near Casa Saman and Quercotilla and a few specimens which may belong to this species have been collected from the Punta Bravo grits. A species of *Cypraedia* represented in our collections by very fragmentary material, occurs in the basal Talara beds of Yasila.

Locality and Geologic Occurrence.—Mancora formation, Punta Bravo grits of Caleta Sal. Chira formation, near Casa Saman and Quercotilla.

Family CASSIDIDÆ Adams

Genus MORUM Bolten
Subgenus ONISCIDEA Mörch

Morum (Oniscidea) peruvianum, n. sp. Plate 17, figs. 5, 7

Shell of medium size, solid; spire low, conic; nucleus (as preserved) small of one and one-half smooth turns followed by 4 subsequent whorls; body-whorl large, four-fifths the length of the shell, shouldered; on the subsequent whorls the anterior cords become lower in position and gradually are submerged by the suture so that on the penultimate turn only a single cord is present on the shoulder; on the body whorl there are 10 or 11 coarse spiral cords separated by very wide, flat interspaces; the shoulder area having about one and a half times the width of the interspace is smooth; the surface is further sculptured with small, linear riblets which give rise to a coarse, cancellate sculpture; aperture linear, surrounded except for a break by the anterior sinus by a callus platform; outer lip is strongly thickened or rib-like, coarsely dentate within; callus of inner lip spreading but thin, non-pustulate but with the sculpture of the body-whorl showing through; no sulcus at the posterior end of aperture.

Height 25mm.; diameter 16mm.; aperture 20mm.
27mm. (imperfect); 20mm. (imperfect)

Remarks.—This species is related to *O. harpula* Conrad[40] from the Vicksburg of Mississippi. A direct comparison of *peruvianum* with Conrad's type specimen of *harpulum* preserved in the collections of the Philadelphia Academy shows that the most striking difference between the two species, is the more strongly contracted base or anterior portion of *harpulum.* In sculpture, *harpulum* and *peruvianum* resemble *domingensis* Sowerby[41] of the San Domingan Miocene. In *domingensis,* the shell is usually larger, the ends of the longitudinal ribs do not continue across the slightly concave, smooth sutural zone, the parietal callus is strongly and thickly pustulated and the posterior end of the lip has the deep sulcus of *Herculea* as pointed out by Dall[42].

[42]Dall, 1915, Bull. 90, U. S. Nat. Mus., p. 85, pl. 12, fig. 28.

Locality and Geologic Occurrence.—Chira formation, Chira shales, near Casa Saman.

[40]Conrad, 1847, Journ. Acad. Nat. Sci. Phila., 2nd series, vol. 1, p. 119, pl. 12, fig. 6.

[41]Sowerby, 1849, Quart. Journ. Geol. Soc. London, vol. 6, p. 47, pl. 10, fig. 3. Maury, 1917, Bulls. Amer. Pal., vol. 5, p. 276, pl. 18, figs. 7, 8. Pilsbry, 1922, Proc. Acad. Nat. Sci. Phila., vol. 73, p. 363.

Morum (Oniscidea) chiraense, n. sp. Plate 17, figs. 6, 8

Shell smaller than the last (*peruvianum*) and finer sculptured; spire short, conic and with flat or straight-sided whorls; sutures indistinct; body-whorl large, widest at the shoulder which is rounded or slightly angulated; sculpture is concellate, formed by the intersection of nearly equal riblets and spirals; the riblets are straight, regular and number about 15 or 16 on the last whorl and continue from the upper suture nearly to the tip of the anterior canal; the spirals consists of narrow revolving cords somewhat coarser about the upper suture and on the shoulder, slightly finer on the base and anterior canal; the spirals number 15 or 16 from the shoulder of the last whorl to the tip of the anterior canal; outer lip greatly thickened; inner lip with a spreading callus carrying 2 or 3 rows of coarse pustules, the inner row cord or plait-like with their longer axis lying in the transverse direction.

Length 23.5mm.; diameter 13mm. lip imperfect.
19mm.; 14mm. crushed.

Remarks.—A smaller and more finely sculptured species than *peruvianum.*

Locality and Geologic Occurrence.—Chira formation, Chira valley, near Casa Saman.

Morum (Oniscidea) dolioides, n. sp. Plate 17, figs. 3, 4

Shell of medium size, thin to medium weight; nucleus unknown; post-nuclear whorls 4 or more, shouldered and sculptured *Dolium*-fashion with strong, spiral ribbons separated by flat interspaces which are nearly as wide as the bands themselves; the whorls are narrowly shouldered with the space between the shoulder and suture slightly concave; sutures grooved; early spire-whorls have a pseudo-cancellata sculpture of numerous ribs crossed by 3 spiral cords; on the body-whorl, the spiral bands number about 14, with 6 smaller, closer-spaced ones near the tip of the anterior canal; the main spiral bands are quite regular in size and spacing; last whorl slowly tapering to the anterior canal; aperture unknown.

Length 47mm.; diameter 28.5mm.
39mm.; 20mm.

Remarks.—The only specimens known, are fragmentary and crushed so that the above measurements give but a general idea of the size and general porportions. The texture of the shell is fairly light and sculptured like *Dolium* with strong banded spirals. The earlier spire-whorls have a cancellate sculpture of spirals and riblets but the riblets are practically lacking from the later turns.

Locality and Geologic Occurrence.—Mancora formation, Mirador sandstones of Que. Charanal. Punta Bravo grits of Caleto Sal.

Subgenus HERCULEA Hanley

Morum (Herculea) charanalense, n. sp. Plate 17, figs. 1, 2

Shell of medium size, *Cassis*-like with a very short spire and large body-whorl; nucleus of 2 smooth, convex whorls followed by 4 subsequent whorls; body-whorl large nearly as long as the total length of the shell; whorls shouldered except for very faint, subobsolete spiral bands and more pronounced but delicate, narrow, linear ribs which extend from the suture to the tip of the canal; there are about 10 ribs on the last whorl; aperture linear with a heavily thickened or rib-like outer lip; inner lip with a callus platform spreading over the ventral face of the body-whorl; this callus is smooth with the covered linear ribs showing through.

Length 25mm.; diameter 16.25mm.
24mm.; 16mm. (crushed)

Remarks.—This species is represented by 3 specimens from Que. Charanal, 2 being broken and crushed, the 3rd or Holotype, partly enclosed in rock.

The preceding species (*peruvianum* and *chiraense*) belong to *Oniscidea,* the sculpture being cancellate and without a sulcus at the posterior end of the aperture. In this species, the sculpture is not cancellate and there is a pronounced posterior sulcus as characteristic of *Herculea. Cassidea maccormacki* Olsson from the basal Talara of Lagunitas should also be referred to *Herculea.* In *maccormacki,* the shell is larger, more solid, with strong ribs and heavier spiral sculpture.

Locality and Geologic Occurrence.—Mancora formation, Que. Charanal.

Family FICIDÆ

Genus FICUS "Bolten" Roeding

Ficus chiraensis, n. sp. Plate 18, figs. 10, 12

Shell small, thin, pyriform; spire moderately elevated, composed of 4 or 5, rounded convex whorls between close distinct sutures; protoconch of fair size, composed of 2 or 3, globular, smooth whorls; body-whorl large, moderately inflated about the upper half, contracted about the base and produced to form the long anterior canal; aperture semilunar, widest at the middle; sculpture pattern of a set of heavy, primaries, spaced about 1.25 to 1.50mm. apart and with 3 or sometimes 4, smaller secondaries in between; these spirals are decussated by regular, elevated longitudinal threads, one-half to three-fourths of a millimeter apart on the center of the body-whorl.

Height 26mm.; diameter 18mm.

Remarks.—*Ficus woodringi* and *chiraensis* have the helicoid nucleus of *ventricosus* except that it appears to be somewhat larger and less submerged by the subsequent whorls. The sculpture pattern is similar to *ventricosus*, consisting of regularly spaced primaries with the wide interspaces ornamented by 3 fine secondaries. *Ficus mississippiensis* Conrad from Vicksburg belongs to the *ventricosus* group. Is differs principally from *chiraensis* by its lower spire and more slender form.

Locality and Geologic Occurrence.—Chira formation, near Casa Saman.

Ficus woodringi, n. sp. **Plate 18, fig. 8**

Shell small, thin, pyriform; spire low but elevated with about 4 slightly convex or rounded whorls; protoconch of fair size, composed of about 2 complete turns, smooth and more or less globular in shape; body-whorl is large, strongly convex about the upper one-third, produced and strongly contracted or narrowed anteriorly; the sculpture is composed of a set of heavier, revolving primary spirals, spaced in full-grown shells about 3.5mm. apart; the interspaces have usually a single, central secondary (which on the anterior canal may nearly equal the primaries) and 1 or 2 smaller threads on each side; the whole surface is also covered with fine, longitudinal threads which produce a finely reticulated sculpture pattern; on the spire-whorls, the revolving spiral threads may be slightly beaded by the longitudinal.

Height 31mm.; diameter 20mm.

Remarks.—A few specimens have the spire as low as in the living *F. ventricosus* Sowerby (*decussatus* Woods) but normally the spire is somewhat higher but less than in *chiraensis*. The sculpture pattern of *woodringi* belongs to the *ventricosus* type but is finer and more complex. It consists typically of a set of widely spaced primaries which are spaced about 3.5mm. apart on the back of the holotype. Each interspace has a central secondary which is in turn bordered on each side by 3 finer threads. The surface is finely decussated by regular, close-set, longitudinal threads. The wide spacing and coarseness of the primary spirals is quite similar to the sculpture pattern of *F. micronematica* Brown and Pilsby[43] from the Culebra beds of the Canal Zone. The holotype of *micronematica* is a small shell of a length of 28.8mm. It differs from *woodringi* by its lower spire and in having the spiral cords noticeably knotted by their intersection with the widely spaced, axial threads.

Locality and Geologic Occurrence.—Heath formation, basal Heath or Caleto Mero shales of Caleto Mero.

Superfamily RACHIGDOSSA
Family BUCCINIDÆ Troschel
Genus TRITIARIA Conrad

Tritiaria chira, n. sp. Plate 21, fig. 16

Shell small, slender, solid, the spire pointed and about one-half the length of the shell; protoconch nassoid, of 2 or 3 whorls, smooth except the last quarter turn which is sculptured with strong ribs; post-nuclear whorls about four and one-half, straight or slightly convex; sutures close, indistinct and carrying a strong spiral cord, bordered in front by a deep and wider spiral groove; sculpture of both ribs and spirals; the ribs are heavy, strong folds and extend from the sutural groove across the base to a contracted zone just above the anterior canal; they number about 7 on the last whorl and are separated by fairly wide interspaces; ribs and interspaces are crossed by even spiral threads which number about 5 on the spire whorls (not counting the sutural cord) and 11 or 12 on the body-whorl above the anterior canal; anterior canal nassoid, somewhat twisted and bordered above by a contracted zone.

Height 16mm.; diameter 7.5mm.; aperture 7mm.

Remarks.—The genus *Tritiaria* of Conrad based on *Buccinium mississippiensis* of Vicksburg as type, has recently been discussed

[43]Brown and Pilsbry, 1912, Proc. Acad. Nat. Sci. Phila., vol. 44, p. 507, pl. 22, fig. 8.

by Woodring in his Bowden Gastropods. It is a group of small *Nassa-Phos*-like shells of the late Eocene and early Oligocene deposits of the Gulf Coastal Plain. *Phos hilli* Harris as pointed out by Stewart is very similar to *mississippiensis*. *Buccinium vicksburgensis* Aldrich of the Byram Marl of Mississippi should probably also be referred to *Tritiaria*. *T. chira* differs from *T. terebratula* of the Lomitos conglomerate by its larger size and higher spire. The sutural cord is also stronger and more persistant.

Locality and Geologic Occurrence.—Chira formation, Chira valley, near Casa Saman.

Tritiaria sullana, n. sp. Plate 21, figs. 8, 15

Shell small, slender, solid; spire much longer than the aperture, pointed; protoconch unknown; post-nuclear whorls 5 or more, rugose, moderately convex between distinct, wavy sutures; sculpture consists of strong ribs between wide, flattish interspaces; these ribs number 6 or 7 on the last whorl and are continuous from the upper suture across the base to the contracted zone just above the anterior canal; the ribs and interspaces are further sculptured with a set of primary threads which number 6 or 7 on the spire-whorls and 12 or 13 on the body-whorl between the contracted basal sulcus and the upper suture; the spiral interspaces are wide, flattish and minutely marked with fine, submicroscopic spiral threadlets; anetrior canal of moderately length, twisted and sculptured with irregular spirals; aperture concealed.

Height 19mm. (broken);	diameter 9mm.;	aperature 10mm.
16mm. (broken);	9.5mm.;	9mm.

Locality and Geologic Occurrence.—Chira formation, Chira valley, near Casa Saman.

Genus POLLIA Sowerby

Pollia huitra, n. sp. Plate 18, fig. 9

Shell of medium size, subfusiform with the spire and anterior canal of equal length; whorls 4, extreme tip of spire being broken; the outline of the spire is conic, with flat-sided whorls between grooved or slightly channelled sutures; body-whorl is large, moderately convex with a sloping, slightly contracted base; the spire-whorls are sculptured with fairly regular, curved riblets, crossed by spiral threads; on the last whorl, the axial riblets tend to become obsolete and the middle of the whorl or the last three-fourths turn is nearly smooth; the spiral sculpture consists of a sutural cord, which is strong on the spire-whorl but becomes irregular or double on the last turn; in front of the sutural cord, the early spire-whorls have 3 strong spirals which nodulate the top of the riblets; the spirals increase through intercalation of finer threads in the interspaces and at the same time becoming lower and smoother; the sculpture gradually becomes obsolete and center of the body-whorl is nearly smooth; the anterior canal has 10 to 12 strong spirals; internal characters of anterior canal and aperture concealed; growth-lines curved in the middle.

Height 22mm.; diameter 13.25mm.

Remarks.—In form, this species is very similar to *Pollia undosa* Linné, the genotype. It also resembles by its sinuated growth-lines and obsolete body-sculpture, the recent West Coast *Cantharus distortus* Gray except in being very much smaller. The outer lip is broken and the aperture is filled with matrix.

Locality and Geologic Occurrence.—Chira formation, near Casa Saman.

Genus MELONGENA Schumacher

Melongena charanalensis, n. sp. Plate 19, fig. 6

Shell large, rather elongate, with a high spire and strongly shouldered or coronated whorls; the broken type has 4 whorls preserved but there were probably 6 to 8 when perfect; the whorls are sharply shouldered at the upper one-third with a wide, flattened to concave shoulder area bordering the upper suture; on the early whorls, the shoulder is simply sharply edged but on the later becoming noded or ribbed; on the last whorl preserved there are about 11 short but stout spines on the shoulder angle; the shoulder area is nearly smooth or simply marked by closely spaced, curved growth-lines, concave forward; below the shoulder angle, the early whorls have fairly wide, irregular subobsolete spirals which are nearly absent from the later turns; body-whorl and anterior part of shell broken; near the upper side of the broken aperture there is a strong revolving rib on the inner or parietal wall which forms a deep groove between it and its junction with the outer wall.

Height 62mm.; diameter 47mm.

Remarks.—The generic position of this fine fossil is somewhat uncertain. By its sharply angled shoulder and elevated spire, it recalls the *Melongena sculpturata* var. *turricula* Dall[44] of the Tampa Silex beds.

[44]Dall, 1915, Bull. 90, U. S. Nat. Mus., p. 68, pl. 8, fig. 7.

Locality and Geologic Occurrence.—Mancora formation, Que. Charanal.

Genus SIPHONALIA A. Adams

Siphonalia ? belenensis, n. sp. Plate 18, fig. 11

Shell of medium size, thin, elongate, bucciniform; spire rather high, the penultimate and spire whorls about equal to the aperture in length; nucleus unknown; subsequent whorls 4 or more, those of the spire convex to sharply shouldered, the body-whorl weakly shouldered to rounded or convex; axial sculpture of numerous, slightly curved riblets or plications, there being about 15 on the last turn; these riblets extend from suture to suture on the spire-whorls and to the approximate upper edge of the base on the last turn; the riblets are more or less nodulated by the angle of the shoulder; in addition, the whole surface has low to subobsolete spiral bands of which there are 7 or 8 on the spire-whorls and about 15 on the last; aperture subelliptical with a medium length, curved and twisted anterior canal; outer lip thin, with a shallow but broad sinal curve on the line of the shoulder and a slight forward bulge below.

Height 36mm.; diameter 18mm.; aperture 21mm.

Remarks.—*Siphonalia belenensis* differs from the next (*tessaria*) by being more slender, the axial riblets are more numerous and less strong, and on the spire-whorls extend from suture to suture. I have also a much larger species from the Mambri shales of San Pedro, near Manglaralto, Ecuador, but the specimens are too poorly preserved for description and figuring. The largest specimen is 60 millimeters in length. Patches of the original shell show sharp, noded, axial riblets and spirals similar to *belenensis.*

Both *belenensis* and *tessaria* are not typical Siphonalias and probably constitute a separate group. The *Buccinum annæ* Ortmann[45] from the Patagonian beds is probably related to the Peruvian fossils. It differs chiefly in having a wider aperture, the anterior canal is more twisted and with an encircling cord or keel. Its sculpture is quite similar with the shoulder becoming nodose or armed with small, sharp spines. Ortmann places his species in the subgenus *Cominella.*

Locality and Geologic Occurrence.—Heath formation, Pajarabobo.

[45]Ortmann, Princeton Patagonian Expedition, vol, 4, p. 208, pl. 33, fig. 17.

Siphonalia ? tessaria, n. sp. Plate 18, fig. 3

Shell of moderate size, thin, bucciniform, with a medium height spire; nucleus unknown; subsequent whorls 4 or more, angled about the middle by the short, sharp, axial ribs; sutures distinct; somewhat appressed; body-whorl large and about three-fourths the total length, sloping but not strongly contracted about the base; axial sculpture of short, sharp riblets or plications which are found only on the middle or shoulder of the whorls; on the last turn, there are 13 riblets; along with the axial sculpture, the surface is covered with low, smoothish spiral bands, there being 8 or 9 on the spire-whorls between the sutures and 21 or more on the last whorl; the spiral bands are somewhat heavier on the base, low and subobsolete on the area adjacent to the upper suture; aperture subovate, imperfect in our specimens; anterior canal of medium length, recurved; growth-lines sinuous.

Height 38mm. (broken); diameter 21mm.

Locality and Geologic Occurrence.—Heath formation, Pajarabobo. Mancora formation, Mirador, Que. Tamarindo.

Genus CYRTOCHETUS Cossmann

Cyrtochetus ? chiraensis, n. sp. Plate 14, figs. 10, 14

Shell *Metula*-like in general form and sculpture; spire elongate with convex whorls and close, indistinct sutures; protoconch and early spire whorls unknown; body-whorl is moderately convex about the upper half, contracted about the base and produced to form the short and probably recurved beak of the anterior canal; sculpture consists of numerous, curved, narrow axial ribs and spiral threads; the ribs are sinuous, concave towards the aperture on the upper half, convex forward on the lower half; the spirals are numerous, narrow, raised threadlets separated by wider flat intervals; anterior canal is broken in our specimens but evidently carried a short, recurved beak as in *Euthria;* outer lip sinuous, thickened; interior concealed.

Height 19mm. (2 whorls); diameter 11mm.; aperture 14mm.

Remarks.—Our specimens are fragmentary and have only the penultimate and body whorls preserved. The tip of the anterior canal is broken, but it seems to have had a short, recurved beak. Probably the fossils belong near *Euthria,* but the typical members of that genus are smooth and more solid. I am therefore provisionally referring the species to the genus *Cyrtochetus* of Cossmann, its type species *bistriatus* Lamarck of the Middle and Upper Eocene of France, agreeing closely in form and sculpture.

Locality and Geologic Occurrence.—Chira formation, near Quercotilla.

Genus METULA Adams

Metula peruviana, n. sp. Plate 18, fig. 13

Shell rather delicate, with the spire and anterior canal nearly of equal length; whorls 6 or more, slightly convex between fine but distinct sutures and forming a fairly long, moderately tapering, sharp ?pointed spire; sutures bordered in front by an elevated thread; body-whorl is moderately convex or inflated, the greatest diameter about the anterior one-fourth; protoconch unknown; the earliest spire whorls are somewhat shouldered and sculptured with numerous, strong axial riblets and spirals, the spirals and riblets both being heaviest about the upper half of the whorls; on the succeeding turns, the riblets disappear, only the spiral threads remaining on the penultimate and last whorls; the spiral sculpture is *Pyrula*-like consisting of narrow, raised threadlets with much wider interspaces and number about 35 on the last whorl, and 13 on the penultimate; the interspaces often with a central secondary thread and very fine tertiaries; outer lip slightly expanded and thickened; interior concealed.

Height 26mm.; diameter 12mm.; aperture 15.5mm.

Remarks.—In form, this species resembles *Metula gabbi* Brown and Pilsby, of the Panama Canal Zone, but has a proportionately larger body-whorl and different sculpture. Only the earliest spire-whorls have a cancellated sculpture of ribs and spirals.

Locality and Geologic Occurrence.—Chira formation, Chira valley, near Casa Saman.

Family MURICIDÆ Tryon

Genus YASILA Olsson

Yasila chiraensis, n. sp. Plate 14, figs. 9, 11

Shell small, muriciform with a short, elevated spire and medium-length anterior canal; nucleus not preserved; post-nuclear whorls 4 or more; body-whorl large, inflated and shouldered, and forming three-fourths or more of the whole shell; the whorls are sculptured with strong ribs which number about 7 on the last turn; they are fairly widely spaced and pass from suture to suture and on the last whorl from the upper suture to the base or posterior end of the anterior canal; on the spire-whorls, the space between the ribs are about the same width as the ribs but on the body-whorl the ribs are narrower with the interspaces often quite wide; the whole surface is further sculptured with nearly even, elevated, spiral threads which are peculiarly beaded by fine, longitudinal lines; the spaces between the spirals are quite wide; the spirals number 6 or 7 on the penultimate whorl and approximately 28 on the back of the body-whorl; anterior canal of medium length; outer lip thickened by the last rib; the aperture is ovate to semi-lunar in shape; interior of aperture and columellar region concealed.

Length 12mm.; diameter 9mm.; aperture 9mm.

Remarks.—This shell is evidently related to *Yasila paytensis* Olsson from the basal Talara beds of Yasila but is distinguished by its more robust form, less strongly shouldered whorls and in having the ribs rounded and not carinated or spiniferous on the shoulder.

Locality and Geologic Occurrence.—Chira formation, Chira shales, near Quercotilla.

Family THAISIDÆ Dall

Genus CYMIA Mörch

Cymia berryi, n. sp. Plate 18, fig. 6

Shell purpuroid, rapanoid, coarse, biconic; spire and anterior side about equal in length; 4 whorls preserved on our specimen, those of the spire with a middle row of large coarse tubercles or nodes; body whorl large, strongly shouldered and with 5 very large, coarse, spine-like ribs only on the shoulder between wide, shallow interspaces; the area above and below the shoulder concave or impressed and the whole surface overrun with alternating coarse and fine spiral threads; anterior canal rapanoid, with a deep umbilicus in the center; aperture and columella concealed.

Height 34mm.; diameter 27mm.; aperture 30mm.

Remarks.—Although the columella is concealed by matrix so that the presence or absence of a strong columellar fold cannot be established by direct observation, the species is referred with but little doubt to the genus *Cymia.* Several fossil and recent species have been referred to *Cymia* or *Cuma* but most of these have since been found to belong to other genera so that the genus *Cymia* at present includes but four other species: *Cymia tectum*

Wood living along the west coast of South America and the Miocene forms, *Cymia woodi* Gabb from New Jersey, *Cymia Henekeni* Maury and variety *tectiformis* Pilsby from Trinidad and Santo Domingo and *Cymia heimi* Hertlein and Jordan from Lower California.

Locality and Geologic Occurrence.—Mancora formation, Punta Bravo grits, Caleta Sal.

Genus ACANTHINA Fischer de Waldheim

Subgenus CHORUS Gray

Acanthina (Chorus) meroensis, n. sp. Plate 18, figs. 4. 5, 7

Shell small, smooth with shouldered whorls; spire elevated, nearly one-half the length of the shell with 5+ whorls; body-whorl is large, strongly convex about the upper one-third, contracted and produced anteriorly; except the earliest spire-whorls which seem to have been evenly convex and strongly ribbed, the whorls are strongly shouldered, flattened or concave above, thus forming a well-defined sutural zone; protoconch not preserved; the early spire-whorls seem to have been sculptured with strong ribs and spirals, this sculptured soon becoming obsolete so that on the later turns, the surface is smooth; body-whorl contracted about the base and produced into the anterior canal; the base is marked with deep spiral grooves, the larger and deeper arising from a labial tooth situated slightly below the middle of the outer lip.

Length 26mm.; diameter 18mm. (4½ whorls)

Remarks.—The subgenus *Chorus* of Gray is distinguished from *Acanthina* F. de Waldheim in its *Pyrula*-like form and in having the labial tooth situated a short distance below the middle of the outer lip. Cossmann on the authority of Arnold, cites but a single fossil species from the Pleistocene and Pliocene of California, the *Chorus Belcheri* Hinds. In Dall's Check list of Northwest Coast Mollusks, this species is referred to the Genus *Forreria* Jousseaume. Several species of *Monoceras* are figured by Philippi from the Tertiaries of Chile. According to Philippi, most of the species belong to the group of *M. giganteus* Lesson which is the type of *Chorus.*

Locality and Geologic Occurrence.—Heath formation, basal Caleto Mero shales at Caleto Mero.

Acanthina (Chorus) sula, n. sp. Plate 18, figs. 1, 2

Shell small or medium size, thin, muriciform; whorls with a sloping shoulder and sculptured with broad, subobsolete spiral bands; spire elevated, nearly one-half the length of the shell; protoconch and early spire whorls missing; body whorl large, inflated with a wide, flat and sloping shoulder area about the upper suture; base of whorl contracted and with a fairly long, bend or twisted anterior canal; sculpture of the penultimate whorl and the upper part of the last whorl is smoothish or with faint, spiral bands; on the lower half of the body whorl, the spirals are more cord-like and heavier; aperture broadly elliptical, widest about the middle.

Height 44mm.; diameter 28mm. (2 whorls, broken)
27mm.; 18.5mm. (2 whorls, broken)

Remarks.—This species will be recognized from the preceding by its thinner, larger shell; wide, flat, sloping and not concave shoulder and by its heavier sculpture of spiral bands and cords. The specimens from Ecuador are much crushed but agree with the Peruvian fossils.

Locality and Geologic Occurrence.—Heath formation, basal Caleto Mero shales of Caleto Mero. Posorja, Ecuador.

Family FASCIOLARIDÆ Chenu

Genus LATIRUS Montford

Latirus quercotillaensis, n. sp. Plate 21, figs. 2, 3

Shell slender, fusoid, with a long spire and a shorter anterior canal; whorls 7+ (spire tip broken), forming a high spire, nearly twice the length of the anterior canal; whorls sculptured with about 8, strong ribs or folds which do not quite extend to the upper suture or far down on the base; in addition, the sculpture consists of heavy spiral cords, strongest on the ribs, weaker about the upper suture and on the base and anterior canal; the intervals between the spirals are deep and groove-like, often with a smaller secondary spiral; sutures distinct but not noticeably appressed; aperture broken or concealed.

Height 30mm. (broken); diameter 14mm.
33mm. (estimated length)

Remarks.—The anterior canal and inner lip being broken or concealed it is not certain that this fossil belongs to *Latirus.* The strongly sculptured spire whorls of *Chiralithes cynosuris* may be mistaken for this species but their sculpture is finer and soon becomes smooth and obsolete.

Locality and Geologic Occurrence.—Chira formation, near Quercotilla.

Genus MANCORUS n. gen.

Type Mancorus grabaui, n. sp.

The following is a description of the genus *Mancorus.*

Shell stout, massive, *Xancus*-like; early post-nuclear whorls sculptured with ribs and spirals, the ribs quickly disappearing and the surface of the whorls becoming smooth or only faintly lined with subobsolete spirals; often a contracted zone about the upper half of the whorls disappearing with age; sutures deep, grooved; body-whorl large and in gerontic specimens developing a strong, *Strombus*-like shoulder and ascending sutures; base of last-whorl contracted or simply with an even taper; anterior canal straight, stout; aperture subelliptical, the outer lip strongly thickened at its upper or posterior junction with the body-whorl; inner lip with a heavy callused platform, its inner edge distinct and free; a strong parietal keel near the upper end of aperture; growth-lines straight to slightly sinuous; no columellar folds.

Remarks.—True *Clavilithes* and its related subgenera and sections as noted by Grabau[46] is essentially a Middle Eocene group. In the Peruvian section, *Clavilithes* is abundant in the so-called *Clavilithes* series (or Salina-Parinas group) but it does not ascend far above the basal Talara or lower Upper Eocene.

The protoconch is not preserved on our specimens. The early spire-whorls have both ribs and spirals which rapidly fade away on the subsequent whorls so that the last few turns are entirely smooth or simply lined with a few faint spiral bands. Externally, the shells bear a greater likeness to *Xancus* than to *Clavilithes* but the columella appears to be entirely free from plaits. The peristome is nearly continuous, the inner lip is thickened and free-edged as in the recent *Cyrtulus serotinus* Hinds. Its posterior end is greatly thickened.

In external appearance, *Mancorus* is intermediate between the true Eocene *Clavilithes* and the genus *Cyrtulus* Hinds of the recent Indo-Pacific fauna. Cossmann[47] unites *Cyrtulus* with *Cla-*

[46]Grabau, 1904, Phylogeny of Fusus, Smith. Misc. Coll., vol. 44, no. 1417, p. 151.

[47]Cossmann, 1901, Essais Pal. comp., pt. 4, p. 19.

vilithes but as shown by Grabau[48], *Cyrtulus* is more nearly related to *Fusinus* Rafinesque (*Fusus* Lamarck, group of *Fusus colus* Linné) than to the Eocene forms of *Clavilithes*. *Mancorus* differs from *Clavilithes* by its more *Xancus*-like form and heavier shell. The body-whorl is large, forming more than three-fourths of the shell. In mature and gerontic individuals, the upper edge of the whorl may become shouldered or angled (*Strombus*-like) with strongly ascending sutures. The outer lip is heavily thickened at its posterior junction with the body-whorl, the upper edge of the lip often extending nearly to the upper suture. The inner lip is similarly thickened as a broad plate, its outer edge free and often elevated. The surface show spiral lining even though faintly in most cases.

From the eastern Pacific region, two species probably belonging to *Mancorus*, are figured by Martin[49] from the Miocene of Java, as *Fusus* (*Clavella*) *Verbeecki* and *tjadamarensis*. The protoconch of *tjadamarensis* is quite similar to *Cosmolithes*[50] as figured by Grabau, except that it has one more turn. The nuclear characters of *tjadamarensis* would therefore indicate that the Javanese species are nearer *Clavilithes* than to *Cyrtulus*.

Two species of *Mancorus* occur in the Peruvian Tertiaries. *M. burtti* Hanna and Israelsky and *grabaui* n. sp.

Mancorus grabaui, n. sp. Plate 19, figs. 1, 4

Shell stout, fusiform, the spire and anterior canal of about equal length; protoconch unknown; whorls 6 or more, the earlier ones sculptured with ribs and spirals, the subsequent whorls being smooth or marked with faint spirals; sutures deep, grooved; spire high, acute with 7 heavy ribs, crossed by 6 or 7 spiral threads, separated by wider interspaces and of which the uppermost spiral next to the suture, is much stronger and usually beaded; the upper edge of the spire-whorls is contracted developing still later into a pronounced, appressed band on the subsequent whorls but usually obsolete towards the end; body-whorl large, convex, its greatest inflation just below the suture, contracted about the base and narrowed, produced to form a medium length, straight anterior canal; aperture subovate, the outer lip thick-

[48]Grabau, idem., pp. 96, figs. 13, 14.

[49]Martin, 1895, Die Fossilien von Java, Samml. des Geol. Reichs Museum in Leiden, p. 85, pl. 12, figs. 188-192a; pl. 13, figs. 193-195, 197-198, 199-201a.

[50]Grabau, idem., p. 143, figs. 22, 23.

ened, winged at its posterior junction with the body-whorl; inner lip with a thick spread of callus which in the columellar region forms a free edged or shelf-like platform; posterior end of aperture with a narrow, upright anal sinus; a heavy transverse plait at the posterior end of inner lip.

Length 60mm.; diameter 34mm.; aperture 36mm.
65mm.; 38.5mm.; 58mm.

Remarks.—This species is represented by 7 specimens in our collection, 3 from the Mirador sandstones and conglomerates, 3 from the Chira shales and 1 from the Saman sandstones. The largest specimen comes from the Mirador conglomerates but is thickly encrusted with a hard matrix. Although the spire is not quite complete, this specimen measures nearly 110mm. The anterior canal is very long and slender, the aperture measuring about 72mm. The Saman sandstone specimen, also with an imperfect spire, is 65mm. in length. From *burtti* Hanna and Israelsky or the next species, *grabaui* differs by its shouldered spire-whorls and more contracted base.

Locality and Geologic Occurrence.—Mancora formation, Mirador conglomerate near Tamarindo, Que. Charanal. Chira formation, near Casa Saman. Saman formation, Casa Saman.

Mancorus burtti Hanna and Israelsky Plate 19, figs. 5, 7

Clavilithes burtti Hanna and Israelsky, 1925, Proc. Calif. Acad. of Sci., 4th series, vol. 14, no. 2, p. 44, pl. 7, figs. 8, 9.

"Shell broadly fusiform, heavy, early whorls strongly lirate, later ones weakly lirate; growth lines distinct; spire short; whorls sharply keeled at the periphery; shoulder flat, inclined outward; suture deeply impressed; aperture ovate, opening into an open, narrow anterior canal; inner lip strongly calloused; columella nearly straight, smooth; alt. 63.4mm. (spire and canal broken); diam. 37.3mm." - Hanna and Israelsky, 1925.

Que Mancora.

Remarks.—Our collection contains 3 specimens of this species, 2 from the top of the Mancora sandstones at Boca de Mancora (near the village of Mancora Chica) and 1 from Que. Charanal. From *grabaui,* it differs by its more solid, heavier shell, less contracted base, unshouldered spire-whorls and thicker, more strombiform outer lip.

Locality and Geologic Occurrence.—Mancora formation, Boca de Mancora, Que Charanal.

Genus PERUFICUS Olsson

Peruficus lagunitensis Olsson var. **charanalensis**, n. var.

Plate 17, figs. 10, 11, 12

Shell small or medium size, *Sconsia*-like in general form and sculpture; body-whorl large, inflated with a low, pointed, elevated spire, a fifth or less the length of the whole shell; whorls (including the nucleus) about 5, the post-nulcear rather coarsely sculptured with strong spirals and heavy ribs; sutures deep, distinct, bordered by a wide, appressed band, waved as it crosses the strong axial riblets of the spire whorls; on the body-whorl, the riblets soon become obsolete or may be entirely lacking together with the finer spirals so that the middle of the shell is nearly smooth; spirals heavier and persistant on the contracted base and anterior canal; resting marks are indicated by low ridges, spaced at irregular intervals; aperture elliptical, long, extending nearly the full length of the last whorl; outer lip thickened, united above to the body-whorl by a heavy callus spreading over the inner lip and with an evident posterior canal; anterior canal long, slender and straight; columella with 2, strong folds of which the upper is the larger.

Height	17mm.;	diameter 11mm.;	aperture 14mm. (immature)
	25mm.;	16mm. (crushed);	21mm.

Remarks.—This shell should probably be considered as a distinct species differing from *lagunitensis* of the lower Talara, by its larger size, more inflated body-whorl, less contracted anterior canal and finer sculpture. On full grown specimens, the sculpture tends to become smooth on the back of the body-whorl. Specimens from the Chira shales near Casa Saman are much smaller or about the same size as typical *lagunitensis* but they have the smooth subobsolete sculpture of *charanalensis*.

Locality and Geologic Occurrence.—Mancora formation, Que. Charanal. Chira formation, near Casa Saman.

Family VOLUTIDÆ Gray

Genus LYRIA Gray

Lyria peruviana, n. sp. Plate 19, figs. 2, 3

Shell small, solid, resembling a small *Voluta musica;* whorls

4+ (the tip of the spire with protoconch missing), solid, slightly coronated or shouldered with about 8, longitudinal ribs or shallow folds; these ribs are strong and regular on the spire whorls but become rather irregular on the back of the body-whorl on full-grown specimens; with exception of the heavy ribs and crowded longitudinal growth-lines, the surface is smooth and porcellaneous, but with feeble ,subobsolete spirals about the anterior canal; anterior canal slightly twisted, with a deep siphonal sinus at its tip, its former positions perpetuated in a band of sinuous growth lines; aperture lanceolate, slightly wider in its anterior position; outer lip thin; columella not well exposed but bearing more than 5 folds.

Height 31mm.; diameter 16.5mm. (4 whorls) Holotype
23mm.; 13mm. (3½ whorls)

Remarks.—This species is near *Lyria musicina* Heilprin of Florida as figured by Dall[51]. The Peruvian shell is more slender and more strongly shouldered. Comparison with specimens of *musicina* from Bailey's Ferry, shows the Lower Miocene shell as being larger, the whorls scarcely shouldered and often developing a contracted zone which may coronate the ends of the ribs adjacent to the ribs. The *Lyria calligona* Maury[52] from the Miocene of eastern Brazil, resembles our species in having shouldered whorls. The ribs are relatively few, 8 or 9 to the turn.

Locality and Geologic Occurrence.—Chira formation, Chira valley, near Casa Saman.

Genus CHIRALUTA n. gen.

Type. Chiraluta inca, n. sp.

The following is a description of the genus *Chiraluta.*

Shell short, solid with a strong shoulder and low spire; body-whorl large, smooth; nucleus unknown; early spire whorls with ribs and spirals, later turns nearly smooth except for fine growth-lines; sutures appressed; columella with 3 strong slightly oblique sharp folds and a 4th smaller anterior one; spihonal sinus giving rise to a fasciolar band bordered on the posterior side by a sharp keel; outer lip slightly thickened, when full-grown with a

[51]Dall, 1915, Bull. 90, U. S. Nat. Mus., p. 59, pl. 9, figs. 1, 4.

[52]Maury, 1925, Fosseis Terciarios do Brasil, Servicio Geologico e Mineralogico, Mon. 4, p. 173, pl. 8, figs. 9, 14.

wide, shallow anterior sinus on or just above the shoulder.

Remarks.—The Peruvian Volutes, although differing greatly in shape and sculpture, agree with each other in possessing a true posterior or anal sinus during maturity. In *Peruluta peruviana* the posterior sinus is very deep, narrow and lies closely adjacent to the suture. This character alone would indicate that they have a common genetic relationship. In *Peruluta* there are 3 strong, columellar folds and the shoulder is armed with sharp, spine-like ribs, often covered by callus growth. The *Volutospina crassiuscula* Woods of the Negritos or *Turritella* beds resemble *Chiraluta* in form but has only 3 columellar folds as in *Peruluta.* The 4th columellar fold of *Chiraluta* is constantly much smalled than the upper ones and is probably a newer development during Oligocene times. *Diploconus* of Douville[53] from the early Eocene of India, resembles *Chiraluta* in form and in possessing a posterior sinus but lacks entirely the anterior sinus and fasciole. Douville considers *Diploconus* as belonging to the *Fusidæ.*

Chiraluta inca, n. sp. Plate 20, figs. 1, 2, 10

Shell small, solid, short with a strong shoulder and relatively low spire; body-whorl large, smooth; post-nuclear whorls 5 or more, the earlier ones forming a small but elevated, projecting tip to the spire and ornamented with 6, low but sharp ribs; these ribs gradually become obsolete leaving the succeeding whorls smooth; sutures distinct sometimes bordered by an appressed band; general surface of body-whorl smooth except for strong lines of growth; anterior canal with a deep siphonal canal giving rise to an obliquely revolving band or fasciole bordered above by a rib or keel; anal sinus, wide but comparatively shallow and situated on the angle of the shoulder or just above; columellar straight above, twisted or curved backwards below and carrying 4 slightly oblique plications of which the upper 3 are much larger and stronger than the 4th; outer lip slightly thickened.

Height 45mm.; diameter 25mm.
30mm.; 23mm.

Locality and Geologic Occurrence.—Chira formation, near Casa Saman.

Genus STRIGATELLA Swainson

Strigatella peruviana, n. sp. Plate 20, figs. 4, 6

Shell small or medium-sized, columbelloid, solid; sutures fine;

[53]Douville, 1929, Conches a Card. Beaumonti du Sind, Geol. Surv. of India, n. ser., vol. 10, p. 36, pl. 7, figs. 1-9.

body-whorl large, moderately convex, the greatest diameter about the middle; spire conic, about one-third the length of the shell; surface is generally smooth except the earlier spire-whorls which have 8 or 9, low folds or riblets; full-grown specimens may have 3 or more, deep, folds or undulations on the back of the body-whorl; aperture narrow with a strongly thickened outer lip and a wash of callus over the inner lip; anterior canal short, with a deep, upward curved siphonal sinus forming a narrow fasciole which is bordered on the posterior side by a low, sharp thread; columella straight, with 4, strong, slightly oblique plicæ.

Height 21mm.; diameter 12mm.; aperture 15mm.

Remarks.—The Mitreolas are small or medium-sized shells fairly abundant in the European Eocene and passing into the Lower and Middle Miocene. They are typically characterized by their solid shell, columbelloid form, usually smooth or costulated surface, 4 columellar plaits and thickened outer lip. The genus *Strigatella* Swainson (genotype *Mitra literata* Lamarck) is similar to *Mitreola* but has a thicker lip and a strong labial tooth. The Peruvian species agree in essential characters with *Mitreola* and *Strigatella* and young shells are very similar to immature specimens of *Mitreola labratula* Lamarck, the type species of *Mitreola.* With maturity, *peruviana* becomes more solid, the outer lip is thicker and strong, rib-like folds appear on the dorsal surface of the body-whorl. Since the aperture is filled with matrix, the internal characters of the inner lip are not known.

Mitra (*Strigatella?*) *perturbatrix* Maury[54] from the San Domingan Miocene is probably a true *Mitreola.* Dall's[55] *Strigatella americana* from the Tampa silex beds of Florida, is similar to *peruviana* but has faint spirals about the spire and upper half of the body-whorl.

Locality and Geologic Occurrence.—Chira formation, Chira shales, near Quercotilla.

Family HARPIDÆ Troschel

Genus HARPA LAMARCK

Harpa myrmia, n. sp. Plate 20, fig. 7

Shell small or medium size, ventricose with a relatively short spire; whorls 5 or 6 (the tip or protoconch destroyed); the last

[54]Maury, 1917, Bulls. Amer. Pal., vol. 5, p. 76, pl. 14, figs. 1, 2.

[55]Dall, 1915, Bull. 90, U. S. Nat. Mus., p. 61, pl. 9, fig. 2.

whorl is very large, coronated; sutures indistinct, often covered by the appressed ends of the ribs extended forward and forming a disconnected sutural band; body-whorl very large, ventricose and *Cassis*-like in form; sculpture consists of heavy ribs which number about 9 on the last turn; most of the ribs are narrow and sharp on the spire whorls and ventral side of the body whorl, except the last three or four on mature shells which are broad and heavy; they are separated by wide, flat interspaces, minutely trellised by fine growth lines and spirals; aperture broad, the outer lip thickened by the longitudinal ribs; columella and inner lip with a spread of callus, apparently not free edged on the outer side; anterior sinus deep, typically developing an encircling cord-like fasciole.

Height 31mm.; diameter 21.5mm.

Remarks.—This species seems to be a true *Harpa,* the columellar and parietal callus being thin, spreading, its outer edge not free or detached as in the Parisian *Eocithara* Fischer. *Harpa jacksonensis* Harris[56] from Mississippi has a much higher spire.

Locality and Geologic Occurrence.—Chira formation, near Quercotilla.

Family OLIVIDÆ d'Orbigny
Genus OLIVA Martyn
Subgenus OLIVA s. s.

Oliva (Oliva) pichincha, n. sp. Plate 20. figs. 9, 17

Shell small or medium-sized for the genus, cylindrical with a short, conic spire, the penultimate and last whorl together less than one-fourth the total length; whorls 5 or 6, straight-sided; suture distinct, grooved; body-whorl large, subcylindrical, its greatest diameter or circumference at the upper one-third or opposite the posterior end of the aperture; shoulder region broadly rounded so that the sutural area appears broadly appressed; aperture subelliptical; columellar area excavated; inner lip not exposed, the fasciolar callus band *Oliva*-like with 2 or 3, close, oblique plaits at its anterior end.

Length 23mm.; diameter 10mm.; aperture 16mm.

Remarks.—The inner lip and parietal region is largely concealed by matrix but the shape of the shell suggests that is should be referred to the genus *Oliva.* The spire is rather stout but

[56]Harris, 1896, Proc. Acad. Nat. Sci. Phila., p. 472, pl. 18, fig. 10.

somewhat longer than in the members of the group of *Oliva reticularis.* The spire is more slender and pointed than in *O. kaleontina* Duclos of the recent Peruvian fauna.

Locality and Geologic Occurrence.—Posorja, Ecuador.

Genus OLIVANCILLARIA d'Orbigny

Subgenus OLIVANCILLARIA s. s.

Olivancillaria (Olivancillaria) aequatorialis, n. sp. Plate 20, figs. 3, 5, 8, 11

Shell of medium size, solid, ventricose; spire short, conic with the nuclear tip slightly elevated and concealed by callus; whorls about 4; sutures distinct and grooved on the last turn, concealed by a wash of callus on the earlier; body-whorl large, inflated, strongly convex about the upper one-third or opposite the posterior end of the aperture; aperture narrow, lenticular, widely obliquely truncate at its anterior end; inner lip with a large lumpy mass of callus on the parietal wall, the columellar area excavated and with 2, strong, oblique plaits at its anterior end; basal or fasciolar callus band, thick and sharply limited; siphonal sinus wide.

Length	21mm.;	diameter 14mm.;	aperture 17mm.
	21.5mm.;	16mm.	
	23mm.;	15mm.;	18.5mm.

Remarks.—*Olivancillaria aequatorialis* belongs to the typical section of *Olivancillaria* as evemplified by *Oliva brasiliana* Chem. and probable is the first record of the occurrence of the typical genus as fossil in rocks older than the Pleistocene or late Tertiaries. Our shells are nearest *O. claneophila* as figured by Duclos (Mon. de Genre *Oliva* pl. 29, figs. 8, 9.) in that the shoulder is more broadly rounded than *brasiliana* and with the suture situated some distance above the greatest inflation of the body-whorl. The tip of the spire is concealed by callus but leaving the suture free and fully exposed on the last turn. In *Olivancillaria eocenica* Woods from the Older Eocene of Peru, the suture is free from callus to the very tip of the spire.

Locality and Geologic Occurrence.—Upper Middle Oligocene of Posorja, Ecuador.

Subgenus AGARONIA Gray

Olivanvillaria (Agaronia) antisana, n. sp. Plate 20, fig. 13

Shell small with a short pointed spire, the penultimate and spire-whorls together less than one-fourth the total length; body-whorl large, moderately convex, its greatest diameter or circumference just about the middle; nucleus like *A. hiatula* but smaller is high, exserted or projecting above the post-nuclear whorls; post-nuclear whorls three and one-half or 4 between deeply grooved sutures; apertures as in *hiatula;* inner lip with a thick, parietal callus, the columellar area slightly excavated and with 3, strong, oblique plaits, the upper 2 splitting into smaller ones in the interior; outer lip imperfect.

Length 22mm.; diameter 9.5mm.; aperture 16mm.

Remarks.—This species is represented by the unique type from the basal Upper Oligocene beds of Posorja, Ecuador. Its nuclear characters appear to be exactly similar to the recent Panamian *A. hiatula* except in being smaller. The *A. hiatula* group is well represented in the Miocene rocks of Costa Rica.

Locality and Geologic Occurrence.—Posorja, Ecuador.

Olivancillaria (Agaronia) cotapaxi, n. sp. Plate 20, fig. 14

Shell small, with a medium-height, straight-sided conic spire; sutures distinct, slightly grooved; whorls about 6; body-whorl large, moderately convex, its greatest convexity approximately about the middle; aperture about three-fourths of the total length, narrow-lanceolate at its posterior end, effuse and obliquely truncated anteriorly; inner lip straight with a thin parietal callus and 3 oblique plaits at its anterior end.

Length 20mm.; diameter 8.25mm.; aperture 14mm.

Remarks.—Only the type species is known. It will be distinguished from the preceding species by its longer, more conic spire and *Olivella*-like outlines. Its nucleus only partly preserved is small, submerged and not exserted or projecting as in the members of the *hiatula* group.

Locality and Geologic Occurrence.—Posorja, Ecuador.

Genus OLIVELLA Swainson

Subgenus LAMPRODOMA Swainson

Olivella (Lamprodoma) illesca, n. sp. Plate 20, figs. 12, 15, 16

Shell small, thin, with a spire of moderate length; nucleus blunt, consisting of about one and one-half small whorls; post-nuclear whorls 4; last whorl quite large with the sides evenly but not strongly convex and with the maximum inflation approximately about the middle; sutures grooved, bordered on the posterior side by a narrow band of callus; columella not excavated, bearing an anterior band of callus with obliquely revolving plaits arranged as follows: a small posterior plait succeeded by a strong posterior one bordered on the anterior side by a deep groove, followed by 5 much smaller plaits gradually diminishing in strength anteriorly; parietal region not visible.

Length 12mm.; diameter 5mm.

Remarks.—A fairly common species at Que. Charanal but most of the specimens are flattened, showing that the shell was quite thin and delicate. The parietal and columellar regions are not fully exposed on any of our specimens. The banded sutures should aid in the identification of the species.

Locality and Geologic Occurrence.—Mancora formation, Que. Charanal.

Family TURRIDÆ
Genus TURRICULA Schumacher
Section SURCULA H. and A. Adams

Turricula (Surcula) piura, n. sp. **Plate 21, figs. 9, 13**

Shell small or medium size; whorls 8 (tip broken) forming a long, slender, pointed spire about half the length of the whole shell; the last whorl is more or less contracted about the base and with a long, slender, anterior canal; anal fasciole deep, concave, smooth, more rarely with fine spirals and bordered above close to the suture by two small spirals; the sculpture consists of 6 or 7, faint or subobsolete ribs on the middle of the whorl but lacking both above and below; the summit of the ribs is crossed by two spirals, the lower being much the stronger and keel-like; below the periphery and to the upper edge of the base, there are 3 or 4, strong, widely and irregularly spaced spirals together with several smaller ones; base of whorl and anterior canal with 8 to 10, strong spirals and finer secondaries; anterior canal long and straight.

Height 25mm. (8 whorls); diameter 9.5 mm.

Remarks.—From *eolavinia* Olsson of the basal Talara beds, this species differs by its larger size and sculpture. On *piura,* the spiral threads are very irregular on the middle and base of the last whorl while the spiral sculpture of *eolavinia* is quite regular.

Locality and Geologic Occurrence.—Chira formation, near Casa Saman.

Turricula (Surcula) sullana, n. sp. Plate 21, fig. 1

Shell slender, fusiform; sutures distinct but somewhat appressed and bordered just below by a spiral thread; whorls 7 (tip broken), forming a high, slender and rapid tapering spire; whorls convex or angled about the middle, sloping above towards the upper suture, this area forming a wide, scarsely depressed or concave anal fasciole; sculpture consists of heavy, longitudinal ribs or folds and spirals; on the last whorl, the ribs number about 7, absent or faint on the anal fasciole, gradually fading out on the base and absent from the anterior canal; spirals consists of two kinds, a primary set of small but strong threads, and fine, submicroscopic threadlets overrunning the general surface of the whole shell; there is usually a small spiral just below the upper suture at the posterior edge of the anal fasciole; below the anal fasciole on the spire whorls there are four, primary spirals which show progressively wider spacing towards the lower suture; on the last whorl, there are about 18, primary spirals extending across the base and anterior canal; the submicroscopic spirals consists of very fine threadlets and cover the anal fasciole and spaces between the primary spirals, and give to the shell surface, a peculiar and characteristic sculpture.

Height 23mm. (6 whorls); diameter 11mm.
27mm. (estimated when perfect).

Locality and Geologic Occurrence.—Chira formation, near Casa Saman.

Subgenus KNEFASTIA Dall

Turricula (Knefastia) chira, n. sp. Plate 21, fig. 11

Shell slender, mitraform, the spire and aperture of about equal length; protoconch unknown; post-nuclear whorls 4; sutures indistinct, bordered in front by a low, spiral; whorls are strongly shouldered, above which is a fairly wide, sloping and slightly concave, anal fasciole; the sculpture is predominantly spiral, together with low, axial folds or ribs which number 4 or 5 to each whorl; these ribs are best developed on the spire whorls, and on the body whorl simply as broad, low folds extending from the shoulder and across the base; on the spire whorls, the spiral sculpture consists of a low, sutural cord bounding the upper side of the fasciole, a heavy, wide cord about the shoulder of the whorls and a third, somewhat finer spiral next to the lower suture, the anal fasciole and spiral intervals being smooth except for growth lines; the surface of the body-whorl, from the shoulder and across the base to the anterior canal, have 10, coarse, spiral cords with wide, smooth intervals; there is a sharp keel, encircling the lower part of the anterior canal; anterior canal straight; a shallow, anal sinus in the fasciole.

Length 22mm. (imperfect); diameter 8mm.; aperture 12mm.
24mm. (estimated).

Locality and Geologic Occurrence.—Chira formation, near Casa Saman.

Genus CLATHRODRILLIA Dall

Clathrodrillia mira, n. sp. Plate 21, fig. 5

Shell slender, acute, the spire much longer than the aperture; protoconch not known; post-nuclear whorls 5+ (tip broken), slowly increasing in diameter; sutures indistinct, appressed and wavy, bordered in front by an undulated spiral cord; sutural fasciole not pronounced, scarcely differentiated on the earlier spire whorls, best defined on the later whorls as a slightly depressed or concave zone between the end of the axial ribs and the sutural cord; sides of the whorls slightly bulged in the middle by the ribs, otherwise the profile of the spire is quite straight; sculpture on the spire whorls of about 6, low ribs which become obsolete on the back of the body-whorl; spiral sculpture consists of fairly strong, revolving threads which cover the whole surface; besides the sutural cord, there are 2 cords in the fasciole and 3 between the fasciole and the lower suture, and 10 more on the base of the body-whorl and anterior canal; anterior canal of moderate length, narrowed and somewhat curved or twisted.

Height 16mm. (3½); diameter 6mm.; aperture 7mm.
21mm. (estimated length)

Locality and Geologic Occurrence.—Chira formation, near Quercotilla.

Genus SCOBINELLA Conrad

Scobinella meloda, n. sp. Plate 21, fig. 12

Shell small or medium-size, *Mitra*-like in form and sculpture; whorls 5+ (tip broken), forming a straight-sided, rapidly tapering spire about half the length of the shell; sutural fasciole wide but shallow with an anal sinus as in *Drillia;* sculpture of the earliest spire whorls consists of two, beaded spirals about the middle and a plain, smooth spire above the sutural fasciole and just below the upper suture; on the succeeding whorls, the two, central beaded spirals become smooth and a fourth, small, spiral thread may appear in the center of the fasciole; the last whorl has in addition to the above, 12, simple, smooth spirals on the base and anterior canal, the resulting sculpture being *Mitra*-like; anterior canal straight, the pillar with 3 or more, slightly oblique plicæ, the upper being much the stronger.

Height 32.5mm.; diameter 11mm.
20.5mm. (5 whorls); diameter 7mm.
22mm. (estimated length)

Remarks.—This species resembles a smooth spiralled *Mitra* but is distinguished by its *Drillia*-like anal sinus lying in a sutural fasciole. It also resembles the *Turris* species grouped about *Turris albida* Perry to which Woodring has recently given the generic name of *Polystira.* It differs from these by the superior position of the anal sinus and in possessing columellar plications. In the typical species of *Scobinella,* the sculpture is beautifully beaded as in the type species *coelata* Conrad from Vicksburg and the Miocene species, *Morierei* (Laville) Cossmann from Panama and *magnifica* Gabb from Santo Domingo and Jamaica.

Locality and Geologic Occurrence.—Saman formation, the Lagunitas sandstones of Lagunitas. Chira formation, near Casa Saman.

Genus BORSONIA Bellardi

Borsonia peruviana, n. sp. Plate 21, figs. 10, 14

Shell fusoid with a high spire and a long, straight, anterior canal; whorls 5+ (tip broken), forming a long, slender spire about half the length of the shell; sutural fasciole deep, concave, with a single, spiral thread at its upper margin and bordering the suture; sculpture of about 10, low and somewhat irregular ribs on the middle of the spire whorls and the shoulder or periphery of the last; these ribs do not extend above into the sutural fasciole or onto the base; spiral sculpture consists of a spiral around the upper edge of the fasciole previously mentioned, generally 2, more rarely 3 crossing the summit of the ribs and 8 or more spirals on the base and anterior canal; very faint spiral threads in the spiral intervals and on the otherwise smooth, sutural fasciole; posterior sinus as in *Drillia,* situated in the fasciole; anterior canal long, straight with two plicæ of which the upper is the stronger.

Height 20mm. (broken spire, 5 whorls) ; diameter 8.25mm.
22mm. (estimated length)
25mm. (broken, 5 whorls) ; diameter 11.5 mm.
30mm. (estimated length).

Remarks.—This species seems to be a typical *Borsonia* and probably the first to be discovered in the Pacific region. According to Cossmann[57] (see also Dall[58]), *Borsonia prima* Bellardi, the genotype, has two columellar folds, although Bellardi mentions only one. *Borsonia peruviana* agrees with *prima* in being sub-fusiform and in its main features, but has a heavier and sharper spiral sculpture. The recent Pacific species, according to Dall belong to *Borsonella* Dall, characterized by a single columellar fold and principally by a feeble sculpture of spiral lines.

Locality and Geologic Occurrence.—Chira formation, Chira valley, near Casa Saman.

57Cossmann, 1896, Paleon, comparee, vol. 2, p. 97.
58Dall, 1908, Bull. M. C. Z., vol. XLIII, no. 6, p. 258, also Proc. U. S. Nat. Mus., vol. 54, p. 323.

Plates*

Plate 1 (13)

*Generously furnished, ready for insertion, by the author

EXPLANATION OF PLATE 1 (13)

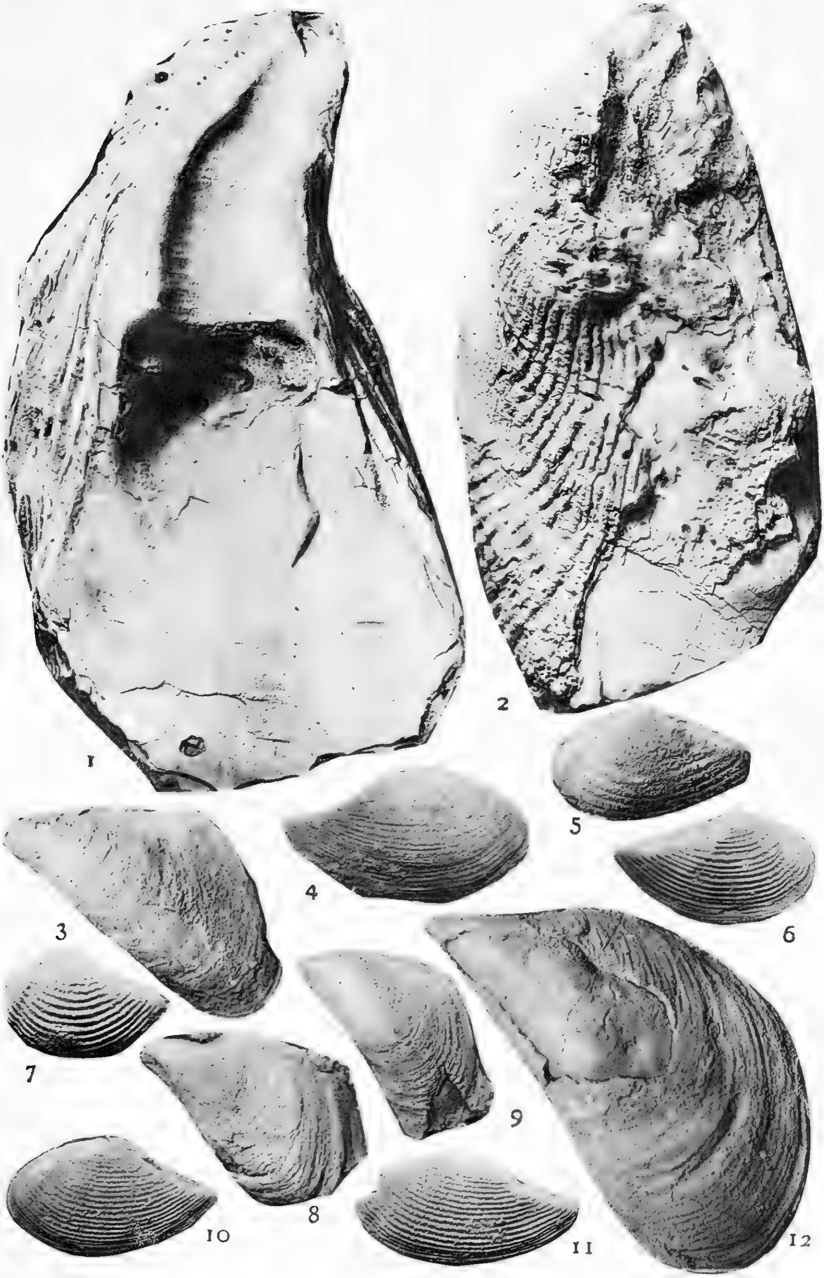
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Plate 2 (14)

EXPLANATION OF PLATE 2 (14)

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1.	**Arca (Argina) puntabravoensis,** n. sp. Cotype, length 22 mm. Punta Bravo grits, Caleto Sal.	38
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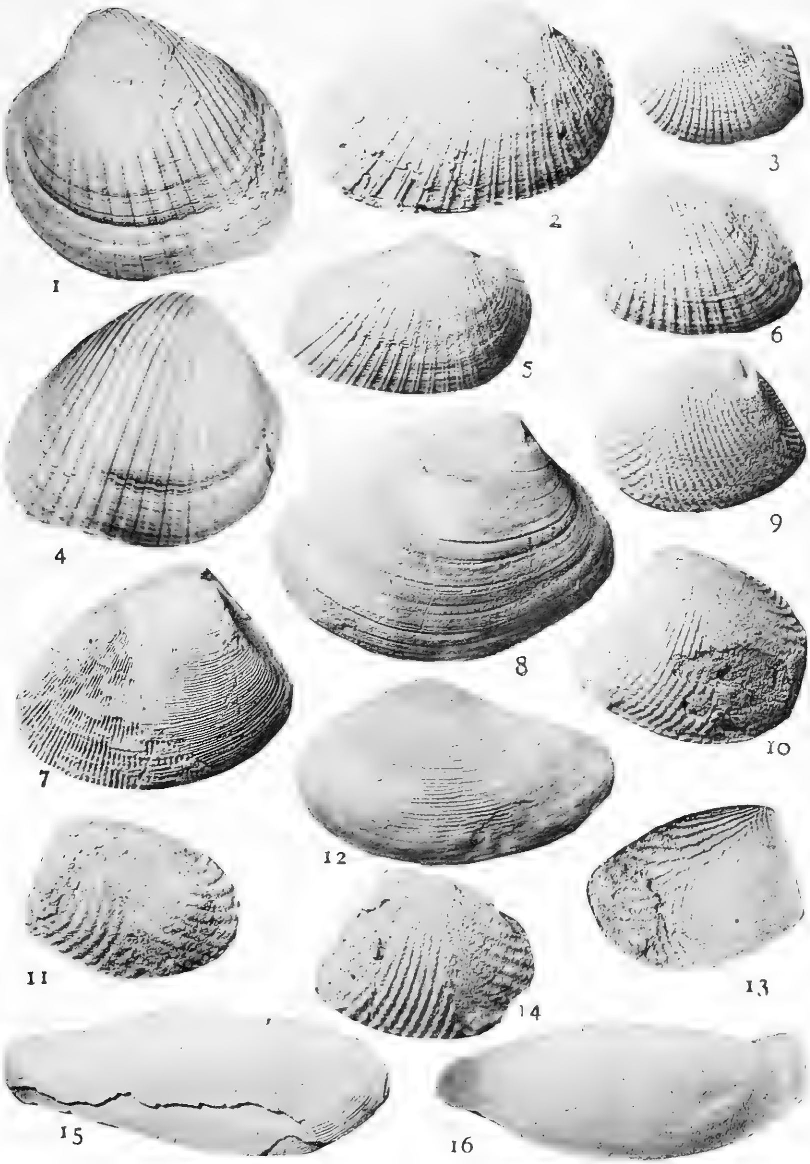
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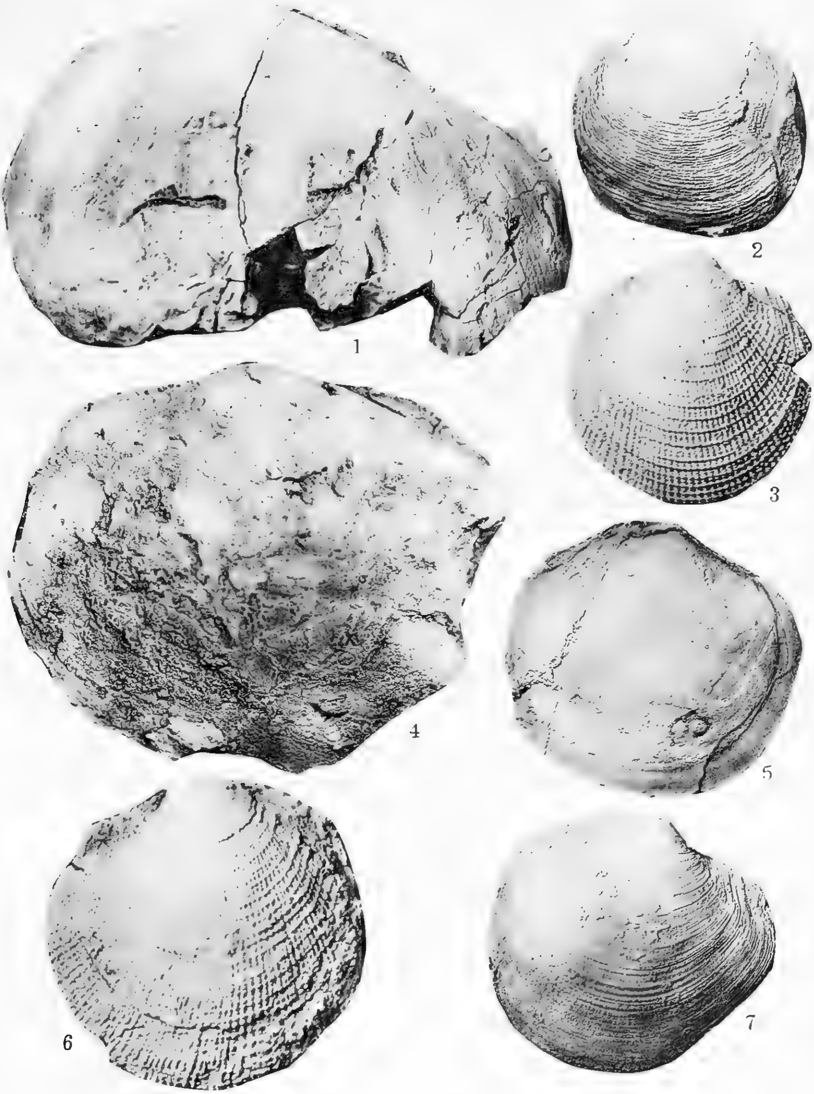
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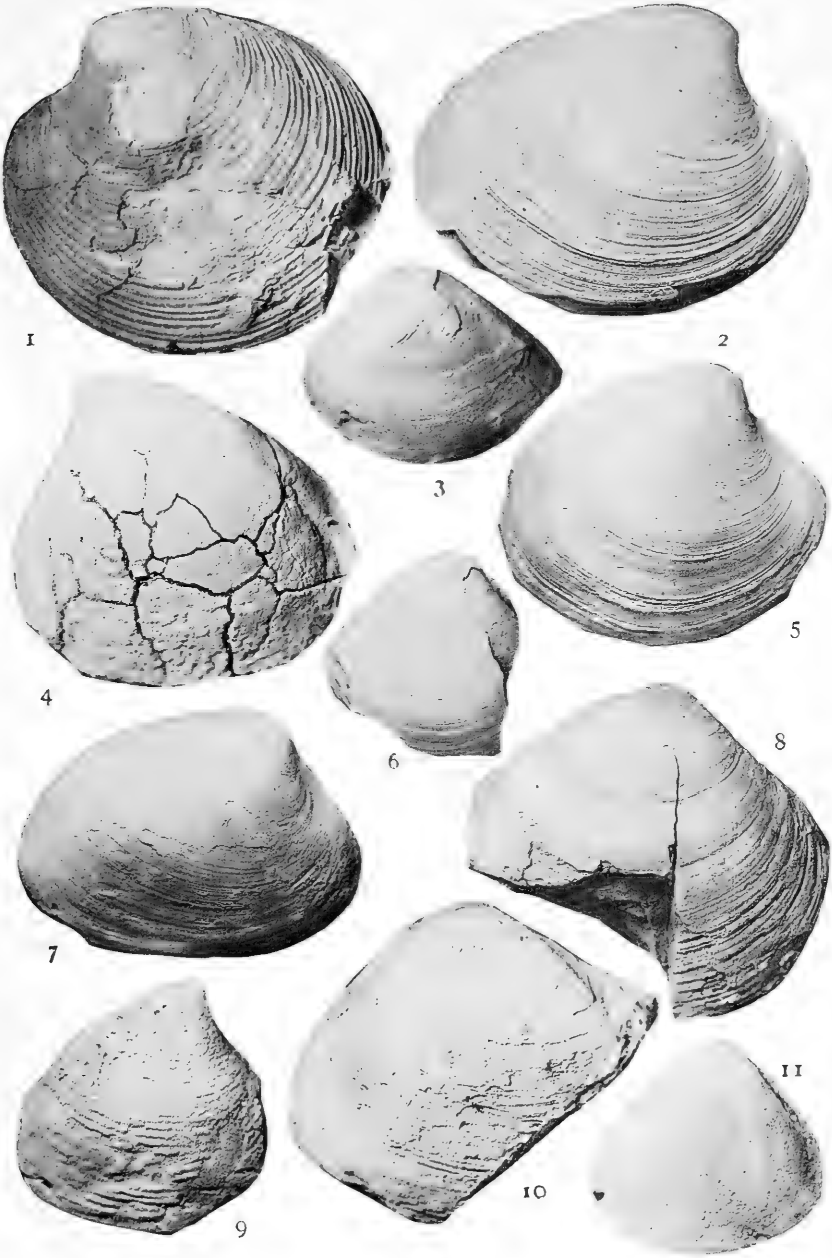
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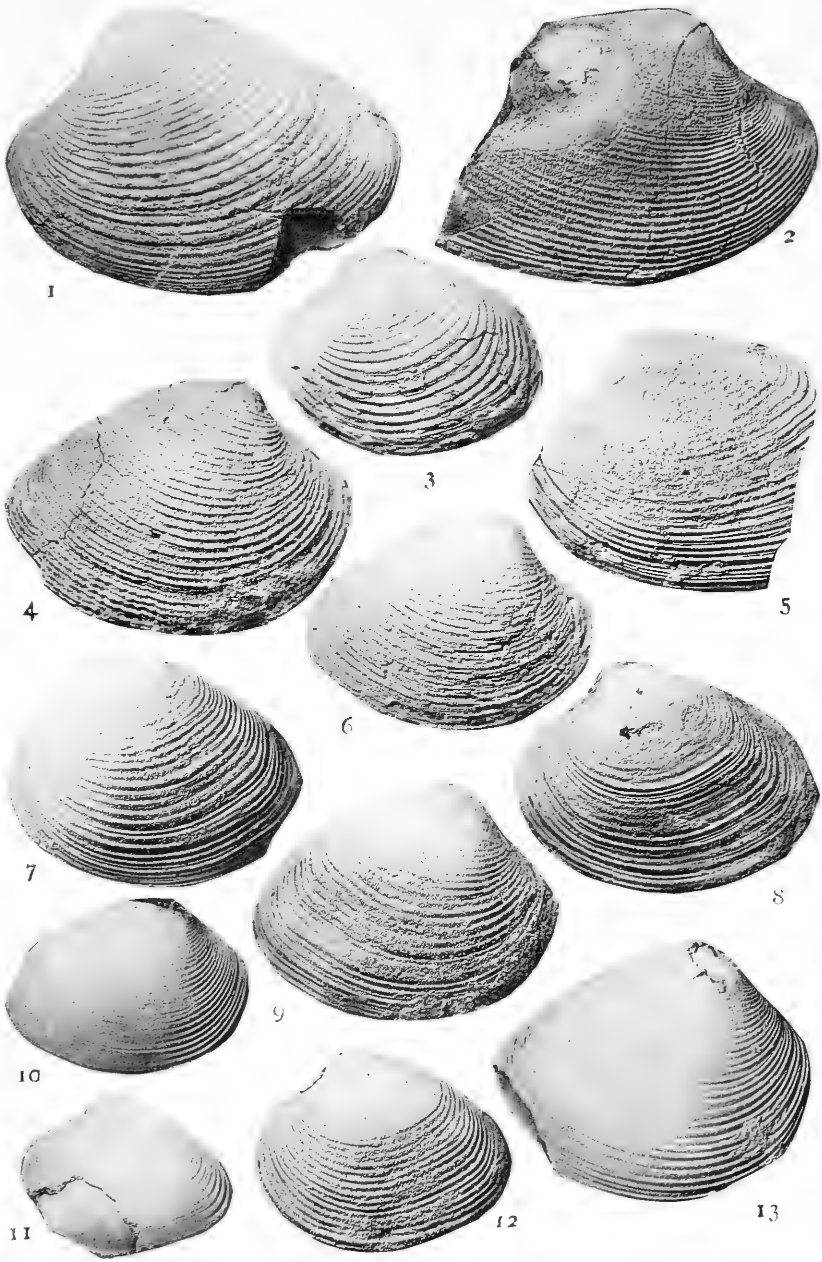
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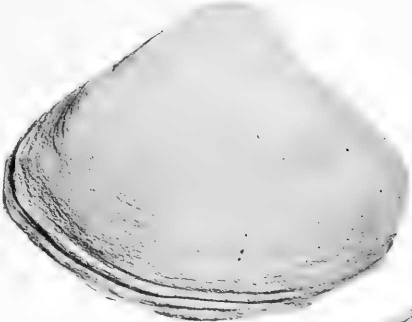

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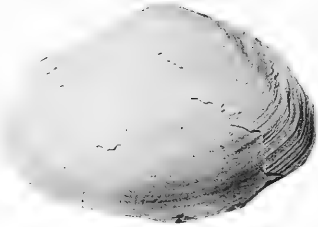

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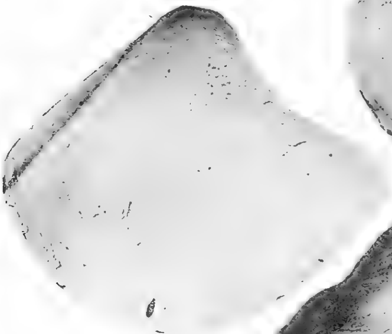

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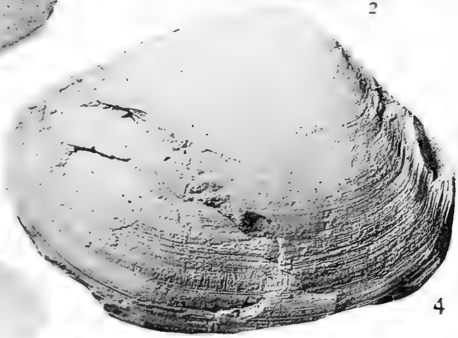

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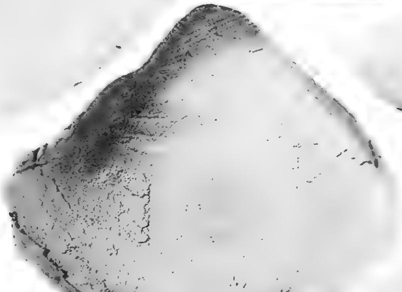

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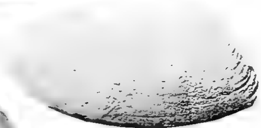

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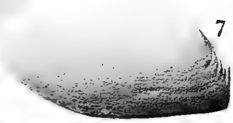

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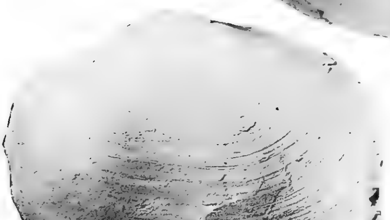

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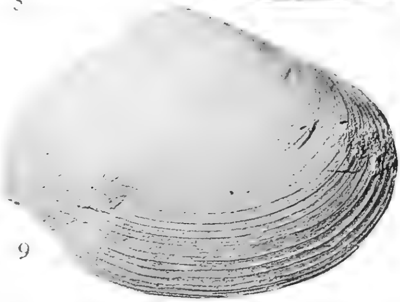

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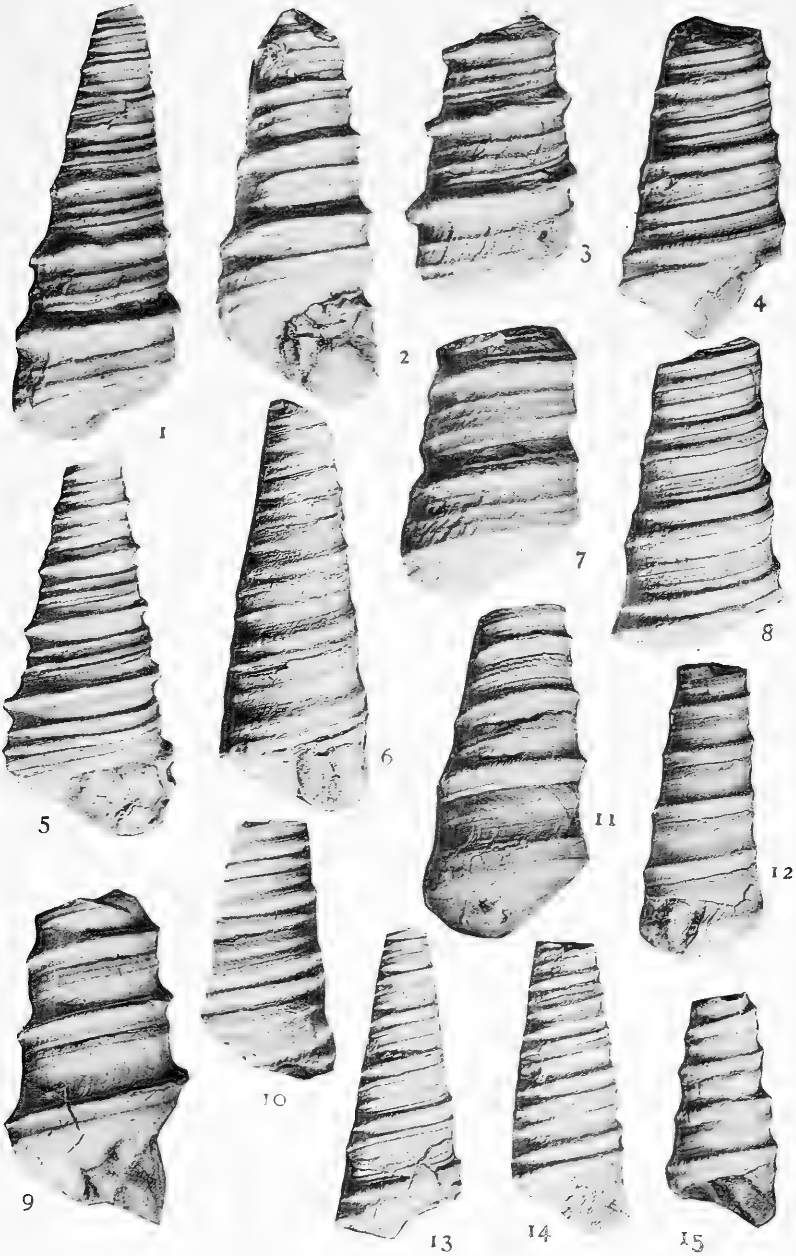
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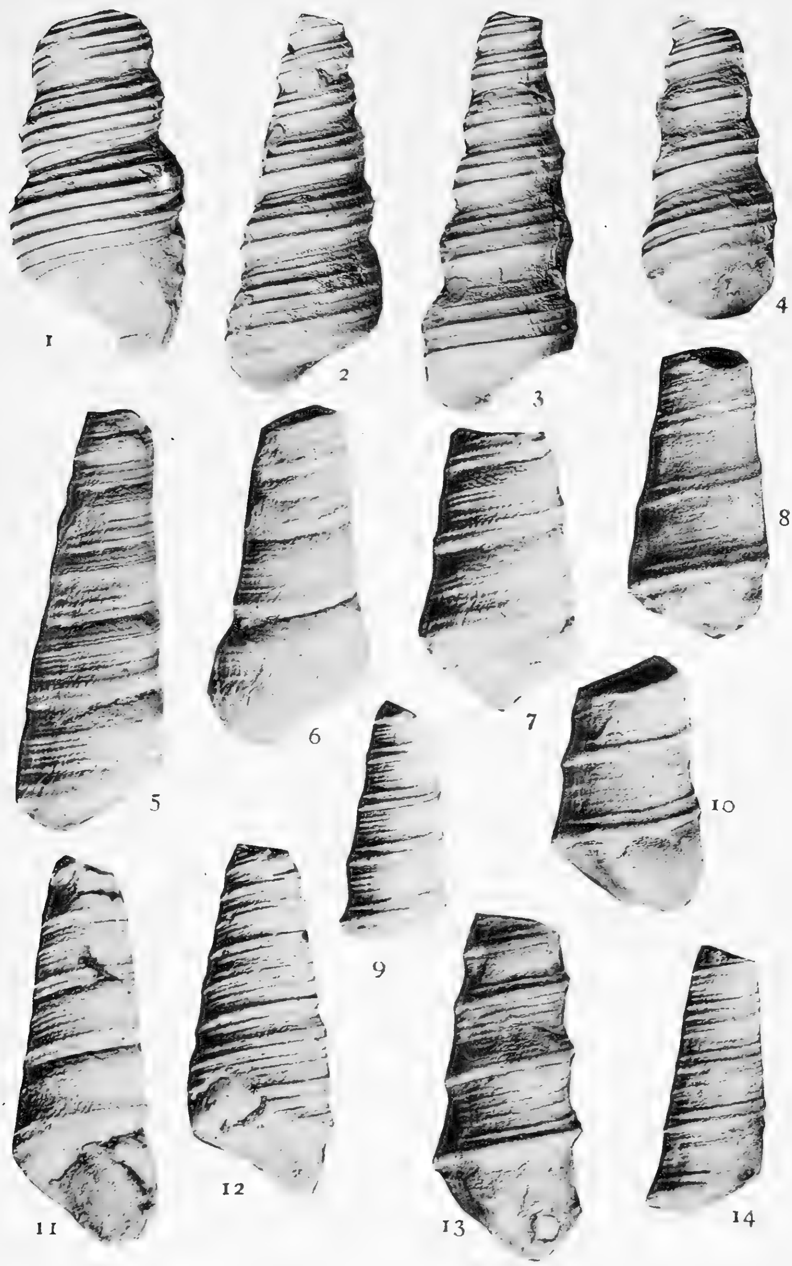

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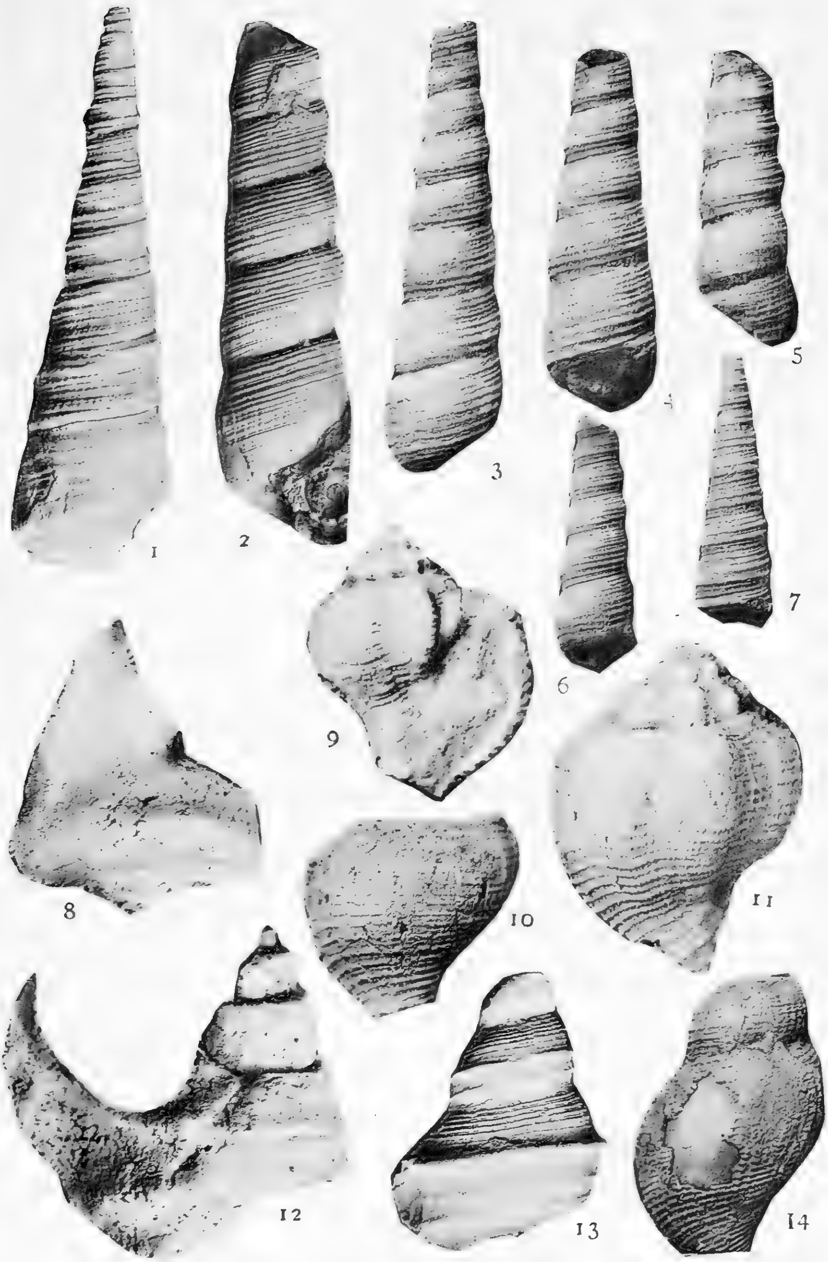
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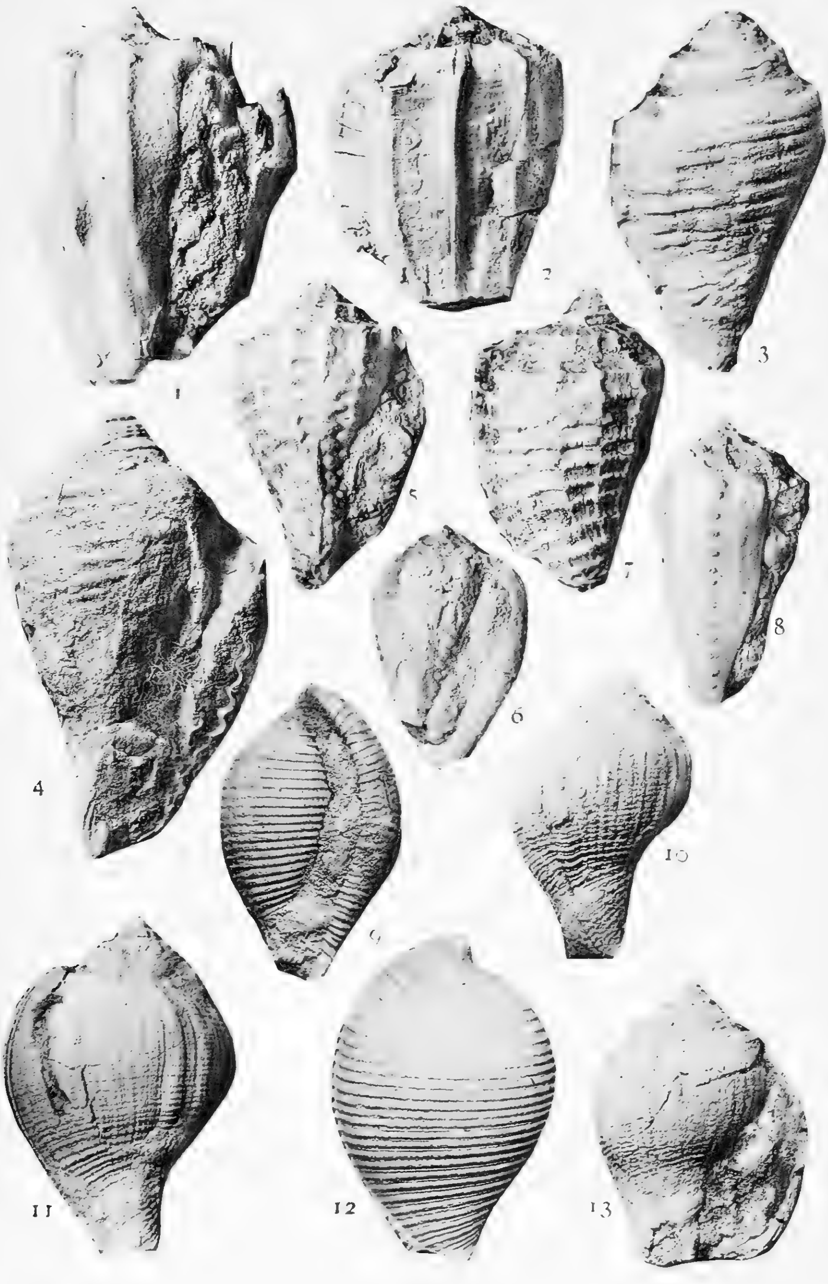
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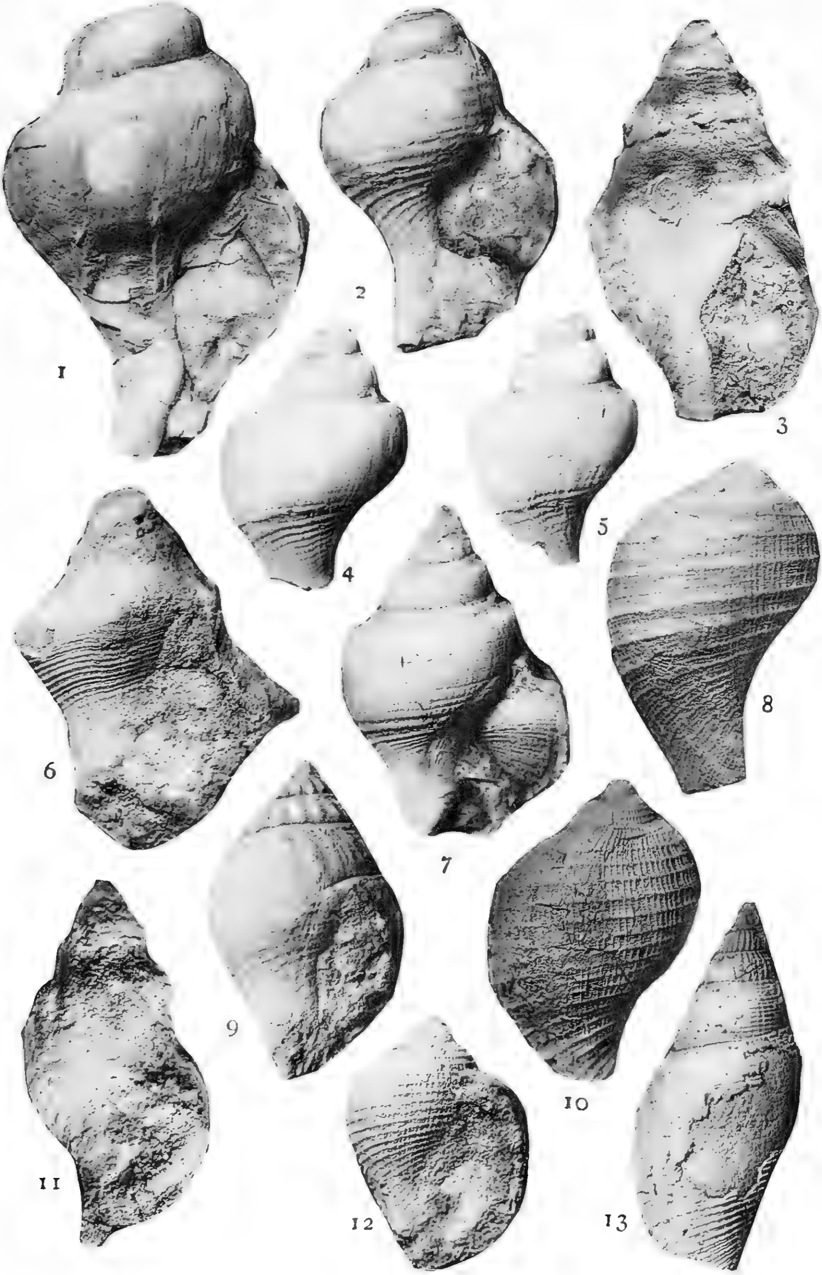
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