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PROCEEDINGS

OF THE

ACADEMY OF NATURAL SCIENCES

OF

PHILADELPHIA.

1911.

January 3.

Henry Skinner, M.D., in the Chair.

Thirty-seven persons present.

Mr. James A. G. Rehn made a communication on the Hebard Academy Expeditions to the western United States, 1909 and 1910. (No abstract.)

January 17.

Philip P. Calvert, Ph.D., in the Chair.

Thirteen persons present.

The reception of a paper entitled "The Fishes of Delaware," by Henry W. Fowler (January 14), was reported.

Henry A. Pilsbry, Sc.D., made a communication on the natural history of the Mexican boundary, embodying an account of his expedition of the summer and fall of 1910, with special reference to a knowledge of the molluscan fauna. (No abstract.)

The following were elected members:

Thomas G. Ashton, M.D.,
Lynford Biddle,
Francis E. Bond,
William J. Conlen,
David E. Dallam,
G. L. S. Jamison, M.D.,
Wilmer Krusen, M.D.,
Bertram Lippincott,
Parke Longnecker,
Collier F. Martin, M.D.,
W. S. Newcomett, M.D.,
George W. Norris, M.D.,
William Pepper, M.D.,
E. Hollingsworth Siter, M.D.,
Charles Stewart Wurts.

Walter Rothschild, Ph.D., was elected a Correspondent.

The following were ordered to be printed:

THE FISHES OF DELAWARE.

BY HENRY W. FOWLER.

The waters of the State of Delaware may well be included in the marine fauna known as the Virginian, which is not essentially different from that of New Jersey. The extent of sea-coast is comparatively short, about 23 miles, and from this little positive information has yet been obtained. Several years ago the deep-sea pound established off Dewey Beach was abandoned, so that no important fish industry is carried on at present. Many of the off-shore fishes are said to have been taken in the pound, and some of them quite frequently.

The surf fauna along the beaches, which are usually moderately inclined and easily seined in many places, furnishes schools of smaller fishes, such as *Mugil*, *Trachinotus* and *Menticirrhus*. Crustacea, such as *Ocypode albicans*, *Callinectes sapidus*, *Ovalipes ocellatus* and *Emerita talpoida*, are abundant and often constitute the food of many fishes.

The bays present peculiarities in their tides. The greatly larger area of Delaware Bay has a broad outlet to the sea with the usual tidal, allowing a great influx of marine forms, most of which ascend to Ship John Light or Bombay Hook Point. On the other hand, though both Indian River and Rehoboth Bays are salt water, they have little or no tides, as the only channel of egress to the sea is the Indian River Inlet, which being very narrow allows only a comparatively small escape and inflow of water. However, marine fishes enter these bays by this passage, and sometimes in numbers. *Uca* ranges along the salt and brackish marshes as far north as Armstrong's Creek in Newcastle County. Prawns, like *Palæmonetes vulgaris*, occur almost everywhere.

The fresh-water fauna may be divided into a tidal and an above-tidal region, of which the latter may again be divided into a lowland and an upland region. The first of these is largely homogeneous throughout the drainage of both the Delaware and Chesapeake Bays. *Acipenser sturio*, *Lepisosteus*, *Pomolobus pseudoharengus*, *Alosa*, *Osmerus*, *Ameiurus catus*, *Fundulus heteroclitus macrolepidotus*, *Tylosurus*, *Roccus* and *Morone* are characteristic. *Apeltes quadracus*, not yet taken in the State, may also occur, likewise *Dorosoma cepedianum*. *Palæmonetes vulgaris* is the most abundant crustacean.

The lowland region above tide has comparatively few forms characteristic. They are *Notropis chalybæus, Erimyzon, Amciurus natalis prosthistius, Esox, Umbra, Gambusia, Aphredoderus, Enneacanthus, Mesogonistius* and *Boleichthys*. Though *Acantharchus pomotis* has not yet been obtained in Delaware, it may occur in this region. An interesting condition is presented along the basin of Laurel Creek above Laurel, where there is still a cypress swamp of moderate extent. The water in these fresh lowland streams is mostly dark, though less deeply stained than the costal or pine-woods streams in New Jersey. The fishes are also less darkly colored, though locally some are quite smutty. But little sphagnum has been noted, and I have not seen any submerged beds. *Palæmonetes vulgaris* is everywhere the most abundant crustacean. *Rana clamata, R. pipiens* and *R. palustris* are abundant amphibians, and *Natrix, Kinosternon, Sternothærus* and *Chrysemys* the most common reptiles I met with along the streams.

The upland region, comprised mainly in the bed of Christiana Creek, in the upper part of New Castle County, and therefore of comparatively small area, agrees largely with the rest of its extent in the adjoining portions of Chester and Delaware Counties in Pennsylvania. Many of these streams are quite rocky. *Hybognathus, Pimephales, Semotilus, Abramis, Notropis, Rhinichthys, Catostomus commersonnii, Erimyzon, Ameiurus nebulosus, Schilbeodes, Esox, Fundulus diaphanus, Lepomis, Eupomotis, Boleosoma* and *Perca* are characteristic. I have not found *Rhinichthys cataractæ, Exoglossum maxillingua, Catostomus nigricans* or *Cottus gracilis* within the limits of the State, though they all occur in the Brandywine basin just over the Pennsylvania line.

Certain catodromous fishes, like the eels, and the anadromous lampreys and clupeoids may be met with in many fresh waters, though their true homes are in the sea. Fresh-water forms of wide distribution, like *Abramis, Esox, Umbra, Eupomotis* and *Perca*, are interesting, as they often range down close to the sea.

The present account is offered, although very little has yet been published on this interesting fish-fauna, and though necessarily preliminary, in the hope that it will be of use in the study of geographical distribution. The few scattered records or notes relating to the fishes of this State which have been published are included as foot-notes. For these reasons I have visited a number of localities, at the same time making collections and studies. All such materials obtained have been placed in the collections of The Academy of Natural Sciences of Philadelphia. I am especially indebted to Mr. A. D. Poole, President of the Delaware Game Protective Association, for the grant of a permit to collect fishes in Delaware and for enabling me to secure some valuable collections from Wilmington. I am also under obligations in many ways, either for notes or contributions of specimens, to Dr. R. J. Phillips, Mr. S. N. Rhoads, Mr. T. D. Keim, Mr. C. J. Pennock, Dr. Herman Burgin, Mr. H. L. Mather, Jr., Mr. B. W. Griffiths, and others. A number of the more common market fishes have also been examined, though none of these were preserved.

Myxine glutinosa Linnæus.

Only known from off-shore by Smith and Kendall's record.[1]

Petromyzon marinus Linnæus. "Lamprey."

I found a small one in the White Clay Creek near Thompson, April 9, 1910, which was not preserved. Mostly taken in the spring, in tidal waters and ascending streams with direct communication to the sea. Mr. Poole says they formerly ascended Mill Creek near Wilmington.

Eulamia milberti (Müller and Henle). "Shark."

One small example taken at Dewey Beach, Sussex County, October 12, 1910.

Sphyrna zygæna (Linnæus). "Hammer-head Shark."

Although I have no examples, it undoubtedly occurs about Rehoboth, where Mr. Charles Jaeger says he saw a number of small examples, the largest not over 3 feet in length, in September several years ago.

Squatina squatina (Linnæus). "Lizard Fish."

Greatly detested by the fishermen, who say it has been common at times off Dewey Beach, many having been taken in the pound. Several years ago they were also said to have been very abundant southward, as at Ocean City and Chincoteague, sometimes greatly annoying the sturgeon fishermen by being gilled in their nets. A stuffed example in the Academy was evidently secured at Lewes some years ago.[2]

Manta birostris (Walbaum).

Twice described[3] from the entrance to Delaware Bay. No examples from Delaware in the Academy.

I have a number of egg-cases, empty, collected recently on Dewey and Rehoboth Beaches, which probably belong to *Raja ocellata* and *R. eglanteria*, both of which are said to be abundant in the region.

[1] *Rep. U. S. F. Com.*, 1896 (1898), p. 169.

[2] *Squatina dumerili* in *Proc. Acad. Nat. Sci. Phila.*, 1875, p. 510, from A. Purvis, in list of donations to the Museum.

[3] *Cephalopterus vampyrus* Mitchill, *Ann. Lyc. Nat. Hist. N. Y.*, I, 1824, p. 23, Pl. 2, fig. 1. *Cephaloptera giorna* Le Sueur, *Journ. Acad. Nat. Sci. Phila.*, IV, 1824, p. 115, Pl. 16, figs. 1–4.

Acipenser sturio Linnæus. "Sturgeon."

Reported from Delaware City by Ryder,[4] where it was formerly abundant and the object of extensive fisheries, though now said to be scarce. The occasional large sturgeon still to be seen in Philadelphia markets is usually now captured further down the coast. I recently picked up a large dorsal scute on Dewey Beach.

Acipenser brevirostrum Le Sueur.

Included on Ryder's authority.[4] He notes[5] from Delaware City.

Lepisosteus osseus (Linnæus). "Gar Pike."

Described many years ago from a stuffed example still in the Academy, probably from Bombay Hook.[5] Mr. Rhoads secured heads at Seaford and in the Indian River about 3 miles below Millsboro.

Pomolobus pseudoharengus (Wilson). "Branch Herring."

Ascends fresh-water streams and such waters above tide as have direct communication with the sea. Though no examples in the Academy from Delaware, I have examined examples at Wilmington. In many places very abundant in the spring runs, great numbers being captured in the Indian River to Millsboro, Laurel Creek to Laurel, Mispillion Creek to Milford, Delaware City and the canal at St. Georges. *P. mediocris* appears at the fisheries earlier and *P. æstivalis* comes much later, and though I have not obtained either, both doubtless occur in most tidal waters.

Alosa sapidissima (Wilson). "Shad."

This far-famed food-fish is taken in numbers in most of the larger tidal waters during the spring run,[6] though not running into the smaller fresh waters so far as the branch herring. I have seen market examples at Wilmington. Young in the Academy from Fort Delaware.

Brevoortia tyrannus (Latrobe). "Menhaden."

Common along the coast[7] and in Delaware Bay. Sometimes ascends the Delaware nearly to Philadelphia. Young in the Academy from Fort Delaware.

Anchovia mitchilli (Valenciennes).

Many from Fort Delaware, obtained by Dr. C. Arrott, are in the collection.

[4] *Bull. U. S. F. Com.*, VIII, 1888 (1890), p. 240.

[5] *Lepidosteus crassus* Cope, *Proc. Acad. Nat. Sci. Phila.*, 1865, p. 86.

[6] *Forest and Stream*, VI, February 10, 1876, p. 6. A few in January and February at Bombay Hook.

[7] *L. c.*, V, November 11, 1875, p. 230. Great numbers chased ashore by bluefish.

Salmo salar Linnæus. "Salmon."

Introduced in the Delaware River, and Harmsworth mentions subsequently that they had been taken one season in most shad fisheries from Fort Delaware to the Water Gap.[8] I have no recent information and never saw an example.

Salvelinus fontinalis (Mitchill). "Brook Trout."

Several streams in Kent County were reported, some years ago, as having been stocked with brook trout.[9] Though apparently rare or entirely absent in suitable localities at present, it is likely to have been indigenous perhaps in some streams in the northern portions of Newcastle County in early times. No examples.

Osmerus mordax (Mitchill). "Smelt."

Recorded many years ago from the Brandywine Creek at Wilmington.[10] No examples.

Anguilla chrisypa Rafinesque. "Eel."

Abundant in almost all waters. Many have been taken about Lewes, and in Indian River Bay quite an eel-pot industry is carried on, though the eels taken in these pots are all rather small or of moderate size. My examples from Mispillion Creek, Milford, Brown's Branch near Harrington, Armstrong's Creek, Newcastle and Wilmington.

Leptocephalus conger (Linnæus).

No examples. Reported about the breakwater at Lewes, where Mr. F. J. Keeley secured one of 15½ pounds.

Hybognathus nuchalis regius (Girard).

A few from the Brandywine Creek near Wilmington.

Pimephales notatus (Rafinesque).

No examples. Said[11] to range from the "St. Lawrence River to Delaware."

Semotilus bullaris (Rafinesque). "Fall Fish."

Abundant in the Christiana Creek basin. Dr. Phillips has found it in Burrow's Run, the Red Clay Creek throughout its course, Mill Creek near Hockessin, and the White Clay Creek near its mouth. My examples from near Holly Oak in a small run, and the Brandywine basin near Wilmington.

Semotilus atromaculatus (Mitchill).

Abundant in the Christiana upland basin. Dr. Phillips has found

[8] *Forest and Stream*, XLIV, June 8, 1895, p. 464.

[9] *L. c.*, XXIX, December 1, 1887, p. 369.

[10] *Osmerus viridescens* Norris, *Am. Angler's Book*, 1864, p. 263. *Forest and Stream*, XI, December 5, 1878, p. 361.

[11] Blatchley, *Proc. Acad. Nat. Sci. Phila.*, 1885, p. 64.

it in Mill Creek near Hockessin and Burrow's Run, in Newcastle County. I have examined examples from near Wilmington.

Abramis crysoleucas (Mitchill). "Roach. Bitter Head."

Found in almost all sluggish or still waters. Dr. Phillips secured it in the Red Clay Creek near the State line. I have examined very many examples from Naaman's Creek, Wilmington, Newcastle, Armstrong's Creek, White Clay Creek near Newark, Mispillion Creek near Milford, and Laurel Creek at Laurel.

Notropis bifrenatus (Cope).

I have found a few in the Brandywine Creek near Wilmington.

Notropis procne (Cope).

Found abundant in Laurel Creek tidal near Laurel and the Choptank headwaters near Marydel.

Notropis hudsonius amarus (Girard).

Very abundant in the Brandywine at Wilmington, near where I have secured many examples.

Notropis whipplii analostanus (Girard).

The most abundant cyprinoid in the Christiana basin. Very many examples from Wilmington, the White Clay Creek near Newark and Naaman's Creek.

Notropis cornutus (Mitchill). "Red Fin."

Many examples examined from Naaman's Creek, Shellpot Run, Wilmington, White Clay Creek at Newark, Laurel Creek tidal near Laurel, and the Choptank headwaters near Marydel.

Notropis chalybæus (Cope).

Abundant in lowland streams, especially in rather sluggish water. Many examples from Millsboro, Milford, Laurel and Marydel.

Notropis photogenis amœnus (Abbott).

A few small examples from the Choptank headwaters near Marydel.

Rhinichthys atronasus (Mitchill). "Black-nosed Dace."

Abundant in all upland brooks and streams. I found it in the Brandywine at Wilmington, Naaman's Creek, run near Holly Oak, Silversides, Shellpot Run and the White Clay Creek near Newark.

Cyprinus carpio Linnæus. "Carp."

Introduced in many waters. I have examined numbers of examples, finding several of the well-known varieties, not only market specimens, but many taken near Wilmington, and others at Millsboro. At the latter place some of the examples were at least 2 feet long.

Catostomus commersonnii (Lacépède). "Sucker."

Very abundant in the Christiana basin, and valued as a food-fish chiefly in cold weather. Dr. Phillips found it in the Red Clay Creek below Ashland and in Burrow's Run. Very many examples, of all ages, examined, from Silversides, Naaman's Creek, Shellpot Run and Wilmington.

Erimyzon sucetta oblongus (Mitchill). "Mullet."

Common in almost all streams, and the young often associated with young roach and *Notropis chalybœus*, characteristic of quiet lowland waters. Many examples of all ages examined from Wilmington, Millsboro, Milford, Laurel and Marydel. Though rather dark in color, like other small fish from dark lowland waters, none showed such intense melanism of similar fishes found in the deeply stained cedar streams of the New Jersey lowlands.

Ameiurus catus (Linnæus). "White Catfish."

A valued food-fish, and in some places reaching a good size. Said to be common at Delaware City, Slaughter Beach, Lewes and Indian River Bay. Cope found it in Mispillion Creek. Dr. Burgin has secured it at Ship John Light, off the jetty at St. Georges and at Delaware City. My examples from Wilmington and Laurel.

Ameiurus natalis prosthistius (Cope). "Catfish. Black Catfish."

I have 3 large examples secured in the Indian River at Millsboro on October 14, 1910. This is quite interesting as being the first instance of the species being known from the peninsula. It appears to be frequent in this region, as a number of others were also secured by the fishermen.

Ameiurus nebulosus (Le Sueur). "Catfish. Yellow Catfish."

Abundant in almost all waters, especially in the Brandywine and Christiana Creeks. I have examined examples from Naaman's Creek, Wilmington and Armstrong's Creek. This species was described once from Mispillion Creek.[12]

Schilbeodes gyrinus (Mitchill).

One labeled "Delaware" was obtained many years ago from Dr. Pickering.

Esox americanus (Gmelin). "Pike."

Valued as a food-fish, though less so than the next, as it does not reach so large a size. Many examples examined from Naaman's Creek, near Chippewa, Armstrong's Creek, Wilmington, Delaware

[12] *Amiurus mispilliensis* Cope, *Proc. Am. Philos. Soc., Phila.*, XI, 1870, p. 486.

City, Brown's Branch near Harrington, and the Choptank headwaters near Marydel.

Esox reticulatus Le Sueur. "Pickerel."

One of the most valued food-fishes, though its game qualities are generally best exhibited after it has been hauled into the boat. Dr. Phillips found it in fresh water near Rehoboth, and it is also said to have been abundant in the canal at St. Georges. Many examples from Millsboro, Milford, Brown's Branch near Harrington, Laurel and Marydel, were examined.

Umbra pygmæa (De Kay). "Mud Minnow."

A seclusive little fish, often found buried in the muddy bottoms of little pools, or in quiet weedy or choked-up coves, always in fresh water. Dr. Phillips found it in fresh water near Rehoboth and Dr. Burgin has taken it in Bellevue Creek and near Bombay Hook. My numerous examples from Newcastle, Delaware City, Rehoboth, Brown's Branch near Harrington, and Laurel.

Fundulus heteroclitus maorolepidotus (Walbaum).

Abundant in almost all tidal waters as well as the costal salt ponds and ditches, where in many places they swarm by the thousand. My examples from Naaman's Creek, Holly Oak, Claymont, State Road, Armstrong's Creek, Red Lion Creek, Delaware City and Rehoboth. Doubtless *F. majalis* is abundant, as reported, about Lewes and Rehoboth in salt water, though I have no examples.

Fundulus diaphanus (Le Sueur).

I have not found this species out of fresh water, though it ranges down close to the ocean. Abundant in Naaman's Creek, Wilmington, Delaware City, Rebohoth and Laurel, where I have obtained many examples.

Cyprinodon variegatus Lacépède.

Abundant about Lewes and Rehoboth. It enters fresh water near the sea, though usually not beyond the reach of tide. My examples collected by Dr. Phillips at Rehoboth.

Gambusia gracilis (Heckel).

This little fish has been credited with ranging as far north as Delaware, on the Atlantic coast of the United States, for some years past.[13] I have been unable, however, to locate the original source of this information, as well as the exact locality in the State where the fish was obtained or observed. I have recently shown[14] that it also ranges

[13] *Gambusia affinis* Jordan and Evermann, *Bull. U. S. Nat. Mus.*, No. 47, I, 1896, p. 680.

[14] *Science*, XXVI, November 8, 1907, p. 639.

into the opposed regions of New Jersey along the southern part of Delaware Bay, where it was found to be very abundant in several streams. It is likewise very abundant in the fresh reaches of the Indian River about Millsboro, where it was first discovered by Mr. T. D. Keim and myself October 13, 1910. We secured many specimens, and found it distributed well above the dams almost everywhere. We also found but a single example in Mispillion Creek above the first dam at Milford, on October 15, 1910, which is evidently the most northern part of the State where it has yet been noted. As yet it has only been found by us in fresh water.

Tylosurus marinus (Walbaum). "Bill Fish."

Ascends almost all waters in their tidal regions. Dr. Burgin found it near St. Georges, the creek at St. Augustine, Mahon Beach and Little Creek Hundred. Mr. Poole has found it in Rehoboth Bay. It has been reported at Lewes and Delaware City. I have no examples, and only examined a few in the markets.

Kirtlandia vagrans (Goode and Bean).

Reported from Cape Henlopen by Smith and Kendall,[15] who thought this the most northern locality for the species at that time, though Bean had recorded it as early as 1888 from Great Egg Harbor Bay in New Jersey.

Menidia menidia notata (Mitchill).

Abundant along the coast, and reported at Lewes, Rehoboth and Indian River Bays. Though I have no preserved examples, I saw a small school at Dewey Beach during the past fall.

Mugil cephalus Linnæus. "Fat-back. Jumping Mullet."

Abundant along the coast in the fall. A good food-fish and many taken in nets for market. I saw over 600, taken in a single sweep of the seine at Dewey Beach, on October 12, 1910.

Mugil curema Valenciennes. "Fat-back."

Very abundant at Dewey and Rehoboth Beaches, and though we seined a great number on October 12, 1910, they were exclusively this species, and all were quite small.

Gasterosteus aculeatus Linnæus.

Included on Bean's Wilmington record.[16]

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[15] *Kirtlandia laciniata* Smith and Kendall, *Rep. U. S. F. Com.*, XXIII, 1896 (1898), p. 170.

[16] *Proc. U. S. Nat. Mus.*, III, 1880, p. 77.

Syngnathus fuscus Storer.

Mr. Pennock secured an example, also of the following species, from below Millsboro in 1905. Both species were known at Lewes.

Hippocampus hudsonius De Kay.

Scomber scombrus Linnæus. "Mackerel."

No examples. A few reported off Lewes every season by the fishermen.[17]

Trachinotus carolinus (Linnæus). "Pompano."

Found very abundant in the surf at Rehoboth and Dewey Beaches, of rather small size, and associated sometimes with *Mugil curema*, during the past October.

Pomatomus saltatrix (Linnæus). "Blue Fish. Snapping Mackerel."

Abundant at Dewey and Rehoboth Beaches, Lewes and along the shores of Delaware Bay, appearing irregularly in warm weather. Fishermen report them as high up the Delaware as Delaware City and Newcastle, but these said to be young. I have a small one from Dewey Beach.

Poronotus triacanthus (Peck). "Butter Fish."

I found an example about 10 inches long at Dewey Beach during the past October. Said to be common at Lewes and in Rehoboth Bay.

Aphredoderus sayanus (Gilliams).

Found abundantly in dark secluded waters, usually in quiet choked-up streams, pools or weedy places. All my examples from fresh-water above tide, in the Indian River at Millsboro, Brown's Branch near Harrington and the Choptank headwaters near Marydel.

Enneacanthus gloriosus (Holbrook).

Very abundant in similar waters in which the preceding species occurs. Many examples from Millsboro, Milford, Laurel, Marydel and Delaware City.

Mesogonistius chætodon (Baird).

This small fish, perhaps the most strikingly handsome of all our fresh-water species, prefers still, quiet, weedy waters, especially in such localities as are productive of *Ceratophyllum* and other luxuriant aquatic plants. Very abundant in many localities. My specimens from Millsboro, Milford and Laurel.

Lepomis auritus (Linnæus). "Long-eared Sunfish. Red-belly."

Abundant in the upper reaches of fresh waters, especially the more

[17] *Forest and Stream*, IV, May 13, 1875, p. 217. About 50 miles east of the breakwater.

upland streams, such as the Christiana basin. It does not apparently descend so far below and into the tidals as the next species. Many examples examined from the Brandywine basin at Wilmington and the White Clay Creek at Newark. Dr. Burgin says it was abundant several years ago in the canal at St. Georges.

Eupomotis gibbosus (Linnæus). "Sunfish. Yellow-belly."

Common in most all fresh waters and approaching near to the lower tidals, though I have not seen any from salt or brackish water. Many examples examined from Naaman's Creek, Holly Oak, Shellpot Run, Wilmington, Armstrong's Creek, Delaware City, Millsboro and 3 miles below in the Indian River, Milford, Laurel and Marydel.

Micropterus dolomieu Lacépède. "Small-mouth Bass."

Introduced in fresh water on account of its excellent game and food qualities. My specimens from Wilmington.

Micropterus salmoides (Lacépède). "Large-mouth Bass."

Introduced like the preceding, and though attaining a larger size and valued as food, it is usually less esteemed by anglers. I have examined a number of large examples at Millsboro.

Perca flavescens (Mitchill). "Ring Perch."

Usually abundant in fresh tidal regions. Dr. Phillips found it common in the canal at St. Georges, and I found it in Naaman's Creek, Armstrong's Creek and Laurel Creek at Laurel, though almost all these examples were small or of moderate size.

Boleosoma nigrum olmstedi (Storer).

Usually found in clear shallow water, preferably on sandy or gravelly bottoms, though often among weeds. Very abundant in the Christiana basin. I have examined many examples, those obtained by Cope in "Sussex County" and Dr. Arrott at Fort Delaware, besides those I secured myself in Naaman's Creek, the Brandywine basin at Wilmington, the White Clay Creek near Newark, and the Choptank headwaters near Marydel. All my examples were obtained above tide.

Boleichthys fusiformis (Girard).

Abundant in almost all lowland fresh waters, at least above tide. It is rather seclusive, and to be found usually associated with *Erimyzon*, *Aphredoderus*, *Enneacanthus*, *Mesogonistius* and similar fishes. Many examples, besides those Cope obtained in Sussex County, examined, from the Mispillion Creek at Milford and Laurel Creek at Laurel.

Roccus lineatus (Bloch). "Striped Bass."

Large examples are sometimes captured during the spring in shad-nets along the Delaware. I saw an example of about 17 pounds weight at Lewes in 1907. Dr. Phillips says it is reported from the Indian River at Cedar Grove Park and the upper end of Rehoboth Bay.

Morone americana (Gmelin). "Black Perch."

Common in most fresh or brackish tidals and also in salt water. Dr. Phillips found it in a fresh pond near Rehoboth. Dr. Burgin notes it off the jetty at St. Georges in 1895. I have examined examples at Lewes and Millsboro, the latter of quite dark or dusky coloration, apparently well gaining the appropriate local vernacular.

Centropristis striatus (Linnæus). "Sea Bass."

A valued and abundant food-fish along the coast,[18] entering Delaware Bay. I have only examined market examples of this species, and also a few of the next.

Stenotomus chrysops (Linnæus). "Porgy."

Abundant along the coast[19] and enters Delaware Bay.

Archosargus probatocephalus (Walbaum).

Apparently scarce, though a valued food-fish.[20] Dr. Burgin reports a few at Ship John Light in 1885. No examples.

Cynoscion regalis (Schneider). "Yellow-finned Trout."

An abundant food-fish along the coast and in Delaware Bay, above which it is said to ascend sometimes to Delaware City and the mouth of Christiana Creek. Dr. Burgin reports a few at Ship John in 1885. Abundant in Indian River and Rehoboth Bays and at Lewes, though most of the larger ones from off shore. I have seen a number of market examples.

Cynoscion nebulosus (Cuvier). "Spotted Trout."

Distributed like the last, though usually less abundant and apparently not wandering so far from the sea.[21] Said to reach a large size off shore, about Lewes, and in Rohoboth and Indian River Bays. I have only seen a few market examples.

Micropogon undulatus (Linnæus). "Crocus."

An abundant costal food-fish, entering Delaware Bay, and also said to be common at Lewes and in Rehoboth Bay. I have seen some adult market examples.

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[18] *Forest and Stream*, XVII, August 11, 1881, p. 31. Off Indian River. *L. c.* XXXIV, April 17, 1890, p. 250. Off Cape Henlopen.

[19] *L. c.*, LIX, July 12, 1902, p. 29. Banks 10 to 12 miles east of the breakwater.

[20] *L. c.*, X, February 7, 1878, p. 6. Breakwater. *L. c.*, XX, June 28, 1883, p. 429. Breakwater. *L. c.*, XXII, June 5, 1884, p. 367. Breakwater.

[21] *L. c.*, LIX, July 12, 1902, p. 29. Banks 10 to 12 miles east of the breakwater.

Menticirrhus saxatilis (Schneider).

An abundant food-fish along the coast and entering Delaware Bay. I secured it at Rehoboth Beach in October.

Menticirrhus littoralis (Holbrook).

Three small examples were seined in the surf at Rehoboth Beach on October 12, 1910. This is the most northern locality at which the species has been taken on the Atlantic coast of the United States.

Tautoga onitis (Linnæus). "Black Fish."

No examples. Reported about the breakwater at Lewes,[22] according to Dr. Phillips.

Balistes carolinensis Gmelin.

One angled at the Lewes breakwater about 1890 by Mr. F. J. Keeley. It was not preserved.

Prionotus carolinus (Linnæus). "Sea Robin."

Young from Rehoboth and Dewey Beaches.

Paralichthys dentatus (Linnæus). "Flounder."

Abundant along the coast and in Delaware Bay in warm weather. I have examined market examples.

Pseudopleuronectes americanus (Walbaum). "Winter Flounder."

Distributed like the last, and remains all the year. Many angled in cold weather in Indian River, Rehoboth and Delaware Bays. I have seen a few market specimens.

Achirus fasciatus Lacépède. "Hog Choke."

Found in most tidal and salt waters. Said to be abundant in Rehoboth and Indian River Bays, and about Lewes. Also small ones occasional at Delaware City. Mr. Rhoads secured, in 1903, an example now in the Academy, three miles below Millsboro.

Zoarces anguillaris (Peck).

Said to range from "Delaware to Labrador."[23] No examples.

Ammodytes americanus De Kay. "Sand Eel."

Found abundant on Rehoboth and Dewey Beaches during last October. Also reported previously as common at Lewes. Many examples in the collection.

Gadus callarias (Linnæus). "Codfish."

Reported common in cold weather off the coast. I have examined market examples. Mr. H. Walker Hand says the first cod known to

[22] *Forest and Stream*, XXII, June 5, 1884, p. 367, breakwater.
[23] Jordan and Evermann, *Bull. U. S. Nat. Mus.*, No. 47, III, 1898, p. 2457.

him from Delaware Bay was captured last spring between Dead Man Shoal and Fourteen Foot Bank.

Urophycis regius (Walbaum).

Dr. Phillips caught 3 on May 18, 1908, at Rehoboth, where they were locally called "tomcod." These specimens were not preserved.

Merluccius bilinearis (Mitchill). "Whiting."

Found off the coast in cold weather. I have examined a number of market examples. Said to be an abundant fish at times and valued as food.

Lophius piscatorius Linnæus. "Goose Fish."

Abundant in Delaware Bay, according to the fishermen who know it at Lewes and Rehoboth. I have examined a Delaware Bay example now in the Academy.

Besides the foregoing, many other marine species are taken, and some very abundantly. Quite a number have been reported to me by various anglers, fishermen or amateur naturalists, and as all have either been found in New Jersey or the coast of Worcester County, Maryland, it is almost inevitable that they will be added to the fauna of the State. Such species are: *Carcharias littoralis*, *Galeocerdo tigrinus*, *Mustelus mustelus*, *Alopias vulpes*, *Eulamia obscura*, *Squalus acanthias*, *Pristis pectinatus*, *Raja erinacea*, *R. lævis*, *Dasyatis centroura*, *D. say*, *Myliobatis freminvillii*, *Rhinoptera bonasus*, *Opisthonema oglinum*, *Synodus fœtens*, *Felichthys marinus*, *Seriola zonata*, *Caranx hippos*, *Selene vomer*, *Seserinus paru*, *Epinephelus morio*, *Orthopristis chrysopterus*, *Lagodon rhomboides*, *Bairdiella chrysura*, *Sciænops ocellatus*, *Leiostomus xanthurus*, *Pogonias cromis*, *Alutera schœpfi*, *Chætodipterus faber*, *Chilomycterus schœpfii*, *Diodon hystrix*, *Lagocephalus lævigatus*, *Spheroides maculatus*, *Mola mola*, *Echeneis naucrates*, *Rissola marginata*, *Hippoglossus hippoglossus* and *Melanogrammus æglifinis*.

NEW CYCADS AND CONIFERS FROM THE TRIAS OF PENNSYLVANIA.

BY AMOS P. BROWN.

The Museum of The Academy of Natural Sciences of Philadelphia has recently received a number of plant fossils from the Trias of Pennsylvania, the gift of Mr. George Velder, of Bucks County. They come from a small local quarry, worked from time to time to supply stone for road metal. The quarry is located in the Norristown Shales of Lyman,[1] the lowermost member of his "New Red," with which is to be correlated the Stockton of Kummel.[2] The stone in which the impressions are found is a thin-bedded, dark, shaly sandstone, with numerous small mica flakes, and sufficiently fine-grained to take a good impression of the plants. These are in such good condition that they were evidently imbedded in the mud when fresh; the flexuous character of some of the species is perfectly reproduced, indicating that the mud in which the impressions were made was very soft. In some of these impressions a coaly deposit has replaced the cellulose; in others the impression shows a rusty deposit, indicating that a certain amount of pyrites was reduced by the vegetable matter after the plant was imbedded, which has become oxidized to limonite, as the rock has been brought to the surface again by erosion. On the specimens thus far studied, two species of Cycadales and four Coniferæ are represented, of which four are new to science, two Cycadaceæ and two Pinaceæ.

Class CYCADALES.

Family CYCADACEA.

Podozamites formosus sp. nov. Plate I.

Rachis rather stout, varying in diameter from 5 mm. to 2.5 mm. in a length of 450 mm., marked near the edges of the upper side by the scars of attachment of the leaflets, of which there are 35 on each side in this distance of 450 mm. Leaflets rather distantly spaced on the rachis, extending about at right angles to it, and the basal leaflets somewhat reflexed; alternate to sub-opposite, nearly sessile; attached

[1] Summary Final Report, *Geol. Surv. Pa.*, III, Part 2, 1895.
[2] *Ann. Rep. State Geol. Surv. New Jersey*, 1896.

at intervals of 11 to 13 mm. by the contracted base. Form of leaflets linear, parallel-sided, with the margin thickened and reflexed and the apex obtuse and rounded, rather suddenly contracted at the base where they are attached to the rachis. The length of the leaflets is about 90 mm., width 10 to 11 mm. They are deciduous, leaving an elongated scar measuring 3 mm. longitudinally by 1 mm. transversely on the rachis when they fall; the middle of the scar is marked by a circular spot where the vessels emerge. Fragments of the bare rachis occur marked with the leaf scars and the individual detached leaflets are found on some slabs. The leaflets are strongly parallel nerved, the nerves radiating from the point of attachment to the rachis and branching dichotomously until beyond the contracted base of the leaflet, from which point they are simple and paralled to the end. Those leaflets towards the basal end of the rachis are variously split at the ends along the veins, or the ends of the leaflets are variously divided into two or three lobes with rounded ends and parallel margins, probably due to erosion or perhaps to cutting by insects. The leaflets must have been rather thick, for they leave behind a distinct coaly film, and in some cases the rachis impression shows a still heavier film of coal. Owing to the linear form of the leaflet and the obtuse apex, there seems to be no contraction of the nerves at this point.

Zamites velderi sp. nov. Plate II.

Rachis slender, about 1.5 mm. in diameter, having about 30 leaflets on each side in a length of 150 mm. Leaflets alternate to sub-opposite, sessile; nearly touching at their bases; inserted on the upper side of the rachis by the contracted base, which expands abruptly from the point of attachment to somewhat more than the normal average width of the leaflet, making the base slightly eared; the leaflets point outward and forward from the rachis at an angle of 65°. Form of the leaflets linear, parallel margined above the expanded base, and rounded and obtuse at the apex; length 40 to 50 mm., becoming shorter towards the base of the rachis; width 3.5 to 4.5 mm.; the edges of the leaflet reflexed and thickened. The leaflets are parallel-nerved, the nerves radiating from the point of attachment to the rachis, but their mode of forking is not well preserved and does not appear to be dichotomous; nerves fine, about six in 1 mm.

The attachment of the leaflets is at the upper side of the rachis, by a sharply contracted base, and the expanded, eared bases overlap the rachis somewhat, as well as being in contact with each other, but there is no evidence on the one specimen of this species that the leaflets are deciduous, nor were detached leaflets of this species observed on other slabs. The specimen shows the upper part of a leaf, near the apex, but 20 to 30 mm. of this end is broken off. The leaflets become shorter near the apex, one of the last preserved on the specimen, and very near the apex, is 28 mm. long.

Class CONIFERALES.

Family **PINACEÆ**

Palissya diffusa (Emmons). Plate III.

This species is represented by several slabs showing parts of branches, one with a length of stem of 200 mm. showing the two sides of the branch on two slabs. The branches on this stem are 6 to 7 on a side in a length of 200 mm.; they attain a length of 130 mm. and the ultimate branchlets extend about 20 mm. on each side of the branches. Some coaly matter along the main stem indicates from its thickness a considerable density for the woody stem. The leaves are crowded on the branches, linear oblong, obtuse at the apex and about 1 by 3 mm. They point forward at an angle of 45° and the branchlets are about 4 mm. wide. One of the smaller specimens is figured in Plate III.

Palissya obtusa sp. nov. Plate IV.

Small branches varying in thickness from 4.5 to 2 mm. in different specimens; ultimate branchlets simple, very slender, terminations flexuous, branchlets up to 100 mm. long, alternately attached to the small branch. Leaves spreading laterally, apparently two-ranked, rather widely spaced; about 30 on a side in a distance of 80 mm.; they are inserted subalternately, nearly oppositely, on the ultimate branchlets, attached by a short petiole, nearly sessile. The form of the leaf is linear, sharply contracted at the base and obtuse at the apex, which latter character distinguishes this species from *P. sphenolepis* (Fr. Braun). Their size is 7 mm. in length by 1.5 mm. in width, the midrib is generally distinct. The ultimate branchlets are deciduous, at least in part, as is the case with our living *Taxodium distichum* (L.) which this species recalls.

This species appears upon a number of slabs, all representing terminal or lateral twigs of a branch; those showing definitely a termination are very flexuous and fernlike. The largest specimen shows parts of a branch 300 mm. long and the spreading branches from the main stem are 300 mm. across; parts of adjacent branches cover the slab as though a limb of considerable size had been imbedded at one time. Upon one of these twigs the side branchlets are simple in that portion towards the trunk of the tree, about 70 to 100 mm. long; these are succeeded towards the apex by compound branchlets 150 to 200 mm. long, the little ultimate branchlets upon which are 20 to 30 mm. long. The entire branch evidently expands from the base and tapers again towards the apex recalling the frond of a fern, as is the case with our "cedar" or arbor vitæ of the Pacific coast, *Thuya plicata* D. Don.

Cheirolepis muensteri (Schenk).

This species is represented by some small portions of branches on two of the slabs. While the preservation is very perfect and the characters well shown, the surfaces of the specimens exposed are small in each case. The best one shows a portion of a branch with 8 complete ultimate branchlets on one side and fragments of the ultimate branchlets on the opposite side. These ultimate branchlets are 18–20 mm. long, very thin and flexuous, and tapering from a little over 2 mm. to a point. They are densely leafy, the scale-like leaves being about 2 mm. long and pointing forward at a sharp angle, closely crowded and decurrent at the base. The tip of the leaf is acuminate, pointing forward as a spine; the midrib is pronounced. The best specimen is on a slab with *Palissya obtusa*. The tapering of the ultimate branchlets is due to the leaves' becoming smaller and more closely appressed to the axis of the branchlet towards the tip.

Cheirolepis latus sp. nov. Plate V.

This species is represented on two slabs, one specimen showing the terminal part of a branch. On this specimen the branchlets near the trunk end are 80 mm. long and 25 mm. wide; ovate lanceolate in outline and they stand at 90° from the stem; towards the terminal part they stand at an angle of 80° and they are 60 mm. long, tapering from 15 mm. wide at the base to a point, at the apex of the branchlets, making them linear lanceolate in outline. The branchlets are nearly opposite upon the stem, or sometimes more nearly alternate; they are deciduous, leaving a scar projecting where they fall. The main stem is marked by strong, acutely pointed scales or leaves, covering these points of attachment of the branchlets; these scales often become reflexed after the branchlets fall and produce the appearance of hooks pointing backward on the stem. The ultimate branchlets are two ranked upon the larger branchlets from the stem above described; they are arranged sub-alternately to nearly oppositely, but they are never truly opposite; they are covered with densely crowded leaves which are spirally arranged in four ranks, closely appressed and scale-like, apparently decurrent at the base.

Explanation of Plates I–V.

Plate I.—Portion of leaf of *Podozamites formosus* sp. nov. Natural size.

Plate II.—Leaf of *Zamites velderi* sp. nov. Natural size.

Plate III.—Portion of small branch of *Palissya diffusa* (Emmons). Natural size.

Plate IV.—Small branches, bearing ultimate branchlets, of *Palissya obtusa* sp. nov. Natural size.

Plate V.—Branch of *Cheirolepis latus* sp. nov., showing the varying shape of branchlets and the scars left by the fall of former branchlets. Natural size.

FEBRUARY 7.

The President, SAMUEL G. DIXON, M.D., LL.D., in the Chair.

Forty-five persons present.

The receipt of papers under the following titles was reported:

"New Cycads and Conifers from the Trias of Pennsylvania," by Amos P. Brown (January 18).

"The Ethno-Botany of the Gosiute Indians," by Ralph V. Chamberlin (February 6).

The deaths of Frank Haseltine, July 18, 1910, and of William T Biddle, August 11, 1910, members, were announced.

The meeting was held in conjunction with the Biological and Microscopical Section.

MR. FRANK J. KEELEY gave a summary of the work accomplished by means of the micro-spectroscope. (See paper.)

DR. HERBERT FOX exhibited specimens of sputum showing the human type of tubercle bacilli, section of a lung of a guinea-pig showing bovine bacilli in a histologic tubercle, an avian tuberculoma with tubercle bacilli in the epithelioid cells, the *Trypanosoma lewisi* in the blood of a rat, and two forms of the malaria of birds, *Proteosoma* and *Halteridium*, showing their relations to the nucleus of the red blood-cell. The first three sections were from the Laboratory of the Pennsylvania Department of Health, the last three from the Laboratory of Comparative Pathology of the Philadelphia Zoological Society.

MR. W. H. VAN SICKLE spoke of carniverous plants, with illustrative specimens. (No abstract.)

MR. HUGO BILGRAM referred to the moulting of caterpillars involving the duplication of organs and called attention to illustrative preparations.

MR. CHARLES S. BOYER exhibited sections of Selenite and Leucite.

DR. D. E. OWEN showed specimens of *Ishnia nervosa*, a diatom from the coast of Maine, not before reported from that locality.

DR. THOMAS S. STEWART exhibited preparations of the blood of a leucæmic patient, the fly and larva of the Congo blood-sucker, and specimens of hydroids.

FEBRUARY 21.

MR. WITMER STONE in the Chair.

Forty persons present.

The Publication Committee reported the receipt of papers under the following titles:

"Micro-Spectroscopic Observations," by Frank J. Keeley (February 14).

"Variations in some Jamaican Species of Pleurodonta," by Amos P. Brown (February 16).

DR. HENRY SKINNER made a communication on some of the world's interesting butterflies. (No abstract.)

The following were elected members:

Mrs. Arthur Biddle.
Alexander Brown.
William H. Rau.
Edward A. Schumann, M.D.
Alexander A. Uhle, M.D.

The following were ordered to be printed:

THE ETHNO-BOTANY OF THE GOSIUTE INDIANS.

BY RALPH V. CHAMBERLIN.

The home of the Gosiute Indians was formerly all of the generally desert territory bordering the Great Salt Lake on the south and extending westward into eastern Nevada. To the passing traveller this whole region, before certain favored portions were reclaimed by irrigation, appeared so utterly desolate and uninviting that he must have wondered that any human being should be found there excepting from direst necessity. Yet to the Gosiute this still is, as it long has been, home and native land, and he loves it with a love as ardent as ever burned in the breast of patriot. Away from it he pines; and no thought to him is so harrowing as that the Government may yet force him away to some hated reservation; no suffering so deep as that he bears when he sees his last remaining foothold steadily encroached upon by stockman and rancher. He knows well the haunt and habits of its living creatures; the familiar note of its every bird has become woven into his very life; while from grandparents he knows the quality of root and leaf and seed of its plants, among which he finds food for every season and for every ill a medicine. Nature's severe parsimony in this land forced him to know minutely and to use to the utmost such resources as she had bestowed.

The region is broken by a series of mountain ranges running in a generally north and south direction and rising for the most part from one to six thousand feet above the plateau. Between the ranges are level valleys floored with alluvial gravel, sand and silt, washed and accumulated through many ages from the mountains and charged with the alkaline salts forming so marked a characteristic of the country. In the lower central portions of each valley there is typically an alkaline flat or playa where in the winter season water collects in a shallow sheet and converts the soil into a soft clay-like mud that is "bottomless and impassable." In the summer time the flat is dry and hard and often shows white and glistening from an incrustation of the alkaline salts. The mountains are furrowed with many gulches and narrow canyons which here and there in their courses widen into pleasant, meadow-like basins which are locally termed "parks."

The annual rainfall in the valleys is very low, the precipitation increasing slowly with the altitude up the mountains. The air is naturally excessively dry, the moisture content being, according to Gilbert,[1] but 45 per cent. of that necessary for saturation, as against 69 per cent. in the region between the Mississippi River and the Appalachian Mountains, and the power of evaporation annually 80 inches, as against 22 inches over Lake Michigan. From the lower ranges the snow that falls generally evaporates without melting or melts without the formation of definite streams. The heavier snows of the higher ranges feed scattered springs and the small streams running down the canyons and out a varying distance into the valleys, where, often after becoming heavily charged with alkali, they sink into the parched soil and are lost. Many of the springs at the bases of the ranges are brackish or salt and some are warm.

The vegetation of this arid region, while generally scant, is more abundant than most would expect; and there is no part even of the valleys in the driest times wholly devoid of plants, excepting some of the playas most heavily charged with alkali, and especially the Great Salt Lake Desert. In these places scattered clumps of the several "greasewoods" occur about the margins. The vegetation of the valleys and slopes as well as of the hills and of much of the mountain sides presents a monotonous uniformity of appearance due to an immense profusion of individuals of but few species. Those most constant and conspicuous are shrubby and suffrutescent plants which occur almost to the exclusion of other forms. No trees are found among them. Grasses grow in tufts, but these die out with the advancing season everywhere excepting in favored recesses and parks of the mountains. Turfing grasses, such as are so conspicuous in parts of the plains region east of the Rockies, do not occur, excepting certain salt forms almost worthless for pasturage and confined to the alkaline meadow lands. As a protection against the intense dryness of the region, the characteristic plants above mentioned have mostly reduced leaves with tough cuticle and often a dense covering of hair. The prevalent color of the vegetation is a wearisome gray or dull olive. Only at long intervals is this monotony of color relieved by the bright green of the richer vegetation of the oases about springs and along streams.

It is impossible for plants of the higher orders to thrive in the strongly alkaline soil in the lower portions of the valleys. The plants growing here belong for the most part especially to the Chenopodiaceæ,

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[1] *Lake Bonneville,* pp. 6 and 7, 1890.

of which one of the best known and most widely distributed is the common greasewood (*Sarcobatus vermiculatus*). Of similar habit and abundance is *Halostachys occidentalis*. Along with these, among other abundant plants of the same family, occur *Sueda depressa* and especially the peculiar glasswort or samphire (*Salicornia herbacea*), which in marshy saline ground flourishes over wide areas about the Great Salt Lake and forms, with its brightly colored, fleshy stems, a pleasing feature of the landscape.

Farther back from the playas are found the chenopods *Eurotia lanata*, the white sage, the familiar and excessively abundant *Grayia polygaloides*, the larger spinescent *Shepherdia argentea*, several species of *Atriplex* and others.

Intermingling to some extent with the last-mentioned forms, and beyond the alkaline soil of their preference wholly predominant, is the ever common sage-brush (*Artemisia tridentata*). This form almost completely usurps the better soil of the valleys and plains and extends far up on the mountain sides. With the sage-brush, over the gravelly foot-hills, are also found *Tetradymia canescens*, *Purshia tridentata* and *Cowania mexicana*. In the swales and other places favored by the drainage *Bigeloria* is a common plant. The smaller suffrutescent rabbit-brush or torch-weed, *Guttierezia*, abounds almost everywhere and often forms a conspicuous feature over large areas. Among the Artemisias occur here and there the brilliantly flowered cacti, and, during the early summer, such herbaceous forms as the common *Phlox longifolia*, various Gilias, Phacelias, Lithospermums and Echinospermums, Œnotheras, *Allium*, several species of *Astragalus*, the gaudily flowered *Balsamorrhiza sagittata* and other Compositæ, with later in the season, in most parts, the beautiful sego lily, *Calochortus nuttalli*.

The lower mountains, like the valleys, are chiefly destitute of trees and are overgrown with bush and shrub of kinds occurring on the foot-hills or with these, because of the more exposed situation, more scattered and dwarfed. On the higher mountains, however, coniferous woods occur in often wide tracts. At lower levels the cedar (*Juniperus*) is everywhere common, as at higher levels is the spruce. The nut pine, of so much importance formerly to the Indians, is abundant in certain ranges, of which should be mentioned especially the Deep Creek Mountains. The mountain mahogany (*Cercocarpus ledifolius*), also much used in earlier times by the Gosiutes, is widespread. Among herbaceous forms common over the mountains are such as *Ferula multifida*, species of *Peucedanum*, the much prized *Carum gairdneri* and other Umbelliferæ; *Castelleia parviflora* and *Penstemon glaber*, *Heuchera* and *Mitella* and other Saxifragaceæ; the larkspurs *Delphinium menziesi* and *bicolor;* Eriogonums and various species of the Compositæ.

In the canyons containing streams of water occurs a comparative wealth of plants not found elsewhere. Of trees and shrubs growing along the stream margins are various species of willow, the quaking aspen, the cottonwood, the birch (*Betula occidentalis*), the service-berry or june-berry (*Amelanchier alnifolia*), the wild or choke-cherry (*Prunus demissa*), haws (*Cratægus rivularis*), the kinnikinnic (*Cornus stolonifera*), the elder (*Sambucus racemosa*), the maple (*Acer glabrum*), the sumac or "squaw-berry" (*Rhus aromatica*) and the wild rose (*Rosa californica* and *nutkana*). In the richer soil of canyons and foot-hills the scrub-oak (*Quercus undulatus*) grows in dense patches. As an undergrowth over the sides of the canyons the box (*Pachystima myrsinites*) and Oregon grape are common, while various species of wild-currant (*Ribes*), *Ceanothus velutinus* and other shrubby plants often grow thickly. Of common herbaceous plants growing in favorable places and season may be mentioned such forms as *Erythronium grandiflorum*, *Fritillaria pudica*, *Smilacina amplexicaulis* and other Liliales; *Claytonia*, *Geranium richardsoni*, *Wyethia amplexicaulis*, *Mimulus luteus*, *Mentha* and other Labiatæ, *Clematis*, *Aquilegia* and others.

In this ill-favored region large game was not relatively abundant, and the Gosiutes could not be primarily a hunting tribe. They seem to have placed no regular dependence upon forms larger than the abundant hare or "jack-rabbit," although when opportunity was propitious they sometimes undertook the securing of antelope and deer. At one side of Mill Creek Canyon, which is in the Wahsatch Mountains and opens into the Salt Lake Valley, there is a mountain valley which, broad and open at its upper part, narrows toward the canyon into a vertically-sided gorge which terminates abruptly at a precipice of great height. Occasionally the Gosiutes resorted to this richer region beyond their proper territory, and at opportune times surrounding deer and antelope would drive them down the valley to the gorge, where the terrified animals, finding retreat impossible, leaped over the precipice to their deaths. From this the Mill Creek Canyon is known to the Gosiute as Tingoup, which means rock or "precipice trap." Some of the older men also tell of a great "trap" artificially constructed in the Cedar Mountains and formerly kept in repair from year to year. This was a great run of V-shape, the sides of which were walls or fences formed of logs and brush. At the time of a drive all available men and women would make a wide semicircle about antelope or other game that might be in the region and, shouting and continually closing in, would drive the animals to the narrow apex of the run or corral, where hidden hunters easily killed the bewildered game.

While antelope, deer, bear and other large game formed scarcely more than an occasional source of sustenance among the Gosiutes, the jack-rabbit, exceedingly abundant throughout the region, was highly important to them and was regularly a chief dependence in fall and winter for meat, raiment and blankets. After a hunt the meat was dried and preserved, while the skins were dressed and largely twisted into fur ropes. These fur ropes were then bound together to form blankets or articles of clothing which were very warm and serviceable. It was the custom to hold great rabbit hunts or drives every fall. In these drives the entire tribe engaged and were sometimes joined by neighboring bands. The common procedure was to construct of sage-brush, greasewood or other convenient material a great V-shaped run similar to the one described in the preceding paragraph, but of course with lower and tighter walls. At the apex was a hole leading into an underground passage covered or roofed with a hide. The hares were surrounded and driven into the enclosure by the co-operation of men, women and children. As the hares reached the apex of the enclosure they would run into the covered passage, from which they were taken by men stationed for the purpose. Sometimes the hares were merely driven into the heap of brush, where, bewildered and impeded, they were readily killed by means of clubs.

In the spring and early summer the ground-squirrel or spermophile, everywhere present, was trapped or hunted, originally with bow and arrow. It is still sought as food, as which it is much relished. Certain of the larger desert lizards and some snakes were formerly eaten, but these forms are no longer sought for this purpose, although declared to be good tasting.

An abundance of food was furnished at times by the black cricket (*Anabrus simplex*), several species of locusts and the cicada. The crickets often occurred in vast swarms or "armies." They were not only eaten in season, but were dried and preserved for winter use in baskets or other receptacles covered in pits. A favorite method of cooking fresh crickets was to place them in pits lined with hot stones in which they were covered and left until thoroughly roasted. This dish is really very palatable and is compared by the Indians to the shrimp, which they accordingly term the aquatic or "fish cricket." Locusts were likewise eaten and were similarly prepared and preserved for winter use. The cicada was eaten both fresh and after cooking. Indian children may still often be seen catching these insects, deftly removing head and appendages, and eating the bodies at once with evident relish.

It was, however, upon the products of the plant kingdom as available in the flora in some of its features outlined above that the Gosiutes placed their chief dependence for food, a fact that led, in the trapper and pioneer days, to their being included under the odious omnibus designation of "diggers." Living close to nature and impelled by strict necessity, they knew the plants of their region with a thoroughness truly remarkable. From root to fruit they knew the plants in form and color, texture and taste and according to season and habitat. Whatever portion of a plant could serve in any degree for food they had found out, and whatever would poison or injure they had learned to avoid. From plants, too, they obtained most of their remedies, which were many, as well as the materials for making most of their household and other utensils. The education of the Gosiute children in a knowledge of these and other matters important to them in their original state was looked after with great care by the grandparents, as among other Indians, the older men and women, because of their longer experience and consequent more extensive knowledge, being looked up to as the natural teachers and advisers in the tribe; but since the change in mode of life consequent upon the coming of the white race this education is much neglected. As a result, the knowledge concerning plants and their properties possessed by the younger generations is much inferior to that of the older men and women now fast passing away.

The Gosiutes ate the leaves and stems of many plants as "greens" after boiling them in water according to the usual custom. Some members of the Cruciferæ and Compositæ containing acrid or otherwise distasteful oils or other principles were sometimes taken through a preliminary course of repeated washings to remove the objectionable taste as far as possible, after which they were cooked and eaten as usual. The leaves and petioles of the arrowroot (*Balsamorhiza sagittata*), termed *ku'-si-a-kĕn-dsĭp*, furnished one of the most used and dependable foods of this type. This is a conspicuous and abundant member of the early-season flora throughout the region. The hastate leaves of this plant, mostly radical and forming a tuft, are eight or nine inches long, with still longer petioles, and the flowers are large, showy heads like those of the sunflower. *Cymopterus longipes*, *an-dzup'*, is an umbellate widely distributed and abundant like the preceding form. It is an early spring plant with tufted leaves of pinnately decompound form and with umbels of yellow flowers. The leaves of this plant in season furnished a standard and favorite dish. The leaves of the closely related *Cymopterus montanus* were not eaten, though the rootstocks and proximal portions of the petioles were. Among many other plants of which the leaves were eaten may be mentioned *Troximon aurantiacum*, *mu'-tci-gi*, native water-cress (*Nasturtium*), *pa'-mu*, and *Ranunculus aquatilis*, the entire plants of the latter form being used. The entire plant of the cancer-root (*Aphyllon fasciculatum*), *po'-ho-ru*, a pale leafless parasite growing upon the roots of the sage-brush and several species of *Eriogonum*, was also eaten. The stems of the plumed thistle (*Cnicus edulis*), *po'-gwo*, as did also in quantity the lower tender stems and root-stocks of the bulrush (*Scirpus validus* and *maritimus*), *saip*. A plant of primary importance to the Gosiute, because it furnished one of their most valued medicines, but which was also the source of a certain amount of food, is *Ferula multifida*. Only the youngest shoots, just as they were breaking through the ground, were used as food, the ill-tasting older growths being rejected as unusable.

Of the plants that furnished food to the Gosiutes in the form of roots, root-stocks, tubers and bulbs, none is popularly so well known as the beautiful *Calochortus nuttalli*, *si'-go*, to the Indians, whence our common name sego, which is the State flower of Utah. The bulbs of this lily were formerly gathered as food. Not only were they eaten in season, but they were preserved in quantity for winter use by being dried and placed in pits like those described below. From these pits they were taken as needed. They were most commonly cooked with meat in "stews." When the Mormons first arrived in Utah and the struggle for food was so severe with them, they learned from the Indians the value of this article, and the digging of the bulbs in the spring did much in many families to stave off starvation.

Another lily furnishing an edible bulb is *Fritillaria pudica*, *wi'-na-go*, a yellow-flowered form blooming in the mountains in early spring. It was much less important, however, than the sego. The *Camassia*, *pa'si-go*, furnished a more important food of this class and in some sections where more available was extensively used. The bulbs of the wild onions (*Allium bisceptrum*, etc.), *küñ'-ga*, and those of the common spring beauty (*Claytonia caroliniana*), *dzi'-na*, were also eaten in season, but are said not to have been preserved for winter use.

One of the most highly prized of all food plants among the Gosiutes was *Carum gairdneri*, *yamp* or *yam'-pa*, which occurs in abundance in favorable places in the higher mountains. It grows to a height of four feet and bears rather few pinnately compound leaves. The roots are swollen and tuberous. It is these that are eaten. They are sweet and pleasant to the taste and are nutritious from the presence of an abundance of starchy material. The Indians were very fond of it and still frequently gather it. The usual method of cooking the roots was to roast them in pits lined with hot stones in which they were commonly covered and left overnight. Sometimes they were boiled. These roots were cached in large quantities for winter use.

An industry of the Gosiutes and related tribes very frequently noticed by early travellers was the gathering of the seeds of grasses and of various other plants, a source of food of fundamental importance. While many kinds of plants furnished seeds that were used, by far the greater proportion came from the grasses and members of the Chenopodiaceæ. Few grasses occurring at all abundantly did not furnish them seeds, as those mentioned in due order in the later lists will indicate.

Various chenopods previously mentioned as forming such a predominant and characteristic element of the flora over the valleys and flats furnished a great quantity of nutritious seeds; and in some localities species of *Atriplex* and *Chenopodium* in particular, and in wet places *Salicornia*, appear to have been the chief source of supply. Plants of these genera are so often seen growing thickly over wide areas that they would seem in places to have furnished a food supply limited only by the capacity and inclination of the Indians to harvest it. Especially *Atriplex confertifolia*, *suñ*, is abundant in the alkaline valleys throughout the region, occurring in enormous profusion in the more favorable places so as to have been much depended upon. Another species also furnishing seeds is *Atriplex truncata*, *a'-po*. The brittlewort or samphire (*Salicornia hebracea*), *o'-ka* or *pa'-o-ka*, previously mentioned, is a low, leafless, herbaceous plant with fleshy jointed stems. It has been compared in appearance to branching coral, to living groves of which the resemblance is accentuated by its presenting colors in many shades of p nk, red and yellow. The plant occurs over extensive areas in marshy ground about the shores of the Great Salt Lake and elsewhere throughout the region, often thickly covering the ground for miles where no other plant is found. The seeds of this plant when made into a meal and cooked are said to have furnished an article tasting like sweet bread, and one of which the Indians were very fond.

Of Cruciferæ furnishing edible seeds the most important seems to have been the hedge mustard (*Sisymbrium canescens*), *poi'-ya* or *po'-nak*, the seeds of which were gathered and used in the ordinary way, but were also, it is said, after being ground up to have been mixed with snow in the winter time and in this form eaten as a sort of refreshment. In the borage family the species of *Lithospermum*, *tso'-ni-baip*, more especially, furnished a portion of seeds. Seeds of the mints *Drachocephalum parviflorum* and *Lophanthus urticifolius*, both known under the name *ba'-gwa-nup* or *toi'-ya-ba-gwa-nûp*, were also regularly gathered. Especially nutritious and important were the seeds beaten from the heads of a number of species of the Compositæ. Among various others may be mentioned the arrowroot (*Balsamorhiza sagittata*), previously spoken of as furnishing edible leaves, the related *Balsamorhiza hookeri*, *mo'-a-kûmp*, *Wyethia amplexicaulis*, *pi'-a-kĕn-dsĭp*, *Gymnolomia multiflora*, *mu'-ta-kai*, and the sunflower (*Helianthus*). The familiar arrow-grass (*Triglochin maritimum*), *pa'-na-wi*, and the cat-tail (*Typha latifolia*), *to'-ĭmp*, are also to be included here. The ripe spikes of the latter were gathered and the bristles were burned off, by which process the seeds were freed and were at the same time roasted.

The seeds of all these and of other plants were collected in approximately the same way. They were first gathered in large baskets commonly about two and a half feet wide by three feet deep and designated by the name *na'-pi-o-sa* or sometimes as *wu'-tsi-a-nûmp*. These baskets were closely woven and were made tight by means of the gum or pitch of the pine by which the meshes were thoroughly filled, as in the case of water-jugs. The ripe spikes or heads of grasses and the seed containing portions of other plants were knocked or swept into this basket (*ta'-ni-kûm-ma-wu'-ti-ya*) by means of a second smaller basket about the size of a three- or four-quart milk pan and known as the *da'-nĭq^u*. Often this *da'-nĭq^u* was provided with a handle projecting from one side like the handle of a dipper and along the side opposite the attachment of this handle with a flat piece of wood sharpened to an edge like the blade of a knife, its use being to strike against and cut off the fruiting portions of the plants. The large basket might be held in convenient position beneath the taller plants with the left hand, while in the right the smaller one, or *da'-niq^u*, was used to sweep the tops of the plants; but more frequently the *na'-pi-o-sa* was carried beneath the left arm or swung upon the back. When in the latter position a quick sweep of the *da'-nĭq^u* was made from right to left across the plants and then up over the left shoulder so as to carry the loosened material into the receptacle.

The materials gathered in the baskets in this way were carried to some convenient and suitable place near the encampment and piled upon the ground preparatory to threshing. This operation (*man-gop-ma-wu-pain*, to beat seed vessels, to thresh) was performed simply by beating thoroughly with sticks or paddles until the chaff, pods and other accessory parts were fully loosened from the seeds. The separation of the seeds from the chaff and other waste parts, the winnowing, was next accomplished by slowly shaking the threshed material from a special winnowing basket or fan held at a height when the wind was blowing which could carry away the chaff while allowing the seeds to fall more directly to the ground or upon skins spread for the purpose (*ma-wi'-a-nĭn*, to winnow). The winnowing basket (*tĭʷ'-u-wa*) was circular or ovate in form and was shallow, being but gently and gradually depressed from the margins toward the center. Larger or heavier materials were separated by hand. At the present time the Gosiutes grow wheat and oats in considerable quantity which they thresh and winnow in this primitive way as do various other Indians. The threshing is sometimes done by means of horses driven round and round in a circle over the cut grain spread out on a floor or upon hard ground, the tramping of the horses accomplishing what is more commonly effected by the pounding with sticks or paddles. The same method is used not only among other Indian tribes in the West, but also among peoples of the Orient.

After winnowing, the seeds were stored in baskets or other appropriate receptacles for winter, the containers being covered in pits in the usual way. Before using, the grain commonly was made into a meal by being ground up by hand in the well-known mortar or mill. Among the Gosiutes this was a flat stone of mostly oblong form (*pa'-to*) upon which the seeds were placed and pulverized by means of a smaller, mostly subcylindrical stone (*du'-su*), which was rubbed back and forth over the mortar under pressure. This operation in time resulted in wearing out the mill over the middle portion and leaving an elevated rim along each side, which served the better to keep the grain in place. The meal thus obtained was largely used as a porridge or mush or was baked into crude cakes.

Of high importance to the Gosiutes as food was the fruit of the nut-pine (*Pinus monophylla*). The expedition to the mountains each fall for gathering pine nuts was one of the great fixed events of the year; and to this day, when so little dependence is placed upon most of the original sources of their food supply, pine nuts (*ti'-ba*) are gathered regularly in considerable quantity and are kept for use or, to some extent, marketed among the white people in trade. In visiting the regular Gosiute encampments during the pine-nut season one may feel certain to find them in great part deserted. The method of obtaining the nuts is to gather the cones and partially to burn them in a fire. In this process the nuts are roasted. The nuts are next beaten out of the cones. If further roasting be found necessary, it is carried out by placing the nuts in ovens. The roasted nuts were eaten directly with or without shells or they might be ground up in the mill into a meal. Formerly the nuts, after roasting, were placed in specially made, tall, sack-like baskets in which they were kept in pits or cellars.

The acorns (*ku'-ni-ro-ûmp*) of the Rocky Mountain or scrub-oak (*Quercus undulata*, var.), *ku'-ni-ûp*, found over portions of this regions, were used as food in season, but they are said not to have been preserved for winter use. They were by no means of the high use to the Gosiutes that the fruit of some oaks are to other tribes, such as those of California.

Of succulent fruits that of the service-berry (*Amelanchier alnifolia*), *ti'-ûm-pi*, was probably most important. Not only did it furnish food in season, but it was preserved in large quantities for winter use. For preservation the berries were mashed up, spread out in layers, exposed to the sun and allowed to dry thoroughly. The dried fruit was then placed in pits lined with grass. Immediately over the top of the fruit was placed a layer of the leaves of the sage-brush, the whole being overlaid with cedar bark and covered finally with earth. For use in the winter the dried material was broken up in the mill and then boiled either with or without some kind of meat. To this was often added a portion of certain seed meals said much to improve the flavor and general palatability. The native currants (general name, *po'-go-nûp*) were gathered and preserved in the same way as the service-berries. Among these currants were the black or Missouri currant *Ribes aureum*, *kai'-i-ûmp*, *Ribes divaricatum*, *wī'-sa-po-gûmp*, and *Ribes leptanthum* and *lacustre*, *ai'-go-po-gump*. The fruit of the wild cherry or western choke-cherry (*Prunus demissa*) was similarly used and preserved. The fruit of the raspberry (*Rubus leucodermis*), *tu'-kwûn-dau-wi-a* or *tu'-kwûn-da-mi*, and of the strawberry (*Fragaria vesca*), *äñ'-ka-pa-ri-ûmp*, were sought and used in season, but no effort was made to preserve them for later use. The berries of the rose (*Rosa californica*), *tsi'-ûmp*, were also among the foods.

A number of plants furnished the Gosiutes materials for smoking. Most highly prized among these was the native tobacco plant (*Nicotiana attenuata*), *pu'-i-ba-u*, a plant growing in dry places to a height of one or two feet and bearing greenish-white salverform flowers from an inch to an inch and a half long. The leaves, borne on slender petioles and ovate to lanceolate in form, were dried and used as ordinary tobacco. Whether the related *Nicotiana quadrivalvis*, a native of Oregon and formerly cultivated by Indians from that State eastward as far as the Missouri, was formerly grown and used by the Gosiutes is uncertain. *Sedum glandulosum*, *äñ'-ka-ti-wi-a*, *Vaccinium cæspitosum*, *tï'-da-kai-mi-ya*, and *Silene menziesii*, *yo'-go-ti-wi-ya*, also furnished leaves which were similarly dried and used as ordinary smoking tobacco. Ranking in importance with the tobacco plant proper was the kinnikinnic (*Cornus stolonifera*), the inner bark of which was smoked alone or after mixture with tobacco.

Of beverages the Gosiutes seem to have had but few originally. A kind of tea made from the leaves of the mint (*Mentha canadensis*) is said to have been drunk considerably, pleasing the taste of many. The leaves of the shrub in early days sometimes termed the mountain-tea, *tĭn'-ai-hya*, were also used for making tea. Another plant termed by the Indians *tu'-tom-pi*, but which I have not as yet definitely identified among those known to me in the immediate region, is said to possess a wood from which a good beverage was formerly made.

There were a number of chewing gums. One was supplied by the gum of the Douglas spruce (*Pseudotsuga douglasii*), *wañ'-go*. Also the latex of *Asclepias* and of *Senecio*, among others, was dried and converted into a gum. The chewing gum that seems to have been most prized, however, was obtained from the roots of the greater rabbit-brush (*Bigeloria douglasi*), *si'-bû-pi*. The inner part of the root having been rejected, pieces of the outer portion were taken into the mouth and chewed, a gummy substance gradually separating out and the more fibrous material being gradually removed. This gum is sweet and pleasant to the taste. Indian children and their elders as well may still often be seen preparing it.

For the making of baskets, bowls, water-jugs, baby-baskets or cradles, etc., various species of willows, *si'-o-pi*, such as *Salix lasiandra*, *longifolia* and others, supplied a considerable proportion of the material, though, when available, many much preferred the shoots of the cottonwood, *so'-ho-pi*, because of their greater toughness. For the frame in the several types of basket work, branches of the service-berry (*Amelanchier alnifolia*), *ti'-ûm-pi*, were used because of their strength and toughness. Water jugs, cooking bowls, seed baskets, winnowing fans and other vessels, designed to hold water or fine material, were made impervious by being coated on the inside or both inside and outside with the gum of the nut-pine. A smooth, glasslike inner surface was often supplied to these vessels, as also and more especially to earthen dishes, by coating them with a mucilage obtained from *Malvastrum munroanum*, *koi'-no-kûmp*. This was secured by mashing or mincing the stems and leaves of the plant in water or simply by drawing it with pressure across the surface to be coated.

Bows were most commonly made from the wood of the mountain mahogany (*Cercocarpus ledifolius*), *tu'-nûmp*, and arrows from the wood of the service-berry. The wood of the kinnikinnic was sometimes used for the frame-work of snow-shoes.

The winter lodges commonly were made almost entirely from the cedar, *wa'-pi*. The main structure was built in the usual shape of logs and poles of this plant, the whole being thatched with the smaller branches and the bark, the latter being specifically termed *i'-na-wa-tsip*. For a covering over the ground within the lodges, the bark and finer branches of the cedar or grasses were used. It was, no doubt, Gosiute lodges that Capt. Stansbury saw in 1849 when travelling through Skull Valley on the west side of the Great Salt Lake. He writes: "In a nook of the mountains, some Indian lodges were seen, which had apparently been finished but a short time. They were constructed in the usual form of cedar poles and logs of considerable size, thatched with bark and branches, and were quite warm and comfortable. The odor of the cedar was sweet and refreshing."[2]

Originally the wood of the sage-brush (*Artemisia tridentata*), *po'-ho-pi*, was largely used for securing fire by means of friction when it was available, which was the rule. For the same purpose, among others, the dried roots of the following were used: cedar (*wa'-pi*), mountain mahogany (*tu'-nûmp*) and Shepherdia.

The Gosiutes obtained empirically considerable knowledge concerning the medicinal properties of the plants of this region that was invaluable to them. It may be noted that most of the valuable remedies in our own Pharmacopœia also were first found out and used empirically. Hence it is not so surprising to find that many of the remedies used by the Gosiutes are very closely related to some of those which we have used for the same purposes. But, naturally, superstition among these Indians played a large part, and we find them often going through a procedure or applying a treatment the value of which must be regarded as wholly fictitious.

Superstitious beliefs and practices seem to have prevailed especially

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[2] *Expedition to the Great Salt Lake*, p. 171.

where animals furnished the material used as medicine or otherwise played a part in the treatment of disease. As one of the less involved cases may be mentioned the procedure in securing rattlesnake oil used for rheumatism. The person having secretly found a rattlesnake must address it in some such way as this: "My good brother, you are powerful; I wish you to help me." The rattlesnake must then be killed by a single shot directed unerringly from bow or gun through the head. The body of the snake was then opened and the fat stripped from within the body into a receptacle, after which the body was buried so as to be seen by no one else, as otherwise the virtue of the oil would be destroyed. The same procedure must be repeated with each snake used. Only when this method had been carefully followed out was the oil when subsequently rubbed upon the affected organ supposed to be curatively effective. As a second example may be cited the procedure supposed by many to effect a cure of persistent nose-bleed. The person affected must secretly take some of the blood from his nose to the nest of the red or occidental ant (*Pogonomyrmex occidentalis*) into an excavation in which it was poured, so that it would be lapped and eaten up by the ants. No dog or other animal must be allowed to touch the blood. If all had been carefully followed out cessation of the hemorrhage was supposed to follow.

The great majority of the many medicines used by the Gosiutes were products of the plant kingdom, though to a limited number of animal substances and preparations curative properties were attributed. As above stated, some of the medicines were of undoubted service, containing active principles identical with or closely related in not a few cases to those used or formerly used by our own practitioners. Often several different medicines might be used for the same ailment or what was regarded as the same, the one selected depending upon season, availability or personal preference. In some cases remedies were combined and given in a mixture, in which case each constituent was supposed to exercise its own particular virtue. Medicines were roughly classified according to their use, the classification being in correspondence with their categories of disease. Thus, medicine for wounds and cuts were classified as *i′-a-na-tsu;* for bruises and swellings as *bai′-gwi-na-tsu;* for burns, *wai′-a-na-tsu;* for coughs and colds, *o′-ni-na-tsu;* for bowel troubles, *koi′-na-tsu;* for "worms," *wu′-i-na-tsu;* for venereal diseases, *tim′-bai-na-tsu;* for rheumatism, *tso′-ni-na-tsu;* for the blood, *bu′-i-na-tsu;* for bladder and kidney troubles, *si′-na-tsu*, etc.

In setting fractured bones in the limbs sticks of some convenient wood about an inch in diameter and of appropriate length were used as splints. These were tightly bound in place by means of buckskin cords passed from one splint to the next about which it was wound and then passed to the next and so on round and round the limb in a spiral. A padding between and beneath the splints was supplied by the reed (*Phragmites*) or other grass. It is said that a paste mixed with this or some other grass, appropriately cut up, was sometimes used, the whole drying or setting between and beneath the splints and forming about the limb a sort of cast that was rigid and effective. In one case of fracture of the leg observed under treatment by the writer, immobilization of the foot was secured by means of a flat piece of wood tied firmly against the sole by means of buckskin strings passing from the splintwork sheath.

In case of a wound from arrow or gunshot, a paste made by pounding or chewing up the root of the arrowroot (*Balsamorhiza sagittata*), *ku′-si-a-kĕn-dsĭp*, previously mentioned among the food plants, was applied. If the hemorrhage was severe, a ligature was applied on the central or proximal side where possible. A tea made by twisting the juice from the roots of *Mitella* or related forms (*to′-sa-na-tsu*) was then given internally, the effect being to hasten elimination and purging. Regarded as considerably more efficacious than the arrowroot was the root of *Ferula multifida*, *to′-dzûp*, which is strong and rank in taste and smell. It was, and still is, used in essentially the same way as the arrowroot, upon wounds, cuts or bruises where the skin was broken. In case of compound fracture this was the application made to the wound in preference to all others. The root for use, as observed by the author, was first minced with a knife and thoroughly ground to a pulp in a mortar or by crushing upon a clean smooth stone by means of another used as a pestle. The paste was then smeared over the wound and bound in place. It was used in dressing the wound throughout the progress of healing. It seems especially to have been relied upon where there was infection or formation of pus. Among other plants furnishing preparations used on wounds, cuts or sores were *Cnicus eatoni*, *ai′-wa-bo-gûp*, and *Gilia*.

Among remedies supposed to have virtue in taking down swelling due to bruising or other causes may be mentioned first the roots of *Valeriana edulis*, which were pounded into a pulp and rubbed on externally. Another was made by steeping the roots of *Wyethia amplexicaulis*, *pi′-a-kĕn-dzĭp*. The flax (*Linum perenne*) furnished a preparation used in the same way, as did also the roots of *Mentzelia lævicaulis* among various others. One informant stated that cases of persistent œdema in the limbs were sometimes treated as follows.

By means of a sharp flint the affected member was cut or gashed in numerous places over the surface from one end to the other and allowed to bleed freely. Next day the limb was ligatured proximally and a vein was located in a favorable position and opened by means of a pointed stick. The blood was allowed to flow from the vein for some time, after which the wound was stopped and the entire limb then covered with a salve made from the roots of *Valeriana* or that constituting some other *bai'-gwi-na-tsu*, and thoroughly bandaged.

For the treatment of burns the most prized remedy was furnished by *Spiræa cæspitosa*, a shrubby prostrate plant forming dense mats over limestone rocks and clefts in the canyons. The plant has fleshy roots and short matted branches upon which silky villous leaves are arranged in dense rosulate clusters. The roots after being cleaned and freed of their epidermis by means of a knife were boiled in water until soft and readily reducible to a pulpy mass. This is then ready for use, the wet, pulpy mass being smeared directly in a layer over the burned part and bandaged in place. On fresh burns the pulp or salve was renewed usually four times each day. The remedy is much valued and in cases observed by the author seemed efficacious. A moss (*Bryum*) is said by some also to have been used on burns. For the same purpose the green wood of the mountain mahogany was also sometimes charred, reduced to powder and, after moistening with water, applied to the wound.

A number of plants furnished materials used as remedies for rheumatism. Such was *Valeriana*, *toi'-ya-bĭt-ûm-ba-ga*, above mentioned, the roots of which are pounded up and rubbed on the affected parts. The common yarrow (*Achilleia millefolium*), *wañ'-go-gĭp*, was also bandaged about affected joints, as were also the steeped leaves of the common sage-brush, *po'-ho-bi*.

Of remedies used for disorders of the alimentary tract there were many. A remedy much valued for intestinal disorders of babies and infants, but also used with adults, often as a secondary treatment in cases of accidents or other bodily trouble, was obtained from the roots of several of the Saxifragaceæ, especially *Heuchera*, *wi'-gûn-dza*, and *Mitella*, *pi'-a-näñk*. The medicine is purgative in action (*koi'-na-tsu*). Because of the white color of the roots the preparation is commonly known as *to'-sa-na-tsu*, meaning "white medicine." It was given in the form of a decoction or tea. Another similar remedy, used especially with children, was prepared from *Arenaria triflora*, var. *obtusa*. The wood of the choke-cherry (*Prunus demissa*), *to'-o-nûmp*, was sometimes scraped and from the scrapings a decoction made which was also used in bowel disorder, in children more especially. In some cases an emetic was given to relieve pain and effect restoration. For this purpose the root of *Silene multicaulis* was said to have been used, this being mashed or ground up and drunk in warm water. Another emetic was prepared from the poison sego (*Zygadenus nuttalli*), *ta'-bĭ-tci-gop*.

In cases where a person was thought to be suffering from worms or other intestinal parasites the gum or resin from *Pinus monophylla*, *wañ'-go*, was sometimes put in boiling water and drunk as hot as could be borne.

The roots of *Peucedanum graveolens*, etc., *i'-jaip*, were used as a medicine called from the high value placed upon it *pi'-a-na-tsu*, a word meaning "great medicine." This was used for affections of the throat by being reduced to a pulp and applied directly by means of a finger. Sometimes a string was tied to a piece of the root and the latter then swallowed to be again drawn back out over the affected part by means of the string. A decoction was also made from the root.

For colds, coughs and bronchial affections a favorite remedy was prepared from the leaves of the cedar (*Juniperus*), *wa'-pi*. The leaves were boiled in water, the decoction being drunk hot. During the winter season in families where there are children one is still likely to find a pot of cedar tea kept boiling over the fire. A remedy for coughs and the colds and the accompanying headaches, etc., was prepared by some by making a decoction of cedar and sage-brush leaves in a tea from *Mentha canadensis*, *pa'-gwo-nûp*. A medicine used for biliousness with severe cold was a mixture of *pi'-a-na-tsu*, previously mentioned, a laxative or *koi'-na-tsu*, and the resin of the pine, a decoction of the three being prepared and drunk at intervals.

A tea prepared from the roots of *Lithospermum pilosum* and *longiflorum tso'-ni-baip*, was much used for kidney trouble. It seems to be a strong diuretic. The author has seen it used for this purpose also among the Utes. It is regarded as very effective.

The Gosiutes had a considerable number of remedies severally regarded as efficacious in varying degrees in the curing of venereal diseases and affections in general of the sexual organs. They are termed *tĭm'-bai-na-tsu*. Among plants furnishing such remedies may be mentioned *Parnassia fimbriata*, *Spiræa millefolium* and *Eriogonum ovalifolium*. The application was made for the most part externally in the form of a wash or as a preparation in a poultice.

A favorite remedy in cases of fever was furnished by the leaves of the common sage-brush (*Artemisia tridentata*), *po'-ho-bi*. This plant was in early days and in many settlements still is similarly much used among the white people of this region. Indeed, among many it is regarded almost as a panacea, being used for coughs and colds, rheumatism and other ailments, as well as for fevers, the medicine sometimes being applied externally and sometimes taken internally, depending upon the affection. In intermittent fevers, the white sage (*Eurotia lanata*), *tci'-cop*, was considerably used.

Some Features of Word Formation in the Gosiute Language.

The primary stems of the Gosiute language are mostly verbal in character. They are monosyllabic in form and are largely further reducible to significant elementary sounds. The vowel sounds where capable of dissociation in this way represent general modes of motion which are modified or conditioned in definite ways by combination with consonants placed in the initial position. Hence, leaving aside secondary and exotic factors, the vital, active part of the language is found to be especially vivid. The verbs largely define themselves, and it is probably for this reason that it has seemed necessary for each verb or verbal combination to be set off or introduced by a general causal particle, *ma*.

In the composition of the primary stems to form secondary combinations and words, the more specific particles come first, those expressing the more general notions being final; *i. e.*, the first syllables control and restrict the final ones. The combination is thus such as clearly to suggest or to define the action or conception to be symbolized or represented. In verbs the final syllable in the indefinite form is one that signifies some general action or mode of action. *N*, *-in* or the more definite *-kin* are such endings representing in effect, making, producing or simply acting or doing; *no* indicates general motion or transportation, etc. By means of such endings nouns are readily converted into verbs. When a stem representing a noun in the objective or other relation is incorporated, it occupies the initial position in the verbal combination. Some simple examples of verb formation follow:

a, *na*, indicates movement or extension out or away from in a straight line, projection, etc.

a'-pi (*a'-vi*, *ha'-bi*), a secondary root derived from the preceding root + *bi*, (*vi*), meaning primarily to accumulate, to rest upon, etc. Hence *a'-pi* means to rest or lie upon while extended, to stretch out upon, to lie down. Used separately in speaking of persons the form of the verb becomes *ha'-vi-do*.

pa′-ha-bi-no, to swim. This word is composed of *pa*, water, + *ha′-bi*, to lie or stretch out (as indicated above), + *no*, indicating motion.
ka′-ri-no, to ride sitting down. Derived from *ka′-ri-*, to sit down, + *no*, indicating locomotion as in the preceding combination. Applied to riding in train, wagon, etc., in a general way.
pûñ′-ga-ri-no, to ride horseback. From *pûñ′-go*, horse, + *ka′-ri-no*, the preceding word.
ai′-no, to lope. From *ai*, a root meaning to leap, to spring or to rebound, + *no*, indicating locomotion as in the preceding words.
pañ′-go-ĭn, to dive. From *pa*, water, + *go*, a root meaning to penetrate, etc., + *in*.
ki′-wa-tso-kĭn, to cut with scissors. From *-gi′-wa*, to bite or cut apart (*gi*, bite or cut in two, + *wa*, to press aside or apart, to separate), + *tso*, squeeze or press together, + *kĭn*, explained previously.
gwa′-ci-kĭn, to braid. From *gwa′-ci*, tail, braid, etc., + *kĭn*, to make, etc.
ba′-hu-ĭn, to smoke (as a cigarette). From *ba′-u*, tobacco, + *ĭn*, explained above.

Nouns, with which we are here chiefly concerned, are readily derived from verbs and verbal combinations through the use of suffixes which, like the verbal endings previously mentioned, designate general or class ideas. Verbs are sometimes employed as nouns without the use of such suffixes. Nouns compounded of simpler nouns or of other words are frequent. In the plant names hereafter given it will be seen that one noun in such compounds frequently bears a possessive or adjectival relation to the principal. In such cases this relation is indicated by the addition of *n* or of *m* or by using the particle *ûn* or *ûm* more discretely. For example:

ni′-am, my, mine. From *ni′-a*, I, + *m*.
ai′-tĭn-dain-ti, bore of a gun. From *ai′-ti*, gun, + *n*, + *dain′-ti*, hole.
Tĭm′-pĭn-o-gwût, Provo River. From *tim′-pi*, stone, + *n*, + *o′-gwût*, river.
Ai′-bĭm-pa, Deep Creek. From *ai′-ba*, clay, + *m*, + *pa*, water, stream; *i. e.*, "clay water."
to′-go-ûn-go-na, Painted cup (Castilleia). From *to′-go-a*, snake, + *ûn*, + *gu′-na*, fire; *i. e.*, "snake fire."

The more important noun suffixes occurring in plant names are indicated below in order.

1. *tci*, *tsi* (*tc*, *ts*). A common ending in the names of living things

or of the organs or parts of such. In Gosiute it is more frequent in animal names. It also occurs in plant names, but with nothing like the frequency to be noted in the Ute, where it is the commonest ending. Examples:

po'-ni-ûts, skunk.
yû'nû-tsi,' badger.
mu'-tu-nats, humming bird.
yu'-ro-gots, Rocky Mountain jay.
du'-ĭ-tci, child, baby.
näñ'-kĭ-tci, ear (also as *nän'-kûs*).
deutc, brother-in-law.
su'-go-pû-tsi, old man.
o'-tci, grandson.

See further under 3.

2. *bi*. Indicates a living thing or part ot a living thing. In the former case commonly followed by the ending indicated under 1, as represented below under 3. Examples:

bi, the heart.
nam'-pi, foot. From *na*, indicating support or bottom part, + *m*, + *bi*.
pam'-pi, head. From *pa*, top, summit, + *m*, + *bi*.
tĭm'-pi, mouth. From *ti*, referring to teeth or a cutting object, + *m*, + *bi*.
mam'-bi, hand.
mo'-bi, nose. From *mo*, indicating protrusion, extension, etc., + *bi*.

3. *bĭ'-tci*, *bĭtc*. The preceding stem + the animate ending *tci*(*tc*). Indicates a living individual or something regarded as such. Very common in animal names, but only occasional in those of plants. Examples:

i'-a-bĭtc, gopher.
mom'-bĭtc, owl.
tu'-ko-bĭtc, wildcat.
we-gom-bĭtc, turkey buzzard.
päñ'wĭtc, fish.

4. *ûp* (*ĭp*, *-p*). One of the commonest endings in plant names. As a noun ending it indicates substance or material or simply thing or object; and, hence, in plant names it is often the practical equivalent of "plant." In some plant names, in fact, the ending is clearly a

modification of *o'-pi*, meaning wood, tree or plant, rather than the pure suffix *ûp*.

The regular suffix is mostly added to verbs, though it may also under certain conditions be added to nouns. It is also added to verbs to indicate completion of an action forming one past tense or giving a participial effect. Examples:

tĭ'-kûp, food. From *di'-ka-kĭn*, to eat, + *ûp*.
pa'-gĭn-ûp, cloud. From *pa'-gĭn*, to make or produce water, + *ûp*.
wai'-ûp, charcoal. From *wai'-hĭn*, to burn, + *ûp*.
go'-ûp, enclosure, corral, trap, snare, etc. From *go*, a root in its most frequent sense meaning to surround or to enclose, + *ûp*.
da'-pi-ûp, socks, hose. From *da'-pi*, foot, + *ûp*.

5. *ûmp*. Composed of the possessive *ûm(m)* + *ûp(p)*. The possessive would seem to belong primarily to a preceding noun, but the combination has acquired the character of a largely integral suffix with a definite and peculiar force. It conveys usually the idea of a material used for some purpose. It occurs frequently in the names of plants or of plant products used for food. In some plant names, etc., it is likely the representative of the combination *ûm* + *ba*, meaning seed, or + *bi*, rather than of the combination first indicated above. Examples:

tsi'-ûmp, rose berry. From *tsi'-o-pi*, the rose (*i. e.*, the plant), + *ûmp; i. e.*, the part of the plant used for food, the fruit.
po'-gûmp, currant (the berry).
äñ'-ka-ti-wi-ûmp, the sumac berries (fruit of *Rhus*).
so'-ko-ri-ûmp, the Oregon grape (the entire plant. From *so'-ko-ri*, deer, + *ûmp*, the plant serving as food for the deer.
wi'-ûmp, haws.

6. *na*. Used mostly as a prefix to designate a support, source, means or instrument. Examples:

na'-dzi-ta, cane, walking-stick or staff. From *na* + *dsi'-ta*, a stick or rod for thrusting, etc.
na'-tse-ya, handle (as of a tea-cup). From *na* + *tse'-ya*, to carry.
na'-gwa-na, perfume. From *na* + *gwa'-na-kĭn*, to give out a smell or odor.
na'-di-ko, bait. From *na* + *di'-ka-kĭn*, to eat, + *go*, to enclose, to snare.
na'-dsa-to-wi, shell thrower (of a gun). From *na* + *dsa'-to*, to draw or jerk out, + *wi*, iron or thing of iron.

7. *nûmp*. A combination of *na* and *ûmp*, the two preceding suffixes. It is a very common noun ending used to indicate means or instrument. Examples:

ti'-ki-nûmp, table. From *di'-ka-kin*, to eat, + *nûmp*.
ka'-ri-nûmp, chair. From *ka'-ri-do*, to sit down, + *nûmp*.
go'-to-nûmp, stove. From *ma-go'-to*, to heat, to make hot, to burn, + *nûmp*.
tso'-tĭ-gi-nûmp, pillow. From *tso*, particle referring to the hezd, + *ma-ri'-gi*, to lay or place upon, + *nûmp*.
go'-ti-nûmp, spear. From *ma-go'-tĭn*, to stick or thrust into, + *nûmp*.

Some words recurring frequently in plant names may next be listed. In compounds, of course, these words do not occur as a rule in their entirety, but are represented by one or more of the more significant syllables.

As examples of words frequently entering into names to indicate a color characteristic the following may be listed. The form within parentheses represents the syllables ordinarily appearing in compounds.

to'-si-bĭt(to-sa-), white.
tu'-o-bĭt (to), black.
äñ'-ka-bĭt (äñka), red.
pu'-i-bĭt (pui), green.
o'-a-bĭt (oa), yellow.
on'-ti-gait (onti), roan, etc.
ku'-tsĭp (ku-tsi), ashen, gray, etc. Meaning primarily ashes and used in plant names especially to indicate the ashen or grizzly appearance due to thick growths of pubescence, etc.

Words indicating habitat occur with especial frequency in plant names.

ku'-tsĭp. In addition to the force above explained, this word, in combination, may also indicate growth as being in dry soil, etc.
pa, water.
tĭm-pi (tĭm-pi, tĭn, tĭ), rock.
toi'-ya-bi (toi-ya), mountain.
toi'-ya-wünt, canyon.

The two following are very frequent in names of plants where it is desired to indicate size, especially where there are several closely related forms to be discriminated and size represents a prominent difference.

pi'-ûp (*pi-a, pi*), large, tall.
ti'-ai-qŭ-tsi, ti'dŭ-tsi (*ti-a, tĭ-da*), small, short, etc.

Naturally we find in plant names syllables representing or indicating some particular part or feature of the plant.

ba, bi-a, seed, fruit.
gûp, pod, seed vessel, fruit.
o'-pi, wood.
a'-ka, si'-a-ka, stem, shoot, etc.
sĭ'-gi, leaf.
wa'-tsĭp, bark.
ai'-go-gûnt, thorn.
ai'-di-wĭs, wĭ'-sa, spine, prickle.

A few of the more frequently occurring words used in plant names to indicate relations or characters other than those indicated above are these:

na'-tsu, medicine.
ĭ'-ca, wolf, and, secondarily, false.
wu'-da, bear.
pûñ'-go, horse.
tai'-bo, white-man, this being frequent in names more recently devised to indicate forms introduced into the region since the advent of the whites.

The more general terms used by the Gosiutes to indicate plant groups were largely and primarily indicative of habitat, the ecological relations seeming most obtrusive to their minds. Next to the ecological relations, the economic seemed to have influence and we find groupings based upon uses in medicine and as foods. As examples of names applied to plants according to habitat may be mentioned the following.

pa'-bu-ĭp, applied to any plant floating upon water. From *pa*, water, + *bo*(*po*), root, indicating position upon surface of, floating, rising, etc., + *-ûp* or possibly *o'-pi*.

tĭm'-bo-ip, applied to any plant growing upon or over rocks, etc. From *tĭm*, referring to rock as above explained, + *bo*, as in the preceding, + *-ûp*.

toi'-ya-da-tsĭp, applied to a shrub growing on mountain or in canyon.

pan'-di-sip, applied to a plant growing submerged in water. From *pan*, aquatic, + *dĭ'-si-*, meaning to penetrate or thrust into or beneath, + *-ûp*. It is also applied to animals, such as water-beetles, living beneath water.

Catalogue and Vocabulary.

In the case of the great majority of the plants dealt with in these pages, the Gosiute names have been tested repeatedly in order, so far as possible, to eliminate errors and to determine the standard and pure as distinguished from the occasional and extraneous. The work has been carried on largely as recreation at different seasons of the year; and at these various times tests have been made through various better informed men and women of the Skull Valley division of the tribe, these being consulted both singly and in groups. However, there remains a certain number of species the names and uses of which I have not as yet been able to test in a way wholly satisfactory to myself.

The Gosiute plant names, like our own popular ones, with which they are properly to be compared, are frequently generic rather than specific in compass and, naturally, may sometimes apply to species lying in technically different though usually closely allied genera. In some cases they are the practical equivalents of popular English names, while in others they are distinctly different in scope from these or may be without any name in our language at all corresponding, for a large proportion of the native plants in the West are as yet without popular designations of any sort. It often happens that one single kind of plant is known under two or more names to the Gosiutes. In such cases one name is commonly more comprehensive than the other and applicable likewise to various other related or supposedly related forms, while the other may be strictly applicable only to the species under consideration. Then, again, the same plant may be regarded from different points of view, classed on correspondingly different bases, and so come to be designated under several class or generic names indicating these several relations. Thus, it may be regarded as to its habitat, as to its structure or appearance, as to its service to man or animal as food, or as medicine, etc. It may bear a different name indicative of each of these relations in addition to that which may be regarded as in a measure specific and restricted to it alone. The restriction in use of a name depends much upon the commonness or importnce of the plant, there being different names even for closely related species in many cases—proportionately much more numerous than is the rule among our own people.

In ordinary conversation among the Gosiutes a long plant name may frequently be shortened through the omission or dropping out of one or more syllables. Such abbreviations may result in changes in the remaining syllables thus brought into different relations to each other through the operation of definite phonetic laws, as of rhythm in quantity, etc., which cannot be here considered. There may thus result from one original name several current forms.

The values of the letters used in recording Gosiute words in the present paper are approximately those of the Smithsonian alphabet and are essentially as follows:

a is pronounced as in far or as in the German lachen.
ä is sounded like a in the English word fat, etc.
e is pronounced as in they or as in the German Dehnung.
ĕ is pronounced as in then or as in the German denn.
i is pronounced as in pique or as in the German ihn.
ĭ is sounded as in pit or as in the German dick.
o is pronounced as in vote or as in the German Bogen.
u is pronounced as in rule or as in the German du.
û is pronounced as in but.
ü is pronounced as in the German müde or as u in the French lune.
ai is sounded as in the German Kaiser or as i in bite.
oi is pronounced as in boil.
c is pronounced like sh in shall, etc.
d, f, h, k, l, m, n, p, r, s, t, y and z are given their ordinary sounds in English.
g is pronounced as in gig or as in the German geben.
ñ is pronounced like ng in sing.
q is pronounced like ch in German lachen, Dach, etc.
dj is pronounced like j in judge.
tc is pronounced like ch in church or like c in the Italian cielo.
Nasalized vowels are indicated by a small superior n; thus a^n, etc.

Attention should be called to the essential equivalence and, within the limits marked by certain phonetic rules, the interchangeability (1) of k and g; (2) of t, d, and r; and, less completely, (3) of n and m. Of the letters or sounds of the second group, t is most commonly initial in position and r and d internal.

Latin or Scientific Names with Popular and Gosiute Equivalents.

Acer glabrum Torr. Maple.
pa′-go-ni-ûp.
[Probably from *pa*, water, + *ku′-ni-ûp*, oak.]

Abies menziesii Lindl. Balsam.
sa′-nañ-go-bi.
[*sa-na-*, gum, pitch, etc., + *añ′-go-bi*, spruce.]

Abronia fragrans Nutt. Sand Puff.
ta′-ka-dĭ-da-rûp.

Achillea millefolium L. Yarrow.
wañ′-go-gĭp.
Used commonly among the Gosiutes in the form of a tea for biliousness, headache, etc. Also applied externally for rheumatism and sometimes on bruises.

Aconitum fischeri, etc. Monkshood; Aconite.
ĭ′-ca-bo-gop.
[Probably from *ĭ′-ca*, wolf, and secondarily, deceptive, false, baneful, + *bo-gop*, fruit, berry, the name referring to poisonous properties as a result of which horses eating it sometimes die.]

Acorn.
ku′-ni-ro-ûmp.
[*ku′-ni-ûp*, oak, + *ro* + *ûp*.]
See further under Quercus.

Actæa spicata L. Baneberry.
toi′-ya-ba-gwo-no-gĭp.

Agaricus sp. Mushroom.
so′-ai-tûmp.

Agropyrum repens Beauv. Bluejoint.
o′-ro-rop.
o′-ro.
o′-do.
The seeds of this grass were among those formerly used as food.

Allium bisceptrum Watson and *acuminatum* Hook. Wild Onion.
küñ′-ga.
Bulbs eaten in spring and early summer. Not preserved for later use.

Alnus incana Willd. Alder.
u′-gu-dzûp.

Alopecurus aristulatus Mx. Foxtail grass.
tĭ′-so-nĭp.
tĭ- + *so′-nip*, grass.

Amarantus sp. Amaranth.
ats.
Seeds formerly eaten. Constituted an important source of food.

Ambrosia psilostachya DC. Ragweed.
tu′-ro-sip.
[The name seems to mean black sap; *tu′-o-bit, tu′-ro-vi*, black, + *sip*, sap, juice, etc.]
Occasionally used as a remedy for sore eyes. For this purpose the leaves were steeped in hot water and bandaged over the affected organ. The same name was often applied to *Iva axilaris, q. vid.*

Amelanchier alnifolia Nutt. Service-berry; June-berry.
ti′-ûm-pi.
The berries formed a very important source of food among the Gosiutes, being used both in season and preserved in large quantities for winter use. For preservation the berries were mashed and dried as

previously described. If the berrying grounds were not too far distant from the winter encampment, the dried berries were cached on the spot to be obtained during the winter as needed or to be transported at a more favorable time to a more accessible position.

This plant also furnished the material preferred for arrows and for the framework of cradles and other forms of basketry.

Amsinckia tesselata.

ku′-hwa.

tso′-hamp.

Seeds formerly eaten.

Anaphalis margaritacea Benth. and Hook. Everlasting.

mo′-ha-gûp.

Androsace septentrionalis L.

? ka′-na.

Cf. *Lewisia.*

Anemone multifida Poir. Wind-flower.

toi′-ya-mo-ha-gûp.

Angelica pinnata Watson.

pa′-si-gwûp.

Occasionally spoken of as *ku′-i-gwa-nûp*, but incorrectly so, according to best informed Indians.

Roots used as medicine.

Antennaria dioica Gaertn. Everlasting.

toi′-ya-na-tsu.

[*toi′-ya-bi*, mountain, + *na′-tsu*, medicine.]

?ku′-yi-ko-nûp.

ku′-yi-gwa-nûp.

Said by one informant to have been used in cases of snow-blindness, being steeped in water and bandaged over the eyes. The first name is probably not wholly specific.

Aphyllon fasciculatum T. and G. Cancer-root.

po′-ho-ru.

[*po′-ho-bi*, sage-brush, + *ru*, *ru′a*, son.]

The name is given in reference to the fact that this plant is commonly found growing parasitically upon the roots of the sage-brush; hence, "son of the sage-brush."

The entire plant was sometimes eaten.

Aplopappus macronema Gray and *parryi* Gray.

tĭm′-bi-mo-a-gwa-nûp.

Aplopappus suffruticosus Gray (sometimes also *macronema*, the preceding form).

toi′-ya-ba-hwip.

toi′-ya-ba-o-pi.

The name means in effect simply "mountain plant," and is not wholly specific.

Apocynum androsaemifolium L. Dogbane; Indian Hemp.

wu′-da-wa-nûp.

[*wu′-da*, bear, + *wa′-nup*, rope, string, fiber, etc., the name referring to the strong fiber obtainable from this plant.]

Fiber of hemp obtained from. Cf. name Indian Hemp.

Aquilegia coerulea James. Columbine.

pa′-wa-gúmp.

pa′-o-gûm-pi.

Informants stated that plant furnished a medicine that acted on the heart. Seeds were sometimes chewed as medicine; and a tea made from the roots was used for abdominal pains and when one was "sick all over," as it was broadly put.

Arabis holboelli Hornem. Rock Cress.

si′-bo-i-ûp.

Cf. *Cleome lutez,* to which the name is also applied.

Arabis retrofracta Grah. Rock Cress.

pi′-a-poi-na.

pi′-a-si-bo-i-ûp.

[*pi′-ûp,* big, large, + *si′-bo-i-ûp.*]

Arctium lappa L. Burdock.

mu′-pa-tai-gi-nûp.

The burdock is an introduced plant, and the name above given is used only by a limited portion of the Gosiutes, having been formed rather recently.

Arenaria biflora. Sandwort.

tĭm′-bo-ip.

This is a very general term indicative of habitat as previously explained.

Arenaria congesta Nutt. Sandwort.

Classed as a *koi′-na-tsu,* or bowel medicine.

Arenaria triflora var. *obtusa* Watson. Sandwort.

wi′-dcan-gwo-dcop.

[*wi′-dca,* pine-hen, + *n,* + *gwo′-dcop.*]

toi′-yan-tĭm-ba-dzap.

Like the preceding, classed as a *koi′-na-tsu.*

Argemone mexicana var. *hispida* Gray. Prickly Poppy.

pa′ra-tĭ-tsĭn-bo-gop.

toi′yan-bo-gop.

Apparently a somewhat general descriptive term.

Aristida purpurea Nutt. Triple-awned Grass.

yo′-nĭp.

o′-gwĭp.

toi′ya-o-gwĭp.

[*toi′ya-bi,* mountain, + *o′gwĭp.*]

Arnica cordifolia Hook.

ta′ni-kûmp.

Arnica parryi Gray.

mo′ha-gûp.

Cf. Anaphalis.

Artemisia biennis Willd.

pi′a-wa-da.

[*pi′ûp* + *wa′da.*]

wa′da.

on′tĭm-pi-awa.

on′tĭm-pi-a-wa-da.

[*on′tĭm,* brown, roan, + *pi′a-wa-da.*]

The seeds formerly extensively gathered and used as food.

Artemisia discolor Dougl. and *trifida* Nutt.
ku'tsi-pa-wa-tsĭp.
ku'tsi-pa-wats.
ku'tsi-pa-hwats.
[*ku'tsĭp*, ashes, ashen or gray, etc., + *pa'wa-tsĭp*, or its shortened forms, pa'wats or pa'hwats, as in the name of the following species.]
Seeds formerly eaten as with the preceding form.

Artemisia dracunculoides Pursh.
pa'wats.
pa'hwats.
The seeds of this plant are oily and nutritious. Formerly much gathered as food. Said to have formed a favorite dish.

Artemisia tridentata Nutt. Sagebrush.
po'ho-bi.
A tea made from the leaves of this excessively abundant plant was much used as a medicine in febrile conditions, etc. The leaves were also used as a covering over berries and other foods preserved in caches.

Asclepiodora decumbens Gray.
?pi'wa-nûp.
A chewing gum said to have been made from latex.

Aster adscendens Lindl. Aster; starwort.
pa-oto'-ga.

Astragalus iodanthus Watson. Rattle-weed; Buffalo-bean.
na'da-pa-ra-na-günt.
da'pa-rai-nûmp.
The name refers to the shoe-shaped legumes.

Astragalus junceus Gray. Rattleweed.
One of the *pûñ'go-na-tsu* or horse medicines, as which it is said to have been valued. The name is from *pûñ'go*, horse, and *na'tsu*, medicine.

Astragalus utahensis T. and G. Rattleweed.
to'sa-wu-da.
[*to'sa*, *-to'si-bĭt*, white, + *wu'da*, bear, a name apparently suggested by the dense white woolly covering of this plant and its legumes.]
ti'a-sa-ton-dzi.

Atriplex canescens James.
dsi'cûp.
Seeds eaten.

Atriplex confertifolia Watson.
suñ.
su'no.
?ka'nûm-pi.
The seeds were formerly eaten, this and other species of *Atriplex* forming one of the most important sources of seed food. This and the related forms frequently occur in the region over great areas. The seeds were gathered in the same

manner as those of grasses as previously described.

Atriplex truncata Torr.
a′po.
Seeds used as food as with the preceding species.

Avena sativa L. Oat.
o′a-tûmp.
Apparently from English oat + *ûmp.*

Balsamorrhiza hookeri Nutt.
o′a-kûmp.
?mo′a-kûmp.
a′kĕn-dzĭp.
wi′a-kĕn-dzĭp.
Seeds used as food.

Balsamorrhiza sagittata Nutt. Arrowroot.
ku′si-a-kĕn-dzĭp.
[*ku′tsĭp*, ashen, gray, + *a′kĕn-dzĭp.*]
ku′si-ak.
Shortened form of the preceding word.
a′kĕn-dzĭp.
This brilliantly flowered plant, which is abundant over the hills and mountain sides throughout the Gosiute territory, was formerly of much economic importance to them. In the spring the large leaves and their petioles were boiled and eaten. Later, when the seeds were ripe, these were beaten out of the heads into baskets and used as food as in the case of those of *Helianthus.* The root was used as a remedy upon fresh wounds, being chewed or pounded up and used as a paste or salve upon the affected part.

Bark.
wa′tsĭp.

Beckmannia cruciformis Host. Slough Grass.
u′gû-pi.
u′gûp.

Berberis repens Lindl. Oregon Grape.
so′ko-ri-ûmp.
[*so′ko-ri*, deer, + *ump*, indicating food, etc. Hence "deer food."]

Berula angustifolia Koch.
a′tam-bĭ-tcûp.

Betula occidentalis Hook. Birch.
u′di-ûp.

Bigeloria douglasii Gray. Rabbit-brush; Rayless Golden-rod.
si′bû-pi.
The chewing-gum most highly valued among the Gosiutes was prepared from this plant as previously described.

Bigeloria pulchella Gray. Rabbit-brush; Rayless Golden-rod.
ta′bi-si-bû-pi.
[*ta′bi*, sun, + *si′bû-pi*, a name of *B. douglasii*, the preceding species, regarded as the typical *Bigeloria.*]
ta′bi-si-pomp.
[*ta′bi*, sun, + *pam′pi*, head

(probably); "sun-head." Cf. our name sun-flower.]

Branch (shoot).
si′ûñ-gûn.
si′a-ka.

Bromus breviaristatus Thurb., etc. Brome Grass.
to′bai-bi.
to′pai-bi.
to′ho-bai-bi.
to′ho-bi.
Seeds formerly eaten.

Brizopyrum spicatum Hooker.
ku′so-nĭp.

Bryum sp. Moss.
so′-go-ba-gwĭp.
so′-ko-ri-bo-ûmp.
[In the first name *so-go* means earth. In the second *so′-ko-ri* means deer, the reference being to the eating of the moss by this animal.]

Bud.
ĭ′-gi-si-a-ka.
[From ĭ-gi, present, initial, si′-a-ka, sprout, branch, etc.]

Calochortus nuttalli Torr. and Gray. Sego.
si′-go.
The common name for this attractive lily is taken from the Indian name. In the spring and early summer the bulbs of the sego were formerly much used as food by the Gosiutes, constituting a standard source at that time of the year. The bulbs were also dried and preserved for winter use in the usual type of pit or "cellar."

Camassia esculenta Lindl. Camass.
pa′-si-go.
As with the preceding form, the bulbs of this plant were formerly a prized source of food. The bulbs of this plant were likewise preserved for winter use. They were usually cooked by roasting in pits lined with hot stones.

Cardamine cordifolia Gray. Bitter Cress.
?mo-a-gwa-nûp.

Carex hookeriana Dew. Sedge.
ai′bi-baip.
[Prob. *ai′ba*, clay, + *baip* (?from *ba* + *ûp*).]

Carex jamesii Torr., *fistira, muricata*, etc. Sedge.
pa′gi-gĭp.

Carex utriculata Boott. Sedge.
pa′gi-gĭp.
pai′gĭp.
ai′bi-baip.
[*ai′ba*, clay, + *pa*, water, + -*ûp*.]
Children sometimes eat lower tender stems and parts of roots.

Carex sp. Sedge.
pa′ra-wĕ-ce-gop.
Roots rarely used as medicine.

Carum carui.
a′pa.
?tĭn′ta.

Carum gairdneri Benth. and Hook.
yam′pa.
yamp.
The fleshy roots of this plant furnished a food very important to the Gosiutes and related Indians and one of which they were especially fond. The plant is widely distributed and occurs abundantly in the mountains. The roots were commonly prepared by roasting in a pit lined with hot stones. They were preserved in quantity for winter use.

Castilleia miniata Dougl. Indian Paint-brush; Painted Cup.
koi′di-gĭp.
Also spoken of sometimes as *to′go-un-go-na;* but this name more frequently restricted to the next species.

Castilleia parviflora Bong. and *minor* Gray. Indian Paint-brush; Painted Cup.
to′go-ûn-go-na.
[From *to′go-a*, snake, rattle-snake, + *ûn*, + *gŭn*, *gu′na*, fire. Hence, "snake fire."]

Catkin, pistillate, of willows, etc.
bi′a-gĭnt.
[Apparently *bi′a*, *ba*, seed, etc., + *kĭn*, + *t*.]

Catkin, staminate, of willow, etc.
ĭ′dcûm-ûm-bu-i.

Ceanothus velutinus Dougl. New Jersey Tea.
a′di-rûm-bĭp.
a′di-rûm-bĭp-äñ-ka-sip.
[*a′di-rûm-bĭp* + *äñ′ka-bĭt*, red, + *sip*.]

Cercocarpus ledifolius. Mountain Mahogany.
tu′nam-pi.
tu′nûmp.
The wood of the mountain mahogany was the favorite material among the Gosiutes for bows. Powdered charcoal made from the green wood was used by some on burns.

Cercocarpus parvifolius Nutt. Mountain Mahogany.
tu′hi-nûp.

Chaenactis douglasii Hook. and Arn.
wañ′gĭn-gĭp.
?ko′si-bo-qûn-tos.
Sometimes minced or mashed up and rubbed on limbs, etc., for soreness or aching.

Chenopodium capitatum Watson. Goose-foot; Pigweed.
kûm′ûn-tsi-a.
[Prob. *kûm*, rabbit, + *ûn*, + *tsi′a*.]
??pa′gwo-nûp.
Seeds formerly gathered for food, this species being the source of a large supply.

Chenopodium leptophyllum Nutt. Pigweed; Goose-foot.
i′û-pi.
Seeds served as food as with the preceding species.

Chenopodium rubrum L. and *capitatum* Watson. Pigweed; Goose-foot on′tĭm-pi-wai.

[*on′ti-gait*, roan, etc., the name referring to color of ripe fruiting.]

kûm′ûn-tsi-a.

Seeds formerly eaten.

Chrysopsis villosus Nutt., etc. Golden Aster.

toi′ya-dĭ-sas.

[*toi′ya-bi*, mountain, etc., + *dĭ′sas*.]

? tu′go-wa-tsĭp.

Cinna arundinacea var. *pendula* Gray. Wood Reed Grass.

to′bai-bi.

Seeds gathered for food.

Claytonia caroliniana var. *sessilifolia* Torr. Spring-beauty.

dzi′na.

Bulbs used as food. The same name is sometimes applied to the cultivated potato (*vid.* sub *Solanum*).

Claytonia perfoliata Donn.

pa′gwo-dzûp.

?pa′bu-ip.

The second name a general term designating habitat, as previously described and probably not correctly applied to the present species.

Clematis douglasii Hook. Clematis; Virgin's Bower.

o′bĭn-da-ma-nûmp.

?a′ra-si-mu.

Clematis ligusticifolia Nutt. Clematis; Virgin's Bower.

o′bĭn-da-ma-nûmp.

Furnished a medicine.

Cleome integrifolia Torr. and Gray.

a′na-gwa-nûp.

bĭ′tci-gwa-nûp.

Leaves formerly pounded up in water and applied as a remedy to sore eyes.

Cleome lutea Hook.

si′bo-i-ûp.

Occasionally spoken of under the same name as the preceding.

Cnicus drummondi Gray. Plumed Thistle.

tĭn′tsĭñ-ga.

tsĭñ′ga.

tsi′na.

Portions of stems formerly eaten.

Cnicus eatoni Gray. Thistle.

po′gwo.

po′go.

ai′wa-bo-gop.

ai′gwa-bo-gop.

Also sometimes spoken of under second name of the and its variants.

Used as a remedy on cuts and sores. Stems eaten. Probably the thistle most used as food.

Cnicus undulatus Gray. Plumed Thistle.

pa′bo-go.

Also as tsĭñ′ga, etc.

Stems eaten.

Commandra pallida A. DC. Bastard Toad-flax.

tĭm′bo-ip.

A general term.

Cornus stolonifera Michx. Kinnikinnic; Dogwood.
äñ′ka-kwi-nûp.
äñ′ka-koi-nûp.
[Cf. the Shoshoni *äñ′ka-sib.* The name refers to the red color of the shoots.]
The inner bark of this plant, most commonly called kinnikinnic in the West, was formerly much smoked as tobacco. It was often mixed with ordinary tobacco when the latter was procurable. Its effect was mentioned by one Gosiute as being not a little like that of opium. The wood was sometimes used in the making of snow-shoes.

Cone, of Pinus.
ti′ba-ûn-gop.
The name is from *ti′ba*, pine nut, + *un*, + *gop*, pod or seed-vessel.

Cowania mexicana Don. Cliff Rose.
hi′na-bi.
Leaves used as medicine.

Cratægus oxycanthus. Thorn.
bĭ′tcĭp.

Cratægus rivularis Nutt. Haws.
wi′ûm-pi.
wi′ûmp.

Crepis glauca Torr. and Gray.
mu′tci-gi.
mu′tci-gĭp.
mu′ha-ti-bu-i.
Leaves said sometimes to have been eaten.

Crepis occidentalis Nutt.
mo′a-mu-ĭ-tci-gĭp.
mo′a-mu-ĭ-tci-gi.

Cymopterus longipes Watson.
an-dzûp.
[Cf. Shoshoni *toi′yan-dûp.*]
The leaves of this plant, so abundant and widespread in this region, formed a common article of food in the spring. They were prepared by boiling.

Cymopterus montanus Torr. and Gray.
tu′na.
Seeds and underground parts eaten, but not the leaves, as was done with the preceding form.

Cystopteris fragilis Bernh. Fern.
pa′sa-gwûp.

Delphinium bicolor Nutt. and Menziesii D.C. Larkspur.
pa′ga-sau-wi-no-ûp.
tu′ku-ba-gûmp.
The second name refers to the deep blue flowers (*tu′kûm*, the sky, and hence blue, etc.).
Recognized as poisonous.

Deschampsia cæspitosa Beauv. var. Hair Grass.
toi′ya-so-nĭp.
[*toi′ya-bi*, mountain, + *so′nĭp*, grass.]
toi′ya-si-wûmp.
[*toi′ya-bi*, mountain, + *si′wûmp*, q. vid.]
Seeds eaten.

Deschampsia danthonioides Munro. Hair Grass.
mo′no.
?yo′ni-so-nĭp.

Deyeuxia canadensis Beauv. and *stricta* Trin. Reed Bent Grass.
ni′a-bĭp.
añ′go-ma-tai-yu.
añ′go-ma-tsai-yu.
[*añ′go-bi*, spruce, + *ma′tsai-yu*.]

Dodecathion meadia L. Shooting Star.
pa′bu-ĭp.

Dracocephalum parviflorum Nutt. Dragon-head.
toi′ya-ba-gwa-nûp.
[*toi′ya-bi*, mountain, or *toi′ya-wĭnt*, canyon, + *pa′gwa-nûp*, mint, which see further.]
The same name also applied to the related forms *Lophanthus urticifolius* and *Scutellaria*.
Seeds gathered as food.

Echinospermum redowskii Lehm., *floribundum* Lehm., etc. Stickseed.
tso′nap.
This same name was applied to various borraginaceous plants in about the same way as our own English popular name "stickseed."

Eleocharis palustris R. Br. Spike-rush.
wan′dzi-baip.
By some occasionally loosely spoken of as *ba′hwap*, which is correctly the name for Juncus.

Elymus canadensis L. Wild Rye.
ti′wa-bi-nĭp.
o′ro-rop.
o′ro.
o′do.
Seeds formerly gathered for food.

Elymus sibiricus L. Wild Rye; Lyme Grass.
o′ro-rop.
o′ro.
o′do.
By some also spoken of loosely as *ni′a-bi*, *q. vid.* Seeds used for food.

Epilobium alpinum L. Willow-herb.
u′sa.

Epilobium coloratum Muhl. Willow-herb.
tu′si-gĭp.
The name refers to the black seeds.

Epilobium spicatum L. Willow-herb.
pa′ga-so-nap.

Epipactis gigantea Dougl.
wan′di-wa-sûmp.
wan′di-wa-sĭp.

Equisetum hiemale L. Scouring Rush.
ĭ′sa-yu-gĭp.
Name refers to use made of plant by Indian chi dren for whistles.

Erigeron canadensis L. Fleabane.
?on′tĭm-pi-wa-tsĭp.
?on′tĭm-pi-wai.
This name probably not cor-

rectly applied to this form, being by nearly all restricted to species of *Chenopodium*.

Erigeron glabellus Nutt. var. Fleabane.

tĭ′sas.

dĭ′sas.

toi′ya-dĭ-sas.

toi′dĭ-sas.

toi′ya-da-ti-go-ra.

Erigeron grandiflorus Hook. Fleabane.

ta′kan-dĭ-di-a-gûp.

ta′kan-dĭ-dai-gûp.

The root is said to have been used in the preparation of an arrow poison.

[*ta′ka*, arrow, + *dĭ′di-a-kĭn*, to kill, etc., *gop*, *gûp*, snare, means of securing, etc.]

Erigeron leiomerus Gray. Fleabane.

pu′i-dĭ-sas.

[*pu′i-bĭt*, blue, violet, etc., + *dĭ′sas*.]

tĭ′-sas.

dĭ′sas (cf. sub *E. glabellus*).

?toi′ya-ta-son-dzi.

Erigeron macranthus Nutt. Fleabane.

pa′uñ-ga.

kai′si-na-bop.

The name *mo′a-gûp* is often applied in a general way to various fleabanes by some Gosiutes.

Eriogonum brevicaulis Nutt.

pu′i-wa-nûp.

Eriogonum cæspitosum Nutt.

tĭm′pi-tĭm-bo-i-ûmp.

Eriogonum cernuum Nutt.

oi′tcu-mo.

[*oi′tcu*, bird, + *mo′a*, (prob.) leg; given in reference to the peduncle which resemble slender bird legs with toes at top.]

oi′tcu-yo.

Eriogonum heracleoides Nutt.

bĭ′tca-mok.

Name refers to handlike appearance of peduncles and rays.

o′a-pa-dza-ki.

Eriogonum inflatum Torr.

oi′tcu-mo.

oi′tcu-o.

oi′tcu-yo (cf. sub *E. cernuum*, etc.).

?pi′a-ga.

Eriogonum microthecum Nutt. and several others closely related.

sa′na-kün-da.

sa′na-künt.

an′ka-wa-dzûmp.

Eriogonum ovalifolium Nutt. Silver Plant.

sa′na-kün-da.

sa′na-künt.

One of the *tim′bai-na-tsu*. Also an eye medicine and occasionally used for "stomach-ache."

Eriogonum umbellatum Torr.

sa′na-kün-da.

sa′na-künt (cf. preceding species).

o′a-pa-dza-ki.

Eriogonum villiflorum.

toi′gu-pa-gĭnt.

Said to have been used on burns, but this statement not confirmed.

Erodium cicutarium L'Her. Stork's Bill; Alfilaria.

yam'pa-gwa-nûp.

Apparently from *yam'pa* (*q. vid.*). Cf. *gwa'nup*, odor, etc.

Erythronium grandiflorum Pursh. Dog-tooth Violet.

toi'ya-wi-tûm-ba-ga.

Euphorbia montana Engelm., *dentata* Michx., etc.

mo'a-ba-bu-ip.

?toi'ya-ba-bu-ip.

Eurotia lanata Moq. White Sage.

tci'cop.

Used as a remedy in intermittent fevers.

Ferula multifida Gray.

to'dzûp.

The young shoots of this plant are said sometimes to have been eaten, but never the grown plant or old parts, which were far too strong in taste. The roots furnished a remedy highly esteemed as an application on wounds and bruises. For this purpose the roots are first sliced or minced and then thoroughly mashed to a pulp on a stone. It was then ready to be spread upon the affected part. The author saw it thus applied to an Indian's foot that had been crushed under the wheel of a wagon.

Regarded also as an excellent remedy for distemper in horses among the Utes and Gosiutes. The procedure is to burn the roots in a pan held beneath the nose of the sick horse so that the latter shall inhale the smoke.

The seeds are said occasionally to have been eaten.

Festuca tenella Willd. Fescue Grass.

si'wump.

yo'ni-so-nĭp (Goship. Cf. *Glyceria*).

Seeds served as food.

Festuca ovina L. var. *brevifolia* Watson. Fescue grass.

toi'ya-si-wump.

[*toi'ya-bi*, mountain, + *si'-wump*.]

tĭ'sa-hûmp.

yo'ni-so-nĭp (Goship. Cf. preceding form and *Glyceria*).

Occasionally this and preceding form are mentioned as *to'bai-bi* (see *Poa*).

Seeds eaten.

Flower (general term).

hĭ'bĭñ-gûp.

Fragaria vesca L. Strawberry.

äñ'ka-pa-ri-ûmp.

[*äñ'ka-bĭt*, red, + *pa*, *pa'ri*, water, watery, + *-ûmp*; "red water berry."]

Franseria hookeriana Gray.

pi'a-tso-hwa.

Fritillaria pudica Spreng. Buttercup; Yellow Bell.
wi'na-go.
Bulbs formerly eaten to some extent.

Galium aparine L. var., and relatives. Bedstraw.
Said to be one of the *pûñ'go-na-tsu* or horse medicines, but no more specific named could be recalled by informants. Said by one to be good for horses when "give out"; but author has no information beyond this statement.

Geranium fremonti Torr. Wild Geranium; Crane's Bill.
ka'na-gwa-na.
pa'hu-ip.
Decoction made from root used in diarrhœa, etc. The remedy is an active and effective astringent. It may be remarked that a species of the same genus was formerly much used for similar purposes in our own medical practice and that by many it was as such highly esteemed.

Gilia aggregata Spreng., etc.
mu'tu-nats-ûm-bi-ji.
[*mu'tu-nats*, humming-bird, + *um*, possessive, + *bi'dci*, milk, nourishment; "hummingbird's milk or nectar." Names applied also to several other related forms, such as *Zauschneria*.]

Gilia gracilis Hook and *linearis* Gray.
i'am-bĭp.
[Prob. *i'a*, wound, + *m*, + *bĭp*.]
Said formerly to have been mashed up and applied on wounds and bruises.

Glyceria æroides Thurber. Manna Grass.
si'wump.
yo'ni-so-nĭp (Goship. Cf. *Festuca*).
Cf. *Festuca*, to which name is also applied. *Glyceria* is apparently the typical or standard form.
Seeds formerly an important source of food.

Glyceria aquatica Smith. Reed Meadow Grass.
kûm'a-ra-si-yu-gĭp.
pa'si-wûmp.
[*pa*, water, + *si'wûmp*, *q. vid.*: water *si'wump* in reference to habitat in wet ground and along streams.]
Seeds used as food.

Glyceria nervata Trin.
tai'gwi-bi.
si'wûmp.
?pa'si-wûmp (cf. preceding form).
Seeds eaten.

Glaux maritima L. Sea-Milkwort.
pa'ru-sip.
?o'ta-bi-da.

Geum rosii Ser.
Said by one to be an *i'a-na-tsu*.

Geum macrophyllum Willd.
nĭn'ûn-tsai.
Decoction from roots used as medicine.

Glycosma occidentalis Nutt.
pi'a-po-gop.
?pa'si-gwĭp.
Cf. *Osmorrhiza* and *Angelica*, which are also called by the same name, the former probably being the *pa'si-gwip* proper.

Gnaphalium sprengelii Hook. and Arn. Cudweed.
nan'te-bĭtc.
toi'ya-da-ti-bu-da
toi'ya-da-ti-bu-da-go-ra.

Grass (general term).
so'nĭp.

Grayia polygaloides Hook and Arn. Shad Scale.
kan'gûm-pi.

Grindelia squarrosa Dunal. Gum Plant; Arnica.
mu'ha-kûm.
Cf. further the use of this term as indicated in Gosiute list.
A cough medicine is made from the roots among the Utes, but the author has no information of such use among the Gosiutes. However, it was quite likely used.

Gutierrezia euthamiæ Torr. and Gray. Torch-weed; Rabbit-brush.
ku'ki-koi-nûmp.

Gymnolomia multiflora Benth. and Hook.
mo'ta-qa.
ĭ'ca-mo-ta-qa.
[ĭ'*ca*, false, + *mo'ta-qa*.]
Seeds formerly eaten.

Hedysarum mackenzii Richard.
pa'sa-ton-dzĭp.
[Prob. *pa'sa*, dry, + *ton'tso*, clover, + *ûp*.]
pi'o-ra.
[*pi'ûp*, large, long, + *o'ra*, stem.]

Helenium autumnale L. Sneezeweed.
tĭ'da-ya-gûp.
tĭ'ya-gûp.
mo'ta-qa.
mu'ta-qa.

Helenium hoopesii Gray. Sneezeweed; Sneezewort.
tĭ'da-ya-gûp.
ti'ya-gûp.
toi'ya-mo-ta-qa.

Helianthella uniflora Torr. and Gray.
mu'ha-kûmp.
mo'ha-kûmp.
pi'a-pa-ot-qa.
[*pi'ûp*, large, + *pa-ot'-qa*, *q. vid.*]

Helianthus annuus L. Sunflower.
i'ûm-pi.
The seeds of the sunflower formed a highly prized source of food and oil among the Gosiutes. The seeds, when ripe, were beaten out of the heads into baskets by means of paddles or by means of the ordinary collecting baskets previously described.

Heracleum lanatum Michx. Cow Parsnip.
ko′no-gwĭp.

Heuchera rubescens Torr. and related species. Alum-root.
wi′gûn-dza.
pa′sa-wi-gûn-dza.
The roots of this plant and closely related forms, including especially the species of *Mitella*, used as a remedy for colic, etc., in babies and children. The properties of the roots are generally astringent. The preparation from the root is commonly spoken of as "*to′sa-na-tsu*," a word meaning "white medicine," in reference to its color. It is used in the form of a tea or decoction. It is still constantly used and is highly valued.

Hieracium gracilis Hook and *scouleri* Hook. Hawkweed.
mu′tci-gi.
mo′tci-gi.

Holodiscus discolor var. *dumosa* Maxim.
ku′si-wup.
tiñ′go-ĭp.
tĭñ′-gwĭp.

Hordeum nodosum L. and *jubatum* L. Barley.
kwa′tci-ûp.
kan′kwai-tcûp.

Humulus lupulus L. Hop.
wa′nûp.
wa′na-na-tsa-mo-gi.
u′na-tso-mo-gi.
bi′tca-mok.
?Seeds sometimes mixed in small amounts with the meal or flour prepared from seeds of grasses, etc., preparatory to baking into cakes.

Hydrophyllum occidentale Gray and *capitatum*. Waterleaf.
toi′ya-ba-gwo-dzûp.
[*toi′ya-bi*, mountain, + *pa′-gwo-dzûp*.]

Hypnum sp. Moss.
pa′oñ-gûp.
Cf. *Polytrichum*.

Iva axilaris Pursh.
tu′ro-sip.
[*tu′o-bĭt*, *tu′ro-vi*, black, + *sip*, sap, juice, + *ûp*.]
The same name includes also *Ambrosia*, *q. vid.*

Iva xanthifolia Nutt.
tu′ro-sip (cf. preceding form).
?kûm′ûn-tsi-a.
Used by a few, but doubtless incorrectly. See *Chenopodium*.

Iresia gordoni Torr. and Gray.
?toi′ya-wan-go-gĭp.

Jamesia americana Torr. and Gray.
toi′ya-da-tsĭp.
One of a number of mountain plants known under this general designation.

Juniperus californica var. *utahensis*, etc. Cedar; Juniper.
wa′pi.
wap.
The full name as heard among the Shoshoni is *wa′ap-o-pi*,

and clearly means fire, match, or "kindling wood." In the Gosiute and most related dialects the *o'pi*, wood, is not heard, the form remaining variously as *wap*, *wa'pi* and *wai'ap* (cf. the Gosiute *wai'hĭn*, to burn).

One of the most familiar of arborescent plants in the Gosiute territory, occurring widely over the foothills and mountains. It furnished the wood most commonly used in the construction of winter lodges, the bark (*i'na-wa-tsĭp*) being used for thatching and occasionally as a covering on the floor, though smaller branches and especially grasses were commonly applied to the latter purpose. The bark was also used to line and cover the pits in which dried fruits, etc., were stored. The leaves furnished a favorite medicine for coughs and colds, being used in the form of a tea. It is still much in use for this purpose.

The cedar-berries, known as *wap'-ûm-pi*, were sometimes eaten in fall and winter after proper boiling.

Juniperus communis var. *alpina*.

wap.

añ'go-gwa-nûp.

[Prob. *añ'go-bi*, spruce, + *gwa'nûp*, odor, etc.].

Juniperus virginianus L. Red Cedar.

pa'wa-pi.

Kalmia glauca Ait. American Laurel.

tĭm'pĭn-tu-nûmp.

[*tĭm'pi*, rock, + *tu'nûmp*, mahogany.]

Also one of the plants spoken of under the general designation *tim'bo-ip*. Leaves by some used as a medicine.

Krynitzkia fulvocanescens Gray.

ku'si-ya-ni-gĭnt.

[*ku'tsĭp*, ashes, ashen, in reference to the dense gray covering of hair, + *ya'ni-gĭnt*.]

Lactuca leucophæa Gray. Lettuce.

mu'tci-gĭp.

mu'tci-gi.

(pa-ot'-qa; prob. incorrect for this form.)

Lactuca ludoviciana DC. Lettuce.

mu'tci-gĭp.

?bi'tci-gwa-nûp.

mu'tci-gi.

The leaves of the various species of *Lactuca* were eaten.

Lathyrus ornatus Nutt. Everlasting Pea.

mu'da-bĭs.

Also known under the general name of *pi'o-ra*, referring to the stem, and *na'da-pa-ra-na-gĭnt*, the latter in restricted usage applying to *Astragalus* and referring to the pod.

Layia glandulosa Hook and Arn.
mo′ta-qa.
mu′ta-qa.
Applied also to several other related forms. Cf. further in the Gosiute list under *mo′ta-qa*.

Leaf (general term).
sĭ′gi.

Lemna. Duckweed.
wa′da-bu-ĭp.
pai′ya-bo-sip.

Lepidium intermedium Gray. Peppergrass.
wu′bu-i-nûp.
The same name was also applied to several other species belonging to the same family with about the same comprehensiveness and flexibility as our popular name "peppergrass." Cf. *Draba*.

Lewisia rediviva Pursh.
ka′na.

Lichen (general term).
tĭm′pĭn-so-kûp.
[*tĭm′pi*, rock, + *n*, + *sok′ûp*, earth, "rock earth or covering."]

Linum kingii Watson. Flax.
na′na-rĭp.

Linum perenne L. Flax.
Applied as a remedy to bruises, etc. Said to take down swelling, etc. Cf. the use of flax-seed meal.

Lithospermum hirtum Lehm. Gromwell.
äñ′ka-tso-nap.
äñ′ka-tso-ni-baip.
[*äñ′ka-bĭt*, red, + *tso′nap* or *tso′ni-baip* (cf. under next species), the reference probably being to the deep orange color of the corollas.]

Lithospermum pilosum Nutt. and *multiflorum* Torr. Gromwell; Stickseed.
tso′ni-baip.
tsom′ba.
tso′nap.
[From *tso′mo*, *tso*, hook, etc., + *ba*, seed, + *-ûp* or *-ĭp*, the reference being to the burlike fruit. Cf. our popular name "stickseed," which corresponds very nearly to the Indian word.]
The seeds were sometimes eaten. The roots formed a valued remedy in kidney trouble (diuretic).

Lonicera utahensis Watson and *involucrata* Banks. Woodbine; Honeysuckle.
pi′a-ra-dûm-bĭp.
pi′a-da-rûm-bĭp.
pa′ri-a-ûn-dĭk-ûp.
[*pa′ri*, elk, + *ûn*, + *dĭk′ûp*, food; *i. e.*, "elk's food." Cf. the Ute *te′ed-kav*.]
These plants are also often spoken of under the name *wu′da-ûn-dĭk-ûp*, "bear's food," because the berries are said to be eaten by the bear. Cf. the name "bear-berry," applied by the settlers of Montana, etc., to species of *Lonicera*.

Lophanthus urticifolius Benth.
toi′ya-ba-gwa-nûp.
[*toi′ya-bi*, mountain, + *pa′gwa-nûp*, mint (Mentha) the reference being to habitat.]
Cf. *Drzeocephalus* and *Scutellaria*, to which forms the same name is also applied.
The seeds were formerly extensively gathered for use like those of the grasses and chenopods.

Lupinus leucophyllus Dougl., *parviflorus* Nutt., etc. Lupine.
kwi′ta-kwa-nûp.
[Prob. *kwi-tûp*, excrement, + *gwa′nûp*, odor.]

Lycopodium.
?pam′bu-i-ûp.

Lycopus sinuatus Ell. Water Horehound.
nĭ′di-ba.
nĭ′dĭb.
Occasionally heard as *pa′gwa-nûp*, the name of the mint (Mentha).

Lygodesmia grandiflora Torr. and Gray.
Said to be one of the horse medicines or *pun′go-na-tsu*.

Madia glomerata Hook. Tarweed.
nan′tai-bĭtc.
nan′te-bĭtc.
These names somewhat doubtful as applied to this species.

Malvastrum coccineum Gray. False Mallow.
pa′sa-koi-no-komp.
koi′no-komp.
Cf. the following species.

Malvastrum munroanum Gray.
koi′no-komp.
koi′ya-kûmp.
This and the preceding form formerly pounded up in water to form a mucilage or gummy paste (*wi′nau-tsaug*), which was applied over the rough inner surfaces of earthen vessels, especially bowls (*wi′nau*). The paste filled up the small holes and covered over irregularities and upon hardening left thus a smooth surface. The *wi′nau-tsaug* (bowl "filler") was sometimes similarly used in wicker vessels designed to hold water, the latter commonly being first "pitched" with pine gum.

Mammilaria (?).
mu′tsa.
Outer portion of the cactus removed and central part used as food.

Matricaria discoidea.
?mu-i′-tci-gi.

Medicago sativa L. Lucern; alfalfa.
pu′i-di-kûp.
[*pu′i-bĭt* + *dik′ûp*.]

Melica pœoides.
wa′bi.

Mentha canadensis L. Mint.
pa′na-tĭ-so.
pa′gwa-nûp.

From the leaves of this plant a tea was made which was used as a beverage.

Mentzelia lævicaulis Torr. and Gray and *multiflora*.

pi'a-ku-hwa.

Mentzelia pumila, *albicaulis*, etc.

ku'hwa.

Said by one informant to have been used as a medicine for burns (*wai'a-na-tsu*).

Mertensia alpina.

?toi'ya-mo-ta-komp.

Microseris major and *linearifolia*.

mu'ĭ-tcĭ-gi.

mu'tci-gĭp.

Mitella trifida.

pi'a-näñk.

to'sa-na-tsu.

The roots of species of *Mitella* and *Heuchera* were gathered and kept as a medicine for colic in babies. It was used as a decoction and was much valued. The color of the dried roots gave the name of *to'sa-na-tsu*, white medicine, to the preparation as likewise *Mitella* itself.

Monardella odoratissima.

pu'i-dĭ-sas.

Monolepis chenopodoidea.

ko'ga-bi.

ko'ga-rûm-pi.

Seeds said sometimes to have been eaten.

Nasturtium palustre DC. and var. Water-cress.

si'bo-i-ûmp.

Plant eaten.

Negundo aceroides Moench. Box-elder.

gu'su-wup.

Negundo aceroides, staminate flowers of.

ku'ni-ûp.

Negundo aceroides, pistillate flowers of; samara of.

näñ'ki-tco.

[*näñk*, ear, + prob. *tso'mo*, *tco*, bead, etc.].

Nicotiana attenuata Torr. Tobacco.

pu'i-ba-u.

This was the source of tobacco largely used by the Gosiutes, the leaves being dried in the ordinary way and used either alone or mixed with the inner bark of the kinnikinnic (cf. under *Cornus*).

Œnothera biennis L. Evening Primrose.

tsĭ'gi-tûmp.

Seeds said to have been occasionally eaten.

Œnothera cæspitosa Nutt. Evening Primrose.

??ka'na-gwa-nu.

??Roots used as medicine.

Opuntia rutila Nutt., *microseris* DC., etc. Cactus.

ai'gwo-bi.

Formerly used as food, the spines being removed and the joints roasted in hot coals.

Orogenia linearifolia Watson.

kwi'ta-po-ni.

kwi'ta-po.

Gosiutes say the bear often digs up and eats the bulbs of this plant.

Orthocarpus linearifolius Benth.
ta′bi-wûmp.
pi′a-ba-bi-wûmp.

Osmorrhiza nuda Torr. Sweet Cicely.
pa′si-gwĭp.
Cf. also the related *Glycosma* and also *Angelica*.

Oryzopsis cuspidata Benth. Mountain Rice.
wai.
A valuable bunch-grass very common in Nevada and Utah. Formerly it furnished an abundance of seeds or grain to the Gosiutes.

Oxyria digyna Camp. Mountain Sorrel.
äñ′ka-si-yu-na.

Pachystima myrsinites Raf. Box.
ta′tsĭp.

Parnassia fimbriata Banks. Grass of Parnassus.
tĭm′bi-wi-gûn-dza.
tĭm′bi-wi-gûn-ta.
One of the *tĭm′bai-na-tsu*.

Parnassia parviflora DC. Grass of Parnassus.
?koi′gwa-nûp.
toi′ya-gwa-nûp.
Cf. *Saxifraga nivalis*, a related form.

Pentstemon confertus Dougl. var. Beard-Tongue.
tu-go-wi-nûp.

Peucedanum graveolens Watson.
i′jaip.
The roots of several species of *Peucedanum* formed one of the most valued medicines among the Gosiutes, being, in fact, termed by them *pi′-a-na-tsu*, or "great medicine." In cases of sore throat it was mashed and applied directly to the affected surface. In cases of biliousness and severe colds it was sometimes used as a decoction, being by some mixed with a *koi′na-tsu* and pine resin.

Peucedanum simplex Nutt.
bĭ-tca-mu-kûm.
The name applied strictly to a species of *Eriogonum*, but also used in a more general sense to indicate several other plants like the present one, which have long peduncles bearing rays suggestive of fingers radiating from a hand.

Phacelia menziesii Torr. and *circinata* Jaeg.
wu′-si-bĭn-gĭnt.
wu′-si-günt.
The name refers to the clothing of limpid hairs on stems and leaves of these plants.

Phalaris arundinacea L. Canary Grass.
u′-gû-pi.
u′-gĭp.
o-gĭp.
Cf. also *Beckmannia*, to which the name primarily belongs.

Phalaris is regarded as the "little brother" of *Beckmannia*.

Phlœum alpinum L. Cat's Tail Grass; Mountain Herd's Grass.

tĭ′-so-nĭp.

Cf. *alopecurus*, which is also included under the name.

Phlox longifolia Nutt. Sweet William; Phlox.

sĭ-bi.

Phoradendron juniperum L. Mistletoe.

o′-ka.

Phragmites communis Trin. Reed.

paij.

paidj.

This tall reed is found in abundance in some places along streams and about ponds and is common along the shores of Utah Lake. A sweet secretion or honey-dew formed on the leaves by aphides was formerly gathered by the Indians and used as a sugar (*u′-ga-pi-na*). The same was true of similar secretions formed on the leaves of the cottonwood and other plants. In pioneer days in Utah the Mormons also gathered this secretion to some extent.

Pinus monophylls Torr. and Trin. Nut-pine.

ti′-ba-wa-ra.

The nuts (*ti′-ba*) from this tree formed one of the important foods of the Gosiutes, and the invariable journey into the mountains each fall for the gathering the pine-nut harvest is still looked upon as a great fixed event of the year. In the pine-nut season at this time the Indians go chiefly to the Deep Creek Mountains.

Pinus edulis Eng. Piñon Pine; Nut-pine.

ai′-go-û-pi.

When this species was accessible the nuts were gathered and used like those of the preceding species.

Plant (general term).

si′-a-ka.

pu′-i-si-a-ka.

Plantago eriopoda Torr., *patagonica*, *major* L., etc. Plantain.

toi′-gu-pa-günt.

[The name refers to the elevated head of the flowers, *toi*, indicating elevation, etc., + *gûp*, fruit, + *a* connective, + *günt*. The same name is sometimes applied to *Ranunculus* for the same reason.]

Poa californica Munro. Meadow Grass.

ni′-a-bĭp; ni′-a-bi.

Seeds eaten.

Poa tenuifolia Nutt. "Bunch Grass"; Meadow Grass.

mi′-a-ba-so-nĭp.

ni′a-ba-so-nĭp.
ni′-a-bĭp.
Cf. the preceding.
The seeds of this abundant "bunch grass," notwithstanding their small size, were an important source of grain to the Gosiutes.

Poa pratensis L. Blue Grass; Meadow Grass.
ni′-a-bĭp.
añ′-go-ma-tsai-ya.
The latter name commonly applied also to *Deyeuxia*, and apparently more narrowly restricted to the latter. Species of *Deyeuxia* are also often spoken of as *ni′-a-bip*, the forms of the two genera not being sharply distinguished by them, as is only natural. Their names, like our own popular ones, often included species which, scientifically studied, botanists place in separate genera, while in other cases their distinctions were very close.

Polemonium cœruleum L. Greek Valerian.
ĭ′-ca-ûn-toi-nûmp.
The name refers to the fact that the wolf (*i′ca*) is said to eat the berries of the plant sometimes when sick.

Polygonum amphibium L.
pi′-a-pa-oñ-gop-pai′-dja-rûmp.
[*po-ûp*, large, + *pa′oñ-gop*, moss, water-weed, + *pai′-dja-rûmp*.]

Polygonum erectum L.
on′ka-pa-bui-i.

Polygonum hartwrightii Gray.
pa′-gu-ĭp.
ta′-kûm-bu-i.

Polygonum imbricatum Nutt.
ko′-ka-bi.

Polygonum viviperum L.
?toi′-ya-da-ti-bu-da.

Polygonum juniperinum. Moss.
tĭm′-pĭn-pa-bo-i-ûp.
pa′-oñ-gop.
pi′-a-pa-oñ-gop.
Cf. *Hypnum*.

Populus angustifolia James. Cottonwood.
so′-o-pi.
so′ho-bi.
The shoots of the cottonwood furnished the material for much of the basket work among the Gosiutes. Because of greater strength it was preferred to the willows. The honey-dew formed by aphides on the leaves was gathered and used somewhat as sugar.

Populus tremuloides Michx. Quaking Aspen.
sĭñ-gû-pi; sĭñ′-gûp.

Potentilla anserina L. Five Finger.
?so′-ko.

Potentilla fruticosa L.
wa′tsi-gĭnt.
wa′na-gĭnt.

Potentilla glandulosa Lindl. Five Finger.
pa′-sa-wi-gûmp.

Roots used as medicine. Said to be applied as poultice to swollen parts, and also to be used internally.

Potentilla pennsylvanica. Five Finger.
ku′-si-wañ-go-gĭp.
ku′-tsa-ga-ti-wo-ra-rat.

Potentilla plattensis Nutt. Five Finger.
ĭ′-ca-ro-dzûp.
[*i′-ca*, wolf, + *to′dzûp, q. vid.*]

Primula parryi Gray. Primrose.
?pu′-i-pa-si-go.
?toi′-ya-na(da)-ta-bu-da.

Prunus demissa Welpers. Choke Cherry; Wild Cherry.
to′o-nûmp.
toñ′gi-cĭp.

The fruit was used as food. For winter use, after gathering it was mashed and spread out in layers to dry in the sun. It was then cached like that of the service-berry, previously described. For use, the common method was to grind up the dried fruit, boil in water, and to eat as a sort of mush. A decoction from the bark was used as a "blood medicine," *bu′-i-na-tsu*, in cases where a person was affected with frequent hemorrhages at the nose, etc., or, according to the Gosiute explanation, when the person "has too much blood." The bark was also used as a *koi′-na-tsu* for babies and children.

Pseudotsuga douglasii Carr. Douglas Spruce.
wañ′-go.

Purshia tridentata DC.
hi′-na-bi.

Cf. *Cowania*, from which the name is extended by many to the present form.

Pyrus sambucifolia Cham. and Sc.
?ku′-no-gĭp.

This is properly the name of the Elder (*Sambucus*) and it is doubtful whether the name is properly applied to the present form, which in general appearance resembles it, and hence its specific name. It was hard applied to this form, however.

Quercus undulata Torr., var. Scrub Oak; Rocky Mountain Oak.
kwi′-ni-ûp.
ku′-ni-ûp.

The acorns (*ku′-ni-ro-ûmp*) were prepared for food in season, but they were not preserved for winter use.

Ranunculus aquatilis L. var.
mo′-a-pa-oñ-gop.
[*mo′a* + *pa′oñ-gop*, moss, etc.]
?pa′mo.

Said entire plant sometimes eaten.

Ranunculus cymbalaria Pursh. Buttercup; Crowfoot.
ni′-u-ru-pam-pi.
toi′-gûp-a-günt.

The names refer to the elevated cone-shaped heads; *toi*, elevate, etc., + *gûp*, fruit, + *günt*. The names are not wholly specific, being applied to some other forms having similar heads.

Ranunculus sceleratus L. Buttercup.

a′-tam-bĭ-tcĭp.

ha′tam-bĭ-tcip.

Rhus aromatica Ait. var. *trilobata* Gray. Sumac; Squaw-berry.

i′-tcĭb.

ai′tcĭb.

u′-i-tcĭb.

Berries to some extent eaten.

Rhus toxicodendron L. Poison Oak; Poison Ivy.

ta′-da-bi.

Rhus glabra L. Sumac; Squaw-berry.

äñ′-ka-ti-wi-ûmp.

äñ′-ka-ti-wi-a.

Berries eaten. The leaves were formerly smoked.

Ribes aureum Pursh. Missouri or Black Currant.

kai′-i-ûmp.

po′-go-nûp.

po′gûm-pi.

The second name, while often used as applying to this species, is also the general term for the currant berry of this and other species, in this usage being broadly the equivalent of our word currant.

The fruit of this and the following species, which seem to have been less important, was used as food and was dried in quantity and preserved for later use in the usual way.

Ribes divaricatum Dougl. var. Currant.

wĭ′sa-po-gûmp.

The prefixed portion of the name, *wĭ′sa*, refers to the prickles born on this species.

Ribes lacustre and *leptanthum* Gray var. *brachyanthum*. Currant.

ai′-go-po-gûmp.

The prefixed or first portion of this compound name means process or thorn, in reference doubtless to the spines of this species.

Ribes oxycanthoides L. Currant.

toi′-ya-po-go-nûp.

The name means "mountain currant."

Root.

tsĭñ.

tsĭn′ai.

Rosa californica and *fendleri* Crepin. Rose.

tsi′-o-pi.

The name means "prickly plant." The berries, known as *tsi′ûmp* or *dzi′ump*, were gathered for food.

Rosa nutkana Presl. Rose.

ti′-a-bi.

The berries are spoken of as *mo′gon-dzi-ûmp;* which means poison or deleterious rose-berries, these berries not being regarded as good to eat.

Rubus leucodermis Dougl. Raspberry.

tu′-kwûn-dau-wi-a.

tu′-kwûn-da-wi.

Berries eaten.

Rubus nutkanus Moc. Salmon-berry.

tu′-kwûn-dau-wi-a.

wu′-da-ûn-dĭ-kûp.

The second name refers to the fact that the berries are sought for food by the bear. The same name is also given to a species of *Lonicera*, *q. vid.*

Berries eaten.

Rudbeckia occidentalis Nutt. Cone-flower.

tu′-ro-vi-pam-pi.

tu′-ro-pam-pi.

tu′-pam-pi.

The names mean simply "black-head," in reference to the color of the cone-shaped flower heads.

Rumex salicifolius Welman, etc. Sorrel; Dock.

äñ′-ka-pa-ja-rûmp.

äñ′ka-pai-dja-rûmp.

äñ′-ka-pa-tsa-rûmp.

The root furnishes one of the remedies spoken of by the Gosiutes as "blood medicines," "*bu′-i-na-tsu*." A decoction of the root is also said to have been used for injection by the rectum in cases of severe constipation.

Sagittaria variabilis Engelm. Arrow-head.

pa′-bo-bu-ĭp.

pa′ba-bu-ĭp.

pi′a-pa-bu-ĭp.

pi′-a-pa-bo-bu-ĭp.

Salicornia herbacea L. Samphire; Glasswort.

pa′-o-ka; pa′-ho-qa.

o′-ka.

Very abundant in many places in Gosiute territory about alkaline and brackish water or over damp alkaline areas. This is one of the various chenopodaceous plants that contributed seeds so abundantly to these Indians. When the meal from the seeds of this plant was cooked it is described as having tasted like "sweet bread" by those who have eaten it.

Salix longifolia Muh., *and other species*. Willow.

si′-o-pi.

si′hĭp.

[The name seems to mean approximately "water or wet wood or plant (shrub or tree)," probably in reference to its habitat. Another possible meaning would be "sap wood."]

The wood was commonly used in the making of baskets, water-jugs, etc., though cottonwood was by most preferred when accessible. It was used for making fish-weirs (*päñ′gwi-go-ûp*) and for other similar purposes.

Salix amygdaloides Anders., *lasiandra* var., and *flavescens* Nutt. Willow.
sa′-gû-pi.
Also in a general way designated by the name *si′-o-pi*, as for the preceding, which is used largely in a generic sense.
Uses like those of the preceding.

Samara of *Negundo* and *Acer*.
nän′-ki-tco; nän′-ki-tso.
ka′bĭp.

Sambucus glauca Nutt. Elder.
pa′-go-no-gwĭp; pa′-go-no-gĭp.
Bears eat berries.

Sambucus racemosa L. Elder.
ku′-no-gĭp; ku′-no-gi.
ko′-no-gĭp; ko′-no-gi.
The fruit was eaten in season.

Sap.
büc.

Saponaria vaccaria L. Soapwort.
sai′-ya-hyu-gĭn.
Widely introduced into Nevada and Utah through early emigrant travel.

Sarcobatus vermiculatus Torr. Greasewood.

Saxifraga nivalis L. Saxifrage.
toi′-ya-gwa-nûp.
ka′-i-gwa-nûp.
[Prob. *toi-ya-bi*, mountain, + *gwa′-na*, odor, + *ûp*.]

Saxifraga punctata L. Saxefrage.
pa′-sa-wi-gûn-dza.
Cf. *Heuchera*.

Scirpus lacustris L. var. *occidentalis* Watson. Bulrush; Tule.
saip.
The lower, tender portions of the stems were formerly eaten as food.

Scirpus maritimus L. Sea Bulrush.
ai′-bi-baip.
saip.
Cf. *Carex hookeriana* and *utriculata*, which are often grouped under the first names, which is applied to large forms of *Carex* only, the sedges being strictly spoken of as *pa′gi-gĭp*.

Sedum glandulosum, etc. Stonecrop.
äñ′-ka-ti-wi-a.
Leaves formerly smoked. The plant was ranked with the kinnikinnic (*Cornus*) because of this use.

Seed.
ba.
bi′a.

Seedling.
ĭ′-gi-na-ga.
[This name is from *ĭ′-gĭn*, meaning immediate, beginning or initial, and *a′-ka*, plant.]

Senecio, several species. Groundsel.
tĭm′-pi-dza-na-kwo.
The name means "mouth gum," the equivalent of our "chewing-gum," a chewing-gum having been

prepared formerly from the latex.

Shepherdia argentea Nutt. Buffalo-berry.

äñ′-ka-mo-do-nûp.

äñ′-gû-ta-gûp.

äñ′-gûp.

These names refer to the scarlet berries.

o′-pĭp.

Berries eaten.

Shepherdia canadensis Nutt. Buffalo-berry.

a′-da-rûm-bĭp.

pi′-a-da-rûm-bĭp.

Cf. *Ceanothus*, *a′da-rum-bip-äñ-ka-sip*.

Sidalcea malvæflora Gray.

mû′-tsai-kûmp.

mĭ′-ta-kûmp.

mĭ′-ta-komp.

Silene acaulis L. Catchfly.

tĭm′-pi-sa-gwûp.

wa′-si-pĭt.

Said to have been used for colic, etc., in children, being a *koi′-na-tsu*.

Silene antirrhina L. Catchfly.

oi′-tcu-yo.

Silene multicaulis Nutt. and *scouleri* Hook. Catchfly.

In cases of "pain in stomach" this plant was sometimes used as an emetic. The method of use was to pound up, put into warm water, and drink. It was also used as a horse medicine or *pûñ′go-na-tsu*.

Silene menziesii Hook. Catchfly.

yo′-go-ti-wi-ya.

Leaves formerly smoked as a tobacco, being dried and powdered for this purpose.

Sisymbrium canescens Nutt. Hedge Mustard.

poi′-ya.

po′-nok.

Seeds were gathered and used for food, being made into a kind of mush that was much liked.

Sium cicutæfolium Schrank Water Parsnip.

pa′-o-tĭm-bĭte.

?toi′-ya-ro-dzĭp.

Smilacina amplexicaulis Nutt. False Solomon's Seal.

ĭ′-dja-pain-po-go-nûp.

[*i′-djû-pa*, coyote, + *n*. + *po′-go-nûp*, berry.]

ĭ′-ca-bo-gûp.

i′ca-bo-go-nûp.

[*ĭ′-ca*, wolf, + *po′gûp*, *po′-go-nûp*, berry.]

Cf. the name for this plant.

yo-go-ta-ma-nûmp.

Berries said to be eaten by the bear, and hence the plant is designated as one of a number under the name *wu′da-ûn-dĭ-kûp*, "bear food." It is also known from a legendary reference as *pûñ′go-ûn-da-mi* (*pûñ′go*, horse, + *ûn* + *da′mi*.)

Smilacina stellata Desf. False Solomon's Seal.

pai′ya.

Roots pounded up and rubbed on limbs in cases of rheumatism. Bears said to eat berries, as with the preceding species.

Solanum tuberosum L. Potato.
go′-tsa-wĭn.
Sometimes spoken of also as *dzi′na*, the name primarily applied to the Spring-beauty, the bulbs of which were eaten. The potato is cultivated to some extent by the Gosiutes.

Solidago canadensis L., *nemoralis* Ait., *spectabilis* Gray, etc. Golden-rod.
oi′-yĭnk.
o′-a-yĭñk.
[*o′-a-bĭt*, yellow + yĭñk.]
Seeds to some extent gathered and eaten.

Sonchus asper Vill. Sow-thistle.
mu′-tci-gĭp.
An introduced plant designated by the name applied to the closely allied nature species of *Lactuca*, which see.

Spartina gracilis Trin. Salt Grass.
na′-da-pu-gu-ĭ-gi.

Sphæralcea rivularis Torr.
pĭ-tca-gwa-nûp.
toi′-na-ko-nĭp.
koi′-na-komp.
Cf. *malvastrum*.

Sphæralcea emoryi Torr.
koi′-na-komp.
pi′-a-koi-na-komp.
Cf. *malvastrum*. This genus in general characteristics is extremely similar to *Malvastrum*, and it is only natural that popularly and by the Indians no wide differences in designation are present.

Spiræa cæspitosa Nutt. Meadow-sweet.
tĭm-pĭn-tĭm-bo-ûmp.
tĭm′-bo-ûmp.
tĭm′-bi-ma.
While the leaves are used as a bowel medicine, it is mostly employed as a remedy for burns. For this the roots are used. The roots are first freed from dirt and epidermis and then boiled to a pulp, which is applied as a salve to the burned portion, as is described in the earlier portion of this paper. The remedy is highly valued and to the author has seemed efficacious in cases observed.

Spiranthes romazoffiana Cham. Ladies' Tresses.
sai′-gi-tamp.
Used as a medicine in venereal disease—a. *tĭm′-baina-tsu*.

Stachys palustris L. Woundwort.
toi′-ya-ba-gwa-nûp.
[Cf. composition sub. *Lophanthus*.]
Seeds gathered for food along with those of *Lophanthus*, *Scutellaria*, etc., closely related forms known under the same name.

Stalk, stem.
o′ra.

Stephanomeria exigua Nutt.
mo′-a-gûp.

Stipa comata Trin. and Pupr. Feather Grass.
dai′-gwi-wĭq.
o′-gwĭp.
o′gĭp.

Stipa speciosa. Feather Grass.
o′-gwĭp.
o′-gĭp.
yu′-gwĭp.
Cf. *Aristida*, a genus very close to the present one.

Stipa viridula Trin. Feather Grass.
pa′-si-wu-mûts.
pa′-si-wu.
o′gwĭp.
o′gĭp.

Taraxacum officinale Weber. Dandelion.
ti′-bo-hi.
ti′-bu-i.
mu′-tca-gĭp.
mu′-tci-gi.
mu′-tca-gi-a.
Cf. *Crepis*.

Tetradymia canescens DC. var. *inermis* Gray.
si′-bû-pi.
Cf. *Bigelovia*.

Townsendia sericea Hook. var., etc.
mûts′-ĕm-bi-a-di-kûp.
The name means literally "mountain-sheep food" (*muts′ĕm-bi-a*, mountain sheep, + *dĭ′kup*), a name referring to its serving as food for [the mountain sheep. It is not specific.

Trifolium, various species. Clover.
ton′-tso.

Triglochin maritimum L. Arrow-grass.
pa′-na-wi.
Mentioned also as one of the various *pûñ′go-un-da-mi*.
Seeds eaten.

Trisetum subspicatum Beam.
wi′-tcûb.
Also sometimes more generally as *ni′a-bĭp*.
Seeds eaten.

Troximon aurantiacum Hook.
mu-tci-gĭp.
mu′tci-gi-a.
Leaves sometimes eaten.

Troximon sp.
?koi′-nûmp.
See *Microseria*.

Typha latifolia L. Cat-tail.
to′-ĭmp.
[Means mouse or rat.]
Seeds eaten. The bristles of the ripe spikes were burned off, the seeds becoming roasted or partially so in the process. The seeds were then freed and dealt with as usual.

Urtica holosericea Nutt. Nettle.
tĭn′-ai-gop.
The name refers to the stinging hairs or nettles.

Urtica sp.
tu′-i.

Vaccinium cæspitosum Michx. Belberry; Blue-berry.
tĭ′-da-kai-mi-ya.
ti′-mai-hya.
Leaves formerly dried and used as a tobacco. Hence grouped with kinnikinnic (*Cornus*) by the Indians.

Valerianella congesta DC.
a′-pa.

Valeriana edulis Nutt.
toi′-ya-bĭt-ûm-ba-ga.
toi′-ya-bĭt-um-ba.
Roots pounded up and rubbed on externally for rheumatism. Said also to be good on swollen and bruised regions (*bai′gwi-na-tsu*). Roots eaten.

Valeriana sylvatica Banks.
ku′yi-kwa-nûp.
ku′i.
Said to kill horses. An arrow poison is said to have been prepared from the root.

Veratrum californicum Durand. False Hellebore.
ĭ′-ca-po-go-nûp.
The name may be rendered "wolf currant."

Vicia americana Muhl. Vetch.
up′-ta-wu-kwa-dju-nĭñ.

Viola cucullata Ait. Violet.
?pe-ku-ĭp.
Name not specific.

Viola palustris L. Violet.
??dzi′-na-so-so.

Wood (general term).
o′-pi.
wu′-pi.
Commonly used as the equivalent of tree or shrub, *i. e.*, woody plant or even of plant in general.

Wyethia amplexicaulis Nutt.
pi′-a-kĕn-dzĭp.
[*pi′ûp*, big, + *a′-kĕn-dzĭp*, *q. vid.*]
Seeds formerly gathered as food. The roots furnished a remedy applied externally upon bruised and swollen limbs, etc.

Xanthium strumarium var. *echinatum*. Cockle-bur.
kwi′-tcĕm-bo-gop.
The name means "cow" or "bison fruit or berry."

Zauschneria californica Presl.
mu′-tu-nants-um-bĭ-ji.
mu′-tu-nants-pi-na-di-kĭnt.
The first name means "humming-bird's milk"; the second approximately "humming-bird's sugar or sweet food," "humming-bird's nectar." The same name is also applied to *Gilia aggregata*, etc., being of generic character and independent of the more special names of each form.

Zea mais L. Indian Corn; Maize.
ko′-mu.
korn (from English).

Zygadenus nuttalli Gray. Poison Sego.
ta′-bi-si-go-ûp.
ta′-bĭ-tci-gop.
[*ta′-bi*, sun, referring to the clustered flowers (Cf. *ta′*-

bi-si-bû-pi), + *si'-go*, + *ûp*.]

Furnished a medicine used as an emetic. Also one used in certain venereal affections (*tĭm'-bai-na-tsu*).

Gosiute Names with Scientific and English Equivalents.

a'-da-rûm-bĭp.
See a'di-rûm-bip, the more usual form.

a'di-rûm-bĭp.
Ceanothus velutinus Dougl. New Jersey Tea.
Cf. the next name.
Symphoricarpos oreophilus Gray. Snowberry.
This plant is not known to all under this name.

a'-di-rûm-bĭp-äñ-ka-sip.
Ceanothus velutinus Dougl. New Jersey Tea.
By this fuller name distinguished from the Snowberry by those who designate the latter under the preceding name.

ai'-bi-baip.
Scirpus maritimus L. Clubrush; Bulrush.
Carex hookeriana Dew. Sedge.
The name is also sometimes applied to *C. utriculata* Boott.; and other, especially larger forms more strictly designated by pa'gi-gĭp, *q. vid.*

ai'-di-wĭ-sĭ-gi-nûmp.

ai'-go-po-gûmp.
Ribes lacustre Poir. Currant.
Ribes leptanthum Gray, var. *brachyanthum*. Currant.

ai'-go-û-pi.
Pinus edulis Eng. Piñon Pine.

ai'-gwa-bo-gûp.
Cnicus eatoni Gray. Thistle.
Cf. ai-wa-bo-gûp.

ai'-gwo-bi.
Opuntia sp. Cactus.

ai'-tcĭb.
Rhus aromatica Ait. var. *trilobata* Gray. Sumac.
Cf. u'-i-tcĭb, as the name is often heard in the Skull Valley band.

a'-ka.
Name of a plant not identified with certainty. The seeds are said to have been eaten.

ai'wa-bo-gûp(-gop).
Cnicus eatoni Gray.
Cf. ai'gwa-bo-gûp.

a'-kĕn-dzĭp.
Balsamorrhiza hookeri Nutt.
More specifically wi'-a-kĕn-dzĭp, *q. vid.*
Balsamorrhiza sagittata Nutt. Arrowroot.
More specifically ku'si-a-kĕn-dzĭp, *q. vid.*

a'na-gwa-nûp.
Cleome integrifolia Torr., and Gray.

an-dzûp'.
Cymopterus longipes Watson.

añ′-go-bi.
Pseudotsuga douglasii Carr. Douglas Spruce.

añ′-go-gwa-nûp.
Juniperus communis var. *alpina*.
Cf. wa′-pi.

añ′-kai-yûmp.
Rhus glabra L. Sumac.
Shortened from an′-ka-ti-wi-ûmp, the full form.

añ′-go-ma-tai-yu.
See añ′-go-ma-tsai-yu.

añ′-go-ma-tsai-yu.
Deyeuxia canadensis Beam. Reed Bent Grass.
Deyeuxia stricta Trin. Reed Bent Grass.
Poa pratensis L. Meadow or Blue Grass.
Cf. ni′-a-bĭp.

añ′-go-mû-tsa-wai-ni.

añ′-gû-pi; añ′-gûp.
See añ′-ka-mo-do-nûp, from which this is shortened.

äñ′-ka-koi-nûmp.
Sometimes heard in place of äñ′-ka-koi-nûp, *q. vid.*

äñ′-ka-koi-nûp.
Same as äñ′ka-kwi-nûp, the preferred and etymologically more proper pronunciation.

äñ′-ka-kwi-nûp.
Cornus stolonifera *Michx.* Kinnikinnic.

äñ′-ka-kwa-tci-ûp.

äñ′-ka-pa-bu-ĭp.
Polygonum erectum L.

äñ′-ka-pa-dja-rûmp.
Rumex salicifolius Wemman. Dock; Sorrel.

äñ′-ka-pai-dja-rûmp.
Same as preceding.

äñ′-ka-pa-rûmp.
Same as äñ′-ka-pa-dja-rûmp.

äñ′-ka-pa-rûmp.
Same as äñ′ka-pa-dja-rûmp.

äñ′-ka-pa-ri-ûmp.
Fragaria vesca L. Strawberry.

äñ′-ka-po-gomp.
Occasional for äñ′ka-mo-do-nûp, which see.

äñ′-ka-mo-do-nûp.
Shepherdia argentea Nutt. Buffalo-berry.

äñ′-ka-pu-i.
See äñ′ka-pa-bu-ip, the full form.

äñ′-ka-si-yu-na.
Oxyria digyna Comp. Mountain Sorrel.

äñ′-ka-ti-wi-a.
See äñ′ka-ti-wi-ûmp.

äñ′-ka-ti-wi-ûmp.
Rhus glabra L. Sumac.

äñ′-ka-tso-nap.
See äñ′ka-tso-ni-baip.

äñ′-ka-tso-ni-baip.
Lithospermum hirtum Lehm. Gromwell.

äñ′-ka-wa-dzûmp.
Eriogonum microthecum Nutt., etc.

a′-pa.
Valerianella congesta DC.

a′-po.
Atriplex truncata Torr.

a′-ra-si-mu.
?*Clematis douglasii* Hook. Clematis; Virgin's Bower.
See o′bĭn-da-ma-nûmp.

a′-tam-bĭ-tcĭp.
Berula angustifolia Koch.
ats.
Amarantus sp.
ba.
Seed.
ba′-hwap.
Juncus balticus Deth. and *parryi* Eng. Bog-rush.
See pa′-hwap and pa′-ûm-ûp.
bi′-a-gĭnt.
Catkin, female, of willows, etc.
bĭ′-dji-gwa-nûp.
Cleome integrifolia Torr. and Gray.
bi′-tci-gwa-nûp.
Same as the preceding.
bĭ′-tca-mok.
Eriogonum heracleoides Nutt.
bĭ′-tca-mu-kûm.
Eriogonum heracleoides Nutt.
Peucedanum simplex.
büc.
Sap; juice.
dai′-gwi-wĭq.
Stipa comata Trin. and Rupr. Feather Grass.
da′-pa-rai-nûmp.
Astragalus iodanthus Watson. Rattle-weed.
dzi′-na.
Claytonia caroliniana var. *sessilifolia* Torr. Spring-beauty.
Solanum tuberosum. Potato.
Occasional and secondary. Cf. go′tsa-wĭn.
dzi′-na-so-so?
Viola palustris L. Violet.
dzi′-cûp.
Atriplex canescens James.
go′-ni-na-tsu.
See toi′na-tsu, the more common form.
go′-tsa-wĭn.
Solanum tuberosum L. Potato.
gu′-su-wup.
Negundo aceroides Moench. Box-elder.
ha′-ta-bi-tcĭp.
Ranunculus sceleratus L. Buttercup.
See a′tam-bi-tcĭp, the more usual form.
hĭ′-bĭñ-gûp.
Usual form. Flower.
hĭ′-na-bi.
Cowania mexicana Don. Cliff Rose.
Purshia tridentata DC.
hu′-gû-pi.
See also u′gû-pi, the more usual form in which heard.
ĭ′-ca-bo-go-nûp.
Veratrum californicum Durand. False Hellebore.
Smilacina amplexicaulis Nutt. False Solomon's Seal.
See i′djû-pain-po-go-nûp.
ĭ′-ca-bo-gûp.
Aconitum fischeri. Monkshood.
See the preceding.
ĭ′-dja-pa-bo-gop.
Same as ĭ′ca-bo-go-nûp, which see.
ĭ′ca-un-toi-nûmp.
Polemonium coeruleum L. Greek Valerian.
i′-djaip.
Peucedanum graveolens Watson, etc.

ĭ′djûm-ûm-bu-i.
Catkin, male, of willow, etc.

ĭ′-djû-pain-po-go-nûp.
Smilacina amplexicaulis Nutt. False Solomon's Seal.

ĭ′gi-na-ga.
Seedling; germinating plant.

ĭ′gi-si-a-ka.
Bud.

i′-na-bi.
See hi′-na-bi.

ĭ′-sa-yu-gĭp.
Equisetum hiemale L. Scouring Rush.

i′-tcĭb.
Rhus aromatica Ait. var. Sumac; Squaw-berry.
Cf. ai′-tcĭb.

i′-ûm-pi.
Helianthus annuus L. Sunflower.

i′ûp.
See the following.

i′-û-pi.
Chenopodium leptophyllum Nutt. Pigweed; Goose-foot.

ka′-bĭp.
Samara of *Negundo, Acer*, etc.
Cf. näñ′-ki-tco.

kai′-i-ûmp.
Ribes aureum Pursh. Missouri Currant.

kai′si-na-bop
Erigeron macranthus Nutt.

ka′-na.
Lewisia rediviva Pursh. Bitter-root.

ka′-na-gwa-na.
?*Geranium fremonti* Torr. Geranium; Crane's Bill.
Cf. pa′-hu-ĭp.

Œnothera cæspitosa Nutt. Evening Primrose.

ka′-na-gwa-nu.
See ka′-na-gwa-na.

kan′-gûm-pi.
Grayia polygaloides Hook and Arn. Shad Scale.
Cf. mo′-do-nûp.

kan′-kwai-tcûp.
Hordeum nodosum L. and *jubatum* L. Barley.

kan′-kwa-tci-ûp.
See the preceding.

ka′-nûm-pi; ka-nûmp.
Atriplex confertifolia Watson.
See suñ, the standard name.

ko′-ga-bi.
Monolepis chenopodoidea.

ko′-ga-rûm-pi.
Monolepis chenopodoidea.

koi′-di-gĭp.
Castilleia miniata Dougl. Painted-cup.

koi′-gwa-nûp.

koi′-na-komp.
Malvastrum munroanum Gray. False Mallow.
Sphaeralcea emoryi Torr.
Cf. pi′-a-koi-na-komp.

koi′-na-tsu.
General term applied to various medicines and the plants furnishing them which are used in intestinal and stomach troubles. See *Arenaria, Silene*, etc.

koi′-no-komp.
Same as koi′na-komp, which see.

koi′-si-na-bop.
Erigeron macranthus Nutt. Fleabane.
Cf. kai′-si-na-bop.

ko′-ka-bi.
See ko′ga-bi.

ko′-mu.
Zea mais L. Indian Corn.
See Korn.

ko′-no-gwip.
Heracleum lanatum Michx. Cow Parsnip.

korn.
From the English. See ko′-mu.

ko′-sa-mu-i-tci-gĭp.

ko′-si-bo-qûn-tos.
Chænactis douglasii Hook and Arn.
Cf. wañ′-gi-gĭp.

ku′-hwa.
Mentzelia albicaulis Dougl., etc.

ku′-i-do-gĭp.
See koi′-di-gĭp.

ku′-i-gwa-nûp.
Saxifraga nivalis L. Saxifrage.
Cf. toi′-ya-gwa-nûp.

ku′-ki-koi-nûmp.
Gutierrezia euthamiæ Torr. and Gray. Torchweed; Rabbit Brush.

kû′-ma-ra-tsi-yu-gĭp.
Glyceria aquatica Smith. Reed Meadow Grass.
Cf. pa′-si-wûmp.

kûm′-ûn-tsi-a.
Chenopodium rubrum L. and *capitatum* Wat. Pigweed; Goose-foot.
Cf. on′-tĭm-pi-wai.

koi′-nûmp.
Microseris sp.
Cf. mo-i′-tci-gĭp.

ku′-ni-ro-ûmp.
Acorn.

küñ′-ga.
Allium bisceptrum Watson and *acuminatum* Hook. Onion.

ku′-ni-ûp.
Staminate flowers of *Negundo*, etc.

ku′-no-gi.
Quercus undulata Torr. var. Scrub Oak.
See the following.

ku′-no-gĭp.
Sambucus racemosa L. Elder.

ku′-si-a-ka; ku′-si-ak.
An abbreviated form of ku′-si-a-kĭn-dzĭp, which see.

ku′-si-a-kĕn-dzĭp.
Balsamorrhiza sagittata Nutt. Arrowroot.

ku′-si-pa-hwats.
Shortened form of ku′-si-pa-wa-tsĭp.

ku′-si-pa-wats.
Shortened form of ku′-si-pa-wa-tsĭp.

ku′-si-pa-wa-tsĭp.
See ku′tsi-pa-wa-tsĭp.

ku′-si-wañ-go-gĭp.
Potentilla pennsylvanica L. Five-finger.

ku′-si-wûp.
Holodiscus discolor var. *dumosa* maxim.

ku′-so-nĭp.
Brizopyrum spicatum Hooker.

ku′-si-ya-ni-günt.
Krynitzkia fulvocanescens Gray.

ku′-tsa-ga-ti-wo-ra-rat.
Potentilla pennsylvanica L. Five-finger.
See ku′-si-wañ-go-gĭp, supra.

kwa′-tci-ûp.
Hordeum nodosum L. and *jubatum* L. Barley.
Cf. kan′-kwai-tcûp.

kwi′ta-kwa-nûp.
Lupinus leucophyllus Dougl., *parviflorus* Nutt., etc. Lupine.

kwi′-ta-po.
See the next.

kwi′-ta-po-ni.
Orogenia linearifolia Watson.

kwĭ′-tcĕn-bo-gûp.
Xanthium strumarium var. *echinatum*. Cockle-bur.

ma′-ba-so-nĭp.
See mi′-a-ba-so-nĭp.

mĭ′-ta-kom.
See the following word.

mĭ′-ta-komp.
Sidalcea malvæflora Gray.

mĭ′-ta-kûmp.
Same as the preceding.

mo′-a-ba-bu-ip.
Euphorbia montana Engelm., *dentata* Michx., etc.

mo′-a-gûp.
Stephanomeria exigua Nutt.
Anaphalis margaritacea Benth. and Hook. Everlasting.
Arnica parryi Gray.

mo′-a-gwa-nûp.

mo′-ha-gûp.
Same as mo′a-gûp.

mo′a-mu-ĭ-tci-gi.
Same as the following.

mo′-a-mu-ĭ-tci-gĭp.
Crepis occidentalis Nutt.

mo′-a-kûmp.
Balsamorrhiza hookeri Nutt.
Cf. o′-a-kûmp and wi′-a-kĕn-dzĭp.

mo′-a-pa-oñ-gop.
Ranunculus aquatilis L. var.

mo′-do-büc.

mo′-do-nûp.
Grayia polygaloides Hook and Arn. Shad-scale.

mo′-gon-dzi-ûmp.
Berries of *Rosa nutkana* Presl.

mo′-no.
Deschampsia danthonioides Munro.

mo′-ta-ga.
See mo′-ta-qa.

mo′-ta-komp.

mo′-ta-ga.
Helenium autumnale L. Sneeze-weed.
Cf. tĭ′-da-ya-gûp.
Layia glandulosa Hook and Arn.
Gymnolomia multiflora Benth. and Hook.
Cf. ĭ′-ca-mo-ta-ga.
The name is properly applied to these and their relatives and has no popular English equivalent. As may be seen, these forms in general may have also a more specific designation as well. It is probably used in a more restricted sense for *Layia*, etc., daisy-like forms.

mo′-tci-gi.
See mo′-tci-gĭp.

mo′-tci-gĭp.
Same as mû′-tci-gĭp, which see.
mu′-a-kûmp.
See mo′-a-kûmp.
mu′-ha-ti-bu-i.
Crepis glauca Torr. and Gray.
Cf. mu′-tci-gĭp.
mu′-ha-kûm.
See the next word.
mu′-ha-kûmp.
Grindelia squarrosa Dunsl. Arnica.
Helianthella uniflora Torr. and Gray.
mu′-i-tci-gi.
Same as mu′-i-tci-gĭp.
mu′-i-tci-gĭp.
See mu′-tci-gĭp.
mu′-pa-tai-gi-nûp.
Arctium lappa L. Burdock.
mu′-tci-gi.
See the following.
mu′-tci-gĭp.
Hieracium gracilis Hook and *scouleri* Hook. Hawkweed; Thistle.
Sonchus asper Vill. Sow-thistle.
Crepis glauca Torr. and Gray.
Lactuca leucophæa Gray and *ludoviciana* DC. Lettuce.
?*Troximon aurantiacum* Hook.
The word corresponds approximately to the English "thistle," as popularly used, applying to quite a variety of forms as above indicated. Some of these have their more specific designations as indicated under each.
mu′-tsa.
?*Mammilaria* sp. Cactus.
mu′-tsai-kûmp.
Sidalcea malvæflora Gray.
Cf. mĭ′-ta-kûmp.
mû′-tsĕm-bi-a-dĭ-kûp.
Townsendia sericea Hook. and other alpine forms eaten by the mountain sheep.
mu′tu-nants-ûm-bi-ji.
Zauschneria californica Presl., *Gilia aggregata*, etc.
na′-da-pa-ra-na-gĭnt.
Astragalus iodanthus Watson. Buffalo-bean.
Cf. da′pa-rai-nûmp.
nai′-a-bĭp.
See ni′a-bĭp.
na′-na-rĭp.
Linum kingii Watson. Flax.
näñ-ki-tco.
See näñ′ki-tso.
näñ′-ki-tso.
Samara of *Negundo*, *Acer*, etc.
Cf. ka′bĭp.
nan′-tai-bĭtc.
See nan′te-bĭtc.
nan′-te-bĭtc.
Gnaphalium sprengelii Hook. and Arn. Cudweed.
Madia glomerata Hook.
ni′-a-ba-so-nĭp.
See ni′-a-bĭp.
ni′-a-bi.
Same as the following.
ni′-a-bĭp.
Deyeuxia canadensis Beauv. and *stricta* Trin. Reed Bent Grass.
Poa pratensis L. Blue Grass.

Poa tenuifolia Nutt. Bunch Grass; Meadow Grass.

nĭ′-di-ba.
Lycopus sinuatus Ell. Water Horehound.

nĭ′-dĭp.
Same as nĭ′-di-ba.

nĭ′-dĭp.
Same as nĭ′-di-ba.

nĭ′-nûn-tsai.
Geum macrophyllum Willd.

na′-da-pu-gai-gi.
Spartina gracilis Trin. Salt Grass.

ni′-u-ru-pam-pi.
Ranunculus cymbalaria Pursh. Buttercup.

nu′-ro-pam-pi.
Same as preceding.

o′-a-kûmp.
Balsamorrhiza hookeri Nutt.
Cf. mo′-a-kûmp and wi′-a-kĕn-dzĭp.

o′-a-pa-dza-ki.
Eriogonum heracleoides Nutt. and *umbellatum* Torr.
Cf. bĭ′-tca-mu-kûm for the first and sa′-na-kun-da for the second.

o′-a-tûmp.
Avena sativa L. Oats.

o′-bĭn-da-ma-nûmp.
Clematis douglasii Hook and *ligusticufolia* Nutt. Virgin's Bower.

o′-do.
Shortened from o′do-rop, which see.

o′-do-rop.
Same as o′ro-rop, the more usual form.

o′gĭp.
Phalaris arundinacea L. Canary Grass.
Aristida purpurea Nutt. Triple-awned Grass.
Cf. o′gwĭp; u′-gwĭp; toi′-ya-o-gwĭp and yo′nĭp.

oi′-tcĭp.
Cratægus oxycanthus. Thorn.

oi′-tcûn-goi-djok.
Sedum debile Watson, etc. Stone-crop.

oi′-tcu-mo.
Eriogonum cernuum Nutt. and *inflatum* Torr.

oi′-tcu-o.
Same as the preceding.

oi′-tcu-yo.
See oi′-tcu-yo.

o′-ro-rop.
Agropyrum repens Beauv. Blue-joint.
Cf. wa′-don-dzĭp and pĕ′-ga-yu-gĭp.
Elymus canadensis L. Wild Rye; Lyme Grass.
Cf. ti′-wa-bi-nĭp.
Elymus sibiricum L. Wild Rye; Lyme Grass.

o′-ro.
Shortened form of o′-ro-rop, which see.

oi′-yĭñk.
Solidago canadensis L., *nemoralis* Ait., etc. Golden-rod.

o′-a-yĭnk.
Same as oi′-yĭnk and about equally common with it. Doubtless the original form (o′-a-bĭt, yellow, + yĭñk).

o-ka.
Salicornia herbacea L. Samphire.
Cf. pa′-o-ka, which is the definite and far more frequent form, o′ka being narrowly applied to the other plant.

on′-tĭm-pai-wa.
Variant from on′-tĭm-pi-wa-tsĭp, which see.

on′-tĭm-pi-wai.
See on′-tĭm-pi-wa-tsĭp.

on′-tĭm-pa-wa.
See on′-tĭm-pa-wa-tsĭp.

on′-tĭm-pa-wa-tsĭp.
See on′tim-pi-wa-tsip.

on′-tĭm-pi-a-wa.
See the following.

on′-tĭm-pi-wa-tsip.
Chenopodium rubrum L. and *capitatum* Watson. Pigweed.

o′-pi.
Wood; tree or shrub; plant.

pa-at′-ga.
See pa-otq′-ga.

pa′-bĭp.

pa′-bo.
From pa′-bo-go, which see.

pa′-bo-go.
Cnicus undulatus Gray. Plumed Thistle.

pa′-bo-gwo.
Same as the preceding.

pa′-bu-ĭp.
Commonly used as a general term indicating plants growing in water or wet places with the leaves floating or above the water.
Dodecathion meadia L. Shooting Star.
Sagittaria variabilis Engelm. Arrow-head.
See pa′bo-bu-ip.

pa′-bo-bu-ĭp.
Sagittaria variabilis Engelm. Arrow-head.

pa′-da-wĭ-si-go-ûp.

pa′-ga-sau-wi-no-ûp.
Delphinium bicolor Nutt. and *menziesii* DC. Larkspur.

pa′-gi-gĭp.
Carex jamesii Torr., *fistira*, etc. Sedge.
Carex utriculata Boott. Sedge.
Cf. also ai′-bi-baip.

pa′-ga-so-nap.
Epilobium spicatum L. Willow-herb.

pa′-go-no-gwĭp.
Sambucus glauca Nutt. Elder.

pa′-go-no-gĭp.
See pa′-go-no-gwĭp.

pa′-go-nu-ĭp.

pa′-gu-ĭp.
Polygonum hartwrightii Gray.

pa′-gwa-nûp.
Mentha canadensis L. Mint.

pa′-gwo-dzûp.
Claytonia perfoliata Donn. Spring Beauty.

pa′gwo-nûp.
?*Chenopodium capitatum* Watson. Pigweed.

pa′-hu-ip.
Dodecathion meadia L. Shooting Star.

pa′-hwats.
Artemisia dracunculoides Pursh.

paidj.
Phragmites communis Trin. Reed.

pai′-gĭp.
Same as pa′-gi-gĭp, which see.

pai′-ya.
Smilacina stellata Derf. False Solomon's Seal.

pai′-ya-bo-sip.
Lemna. Duck-meat; Duck-weed.
Cf. wa′-da-bu-ip.

pai′-yo-nĭp.
Juncus bufonius. Bog-rush.

pa′-ma-wûp.
Juncus balticus Deth. and *parryi* Engelm. Bog-rush.

pa′-hwap.
See pa′-ma-wûp.

pam′-bu-i-ûp.
Lycopodium sp.

pa′-mu.
Nasturtium palustre DC. and var., etc. Water-cress.
?*Ranunculus aquatilis* L. var.

pa′-mo
See pa′-mu.

pa′-na-tĭ-so.
Mentha canadensis L. Mint.
See pa′-gwa-nûp.

pa′-na-tsu.
Apparently the same as the preceding and etymologically preferable in such case (*pa*, water, + *na′-tsu*, medicine).

pa′-na-wi.
Triglochin maritimum L. Arrow-grass.

pa′-o-gûmp.
See the next.

pa′-o-gûm-pi.
Aquilegia cœrulea James. Columbine.
Cf. pa-wa-gûm-pi.

pa′-o-ka; pa-o′-ka.
Salicornia herbacea L. Samphire; Glasswort.

pa′-oñ-gop.
See pa′oñ-gûp.

pa′-oñ-gûp.
Hypnum sp. Moss.
Polytrichum juniperinum. Moss.
See tĭm′-pĭn-pa-bo-i-ûp and pi′-a-pa-oñ-gûp.

pa-otq′-ga.
Aster adscendens Lindl. Starwort; Aster.

pa′-ra-tĭ-tsĭn-bo-gop.
?*Argemone mexicana* var. *hispida* Gray. Prickly Poppy.
Cf. toi′-yan-bo-gop.
Probably the full form of pa′tsi-na-bo-gop, which see.

pa-o-tĭm-bĭtc.
Sium cicutifolium Gmelin. Water Parsnip.

pa′-ru-sip.

pa′-sa-gwip; pa′-sa-gwûp.
Cystopteris fragilis Bernh Fern.

pa′-tsĭ-na-bo-gop.
Cnicus sp. Plumed Thistle.

pa′-sa-gwo-na-komp.
See pa′-sa-koi-na-komp.

pa′-sa-koi-na-komp.
Malvastrum coccineum Gray. False Mallow.
Cf. koi′-na-komp.

pa′-sa-ton-dzĭp.
Hedysarum mackenzii Richard.

pa′-sa-wi-gûmp.
Potentilla glandulosa Lindl. Five Finger.

pa′-sa-wi-gûn-dza.
Heuchera rubescens Torr. and other species. Alum Root.

pa′-sa-pa-oñ-gop.
Glaux maritimum L. Sea Milkwort.

pa′-sa-wu-mûts.
Stipa viridula Trin. Feather Grass.

pa′-si-hwu.
See pa′sa-hwu-mûts.

pa′-si-go.
See pa′-si-gwĭp.

pa′-si-gwĭp (pa′-si-go-ûp).
Osmorrhiza nuda Torr. Sweet Cicely.
?*Glycosma occidentalis* Nutt.

pa′-ûm-ûp.
See pa′-ma-wûp.

pa′-ûñ-ga.
Erigeron macranthus Nutt. Fleabane.
Cf. kai′-si-na-bo-gop.

pau′-wats.
See pa′hwats.

pa′-wa-pi.
Juniperus virginiana L. Red Cedar.

pa′-wa-sĭp; pa′-wa-tsĭp.

pa′-yam-pa; pa′-yamp.

pi′-a-da-bi-wûmp.
See pi′-a-ta-bi-wûmp.

pi′a-ga.
?*Eriogonum inflatum* Torr. Probably not specific.

pi′-a-koi-na-komp.
Sphæralcea emoryi Torr.

pi′-a-kĕn-dzĭp.
Wyethia amplexicaulis Nutt.

pi′-a-ku-hwa.
Mentzelia lævicaulis Torr. and Gray.

pi′-a-mo-a-gûp.
See pi′-a-mo-ha-gûp.

pi′-a-mo-ho-gûp.

pi′-a-näñk.
Mitella trifida Graham. Mitrewort.

pi′-a-pa-bu-ĭp.
Sagittaria variabilis Engelm. Arrow-head.
See pa′-bo-bu-ĭp.

pi′-a-pa-oñ-gop.
Polytrichum juniperinum. Moss.

pi′-a-pa-otq-ga.
Helianthella uniflora Torr. and Gray.
Cf. mu′ha-kûmp.

pi′-a-koi-na.
Arabis retrofracta Gray.

pi′-a-po-gop.
Glycosma occidentalis Nutt.

pi′-a-pa-wa-gûmp.

pi′-a-pa-oñ-gop-pai-dja-rûmp.
Polygonum amphibium L.

pi′-a-ra-dûm-bĭp.
Lonicera utahensis Watson and *involucrata* Banks. Woodbine.

pi′-a-ba-rûm-bĭp.
See pi′-a-ra-dûm-bĭp.

pi′-a-si-bo-i-nûp.
Same as the following.

pi′-a-si-bo-i-ûp.
Arabis retrofracta Gray. Rock Cress.

pi′-ats.

pi′-a-ta-bi-wûmp.
Orthocarpus linearifolius Benth.
Cf. ta′-bi-wûmp.

pi′-a-so-nĭp.

pi′-a-wa-da.
Artemisia biennis Willd.
Cf. on′-tĭm-pi-a-wa and wa′-da.

pĭ′-ga-dĭt.
See pĭ′ga-yu-gĭp.

pĭ′-ga-yu-gĭp.
Agropyrum repens Beauv. Blue-joint.

pĭ′-tca-gwa-nûp.
Sphæralcea rivularis Torr.

pi′-wa-nûp.
?*Asclepidiora decumbens* Gray.

pi′-o-ra.
A rather indefinite name applied loosely to Hedysarum and other tall or climbing Leguminosæ.

pi′-a-ka-gwa-nûp.
Stachys palustris L. Wound Wort.
Only occasionally so designated, being commonly known as toi′-ya-ba-gwa-nûp, which see.

po′-go.
See po′-gwo.

po′-go-nûp.
Currant (general term); berry.
Ribes aureum Pursh. Missouri Currant.

po′-gûmp.
See po′-go-nûp.

po′-gwo.
Cnicus eatoni Gray. Thistle.

po′-ho-bi.
Artemisia tridentata Nutt. Sage-brush.

po′-ho-ru.
Aphyllon fasciculatum Torr. and Gray. Cancer-root.

poi′-na.
See poi′-ya.

poi′-ya.
Sisymbrium canescens Nutt. Hedge Mustard.

po′-nak.
See poi′-ya

pu′-i-ba-u.
Nicotiana attenuata Torr. Tobacco.

pu′-i-dĭ-kûp.
Medicago sativa L. Lucern; alfalfa.

pu′-i-dĭ-sas.
Erigeron leiomerus Gray. Fleabane.
?*Monardella odoratissima* Genth.

pu′-i-pa-si-go.
Primula parryi Gray. Primrose.
Cf. toi′-ya-na-ti-bu-da.

puĭ-i-wa-nûp.
Eriogonum brevicaule Nutt.

pûñ-go-na-tsu.
A general term applied to a considerable number of plants used as remedies for horses (*pûñ′-go*, horse, + *na′-tsu*, medicine). Such are *Galium aparine*, *Lygodesmia*, *Silene multicaulis*, etc.

pu′-i-si-a-ka.
General name for green or growing plants (*pu′-i-bĭt*,

green, + *si′-a-ka*, plant, which see).

pûñ-go-ûn-da-mi.

A somewhat general term applied to a number of plants (from *pûñ-go*, horse, + *ûn*, possessive, + *da′-mi*).

Smilacina amplexicaulis Nutt. and *Triglochin maritimum* L. are among the plants grouped under this name, utterly divergent forms being brought together upon a basis other than resemblance to each other.

ri′-a-bi.

Rare for ni′-a-bi, which see.

sa′-gû-pi.

Salix amygdaloides Anders., *lasiandra* Benth., *flavescens* Nutt. Willow.

sai′-gi-tamp.

Spiranthes romazoffiana Cham. Ladies' Tresses.

saip.

Scirpus lacustris L. var. *occidentalis* W. Bulrush.

sai′-ya-hyu-gĭn.

Saponaria vaccaria. Soapwort.

sa′-na-kün-da.

Eriogonum microthecum Nutt., *ovalifolium* Nutt., *umbellatum* Torr., etc.

sa′-na-kĭnt.

See sa′-na-kün-da.

si′-a-ka.

Plant, branch, shoot, etc.

sĭ′-bi.

Phlox longifolia Nutt. Sweet William; Phlox.

si′-bo-i-ûp.

Cleome lutea Hook.

si′-bo-i-ûmp.

Nasturtium palustre DC. var. Water-cress.

si′-bû-pi.

Bigelovia douglasii Gray. Greater Rabbit-brush; Rayless Golden-rod.

Tetradymia canescens DC. var.

so′-ho-bi.

Populus angustifolia James. Cottonwood.

si′-hĭp.

See si′-o-pi.

sĭ′-gi.

Leaf.

si′-go.

Calochortus nuttallii Torr. and Gray. Sego.

si′-na-tsu.

sĭñ-gûp.

See sĭñ-gû-pi.

sĭñ′-gû-pi.

Populus tremuloides Michx. Quaking Aspen.

si′-o-pi.

General name for species of *Salix* corresponding to the English "willow." The several types of willows, or rather some of them, have in addition more special names. See under *Salix* in preceding list.

si′-wûmp.

Glyceria distans Wahl. and *nervata* Trin. Manna Grass.

Cf. also tai′-gwi-bi for the latter.

so′-go-ba-gwĭp.
Bryum sp. Moss.
san′-añ-go-bi.
Abies menziesii Lindl. Balsam.
so′-ai-tûmp.
Agaricus. Mushroom.
so′-ko-ri-bo-ûmp.
Bryum sp. (same as preceding). Moss.
so′-ko-ri-ûmp.
Berberis repens Lindl. Oregon Grape.
so′-nĭp.
General term corresponding to the English "grass."
suñ.
From su′-no, which see.
su′-no.
Atriplex confertifolia Watson.
ta′bĭ-tci-gop.
See ta′-bi-si-go-ûp.
ta′-bi-si-go.
From ta′bi-si-go-ûp, which see.
ta′-bi-si-go-ûp.
Zygadenus nuttallii Gray. Poison Sego.
ta′-bi-ci-pomp.
See ta′-bĭ-tci-pomp.
ta′-bi-si-bû-pi.
Bigelovia pulchella Gray. Rabbit Brush.
ta′-bi-tci-pomp.
See ta′bi-si-bû-pi.
ta′-da-bi.
Rhus toxicodendron L. Poison Oak or Ivy.
tai′-gwi-bi.
Glyceria nervata Trin.
Cf. si′-wûmp, also applied in more general way to this plant.
ta′-bi-wûmp.
Orthocarpos linearifolius Benth.
Cf. pi′-a-ta-bi-wûmp.
ta′-ka-dĭ-di-a-rûp.
Abronia fragrans Nutt. Sand Puff.
ta′-kan-dĭ-dai-kûp.
See ta′kan-di-dĭ-di-a-gûp.
ta′-kan-dĭ-di-a-gûp.
Erigeron grandiflorus Hook. Fleabane.
ta′-kûm-bu-i.
Polygonum hartwrightii Gray.
Cf. pa′-gu-ĭp.
ta′-ni-kûmp.
Arnica cordifolia Hook.
ta′-tsĭp.
Pachystima myrsinites Raf. Box.
tci′-cop.
Eurotia lanata Moq. White Sage.
te′-e-pa-ga-sa-wûp.
ti′-a-bi.
Rosa nutkana Presl. Rose.
ti′-a-sa-ton-dzi.
Astragalus utahensis Torr. and Gray. Rattle-weed.
Cf. to′-sa-wu-da.
ti′-ba.
Pine nuts; nuts of *Pinus monophylla*.
ti′-a-tso-nap.
ti′-ba-wa-ra.
Pinus edulis. Piñon Pine.
ti′-ba-wa-na-ma-tsa-mo-gi.
ti′-ba-ûñ-gop.
Pine Cone; cone of *Pinus monophylla*.
ti′-bo-hi.
Taraxacum officinale Weber. Dandelion.

tĭ′-da-kai-mi-ya.
Vaccinium cæspitosum Michx. Bilberry.

tĭ′-da-pa-wa-gûmp.
Aquilegia cærulea James. Columbine.
See pa′wa-gûmp.

tĭ′-da-ya-gûp.
Helenium autumnale L. and *hoopesii* Gray. Sneezeweed.
Cf. mo′ta-qa and toi′ya-mo-ta-qa.

tĭ′-nai-hya.
Cf. tĭm′ai-hya. Mountain Tea.

tĭm′-bai-na-tsu.
General name for medicines used in sexual diseases or for plants furnishing such.

tĭm′-bai-wi-gûn-dza.
Parnassia parviflora DC. Grass of Parnassus.

tĭm′-bai-wi-gûn-ta.
See tĭm′bai-wi-gun-dza.

tĭm′-bi-mo-a-gwa-nûp.
Aplopappus macronema Gray and *parryi* Gray.

tĭm′-bi-ma.
See tĭm′bo-ûmp.

tĭm′-pĭn-ba-bu-ip.
See tĭm′pin-pa-bo-i-ûp.

tĭm-pĭn-pa-bo-i-ûp.
Polytrichum juniperinum. Moss.
Cf. pa′-oñ-gop.

tĭm′-bo-ûmp.
See tĭm′-pin-tĭm-bo-i-ûmp.

tĭm′-pĭn-tĭm-bo-i-ûmp.
Spiræa cæspitosa Nutt.

tĭm′-ba-ip.
Heard occasionally for the preceding and applied generally to various other plants growing on cliffs and over rocks.

tĭm′-pi-sa-gwûp.
Silene acaulis L. Catchfly.

tĭm′-pi-sa-wap.

tĭm′-pĭn-so-kûp.
General name for lichen.

tĭm′-pi-dza-na-kwo.
Senecio, several species, the latex of which was used for preparing chewing-gum. Groundsel.

tĭm′-pĭn-tu-nûmp.
Kalmia glauca Ait. American Laurel.

tĭn′-a-bĭp.
Poa californica Munro. Meadow Grass.
Cf. ni′a-bĭp.

tĭñ′-go-ip.
See tiñ′-gwĭp.

tĭñ′-gwip.
Chamæbatiaria millifolium Maxim.
?*Holodiscus discolor* var. *dumosa*.

tĭ′-nai-gop.
Urtica holosericea Nutt. Nettle.

tĭ′-sas.
Erigeron glabellus Nutt., var. Fleabane.

tĭ′-so-nĭp.
Alopceurus aristulatus Mx. Foxtail Grass.

tĭn′-tsĭñ-ga.
Cnicus drummondi Gray. Plumed Thistle.
Cf. also tsĭñ′-ga.

ti′-ûm-pi.
Amelanchier alnifolia Nutt. Service-berry.

ti′-wa-bi-nĭp.
Elymus canadensis L. Wild Rye.
Cf. o′-ro-rop.

ti′-ya-gûp.
Helenium autumnale L. and *hoopesii* Gray. Sneezeweed. From tĭ′-da-ya-gûp, *q. vid.*

to′-bai-ba-bi.
Bromus breviaristatus Thurl., etc. Brome Grass.

to′-bai-bi.
See to′-bai-ba-bi.

to′-go-ûn-go-na.
Castilleia parviflora Bong., *minor* Gray. Indian Paintbrush.

to′-dzûp.
Ferula multifida Gray.

to′-ho-bai-bi.
See to′-bai-ba-bi.

to′-ho-bi.
Same as to′bai-ba-bi, being a shortening of the preceding form.

to′-ho-bi-so-nĭp.
Probably another form for *Bromus*.

toi′-dĭ-sas.
See toi′-ya-dĭ-sas.

to′-ĭmp.
Typha latifolia L. Cat-tail.

toi′-gû-pa-gûnt.
Eriogonum villiflorum.
Plantago eriopoda Torr., *patagonica* Jacq., etc.

toi′-ya-ba-gwa-nûp.
Lophanthus urticifolius Benth.
Dracocephalum parviflorum Nutt. Dragon-head.
Scutellaria sp. Skullcap.
General term for these closely related labiales, the seeds of all of which were gathered and used for food in the same manner.

toi′-ya-ba-gwo-no-gĭp.
Actæa spicata L. Baneberry.

toi′-ya- a-hwip.
See toi′ya-ba-o-pi.

toi′-ya-ba-o-pi.
Aplopappus suffruticosus Gray, *macronema* Gray.

toi′-ya-ba-gwa-dzûp.
Hydrophyllum occidentale Gray, *capitatum*. Waterleaf.

toi′-ya-bĭn-da-tsĭp.
Jamesia americana Torr. and Gray.
Symphoricarpos areophilus Gray. Snowberry.

toi′-ya-bĭ-tûm-ba-ga.
Valeriana edulis Nutt.

toi′-ya-bi-tûm.
See toi′ya-bi-tûm-ba-ga.

toi′-ya-bo-go-nûp.

toi′-ya-da-tsĭp.
See toi′ya-bi-tûm-ba-ga.

toi′-ya-da-ti-go-ra.
Erigeron glabellus Nutt. Fleabane.
Cf. under Erigeron in preceding list.

toi′-ya-da-ti-bu-da.
?*Primula parryi* Gray. Primrose.
?*Polygonum viviperum* L

toi′-ya-tĭm-ba-dzap.
Arenaria triflora var. *obtusa* Watson. Sandwort.

toi′-ya-mo-gûp.
See the next word, toi′-ya-mo-ha-gûp.

toi′-ya-mo-ha-gûp.
Anemone multifida Poir. Windflower.

toi′-ya-mo-ta-gomp.
Mertensia alpina Don. Lungwort.

toi′-ya-mu-ti-ga.
Helenium hoopesii Gray. Sneezeweed.
Cf. tĭ′-da-ya-gûp.

toi′-ya-na-bo-gop.
Argemone mexicana var., *hispida* Gray. Prickly Poppy.

toi′-ya-na-ti-bu-da.
See toi′-ya-da-ti-bu-da.

toi′-ya-gwa-nûp.
Saxifraga nivalis L. Saxifrage.

toi′-ya-o-gwĭp.
Aristida purpurea Nutt. Triple-awned Grass.
Cf. o′-gwĭp and yo′-nĭp.

toi′-ya-dĭ-sas.
Chrysopsis villosa Nutt. Golden Aster.

toi′-ya-ra-ta-boi-ya.

toi′-ya-ro-dzĭp.
Sium cicutifolium Gmelin. Water Parsnip.

toi′-ya-sa-ton-dzi.

toi′ya-ta-son-dzi.

toi′-ya-si-wûmp.
Festuca ovina var., *brevifolia* Watson. Fescue Grass.

toi′-ya-o-ro-rop.

toi′-ya-so-nĭp.
Deschampsia cæspitosa Beauv. var. Hair Grass.

toi′-ya-wün-ta-mu-ta-qa.

toi′-ya-wĭ-tûm-ba-ga.
Erythronium grandiflorum Pursh. Dog-tooth Violet.
The full form is probably toi′-ya-wünt-ûm-ba-ga (*toi′-ya-wünt*, canyon.) Contrast toi′-ya-bĭ-tûm-ba-ga (*toi′-ya-bi*, mountain).

toi′-ya-wĭ-tûm-ba.
See toi′-ya-bĭ-tûm-ba-ga, from which this is shortened.

toñ′-gi-cĭp.
Prunus demissa Walpers. Choke-cherry.
Cf. to′-o-nûmp.

ton′-tso.
Trifolium, various species, corresponding in usage precisely, or nearly so, to our English word "clover."

to′-no-pi.

to′-pai-ba-bi.
See to′bai-ba-bi.

to′-pai-bi.
Shortened from to′pai-ba-bi.

to′-sa-na-tsu.
A koi′-na-tsu prepared from or consisting of the roots of *Heuchera rubescens* Torr. and related species and of species of *Mitella*, which see in the preceding list. Sometimes applied to the plants themselves.

to′-sa-wu-da.
Astragalus utahensis Torr. and Gray. Rattleweed.

For significance see under this name in the preceding list.

to′-o-nûmp.

Prunus demissa Walpers. Choke-cherry.

Cf. toñ′-gi-cip.

toi′-ya-wan-go-gĭp.

?*Iresia gordonia* Torr. and Gray.

toi′-ya-bo-go-nûp.

Ribes oxycanthoides L. Currant.

toi′-ya-po-go-nûp.

Same as the preceding.

tsĭ′-gi-tûmp.

Œnothera biennis L. Evening Primrose.

tsi′-na.

See tsĭñ′-ga-bo-gop.

tsi′-na-bo-gop.

Cnicus drummondi Gray. Plumed Thistle.

Cnicus undulatus Gray.

tsĭñ′-ga.

See tsĭñ′-ga-bo-gop.

tsĭñ′-ga-bo-gop.

Same as tsi′na-bo-gop, and the preferable form.

Cnicus drummondi, and *undulatus* Gray. Plumed Thistle.

tsi′-ûmp.

Berries of *Rosa californica* and *fendleri* Crepin.

tsi′-o-pi.

Rosa californica and *fendleri* Crepin. Rose.

tsom′-ba.

Same as tsom′-bai-bi.

tsom′-bai-bi.

Same as tso′-ni-baip.

tso′-ni-baip.

Lithospermum pilosum Nutt. and *multiflorum* Torr.

tso′-nap.

Same as tso′ni-baip, which see.

tso′-hwa.

tu′-go-wa-tsĭp.

Chrysopsis villosa Nutt., etc. Golden Aster.

tu′-go-wi-nûp.

Pentstemon confertus Dougl. var.

tu′-hi-nûp.

Cercocarpus parvifolius Nutt.

tu′-i.

Urtica sp.

tu′-ku-ba-gûmp.

Delphinium bicolor Nutt. and *menziesii* DC. Larkspur.

tu′-kwûn-da-mi.

See tu′-kwûn-dau-wi-a.

tu′-kwûn-dau-wi-a.

Rubus leucodermis Dougl. Raspberry.

tu′na.

Cymopterus montanus Torr. and Gray.

tu′-nam-pi.

Cercocarpus ledifolius Nutt. Mountain Mahogany.

tu′nûmp.

Same as tu′-nam-pi, which see.

tu′-pam-pi.

See tu′-ro-vi-pam-pi.

tu′-ro-pam-pi.

Shortened from tu′-ro-vi-pam-pi, which see.

tu′-ro-sip.

Ambrosia psilostachya DC. Ragweed.

Iva axilaris Pursh.

tu′-ro-vi-pam-pi.

Rudbeckia occidentalis Nutt. Cone-flower.

tu′-si-gĭp.

Epilobium coloratum Muhl. Willow-herb.

tu′-tom-pi.

A shrubby plant mentioned by Indians, but not identified by the author.

u′-di-ûp.

Betula occidentalis Hook. Birch.

u′-gai-gût.

u′-gû-pi.

Beckmannia cruciformis Host. Slough Grass.

u′-i-tcĭb.

See ai′-tcĭb.

u′na-tso-mo-gi.

Humulus lupulus L. Hop.

Cf. wa′-na-na-tso-mo-gi.

u′sa.

Epilobium alpinum L. Willow-herb.

u′-gu-dzûp.

Alnus incana Willd. Alder.

wa′-bi.

Melica poœoides Nutt. Melic Grass.

wa′da.

Suaeda depressa Watson. Sea-blite.

wa′-don-dzĭp.

Agropyrum repens Beauv. Blue-joint.

See also under *Agropyrum* in the preceding list.

wai.

Oryzopsis cuspidata Benth. Mountain Rice.

wa′-da-bu-ip.

Lemna sp. Duckweed.

wai′-ûmp.

Probably full form for wai, but only rarely heard.

wai′-a-na-tsu.

General term for medicines used for burns or for plants producing such.

wa′-na-ma-tsa-mo-gi.

See next word.

wa′-na-na-tsa-mo-gi.

Humulus lupulus L. Hop.

wa′-na-tsi-mu-gi.

See preceding word.

wan′-di-wa-sĭp.

See wan′-di-wa-sûmp.

wan′-di-wa-sûmp.

Epipactis gigantea Dougl.

wañ′-gĭn-gĭp.

Chœnactis douglasii Hook. and Arn.

Cf. ko′-si-bo-qûn-tos.

wañ-go-gĭp.

Achillea millefolium L. Yarrow.

wa′-nûp.

Humulus lupulus L. Hop.

Cf. wa′-na-na-tsa-mo-gi.

wa′-na-gĭnt.

Potentilla fruticosa L. Five-finger.

Cf. wa′-tsi-gĭnt.

wañ′-go.

Pseudotsuga douglasii Carr. Douglas Spruce.

Cf. añ′-go-bi.

wan′-dzi-baip.

Eleocharis palustris R. Br. Spike Rush.

wa′-pi.

Juniperus californica var. *utahensis*, etc. Cedar; Juniper.

wap′-ûm-pi.
Cedar berries; fruit of *Juniperus californica* var. *utahensis.*

wa′-si-pĭt.
Silene acaulis L. Catchfly.
See also tĭm′-pi-sa-gwûp.

wa′-tsĭp.
Bark.

wa′-tsi-gûnt.
Potentilla fruticosa L. Five-finger.
Cf. wa′-na-günt.

wi′-a-kĕn-dzĭp.
Balsamorrhiza hookeri Nutt.

wi′-kûn-dza.
See wi′-gûn-dza.

wi′-gûn-dza.
Heuchera rubescens Torr. Alum-root.

wi′-gon-dzĭp.
?*Ranunculus* sp.

win′-au-tsaug.
A gum or mucilage prepared from *Malvastrum munroanum* and used on the inside of earthen vessels as a filling. Also the name is sometimes applied to the plant itself.

wi′-na-go.
Fritillaria pudica Spreng. Lily; Yellow Bell; Buttercup.

wi′-tcûp.
Trisetum subspicatum Beauv.

wĭ′-sa-po-go-nûp.
Ribes divaricatum Dougl. Currant.

wĭ′-sa-po-gûmp.
Same as wĭ′sa-po-go-nûp, which see.

wi′-djan-gwo-djop.
Arenaria triflora var. *obtusa* Watson. Sandwort.
Cf. toi′yan-tĭm-ba-dzap.

wu′-da-wa-nûp.
Apocynum androsaemifolium L. Indian Hemp; Dogbane.

wu′-si-bĭn-gĭnt.
Phacelia menziesii Torr. and *circinata* Jacq.

wu′-si-gûnt.
Same as wu′-sĭ-bĭñ-gĭnt, which see.

wu′-da-ûn-dĭ-kûp.
A somewhat general term applied to a number of plants which are eaten or the fruit of which is eaten by bear. Such are *Lonicera, Smilacina,* etc., which, of course, have in addition their more special designations. See under the respective names in the preceding list.

wu′-bu-i-nûp.
Lepidium intermedium Gray. Peppergrass.

wu′-pi.
Wood, woody plant, stick, etc.
Cf. o′pi.

yamp.
See yam′-pa.

yam′-pa.
Carum gairdneri Benth. and Hook.

yam′-pa-gwa-nûp.
Erodium cicutarium L'Her. Alfilaria; Crane's-bill.

yo′-go-ti-wi-ya.
Silene menziesii Hook. Catchfly.

yo′-go-ti-wi-yu.
See the preceding word.

yo′-nĭp.
Aristida purpurea Nutt. Triple-awned Grass.

yo′-ni-co-nĭp.
See yo′-ni-so-nĭp.

yo′-ni-so-nĭp.
?*Deschampsia danthonioides* Munro. ?Hair Grass.
Glyceria distans Wahl. Manna Grass.
Festuca tenella Willd.

A NOTE ON THE GENUS LOLLIGUNCULA.

BY S. S. BERRY.

In 1881 Professor Steenstrup, as a note to the French résumé of his paper on "Sepiadarium og Idiosepius" (*K. Danske Vidensk. Selsk. Skr.*, 6 R., I, 1881, p. 242), wrote as follows:

"Le *Loligo brevis* de Blainv. est pour moi le type d'un genre à part: *Lolliguncula.* Parmi les espèces connues du genre *Loligo* Lmk., cette espèce, si bien caractérisée par ses nageoires épaisses, larges et très courtes, formant dans leur ensemble un ovale transverse, est la seule dont les famelles reçoivent les spermatophores sur la paroi intérieure du manteau, à côté de la branchie gauche.

Le mâle du *Loligo brevis*, ainsi que celui du *Loligo brevipinna* Les., si ce dernier est réellement une espèce distincte, ne m'étant pas connu, la place systématique du genre nouveau est pour moi encore un peu deuteuse."

L. brevis is an Atlantic form, but I have lately encountered a species from the opposite coast of Middle America which may prove to belong to the same genus.

Lolliguncula (?) panamensis n. sp. Plate VI.

Body of moderate size, plump and compact for *Loligo*, resembling *L. brevis* of Blainville in general shape, but even wider and more swollen. Mantle margin obtusely angled above, and produced forward more acutely on either side of the siphon; broadly emarginate below. Fins large, rhomboid, with an obtusely rounded outline; more than half as long as the mantle; lobate in front, and barely continuous behind around the blunt posterior end of the body. Mantle connectives large and prominent, but offering no especial peculiarities of structure.

Head small, much narrower than the body; squarish; deeply excavated below. Eyes rather large, a low, transverse, membranous crest just behind them. Siphon large and broad, much compressed, and supported by bridles.

Arms rather small, decidedly unequal; order of length 4 = 3, 2, 1; the dorsal pair considerably the smallest and shortest. Suckers small, in two rows, obliquely set on short peduncles; horny rings armed with 11–15 short, broad, squarely truncate teeth, which become nearly or quite obsolete on the lower edge. All the arms except the ventral pair are connected at the base by a very short and thin umbrella.

Hectocotylization unknown.

Buccal membrane well-developed, seven-pointed, the four ventral points attached to the arms, but the three dorsal lappets free, except at the base, and armed at the tips with from 5 to 7 minute suckers.

Tentacles longer than the mantle; club with four rows of suckers, the two inner the larger, but all becoming subequal and very minute distally; horny rings of the large median suckers with from 23 to 27 rather small acute teeth, much reduced on the lower edge.

Gladius thin, very deep, with broad expanded wings, very much like *L. brevis.*

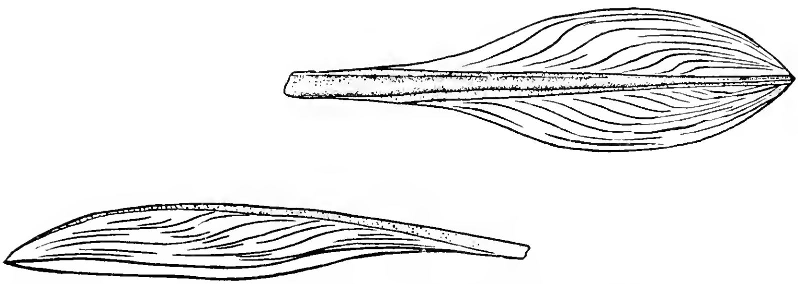

Fig. 1.—*Lolliguncula* (?) *panamensis*, n. sp. Dorsal and lateral aspects of gladius.

Chromatophores small, very evenly distributed over the body everywhere except on the under surface of the fins.

Habitat.—Panama (Hopkins Expedition); Guayaquil, Ecuador (P. O. Simons).

Types in the Museum of Stanford University.

This is a striking species, differing so prominently from both its congeners in the same region (*Loligo gahi* d'Orbigny and *L. diomedeæ* Hoyle) that special comparison with these is quite unnecessary. It certainly appears nearest to *Lolliguncula brevis* (Blv.), but the specimens bear no spermatophores and hence is my uncertainty as to their true generic position. The general form of the body and relative length of the arms among other features are essentially very similar, but the smaller size of *L. brevis*, its relatively shorter and more rounded fins, and sparser toothing of the horny rings are characters to be noted.

My comparison has been with typical *L. brevis* from the Brazilian coast and not the similar or nearly allied forms from the West Indian and Florida regions, which may or may not be the same species. Specimens have been reported from the latter region which are apparently intermediate in character between *Lolliguncula brevis* and *Loligo pealii.* Of such a nature are two very large adult females from Charlotte Harbor, Fla., in the Museum of Comparative Zoology, possibly the same as those in the same museum from the same locality

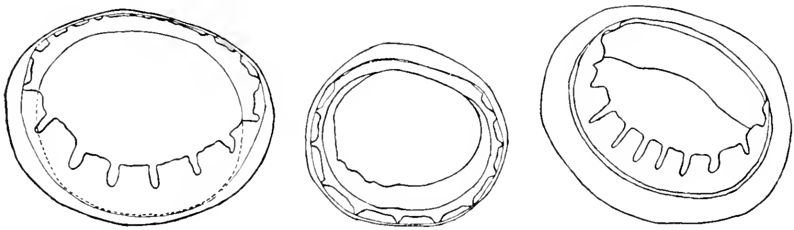

Fig. 2. Fig. 3. Fig. 4.

Figs. 2–4.—Camera drawings of horny rings from the suckers of the third arms of: 2—*Lolliguncula* (?) *panamensis* n. sp. [58]; 3—*Lolliguncula brevis* (Blainv.), Rio de Janeiro, Brazil [46]; 4—*Loligo* (?) sp., Charlotte Harbor, Fla. [54].

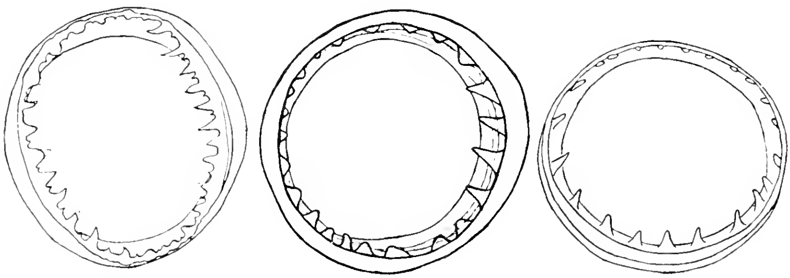

Fig. 5. Fig. 6. Fig. 7.

Figs. 5–7.—Camera drawings of horny rings from the tentacular suckers of: 5—*Lolliguncula* (?) *panamensis;* 6—*Lolliguncula brevis;* 7—*Loligo* (?) sp., Charlotte Harbor, Fla.

listed as *L. brevis* by Verrill (*Ceph. N. E. Amer.*, 1881, p. 345). Here the fins are somewhat sagittal in shape, very much as in juvenile *L. pealii;* the animal is much larger; the gladius has a longer and narrower blade than the Brazilian *brevis*, and there are two lateral thickenings on each wing; the horny rings of the sessile arms have from 8 to 13 elongate, squarely truncate teeth on the upper margin (in *L. brevis* they are nearly obsolete), while those of the larger tentacular suckers have about 24 large, acute teeth alternating with nearly as many minute interstitial ones. Unfortunately, the specimens bore no spermatophores. It may be that further material will show that these represent but an extreme form of *L. pealii*, but it is not altogether impossible that the *brevis-hemiptera-brevipinna* group includes a number of well-defined races, geographically separated but confused in the literature.

In conclusion it may be well to call attention to the fact that the male of *L. brevis*, which has again and again been stated in the literature to be unknown, was well described by Professor Steenstrup himself in his famous paper on Hectocotylus Formation.[1] In the specimens available to me the details of hectocotylization are made out with difficulty, but I can at least confirm his observations. Only the distal portion of the left ventral arm is affected, as in *Loligo*. The first 18 to 20 pairs of suckers are normal. From this point on the suckers of the dorsal (outer) row undergo rapid modification and become degenerated to rather large flattish papillæ. The suckers of the ventral row are but little modified and persist to the tip of the arm. Thus we are still unable to distinguish the genus *Lolliguncula* from the genus *Loligo* by any important character save that the female of the former receives the spermatophores of the male upon a calloused patch within the mantle near the left gill, whereas in *Loligo* they are received on a pad below the mouth.

Explanation of Plate VI.

Lolliguncula (?) *panamensis* n. sp.—Tentacle club and dorsal aspect (*nat. size*) of type. Drawn by Miss Lora Woodhead.

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[1] See English reprint in *Ann. Mag. Nat. Hist.* (2), XX, 1857, p. 86.

Measurements in Millimeters.

	Lolliguncula (?) *panamensis.* Types.			*Lolliguncula brevis*—Rio de Janeiro. M. C. Z. Cat. 3407.								*Loligo* (?). Charlotte Harbor.
Sex.	♀	♀	♀	♀	♀	♀	♀	♂	♂	♂	♂	♀
Total length exclusive of tentacles..	164	171	150									
Length of mantle (dorsal)............	101	105	85	59	64	74	76.5	34	43	43	46	103
Width of mantle..............................	40	40										
Width across fins............................	83			39	47.5	44.5	49	18.5	25	28	31	54
Length of fins.................................	61			23	28	30	33	11	19	18	17	47
Width of head.................................	27											17
Length of dorsal arms.....................	42											38
Length of second arm.....................	45											46
Length of third arm........................	56											56
Length of ventral arms....................	57											52
Length of tentacles.........................	130											177
Length of tentacle club....................	41											

Specimens Examined.

	No. speci-mens.	Locality.	Collector.	Where deposited.	Sex.	Remarks.[2]
Lolliguncula (?) *panamensis* n. sp.	2	Panama.	Hopkins Exped.	L. S. J. U. coll.	♀	[58] Types.
	1	"	" "		♀	[58] Cotype.
	1	Guyaquil, Ecuador.	P. O. Simons.	L. S. J. U. coll.	♀	[57]
Lolliguncula brevis (Blainville) Steenstrup	3	Rio de Janeiro, Brazil.	Hassler Exped.	Mus. Comp. Zool., Cat. 3391	♀	[47]
	3	" " " "	" "	" " " " 3382	♀	[52]
	5	" " " "		" " " " 3429	♀	[46]
	13	" " " "	Thayer Exped., 1865.	" " " " 3414		[48]
	Numerous	" " " "	" " "	" " " " 3413	♂ & ♀	[53]
	14	" " " "	" " "	" " " " 3416	5♀ 9 *juv.*	[50]
	22	" " " "	" " "	" " " " 3407	♂ & ♀	[49]
	1	Santos, Brazil.	" " "	" " " " 3478	♀	[51]
	22	Cameron, Louisiana.	M. H. Spaulding	L. S. J. U. coll.	*juv.*	[56]
Loligo (?) sp.	2	Charlotte Harbor, Fla.		Mus. Comp. Zool., Cat. 644	♀	[54]

[2] Numbers in brackets refer to the private card register of the author.

MICRO-SPECTROSCOPIC OBSERVATIONS.

BY F. J. KEELEY.

Since Sorby devised the micro-spectroscope, nearly fifty years ago, an immense amount of work has been done with this instrument, but principally in the study of organic coloring matters in solution or section, which could be examined by transmitted light. It was understood that the micro-spectroscope could likewise be employed in examining objects by reflected light, but this phase of its utility has been almost completely neglected. With transmitted light, it produces results from very minute quantities of material, but otherwise offers little advantage over an ordinary spectroscope of low dispersion. With reflected light, it is also applicable to the study of small quantities, but has a number of additional advantages. Absorption bands are usually more distinct; a small crystal on a mineral specimen or a gem embedded in an opaque setting may be examined without disturbing or damaging it; and phenomena such as iridescence on opaque substances may be studied.

The microscope employed in connection with this instrument should always be a binocular, which permits the object to be examined through one tube while the spectroscopic ocular is applied to the other. The illumination should preferably be rather brighter and whiter than is generally necessary for the examination of opaque objects, and is best concentrated by means of a parabolic silvered reflector attached to the objective. For preliminary examinations, the older form of micro-spectroscope, as made by Browning or Beck, is preferable, as very faint bands are more readily noted in its short bright spectrum, but for further study and recording the spectra, the Zeiss model, with photographed scale, is more desirable.

There are two classes of spectra that can be advantageously studied under the conditions specified, those showing absorption bands, which permit the identification of certain minerals and gems; and interference spectra, which assist in determining the cause of luster and iridescence.

Of the first class, the characteristic spectrum of didymium is the best known and most useful. While didymium has been resolved into two elements, neodymium and praseodymium, for the present purpose the absorption bands which have become classical as those of didymium can be regarded as indicating the presence of the whole group, including cerium, lanthanum, erbium and terbium, the last two of which likewise have characteristic spectra of their own, not usually visible in minerals to be considered.

Under most favorable conditions, the spectrum of "didymium" contains nine absorption bands, centering at about the following wave lengths, .675, .622, .591, .575, .532, .521, .508, .480, .471 micron, the first two of which, in the red, are not usually visible in a solution or section examined by transmitted light, but quite distinct when a crystallized salt or a mineral such as lanthanite is viewed by reflected light. Position of bands is given as determined by the photographed wave-length scale on Zeiss micro-spectroscope, which was itself adjusted on the D line from a sodium flame, and is probably sufficiently accurate for the purpose. For reference, all spectra should be recorded diagrammatically on paper ruled with lines corresponding to the scale, showing width of band, whether edges are sharp or misty and whether the darkest part of band is central or eccentric.

In determining the presence of this element, it is of course unnecessary that all the bands be visible. If two or three, including the strongest at junction of yellow and green, can be seen and their postion accurately measured, it is sufficient.

Many of the minerals characterized by the "didymium" spectrum occur in microscopic crystals, sometimes not sufficiently well developed to determine with certainty, but if the presence of these absorption bands demonstrates that the mineral is one of the comparatively few which contain the cerium group, there will always be sufficient indications of its identity from color, luster or such few crystal faces as may be present. In this manner, I have been able to confirm the discovery of monazite in Delaware County, where but a few small crystals have been found, and likewise to identify microscopic crystals of parisite from a new locality in New England.

Another element which shows a characteristic spectrum in most of its compounds is uranium, the several equidistant absorption bands in the blue end of spectrum, assisting in determining poorly crystallized microscopic occurrences of such minerals as autunite and torbernite.

A mineral that has afforded material for extensive study of spectra is zircon, which has long been known to show absorption bands, the cause of which seems unexplained. These bands center at about wave lengths .687, .650, .615, .586, .561, .538, .508, .478 and .455

micron, and have been attributed to the presence of the cerium group of elements, but a comparison of the spectra will demonstrate that this cannot be the case, as not a single band occupies a similar position. Another writer refers to them as "the characteristic spectrum of zircon," which is likewise incorrect, as a large proportion of the varieties of zircon show no trace of them. Neither are they due to the coloring matter which gives various tints to this mineral, for except in the case of the red variety, known as hyacinth, these colors are discharged by heating without affecting the spectrum. Having examined more than fifty varieties and colors of zircon, natural crystals and cut gems, many of them both before and after bleaching by heat, can generalize somewhat as follows: In no case have I seen a trace of absorption bands in the spectra of the red hyacinth variety or in the colorless microscopic crystals which can be picked out of magnetic and gold-bearing sands from many localities. They are generally likewise absent in crystals of brown and gray tints, while in the transparent gem varieties from India and Ceylon, those of the characteristic pinkish-brown and yellow tints sometimes show a complete spectrum, sometimes only a few bands and occasionally none whatever. When bleached by heating, the spectrum is unchanged. The strongest and most distinct absorption bands are shown by those stones more or less green in color which become very pale blue after heating. A similar strong spectrum is shown by the microscopic bluish zircons occurring in Vesuvian lava, but no trace of it in the opaque white varieties from the Laacher See and the Azores. It would therefore seem that the spectrum sometimes shown by this mineral is due to the same cause, whatever it may be, that produces a faint blue tint, whether this is originally visible or veiled by other coloring matter which can be bleached by heat. As at least a few of the bands are almost always visible in the spectra of the varieties of zircon employed as gems, except the red, they afford a means of identifying the stone when set. If loose, its high specific gravity is sufficient for the purpose.

Red garnets likewise have a readily distinguished absorption spectrum, including three broad and one narrow band, centering about wave length .618, .578, .520 and .500 micron. This is unquestionably due to the color, possibly manganese, as it is not shown by garnets of other tints than red, but is remarkably constant in all the varieties used as gems. Examination of over a hundred from all parts of the world, including spessartite, almandite and pyrope, as well as varieties, such as the beautiful "rhodolite" from North Carolina, which include both the almandite and pyrope molecules, showed no important exception, hence this spectrum will serve to identify a red garnet with practical certainty. Red spinels show no absorption bands in their spectra.

The ruby exhibits an interesting spectrum consisting of a very narrow bright line between two absorption bands, at wave length .69 micron in the extreme red. A careful search of the literature of the subject has enabled me to find no evidence that this spectrum had been previously observed and recorded, but whether new or old, it is most characteristic, not only of typical rubies, but of every variety of corundum that contains a trace of red in its coloration, including the various shades of pink and amethystine sapphires, even when so pale as to appear colorless with artificial light, star rubies, Montana sapphires of pinkish cast and even corundum from North Carolina and other localities, which has a pink tint. The remainder of the spectrum may vary, all except the red being absorbed by deep colored oriental rubies, or all the colors visible in light tinted varieties, but the narrow bright band in the red remains the same.

This spectrum is unquestionably due to chromium, the coloring matter of the ruby, as it is likewise found in examining artificial rubies which owe their color to the same element. It affords an infallible test for distinguishing a ruby from a garnet, spinel or tourmaline of similar color, and is applicable to stones in deep mountings or even if covered by a plate of glass. The artificial ruby is the only other stone giving a similar spectrum, and it can readily be distinguished by means of the microscope alone.

A number of other precious stones exhibit fainter but nevertheless characteristic spectra. Blue and violet spinels show two narrow and fairly sharp lines in the yellow and green, and, as in the case of the ruby, this spectrum is very persistent, the bands being scarcely less visible when the stone is almost colorless than from one of deep color. It is particularly available as a means for easily distinguishing pale amethystine spinels from sapphires of identical color frequently found mixed in same paper of Indian cut stones.

Among green gems, the emerald exhibits a faint line in the red and a broader shadowy band occluding the orange and yellow. Green garnet or demantoid, often sold as "olivine," has two very faint bands in the red, which coalesce into one when the stone is deep in color, while the true olivine or peridot shows two bands in the blue and violet, which, although rather broad and well-defined, are usually extremely difficult to see, owing to the comparatively small amount of light of the shorter wave lengths transmitted by this mineral.

In studying the luster and iridescence shown by various natural objects, it must first be considered to what causes they may be due, which include:

Simple reflection, as in the case of minute pyrite crystals sometimes used in jewelry.

Refraction and dispersion, generally accompanied by internal reflection and sometimes by absorption, which account for the brilliancy and colors shown by dew drops, frost crystals and most cut gems.

Scattering of light from microscopic particles, to which the blue color of the sky is due.

Polarization, which frequently accompanies the other phenomena, but is rarely responsible for natural colors. If translucent tourmaline enclosed in quartz or mica happens to be examined in the polarized light from the sky at right angles to the direction of the sun's rays, it may act as an analyzer, and if the film of the including mineral between it and the source of light be of suitable thickness, show bright colors.

Diffraction, or the interference resulting from fine, uniformly spaced lines or dots, which has been credited with being the cause of many iridescent effects, with which it rarely has anything to do. The small crustacean *Sapphirina*, which is said to sparkle like a gem when swimming in the sun light, has a shell covered with fine markings similar to those on *Pleurosigma angulatum*, which no doubt cause these brilliant colored reflections by diffraction, and the chatoyance of star sapphires and cat's-eyes may be due largely to diffraction resulting from the symmetrically arranged inclusions. It must not be overlooked, however, that to produce color effects by diffraction, the light must come from but one direction, and the color will vary through the entire spectrum with changes in the angle of incidence.

There is one more cause to which these effects may be attributed, and to which investigation will show that practically all iridescence is due, and that is the interference produced by reflection from thin films, which can be advantageously studied with the micro-spectroscope. Such interference colors generally show dark bands in the spectrum, one in the lower order colors produced by thin films and two or more as the films become thicker so that additional wave lengths interfere. For comparison, records should be made of the spectra of all the brighter colors, which can be done by observing them in the "Newton's rings" produced between two surfaces of glass or by blowing a bubble of melted glass until it bursts when the thin edges will answer the same purpose.

If the natural iridescent surfaces shown by many minerals be now examined, similar interference bands will be noted in the spectra, assuring us of the cause of iridescence and permitting the thickness of the film to be calculated if the refractive index of the mineral be known. This is shown particularly well on the iridescent surfaces which sometimes appear on dendritic inclusions of magnetite in mica from Delaware Co. Penna. One such surface of uniform pink color gave a spectrum with two dark bands, centering at about wave lengths .545 and .457 micron, corresponding to a red of the fifth order, and indicating a thickness, if we assume the film to be a hydrate of the composition of goethite, of about .53 micron or .000021 inch. In a similar manner the colors reflected by scales of hematite, to which the chatoyance of varieties of feldspar known as "sun stone" is due, can be proved to result from the thinness of the films. The oligoclas from Tvedestrand, Norway, frequently contains films of sufficient size and uniformity of thickness to produce sharp interference bands. Some hypersthene as well as other minerals showing aventurine reflections contain similar inclusions, but not always of the same mineral. The common aventurine or gold stone used in jewelry is an artificial glass which owes its brilliancy to reflections from enclosed crystals of metallic copper.

There is no class of objects furnishing better examples of brilliant iridescence than the scales of butterflies, and this is generally attributed to the fine lines and markings with which they are covered, which cannot be the case, as such markings could only cause color effects by diffraction, and the limitations to this cause have already been mentioned. It is true that diffraction effects may be obtained from these scales when held in a certain position with respect to the light, particularly when they have been mounted on glass for examination by transmitted light, but the colors thus produced which undergo changes according to the angle of the illumination are not the characteristic colors of the scales as seen in position on the insect, which are equally well shown in diffused light. Furthermore, it will be found that in many butterflies the scales showing metallic colored reflections are not the ordinary lined scales, but are apparently specialized for their purpose, showing no fine markings, but merely rather coarse longitudinal corrugations. When examined under the micro-spectroscope, most butterfly scales are not sufficiently uniform in color to give pronounced interference bands, but a darkening of the spectrum in some one position may usually be noted, and in the particularly brilliant blue spots on the wings of *Papilio paris*, a distinct black band is shown, having its center at about wave length .588 micron. The position and width of this band correspond to that in the spectrum of blue of the third order, and accordingly may be accepted as indicating a film about .58 micron in thickness, the film being assumed to be of air or gas enclosed within the chitine of the scale, and not consisting of chitine itself, in which case it would be over a third thinner.

The reason for this assumption lies rather in analogy with the results obtained from study of the scales of beetles than in the behavior of the butterfly scales themselves. It is well known that if a portion of a diamond beetle is mounted in balsam, the iridescent reflections from the scales are more brilliant than when examined dry, but if the scales be scraped from such a beetle and then mounted in balsam, most of them will become perfectly colorless, while here and there may be one still retaining its iridescence. A further examination will show that such colored scales are perfect, while the others have all been more or less broken in removing them, indicating that the iridescent film occupied an internal interval, which was penetrated by the balsam in all broken scales, but remained unimpaired as long as no such penetration could be effected.

If the iridescent feathers of birds be next examined, the resemblance of their brilliant metallic reflections to those of butterfly scales would seem to justify the expectation that this is due to a similar cause, but this predication will be contradicted by an examination of their spectra. For instance, the spectrum from a ruby-tinted, iridescent humming-bird feather shows no dark bands, but on the contrary a single bright band, including part of the red and orange, and reference to the record of spectra previously made proves that there can be no color resulting from interference caused by a single film that could produce such a spectrum. We can, however, readily understand the probable cause of this color by first considering to what the colors in precious opal are due, a subject that has been elucidated by high authorities.

In selecting opals for this investigation, those presenting patches of uniform color are to be preferred, and the best will be found among the so-called black opals which have recently become popular as gems. I have examined a large number of these, both in polished specimens and microscopic sections, as a result of which it is evident that they consist of precious opal, which by some convulsion of nature has been shattered to fragments, which were subsequently re-cemented by a further deposition of opal of a gray or black color, which serves to render the reflections more brilliant by cutting out all extraneous light. In the absence of such black opals, a good substitute can be prepared by grinding a thin section of ordinary precious opal and backing it with India ink. Some opals in a dark matrix, likewise serve admirably.

On examining the colored reflections with a micro-spectroscope, instead of a spectrum with a dark band in the position of the complimentary color, which characterizes the interference spectrum from a thin film, we find only a narrow band of same color as that shown visually. This has been explained by Lord Rayleigh as being due to the successive action of numerous parallel films of a thickness of the same order as the wave lengths of light, an explanation first applied to the similar colors reflected by certain crystals of potassium chlorate, in which the films are known to be due to repeated twinning. To what they are due in opal is not known, but under favorable conditions they may become quite visible, although I have hitherto been unable to distinguish them in sections at right angles to the laminæ. In one specimen of opal reflecting a brilliant green color have been able to count laminæ 38,000 to the inch, and as they appeared to be at an angle of about 45° to the plane of the section this would correspond to over 50,000 to the inch at right angles to the plane of lamination.

The manner in which the colors of opal have been accounted for justifies the application of same explanation to the iridescent feathers previously referred to, which show bright-band spectra, although I have seen none in which the band was as sharp and narrow as in the opal, whose colors are probably the purest shown by any natural object. It will not be safe, however, to apply the same reasoning to all feathers, for Nature does not hesitate to use various means to the same end. An illustration of this will be found in another humming-bird feather, which in general structure corresponds to that already mentioned, except that the reflections are blue in color, but at the end of each pinnule there is a single filament which glows with a most brilliant ruby color and shows a spectrum not unlike that of the other ruby-tinted feather, but on examining a balsam-mounted specimen with transmitted light, the color and spectrum are the same as by reflected light, proving that it is due to absorption and not to interference. The brilliancy will be accounted for by examining sections of the filaments, which prove to be somewhat rounded trigonal prisms, with an edge facing outward, so that light striking either side is returned by internal reflection from the back; or, in other words, Nature has here employed the same method that a skilful lapidary would use in cutting a cabochon ruby to bring out its brilliant color to best advantage.

There are other minerals beside opal which show colored reflections due to successive laminæ. The "moon stone" from Delaware Co., Penna., consists of triclinic feldspar, albite or oligoclase, and the opalescence is shown on the face parallel to the laminæ due to repeated twinning, and only on such specimens in which the laminæ are extremely fine. The reflections from this mineral vary from a pearly-white to sky-blue, but in the closely related labradorite they assume all tints, although never as pure as in the case of the opal, probably owing to the less uniform spacing of the laminæ, although these are thin enough to account for the colors. Labradorite sometimes likewise shows entirely different reflections corresponding to those of "sun stone" and due to the same cause, interference resulting from single thin films of included minerals.

The chatoyance of Ceylon "moon stone," frequently cut as a gem, cannot be accounted for in a similar manner, as it consists of adularia, a variety of orthoclase, which does not contain twin laminations, but on examining a section at right angles to the opalescent face, with polarized light and comparatively high powers, a very fine microperthite structure, due to intergrowth with a small percentage of another feldspar, becomes apparent. The micro-spectroscope is of no help here, as the spectra show no characteristic appearances, but the fact that the reflected blue light from one of these "moon stones" is partially polarized raises the question whether it may not be due, at least in part, to the scattering of light such as causes the blue color of a clear sky, and the microscopic texture of the mineral seems better calculated to produce this effect than it does to produce the color by any known form of interference.

If authorities be consulted as to the cause of the luster of pearls, the explanation given will be generally found to be that it is due to the breaking up of the light by reflections from minute corrugations with which the surface of the pearl is covered. This explanation, originally given by Sir David Brewster, has been copied by all the writers in whose works I have been able to find a reference to the subject. Brewster made an extended investigation of the phenomena shown by pearl shell in the form of plates and sections, and finding that light from a contracted source produced undoubted diffraction effects when reflected from the surfaces of such pieces of pearl, concluded that the fine wavy or serrated parallel lines which he discovered were largely responsible for the pearly luster, without apparently giving due consideration to the facts that this luster was likewise present in diffused light and that the lines described might not necessarily be present in an undamaged pearl, but were due to cutting a section through the laminæ which produced them. Brewster's own description of his investigations proves that he did not overlook the light reflected from the laminæ of the pearl, but he does not appear to have regarded it as differing from ordinary reflected light, and paid most attention to the effects of diffraction, which he distinguishes from the reflected light by the term "communicable colors" because they could be communicated by pressure to another surface of softer material. Later writers, however, seem to have regarded only the lines whose influence on the true luster of a pearl is negligible.

I have one shell of the so-called pearl oyster, *Meleagrina margartifera*, apparently in its natural condition, which in places shows comparatively coarse parallel lines on its surface, but have examined numerous pearls without finding any such lines present, although under high powers of the microscope the surface is by no means smooth, but as soon as a small facet was ground on the pearl the typical wavy lines appeared and could be seen side by side with the unabraded surface in same field of view.

Furthermore, the brilliancy of a pearl section is increased by mounting in balsam, instead of being suppressed, as would be the case were it due to corrugations on the surface, and if a nearly diametrical section of a round pearl is observed by reflected light, the pearly luster will be confined to a small spot near the center, where the laminæ are approximately parallel with the surface of the section. Brewster mentions that the distance between the grooves varies from a two hundredth to a five thousandth part of an inch, while Carpenter states that they may be as close as a seventy-five hundredth of an inch, both measurements evidently made on oblique sections, as I have carefully counted the laminæ in a section of Unio pearl at right angles to the surface and found them to range between 54,000 and 57,000 to the inch. This brings the luster of pearls within the range of Lord Rayleigh's explanation of colors due to repeated laminæ, which deduction may be confirmed by the micro-spectroscope.

In round pearls used as gems the patches of color are generally too small and intermingled to permit of satisfactory investigation in this manner, but in sections of pearl shell places can readily be found where the laminæ are nearly parallel to the surface and sufficiently flat to exhibit an area of uniform color large enough to produce a good spectrum, and the single bands of color shown are sometimes almost as sharp as those from opal, proving that the colors are due to the repeated parallel laminæ and not to the lines or corrugations, although the latter may be the only visible indications of structure when viewed with the microscope in the usual manner.

While they probably know or care little about optical science, the fabricators of false gems have not failed to note the resemblance between the colors of pearl shell and those of opal, and an imitation of opal used in cheap jewelry is made by cementing a thin section of pearl shell between two rounded and polished pieces of glass.

VARIATION IN SOME JAMAICAN SPECIES OF PLEURODONTE.

BY AMOS P. BROWN.

C. B. Adams, in his *Contributions to Conchology*, No. 11, published in 1852, gives some "Hints on the Geographical Distribution of Animals," in which he points out that "each species occupies one geographical area only; but, inasmuch as natural types are of all grades of value, the difficulty of discriminating species is great. The difference between some types which inhabit distinct areas is slight and in some cases perhaps impossible to demonstrate; nevertheless, they should be regarded as distinct species. Still it may occur that exceptions to this rule exist, and frequently a number of pairs of such analogues from distinct areas may be so arranged that the amount of difference between each two shall successively diminish from species that are very distinct to species that are scarcely distinguishable, and at last the series shall terminate in two forms quite indistinguishable from each other; that is, in one species. These areas of species vary from a few miles to several thousand miles. Areas of insular terrestrial species, excepting those with the power of flight, do not usually exceed the islands they inhabit, and where the islands are separated by 100 miles or more of water examples of species common to two or more are rare."

In a previous article, published in the *Contributions*, No. 10, 1851, "On the Nature and Origin of the Species of Terrestrial Mollusca of the Island of Jamaica," he says: "Among the *terrestrial shells*, typical forms exist in great profusion. These forms are of every conceivable grade of value, from varieties up to genera and families. They have also a determinable geographical distribution. . . . The island in this respect is a miniature continent." In considering the nature of the species, Adams remarks: "Our first conclusion is this: that in many groups the species are distinguishable by *types* only and not by well-defined limits. This may be illustrated by a figure, in which species are represented by circles, many of which are in contact and whose areas are sprinkled irregularly with dots which represent the varieties. One central dot represents the type of the species. . . . On the boundaries of the species we find varieties which closely resemble their neighbors in the adjacent species, while their affinities with the central types of both species are so nearly balanced that it is not really a matter of much consequence on which side of them the imaginary boundary line of the species is drawn. . . . It should be observed that the boundaries of the circles do not represent any facts which have an objective existence. With the boundary lines we represent the species as described in books; without them we see the species as they exist in nature."

"Since the sub-types of species are distributed with great regard to locality, it is obvious that much perplexity which results from the graduation of species into each other is avoided by those travellers who take but a few specimens from distant localities and by those collectors who are satisfied with a single, well-characterized specimen of each species. Such collections are valuable as exhibiting types, but they very imperfectly represent the *relations of types*." When we consider that Adams wrote these articles almost a decade before the publication of the *Origin of Species,* we must be struck by the modern view of a species which he takes. It was forced on him by the great variability exhibited in the land snails of Jamaica, which he was studying. In the foregoing paragraphs he lays down the general principles of their variation as he saw it and points out the necessity of collecting large series of specimens if we would become acquainted with the relations of the forms to each other. Thus he says that each species occupies one geographical area, and, as he found in this island, these areas may be small. If we only compare selected types from isolated areas the differentiation of the species is easy; but when we disregard the artificial limits we set for one species and examine not selected specimens, but large series, "*we see the species as they exist in nature.*" They vary from station to station, from one set of conditions to another. Tracing the same species from one place to another or finding it living under different environments, the variations represented by the dots on his hypothetical diagram grade one into another and, as he points out, we see that "our circles (which include the species) *do not represent any facts which have an objective existence;*" in other words, our species are purely subjective. The case is perhaps not quite as bad as might be judged from the above, for the examination of a large series of specimens from a single locality may show all grades of variation between the central type and the surrounding forms; or, on the other hand, it may show a remarkable uniformity in the entire series, with only variations in the dimensions. Thus, in one *subspecies* considered in this paper, forms from a single locality could be selected, which, if reported from different zoological provinces, or even neighboring islands, would be given distinctive specific names by any systematist, and yet may have come from a single hill slope where the animals were free to migrate from one part to another. But, on the other hand, in another species which we might examine from the same locality we would find great uniformity in a large series of specimens.

Adams also calls attention to the fact that an insular fauna resembles a continental fauna in little, "the island is a miniature continent." "Among the terrestrial shells typical forms exist in great profusion; these forms are of every conceivable grade of value, from varieties up to genera. They also have a determinable geographical distribution." This makes the island of Jamaica an excellent field for the study of variation and its controlling factors. A complete zoological survey of even such a contracted area as is covered in this paper, (better still if extended to a wider area or to the entire island), would be of the greatest value in the study of the causes of variation, so far as they may be worked out by morphology. The possibilities in this direction appealed very strongly to me during a visit to the island in February–March, 1910, and on a subsequent visit in April–May I collected large series of specimens from definite colonies with this end in view. From a study of the large series of species of *Pleurodonte* taken at this time some facts in regard to the causes of the variation observed seem to be indicated, and they will be found embodied in this paper. In my first visit in February–March I was assisted in the collecting by Mr. Stewardson Brown, who was studying the flora of the region. At this time I had not recognized the importance of collecting by isolated colonies, and the series of specimens we obtained, while useful for biometric measurements on the species of the region as a whole, do not give the data necessary for tracing out the progressive variation from point to point. In my second visit I collected by colonies, keeping each one separate, and thus obtained material for a comparative study. This material has been gone over and individual measurements of each shell made; these measurements have been plotted in various ways and the results compared. The variation in measurement gives a quantitative method of comparison which eliminates very largely the personal equation, and therefore it has been resorted to first in all of these comparisons. The two dimensions of altitude and diameter, plotted as a point, give the best comparison of the dimensions, their ratio to each other, or the index, may likewise be used; and the indices arranged in order and plotted for each colony on one diagram show the variations in the slope of the shell or give a key to the mean divergence. The dimensions, reduced to an average for each colony, may also be compared, and when these are arranged in order geographically, on one diagram, they give a view of the successive variations from station to station.

I included in the specimens taken a considerable number of the old "dead" or semi-fossil shells which are to be found in the soil and in the "graveyards," as they may be called, the great accumulations of old shells that are found at the bases of cliffs, in crevices and in the little "cockpits." More of these should have been taken, for I found on studying them in connection with the living forms of the same colony that additional light was thrown upon these living forms. But their importance was not fully recognized in the field, as each day's collection was simply packed away for later study. They often show much variation from the living forms, and, while many of these "semi-fossil" specimens probably represent the form of the species before the settling and clearing of the country, they also show the amount of variation which may have taken place in a given locality. While it is probably impossible to fix the time that has elapsed since these forms were living, this was probably not great; yet they give an indication of how rapidly organisms may vary when living under conditions that favor variation. Their study, too, may throw some light upon similar variations that are noted in palæontological studies, and some of them may actually be fossils.

In order that the conditions at each colony may be comprehended, a description of this part of Manchester Parish and of the individual colonies will be necessary (see map, fig. 1).

Mandeville is located about the center of the parish of Manchester, some 14 miles in an air line from the sea at Alligator Pond on the south of the island of Jamaica and 35 miles in an air line from the north coast. It is south of the "backbone," or main east and west elevation of the island, which lies some 12 or 14 miles to the north. It is on an elevated plateau which extends to the northwest of Mandeville, to Balaclava, Accompony, Ipswich and the "Cockpit Country." The surface is very uneven, but the individual hills are not large nor high; the small valleys are not very deep. Westward from Mandeville are seen several parallel lines of hills, running north-northwest and south-southeast, and becoming higher to the westward until at about 6 or 8 miles to the west the ground slopes abruptly down to the Black River Valley and the level savannas of St. Elizabeth Parish, which are but little above sea level—a drop of 2,000 feet. To the east and northeast the ground slopes down to the valleys in which Williamsfield and Porus are located, at an elevation of some 1,000 feet lower than that of Mandeville. The country has been settled for many years; in some places but little original forest remains, in others, especially to the north, northwest, west and southwest of the town, large tracts are still covered by original forest. The underlying rock is the Tertiary limestone which forms the surface of Jamaica outside of the great uplift of the Blue Mountain system and belongs mostly to the Cobre formation of Hill. These limestones are generally nearly horizontal or only gently inclined, they outcrop on steep slopes

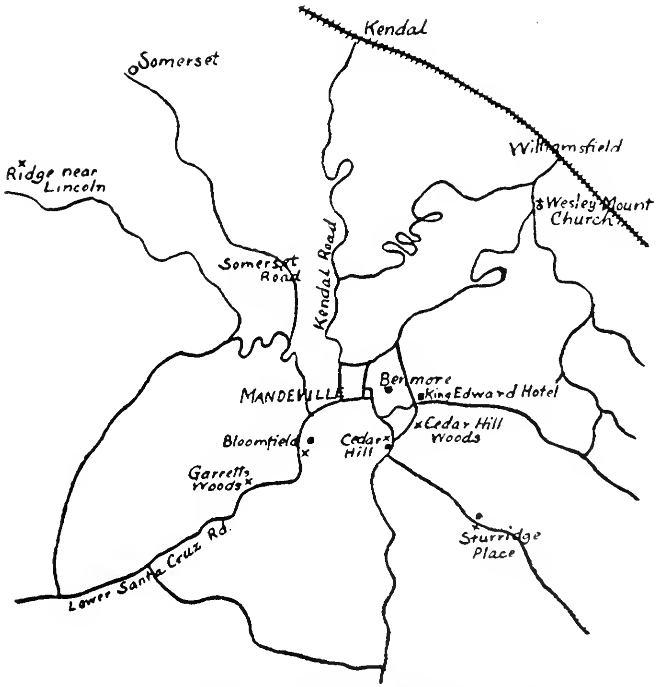

Fig. 1.—Sketch map of the Mandeville region.

of the hills and many hill-tops and stand up in long cliffs on the hillsides. There is no surface water in the district, but the limestones are eaten out into caverns and the drainage is underground. Some of the limestone layers are very pure, some are quite marly. The weathering of the rock depends upon these characters and the two types of stone mentioned present quite different structures when they weather. The marly limestone shows but little in the way of corals or shells or other fossils, being rather even in grain and evidently containing considerable clay. The pure limestone layers are composed of a compact, fine-grained form of calcium carbonate which encloses numerous corals and marine shells; but these, being of the same composition as the ground mass, weather equally with it, and hence do not come out entire by the solution of the stone, but only appear on the surface in section.

The layers of marly limestone upon weathering break up into blocks of varying size, and tops of hills formed of these layers are covered with loose, detached blocks of all sizes. An examination of any of these boulders shows at once that they are very porous and loosely held together; when they disintegrate, the rock passes into a coarse gravel, composed of small angular fragments, and finally into smaller fragments and clay. The residual clay from the marly rock is white to buff-colored, or sometimes yellow-ochre color. This rock, on hill-tops, weathers deeply, by boulder weathering; its porous character makes the soil drain quickly after rain, and such hill-tops are notably dry. They are generally flat-topped, if the hill is of considerable size, and are covered with a growth of the "broom-palm," the leaves and debris from which cover the ground to the depth of several inches. This coating of dead leaves on the ground is generally so dry that the snails find little to feed on in it, and these dry hill-tops furnish few specimens of land gasteropods.

The purer limestone layers, on the other hand, do not weather into blocks by boulder weathering, but the rock passes at once into a fine clay, which is generally very dark red to reddish-brown, as Hill describes that of the Cobre formation. This residual clay, of course, does not persist on the exposed surfaces of rock on the hill-tops, but is washed off by the rains into the hollows and valleys. This pure limestone presents bare rock surfaces that are not porous, and do not absorb moisture; they are not smooth, however, but are honeycombed with irregular holes and cavities, some of large size, and these are, in miniature, the structures characteristic of the Cockpit country. Thus vertical or inclined cylindrical holes or pits may be seen in this limestone, ranging from two or three inches to ten feet in diameter, and often as many feet in depth. The surface of the rock is rough and jagged, sharp spires and knife-edges are characteristic of this pure limestone on the hill-tops. The rock is not porous, but the holes and pits retain the moisture; and the limestone is such a good conductor that moisture condenses and remains on the surface after the deposition of dew each night. These limestones are the most favorable places for land snails. In the country about Mandeville the marly limestone often forms the hill-top, and the purer limestone is found at a lower level; and this is true along the hills to the northwest also, towards Somerset and Green Vale, but the crest of the still higher hill, fronting the plain of St. Elizabeth, is mainly composed of the pure limestone. The marly rock, weathering more slowly, would form the hill-tops in the more or less uneven plateau in which Mandeville is located, but along the escarpment edge of this plateau to the west the purer limestone can form the ridge. While there are certainly several different alternating layers of these two types of rock, the general observation holds true that wherever in the island the purer, honeycombed, jagged limestone is encountered, the land molluscs are more plentiful and larger.

When Jamaica was untouched by cultivation, there is little doubt that all the upland limestone district, and in fact all the surface, except the swamps and savannas, was covered with a continuous forest. Cliffs of rock and exposures of bare rock on some hills were the only exceptions. Under such conditions free migration of the land molluscs from one part of the island to another was possible. In the Mandeville region, where there is no surface water, but the topography is characterized by cup-shaped valleys enclosed by hills, often with no possible connection for surface flow of water from one valley to another, the entire surface was forested before the introduction of cultivation, some 50 years ago. In many places virgin forest is still to be seen on hill-tops, and sometimes extending down into valleys and gullies and connecting hill with hill. The land that is first cleared is in the small cup-shaped valleys, where the soil and humus washed from the wooded hills collect; as the area of cultivation extends, it involves the slopes of the hills and the cultivated or cleared areas join, but they have islands of virgin forest, in the form of the rocky hill-tops, which are not only not arable, but the clearing of which would be a positive detriment to the estates. This is fortunate, for in these islands the plants and animals find a refuge from the encroaching "cultivations." Many of these woods have existed in their present state since the first clearing of the land, and are only occasionally entered now for the cutting of a little firewood or an occasional hardwood tree for lumber, and there is every reason to believe that they will continue to exist unchanged for generations. Each one of these isolated patches of woodland becomes a definite colony for the land molluscs, many of which colonies have existed in their present state for periods varying from 20 to 70 or 80 years. In these areas are found not only the present living snails, but the shells of their ancestors, accumulated in "graveyards," such as the small cockpits, rifts and holes in the cliffs, and in the rock piles and soil. The dead shells are also found in the soil of the cultivated and cleared land, and may readily be obtained for comparison with the living forms now confined to the isolated patches of virgin forest or islands. The district is hence one well adapted to the study of the variation which has taken place since the advent of cultivation in the country.

In a paper[1] published in these PROCEEDINGS by Pilsbry and Brown a list of the species collected in this Mandeville district is given and the exact localities at which I collected the species is recorded. Most of these localities represent definite colonies, and all that are treated of in this paper are isolated colonies. In order that the environment under which the animals lived may be compared, descriptions of these localities will be necessary. Of these Benmore woods, the King Edward Hotel woods, Cedar Hill woods and Bloomfield are in the limits of Mandeville Market; Garrett's woods, Somerset Road 3 miles north of Mandeville, Kendal Road, Ridge near Lincoln, and Somerset are at some distance from the town.[2]

THE BENMORE WOODS COLONY.

This woods covers a hill to the east of the Court House at Mandeville and about a quarter mile distant. It is practically virgin forest on the west slope of the hill where collections were made and includes an area of 6 or 8 acres, the woods extending down to the bottom of the hill on this side. The elevation ranges from 2,000 feet above sea level to perhaps 2,150 feet. The limestone outcrops on the slope and is the pure rock weathering into honeycombed and irregular forms. Where collections were made the ground was moist, covered with a thick coating of leaves and often of loose stones. The leaves furnished abundant fungus food for the Pleurodonts. The shade was dense and this helped to preserve the moist condition. Live *Pleurodonte* were plentiful, some had invaded the neighboring pasture, but were mostly recorded by the dead shells found lying about. Collection was not extended to the hill-top, which was partly cleared and much dryer. It was probably composed of the more impure limestone seen on the top of the neighboring hill at King Edward Hotel.

[1] The Mollusca of Mandeville, Jamaica, and its Environs, by Henry A. Pilsbry and Amos P. Brown, *Proc. Acad. Nat. Sci. Phila.*, 1910, pp. 510–535.

[2] See map, fig. 1, reproduced from the above paper.

The King Edward Hotel Woods Colony.

This piece of woodland also occupies a hill-top, situated across the road from the King Edward Hotel, and lying to the east of the Benmore woods about half a mile distant. It is a conical hill of some 3 or 4 acres, densely wooded, but the wood more open and rather dryer than that at Benmore. Not much limestone is seen in place until near the top of the hill, where low exposures as well as numerous loose blocks are encountered. The limestone is the more impure kind, weathering into blocks of all sizes and producing a great quantity of loose stone in small pieces. The hill is not very high and the elevation is about 2,000 feet above sea level. Roadside cuttings have been made along the west side of the woods, where a certain amount of talus from the hill makes an accumulation of loose small stones that are good collecting places. Where the woods is not stony, a layer of leaves of some inches thick covers the slopes of the hills, and in this many living Pleurodonts were found. Along the road to the west many were obtained crawling in the gutters after rains. The woods is isolated by roads on two sides and open pastures on the other sides as well as across the roads. It is practically virgin forest.

The Cedar Hill Woods Colony.

This rather small woods occupies the northwest slope of a hill on the estate called Cedar Hill or Cedar Grove, and extends from a road at the foot of the hill to the top, where it is bounded by open pasture land, as it is on the southwest side, while cultivated ground bounds it to the northeast. Across the road is open pasture land, extending to Benmore woods, and about a quarter mile to the northeast is the woods at King Edward Hotel. This is a very dense jungly woods, exceedingly rocky; the pure limestone cropping out on the entire hillside, and extending to the hill-top, which is covered by loose blocks of limestone. It is evidently an undisturbed piece of the virgin forest, as can be seen by the flora as well as by the species of mollusca obtained here. The limestone being well exposed and, as usual, much honeycombed by holes, the collecting was good. "Dead" shells were especially plentiful.

The Bloomfield Colony.

The Bloomfield estate lies to the southwest of Mandeville Court House, and the collections were made along a roadside cut and cliff for perhaps a quarter mile on the Lower Santa Cruz Road, including, too, the strip of woods at the top of the cliff. This is much disturbed, but has evidently been recently a piece of original forest. The limestone is in general rather marly; the road runs up hill here from about 2,000 to 2,100 feet above sea level along this cut. "Dead" shells are plentiful, many species were only found in this state. From the list found here it is seen that at one time the fauna must have been much like that at the Cedar Hill woods. *Pleurodonte acuta goniasmos* was evidently well established, as great numbers of young snails of this species were seen crawling actively about. While still a productive locality for many species, there is no great amount of original woods remaining.

Garrett's Woods Colony.

This is the woods on a hill adjoining Mr. Garrett's place, "The Bungalow," and is a piece of virgin forest about 2 miles from Mandeville Court House on the Lower Santa Cruz Road. It occupies the top and part of the slope of a rocky hill (2,200 feet above sea level) with numerous limestone exposures and loose blocks, the hill being capped by the marly limestone, mostly in loose blocks here and underlaid by the purer limestone. The wood is rather dense and moist, the coating of dead leaves on the ground furnishes abundant fungus food for snails. The top has the moist character of the slopes and shows no broom-palm. The limestone on the slopes is partly honeycombed with cavities, and some species, such as *Zaphysema macmurryi* (C. B. Ad.) and *Pleurodonte* (*Eurycratera*) *jamaicensis* (Gmel.), which are rarely seen except in favorable localities in virgin forest, are found here plentifully. *Annularia fimbriatula* (Sowb.) is also very abundant; it is rarely seen except in undisturbed woods. Mr. Garrett informs me that the woods is practically in an undisturbed condition, and is rarely entered except to cut a little firewood. The moist rocks and the honeycombed character of the stone, with the abundance of food, makes this a very favorable habitat for several of the species collected. The woods is completely isolated by open fields and pastures from neighboring patches of woodland and will probably remain in its present condition for many years to come. It has been isolated now for a generation or more, but has remained practically untouched for that time. It was one of the few places where *Stoastoma pisum* (Sow.) was seen alive and moving actively about, up to the top of the hill. The Zaphysemas and Pleurodontes were taken principally from the slopes and near the top.

Ridge Near Lincoln Colony.

To the west of Mandeville the ground rises in a series of ridges, broken by gaps and with a general north-northwest to south-southeast trend. The crest of the main ridge is reached by taking a branch of the upper Santa Cruz Road, which leaves the post road about 3 miles to the west of Mandeville Court House and runs among the hills to Lincoln. At about 6 miles west of Mandeville and somewhat short of the hamlet of Lincoln the main ridge is crossed in a gap occupied by this parochial road, and from this point the ridge was followed some half-mile to the north-northwest. Near the road the larger trees have been cut, but following along the rocky hill-crest one soon passes into untouched virgin forest. From the top of this crest the Santa Cruz Mountains may be seen some 10 miles away across the Valley of Black River. The ridge is formed of the purer limestone, honeycombed by holes and small cockpits, and standing up in sharp spires. The hill is covered with a dense growth of jungle. The elevation of the highest point reached was about 2,800 feet above sea level. *Zaphysema macmurryi*, *Pleurodonte jamaicensis*, *P. acuta goniasmos* and species of *Sagda* were very plentiful. Their dead shells were seen, in rifts in the cliffs and in the cockpits, by the peck. The smaller holes in the limestone were frequently several feet deep, the cockpits were often ten feet and more deep. Careful search was made for living *Zaphysema macmurryi* and *P. jamaicensis*, but while dead shells of both species could have been gathered by the bushel (and many of these were in perfectly fresh condition), no living specimens were encountered. They probably live deep in the holes of the limestone and in the cockpits, and would hardly be seen alive on the surface unless during the rains, which at the time I collected here, May 3, had hardly begun. The conditions of moisture and the character of the vegetation resembled those of the Garrett's woods locality, but in this case the ridge is continuously wooded for some miles with scarcely a break and the forest extends down the slopes for a considerable distance, so that there must be several thousand acres of woodland along this ridge that is more or less continuous. The breaks that occur in the continuity of the forest could probably be crossed by migrating snails during the rainy season, though, at the time of my visit, the dry slope at the end of the hill towards the road would have offered an impassable barrier. To the north, however, it must be nearly continuous forest to Balaclava and the uncultivated Cockpit Country. To the northeast lies the Somerset colony, in a similar forested area, but the intervening valleys are many of them cleared and cultivated. The part examined could be strictly called one colony, but, doubtless, on following out the ridge to the north, many more or less isolated colonies would be encountered.

Somerset Road Colony.

This is a small colony $2\frac{1}{2}$ miles from Mandeville at the turn in the parochial road to Somerset, between the 2 and 3 mile posts. It consists of small roadside exposures of limestone in little quarries and borrow pits along the base of a rocky wooded hill. The limestone is principally the marly variety, and while not weathered to the porous character which this stone acquires on hill-tops, the soil is nevertheless rather dry. The woods are not very dense, but the ground is covered by a layer of some inches of leaves which furnish enough food to support a good population of *P. acuta goniasmos* and many smaller snails, as *Colobostylus jayanus rufilabris*. The collection here was made in about 100 yards of the wood, mostly near the road. The entire patch of woodland was perhaps a couple of acres, but it was only partly isolated from much larger tracts of forest in the adjoining hills to the west. The elevation was somewhat below that of Mandeville, probably 1,900 feet above sea level. In all directions except to the southwest this point of hill is isolated from the lower ground by open pastures. It is about half-way between Mandeville and the Somerset estate, some 3 miles from each, and nearly as far from the Kendal Road colony. Larger forms, such as *P. acuta goniasmos,* could undoubtedly travel during the wet season into this locality from the neighboring wooded hills to the west, southwest and south, but the forms living to the north and east would be completely isolated by cleared land.

Kendal Road Colony.

In collecting out this road $3\frac{1}{2}$ miles from Mandeville, but few large stretches of untouched woodland were found that were favorable for collecting and that reached the post road. The hills were generally wooded; sometimes the forest was practically virgin, but pastures or cultivations isolated them from the road. After passing down the steep zigzag part of the road, in the lower ground, a few pieces of favorable woodland were met with, and along the roadside exposures at one of these places some specimens of *Pleurodonte* were taken. They must have lived in the few acres of woodland, for here the cultivation is more intensive, and this colony would have been completely isolated by open country from any others. It was very noticeable here, an old cultivated district, that the old weathered shells were very different in form from those that were in new, fresh condition. The wood was not entered, so no living forms were taken. The fresh shells collected were from those that had crawled down into the road during rains and been destroyed by ants, the older ones were from shell accumulations in the fissures in the rocks.

The Somerset Colony.

This large estate of some 3,000 acres was visited in February, 1910, and in May I spent a week here as the guest of Mr. A. P. Sutherland collecting molluscs. The property lies on either side of the parochial road (known as the Somerset road) which leads to Medina and Balaclava, and the estate is entered at a point about five miles from Mandeville. From here it extends along the road for a couple of miles. The house at Somerset was built more than half a century ago, but the property is still in virgin forest with the exception of such pastures and cultivations among the hills as have gradually been cleared during the last 30 or 40 years. The surface is very irregular, with a network of narrow valleys and sinks more or less connected, between the meshes of which the round or oblong hills stand up boldly. The topography has been mainly produced by the solution of the limestones forming caves, which have fallen in, making the deep sinks, bowl-shaped valleys and deep gullies that form the network of depressions. The limestone stands up in bold escarpments and cliffs fronting the depressions, and these cliffs follow along the general trend of the hills; in many cases they seem to represent the faces of fault blocks. The main system of these cliffs runs nearly north and south—north-northwest by south-southeast, as a rule; the hills follow these lines in a large number of cases. A more or less continuous depression is followed by the road through the estate, but this is not continuous, and the road is therefore very hilly. Less than half a mile to the west of the road over the first range of hills is a similar and more continuous depression or valley, with a more continuous range of hills rising abruptly on the west, and so the steep hills continue to rise in succession until at about 2½ or 3 miles to the west of the Somerset barbecues and house the ridge overlooking the valley of St. Elizabeth is reached—a continuation of the "Ridge near Lincoln." All of the depressions (except some deep gullies and sinks) and some of the less stony slopes near the parochial road are cleared and partly under cultivation, but this cleared area represents less than one-fourth of the surface near the road, and in the valleys further from the road even less has been cleared. Many of the old cultivations have been abandoned for years and the jungle or "bush" very rapidly covers such abandoned, cleared land. Most of the land at present cleared is in pasture, although some small plantings of ground vegetables, coffee, bananas, etc., have been made. The hills are so close to each other, only separated, as a rule, by pastures, which are often planted with oranges and pimento, that migration of snails from one to the other would be possible during wet periods. That such migration frequently takes place does not seem very likely, but the possibility of it makes the entire tract practically one colony. Even on the same hill it is easy to find evidence that much migration of the forms is not common, but that it occurs in some cases there is good evidence.

Collections were made in the gullies, sink holes and dissected caves that represent the virgin conditions in the low ground; also in the pastures where many forms live, and in the wooded hills, which are everywhere covered by the original forest. More than 20 such hills were explored with thin intervening valleys, an area of several hundred acres. The lower ground and many of the hill slopes are underlaid by the purer limestone, many of the cliffs on the hillsides consist of it, as do the sides of the dissected caves and the sinks (cockpits), and some of the tops of the lower hills. The higher hills are capped by the marly limestone, which covers them with loose blocks of the weathered porous stone, for the rocks are rarely in place here unless the cliffs extend up to the hill-top, which they sometimes do. As a rule, the hills are somewhat flat-topped. On such hill-tops the rocky surface is largely covered by a vigorous growth of the tall, slender palmetto, known as the "broom-palm," above which the hardwood trees of many kinds extend their dense shade. While well-shaded, these hill-tops are, nevertheless, dry on account of the porous nature of the limestone and the deep coating of leaves of the palmetto, which latter decays very slowly and is very porous without forming much humus.

In contrast to this dry condition is the very damp character of the sink holes and deeper gullies in the limestone which are so shaded that even the tree ferns flourish there all the year round. Some of the smaller hills, notably one to the west of the road near the southern edge of the estate are composed of the pure limestone which becomes honeycombed by the action of the weather, and is so liable to develop small sinks and cockpits. In this little hill just mentioned the vertical circular holes abound, many up to 10 feet in diameter. It was in one of these little cockpits that the best specimens of the large extinct form of *P. acuta goniasmos* were procured. Specimens as large as these were not found in the living state, but many from the gullies and lower ground approximated to their dimensions and shape. From a study of the distribution of this species and observations on other species, it is evident that the size is largely a question of moisture, good cover and abundant food, on the one hand, and dry conditions, with poor food supply and generally poor cover, on the other. Favorable conditions as to shade and even as to the character of vegetation (as absence of palms, etc.) may yet produce small forms where there is a deficiency of moisture. Such a case is the sink hole back of the barbecues on the Somerset place, where the forms were rather small because the rock was not honeycombed with holes, and hence the cover was not very good. The conditions of moisture were not the most favorable on account of the overhanging walls, but still the sink was not especially dry. But food was not plentiful and cover was rather lacking. Even the *P. a. goniasmos* was small, as was the *P. jamaicensis* also; but the very fact that this species was found at all, shows that the conditions were rather favorable. Observation on a great many localities on this estate shows that, as regards the distribution of the various sizes of any one species, this is dependent on the character of their habitats, which may be roughly classified as follows:

A. Deep gullies and cavernous or honeycombed rocks, giving good cover, abundant food and moisture, produce large well-fed forms. This region is confined to the uncleared valleys and gullies and the bases of the hills here, but may extend to hill-tops also, as at the small hill noted on this estate and the higher hill at the Ridge near Lincoln.

B. Slopes of hills rising from the more level ground, disturbed woods and isolated hills wooded to the top not covered by the palmetto, yet in virgin forest or bush where the conditions as to shade are favorable, but the rock cover not so good as in A and the food supply not so plentiful, produce the average medium-sized forms in great numbers.

C. Hill-tops, especially those covered by the palmetto called "broom-palm," where the rock cover is wanting and food is not plentiful and where the conditions are dry except after rains, have few and small forms.

In the condition C there is generally another unfavorable feature present, namely, the nests of the large black ant, which in such places builds nests of 7 or 8 feet high and 3 feet in diameter on the ground or in trees. In many cases these nests or ant cities are very old and have exercised an influence for years. Near such ants' nests no shells were seen dead or alive, although sometimes dead shells were encountered within 50 to 100 feet of such nests. The white termites (called locally "duck-ants") also build large dome-shaped nests, but more often on the slopes, and I did not see that they had much influence on the distribution of the molluscs.

Pleurodonte (Eurycratera) jamaicensis Gmel. Plate VII.

Good series of this species were obtained from Somerset, Ridge near Lincoln and Garrett's woods, and a few specimens from Benmore woods, Bloomfield, Cedar Hill woods, and the woods at King Edward Hotel. While these vary considerably in size, the same general form is preserved, so that from the smallest to the largest specimens the dimensions show a nearly even gradation. On account of the shape of the shell, comparable measurements could only be obtained with any approach to accuracy by making certain conventions in regard to the position in which the height and width should be measured. The "height" is measured from the apex of the shell to the outer edge of the lip, the greatest obtainable measurement being taken; the width is measured from just above the upper angle of the lip to the opposite whorl, the measurement being taken whorl to whorl. The height so obtained is not far different from that measured parallel to the axis, but is, of course, much more exact. The height of the mouth was also measured from the same angle of the lip to the tangent-point on the portion of the lip opposite and was found to range near the diameter of the shell. This species is still living at the first four localities mentioned, but, from the appearance of the shells collected, it is most likely extinct at the Bloomfield, Cedar Hill and King Edward Hotel woods. The specimens from Garrett's woods ran uniformly smaller than those from the other locations; of 28 adult shells but 3 exceed 38 x 49 mm. and but one shell of this species from all other localities is as small as this, and that one is an injured shell from the Benmore woods which was stunted by the injury. Of the 28 shells from Garrett's woods mentioned, 18, or 64 per cent., ranged between 35 x 45 mm. and 37 x 47 mm.; but one fell below 35 x 45 mm. and only three were above 38 x 49 mm. The largest shell from this locality was 39 x 52 mm. The index or ratio of width to height ranges from .735 to .82, with 75 per cent. of the shells between .77 and .79. Of the other large series, the Ridge near Lincoln colony and the Somerset group are nearly of the same size, ranging from 40 x 51 mm. to 45 x 57 mm., with the exception of one small specimen from Somerset which was evidently abnormally small, due to some irregularity in growth, as was indicated by the growth lines.

The Somerset colonies furnished shells of more uniform index or ratio of width to height than those of the Ridge near Lincoln colony; this index ranges from .76 to .815, but of the 30 specimens measured from the Somerset locality only 3 fall below .77 and only 6 are above .80. Of the other 21 (or 70 per cent.) which range from .77 to .80, inclusive, 18 (or 60 per cent. of the whole series from Somerset measured) have an index between .78 and .80. From the Ridge near Lincoln colony the range in the index is from .78 to .83; of the 16 examined 4 (or 25 per cent.) were below .79, 6 (or $37\frac{1}{2}$ per cent.) ran between .79 and .80, and a like number were above .80, and of these, 4 (25 per cent.) were above .82.

The few scattering specimens collected at the other localities mentioned are all larger than the majority of the Garrett's woods suite, but the index is very variable, ranging in the Benmore suite from .73 to .80 in six examples.

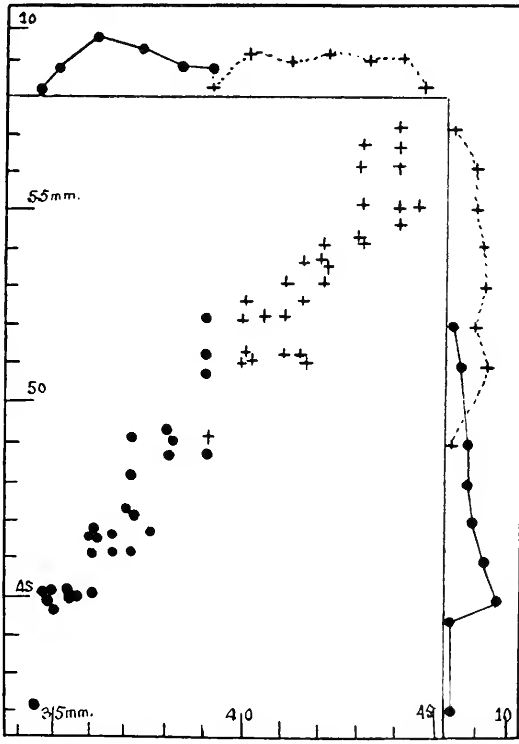

Fig. 2.—*P. jamaicensis.* Garrett's Woods and Somerset Colonies.

A comparison of the forms from the Garrett's woods colony with those of the Somerset and Ridge near Lincoln colonies may be made by examining figs. 1 and 2, which are plotted from the measurements of height and width. From these figures the relative variations can be readily seen. Averaging all the measurements gives about the following:

	Height.	Width.	Index.
Garrett's woods colony, average of 28	46	36	.78
Somerset colonies, average of 30	53	42	.795
Ridge near Lincoln colony, average of 16	54	42	.775

Fig. 2 shows the comparison of the forms from the Garrett's woods colony and the Somerset colony; the former represented by the black dots, the latter by the crosses. As will be seen, there is a gradation in size from one to the other, but the two groups do not mingle; the index is about the same in the two colonies. The size of the shell is given by the millimeter scales, the vertical scale on the left giving the height, while the horizontal scale below gives the width. The frequency curves for width are plotted at the top and those for height on the right. It will be noticed that there is no overlapping in the widths, which run from $34\frac{1}{2}$ to 39 mm. for the forms from Garrett's woods and from 39 to $44\frac{1}{2}$ mm. in the Somerset forms. But in the heights there is a certain amount of overlapping, as the frequency curves show.

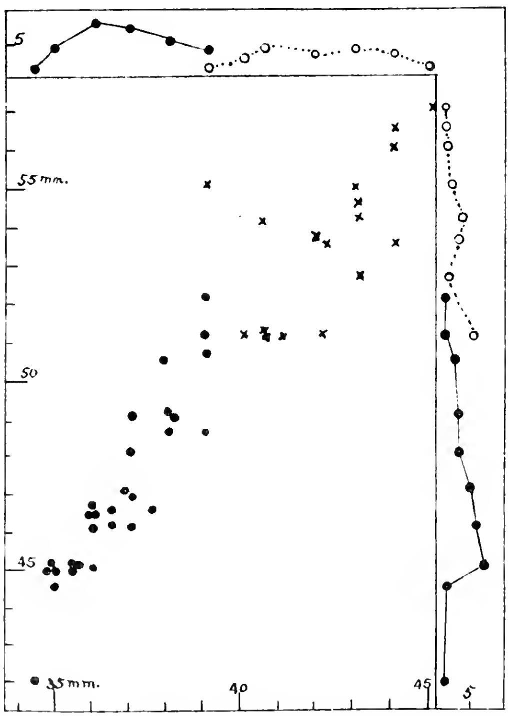

Fig. 3.—*P. jamaicensis.* Garrett's Woods and Ridge near Lincoln Colonies.

In fig. 3 a similar comparison of the Garrett's woods forms with those from the Ridge near Lincoln is given. Here again there is no mingling of the two groups and the frequency curves for width do not overlap, but those for height do so slightly. In plotting all the frequency curves the half-millimeter measurements were distributed to the nearest whole millimeter.

The variation here shown indicates that the Ridge near Lincoln and Somerset colonies are much alike, and indeed these two localities are connected by nearly continuous woods, but the smaller forms from Garrett's woods have been living here for years since their isolation by the clearing of the woods and have become a smaller race in this time. The forms from nearer Mandeville were larger than those from the isolated Garrett's woods colony.

Pleurodonte bainbridgei Pfr. Plate VIII.

Of the large series of this species in the collection of the Academy of Natural Sciences there are two specimens from Mt. Diabolo, St. Ann Parish, which are stated by Jarvis to be typical of the species. They are evidently the extremes of the series found at this locality. One is very near the *P. bainbridgei pretiosa* C. B. Ad. The other is the ordinary type of this species and is similar to those forms found in the immediate vicinity of Mandeville. They are stated to be extinct at Mt. Diabolo and are described as "semi-fossil." That they are really extinct, however, would require an examination for young of the species at the locality, as living adults of this species were not seen during the time of my visit at any of the localities in the Mandeville region considered below, while young shells in very fresh condition were found where the adult empty shells taken were all as weatherworn as either of these two Mt. Diabolo specimens. The two Mt. Diabolo specimens differ in many particulars, but as they came from the sides of the road that crosses the hill they very likely are from different colonies. As Mt. Diabolo is on the water shed dividing the island into north and south portions, it is quite possible that these two types represent a northern-side and a southern-side race. This is rendered still more probable by the variations in the Mandeville district specimens studied, which seem to indicate two races that, in some parts, have intermingled.

The *P. b. pretiosa* type from Mt. Diabolo measures 30 mm. in height by 55.5 mm. in width, with an index of .54, which is considerably lower than many shells of this type that I collected in the Mandeville district. The shell consists of $5\frac{1}{3}$ whorls; on the last half of the last whorl the suture is strongly impressed and the periphery is slightly elevated into an angle that is easily felt, forming a slight keel. The impressed suture is produced by a lowering of the suture line in this part of the last whorl and a wounding of the whorl. This depression of the suture is only to the periphery of the preceding whorl, however, and not below it, as in the typical forms of *P. b. pretiosa*. In this specimen the umbilicus is only half covered by an expansion of the lip. The other specimen is somewhat larger, measuring 32 mm. in width by 60 mm. in height; the index is .534—nearly the same as the last. The shell consists of 5¼ whorls (therefore slightly less than the last), with the suture on the last half of the last whorl only slightly impressed; the periphery in this portion of the shell is flattened, not keeled, and is even slightly impressed. The umbilicus is completely closed by an expansion of the lip.

Compared whorl by whorl with the specimens that are considered below, either of these runs somewhat larger after the second whorl, up to which point there is little difference in any of these forms.

Pleurodonte bainbridgei Pfr. Plate VIII, figs. 1, 2.

At Somerset colony.

Shell moderately elevated with about 5½ whorls, which are more compressed and rounded in the last 1½ whorls than in the Ridge near Lincoln colony, and in fact are the form that has been described as *P. b. pretiosa* by C. B. Adams. The suture at the end of the last whorl drops below the periphery by 1 or 2 mm. in many cases, and in two that were abnormally developed due to an injury; the dropping of the suture line amounts to 3 or 4 mm. and extends around the shell for the last half whorl. A number of the shells from this colony were very old, "subfossil," and yet they did not differ appreciably from the fresh living shells, showing that this form has not been interfered with by the clearing, or at least not altered in form by it. These semi-fossil forms were carefully measured, but they give substantially the measurements of the living adult forms of this locality. The average size is: width 53.2 mm., height 33.2 mm., index .62 x 5. The size varies considerably, however, from 48 x 32 mm. to 54 x 34 mm.; the index ranges from .588 to .694. The mean divergence varies from 110° to 115°.

Pleurodonte bainbridgei Pfr. Plate VIII, figs. 3, 4.

At the Ridge near Lincoln colony.

Shell with only moderately depressed spire, consisting of slightly over 5¼ whorls, the suture of the last half of the last whorl but slightly depressed, much less so than in typical forms of *P. b. pretiosa* C.B.Ad.

The periphery on the last whorl is not angled nor keeled, but is evenly rounded. The range of size in the 18 specimens examined varies but slightly, and the form is nearly the same in all (it is a rather homogeneous colony) and the average dimensions are: height 30 mm., width 54 mm., index .555. Mean divergence about 120°. While the young shell is strongly keeled, this sharp angle of the periphery of the shell is completely lost at $4\frac{1}{2}$ whorls, so that no angle appears along the periphery on the last whorl. The umbilicus is normally closed by an expansion of the lip, but in two shells (one of which is damaged) the expansion does not entirely cover the umbilicus.

Pleurodonte bainbridgei Pfr. Plate VIII, figs. 5, 6.

At the Garrett's woods colony.

Shell with a moderately depressed spire, the outline of which is somewhat concave to linear, with $5\frac{1}{4}$ whorls, of which the last is only slightly depressed along the suture in the last $\frac{1}{3}$, or in some cases not at all depressed; the periphery is slightly angled on the last whorl up to within $\frac{1}{4}$ whorl of the end or in one or two cases up to the end, otherwise rounded in the last $\frac{1}{4}$ whorl, and resembling the more depressed specimens from the Ridge near Lincoln. Umbilicus completely closed by the expansion of the lip in all of the specimens. The average dimensions are: width 53.3 mm., height 29.6 mm., index .555, mean divergence 125°–135°. Number of specimens, 10.

Pleurodonte bainbridgei Pfr. Plate VIII, figs. 7, 8.

At the Benmore colony.

Shell with depressed spire, consisting of 5 whorls or less, with a suture that is not at all impressed or only impressed on the last $\frac{1}{4}$ whorl; the periphery of the shell is slightly angled to the end of the last whorl, this being caused by the last whorl's being somewhat flattened on that part just above the periphery and sloping away rather sharply below. The umbilicus is closed by an expansion of the lip. The dimensions are: width $50\frac{2}{3}$ mm., height $27\frac{1}{3}$ mm., mean divergence about 125°, index 54.

Pleurodonte bainbridgei Pfr. Plate VIII, figs. 9, 10,

At the Cedar Hill colony.

Shell with rather depressed spire, consisting of $4\frac{7}{8}$ to 5 whorls; the suture on the last $\frac{1}{4}$ of the last whorl scarcely at all depressed, and this part of the whorl rounded at the periphery and scarcely angled beyond $4\frac{1}{3}$ whorls. The umbilicus is generally completely closed, but in two specimens it is only about $\frac{2}{3}$ closed by the expansion of the lip. Average dimensions are: width 52 mm., height 26.7 mm., mean divergence 140°, index .515.

Pleurodonte bainbridgei Pfr.

At the King Edward woods colony.

Shell depressed, consisting of somewhat less than 5 whorls ($4\frac{3}{4}$ to $4\frac{7}{8}$), the last whorl rounded or slightly angled at the periphery and with little or no depression at the suture, except at the end of the last whorl in some cases; umbilicus closed by an expansion of the lip. The single (outer) tooth is very small or nearly obsolete. Average dimensions are: width 50.6, height 26, mean divergence about 140°, index .513.

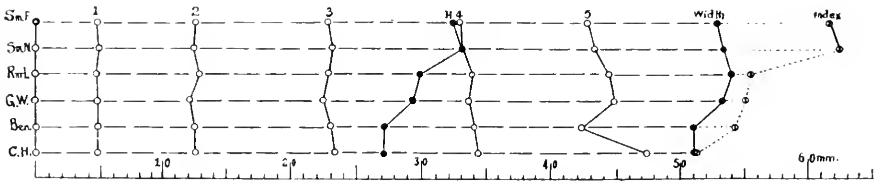

Fig. 4.—*P. bainbridgei.* Comparison by whorls, width and height.

Fig. 4 gives a comparison of the average sizes of this species from five of the stations where collections were made, and from the Somerset estate I have plotted the dimensions of the extinct shells as well as those now living. They are marked Sm. F., the Somerset extinct; Sm. N., the Somerset normal living forms; R. nr. L., the forms from Ridge near Lincoln; G. W., the Garrett's woods colony; Ben., the Benmore woods forms; and C. H., the forms from Cedar Hill. Measurements were taken of each shell, whorl by whorl, with the height and width, and these were then averaged and the index calculated, this being the ratio of the height to the width. These dimensions are plotted, the diameter at whorl 1, whorl 2, etc., being marked 1, 2, 3, 4, 5; and the greatest width is indicated by the black dots marked "width." The height of the adult shell, in the same way, is indicated at H. The indices are marked "Index." It will be noted that the Somerset forms have a high index and, as noted, resemble the forms that have been named *P. b. pretiosa* by Adams. The five localities represented on this figure are arranged geographically from Somerset to Benmore woods and Cedar Hill woods, and it will be noticed that there is a fall in the index from one locality to the other, but a rapid fall from the Somerset station to the Ridge near Lincoln station. This is accompanied by an actual as well as a relative drop in height of the shell, so that the height curve resembles the index curve, but this is natural as the width curve shows less variation. The shells from the Benmore woods colony were not very healthylooking, and this may account for the apparent stunting shown towards the end of their shells after the reproductive organs have developed, as indicated in the curves for "whorl 5" and "width."

Pleurodonte acuta goniasmos A. D. B.

This very variable species is the common large *Pleurodonte* in the Mandeville district. Some 500 specimens of adult shells were collected in this region from the definite colonies above described, as well as about a hundred immature shells; and, in addition, about 150 others from mixed colonies were taken, which are not considered in this comparative study. The largest collection was from the Somerset colonies, a suite of 229 being secured here of the adult shells, as well as a large number of young. Measurements of all of these six hundred shells (adult and immature) from definite colonies were made, and from these curves showing the distribution of dimensions plotted as well as the whole series of dimensions. From the young and from breaking down the whorls of adult and young shells measurements were secured in each case, from which measurements the growth curves of the development of the shells were worked out. Besides these measurements of height and width (the two dimensions recorded for all specimens), in the case of each colony, a small number of typical shells were selected and measured as to the diameter at each whorl, and these were averaged (as well as the heights and widths, and the indices with the mean divergence) and all these factors were plotted to scale. From this last diagram (fig. 6) it is at once seen that the differences in dimensions vary with the geographical position of the colonies and that at least two lines of migration are involved in this region. In the tract examined these begin at Somerset and at the Kendal Road colony, respectively, and, making two series of the colonies arranged in geographical order from these points, two sets of curves are at once obtained in which the graduation in dimensions is regular from one end to the other (fig. 6). The two lines, the Somerset wave and the Kendal Road wave, converge from the northwest and from the northeast towards Mandeville, where they are only separated by about a half-mile; and, doubtless, to the south of Mandeville colonies could be found that show a mingling of these two races. That they were originally one there is no doubt, but they branched off to the north and east from the main common stock and, following the topography of the country and the most favorable ground, became separated, but eventually came together again. In this migration through the "Manchester backwoods," as Chitty calls this region, the animals undoubtedly followed the lines of least resistance, where conditions of food and moisture (the main controlling factors in the case of this species) were most favorable, and they avoided the places where conditions were unfavorable or where resistance to migration was offered by the nature of the ground, such as dry, stony hills, continuous cliffs and very steep slopes. Of course this dispersal and migration was effected ages before the country was settled and cleared. On the basis of these apparent migration lines, the colonies may be divided into two groups. Starting in the area examined with the Somerset colony, we have one group including in order the following localities: Somerset, Somerset Road, Ridge near Lincoln, Garrett's woods and Bloomfield, forming a chain of colonies in one of the migration waves. The other may be taken as starting from Kendal Road $3\frac{1}{2}$ miles north by east of Mandeville and includes the group: Kendal Road, Benmore woods, Cedar Hill woods and King Edward woods, the last three being localities to the east and southeast of Mandeville Court House. From the large number of specimens collected at Somerset the possibility of variation at any one large station could be studied; and as the variation noted in the different colonies depends upon the same factors that control it in the case of the Somerset group of colonies, a study of the species at this station will serve as an introduction to the comparative study of the forms from all the colonies, which will then be taken up in order as given above. The migration lines can then be studied.

Pleurodonte acuta goniasmos A. D. B. Plate VIII.

At Somerset.

From an examination in the field four types of the species may be distinguished at this place, which may be designated as follows:

1. Extinct forms that formerly lived in the deep gullies and honeycombed rocks (localities of type A). Probably the nearest approach to the original stock we have any record of. As they were only found in a much weathered, semi-fossil condition, they are assumed to be extinct and will be called "*Somerset extinct.*" Their nearest descendants are the Somerset gully forms 2.

2. What may be called "*Somerset gully forms,*" the forms now living in localities of type A, as described under the Somerset colonies above.

3. Somerset hill slope forms, living under the conditions described under the Somerset colonies above as type B, the higher hill slopes. These may be called the "*Somerset normal forms.*"

4. "*Somerset hill-top*" forms, living on hills on which the broom-palm or palmetto grows (type C locality).

An examination of the measurements of the entire suite of Somerset specimens shows that the distribution of dimensions follow this grouping. From the plotting of the distribution of height and width the relative numbers of the four types are seen to be as given below

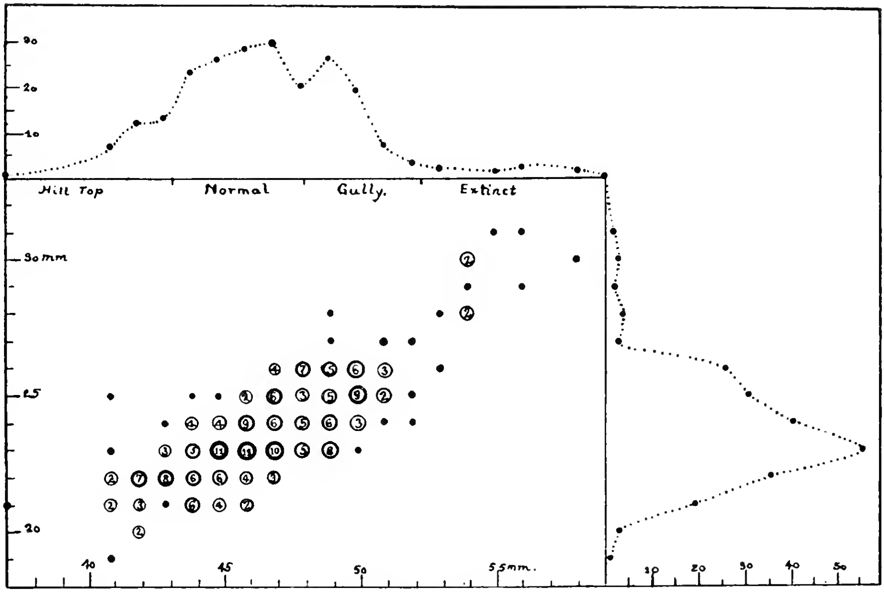

Fig. 5.—Somerset.

in the 229 examples studied. The separation into groups by the width measurements is quite sharp, but, as is explained later, the heights overlap somewhat:

Range of Dimensions in the Four Types at Somerset.

Type.	No. of examples.	Range of width, mm.	Range of height, mm.
Somerset Extinct	12	60–54	33–28
Somerset Gully	55	54–49	28–25 (23)
Somerset Normal	127	48–44	(26) 25–21
Somerset Hill-top	33	43–41	22–19.5

The curves were plotted for the entire 229 specimens and no attempt was made to sort them out into groups. But nevertheless the curves show the types quite plainly. Thus the widths for the 33 *hill-top* forms 13 are 42 mm. and 13 are 43 mm.; whereas the next millimeter in diameter, 44 mm., is represented by 23 specimens, 45 mm. by 29 specimens, 46 mm. by 26, 47 mm. by 25, 48 mm. by 24; this range from 44 mm. to 48 mm., inclusive, representing the normal forms. At a diameter of 49 mm. we find 26 forms; at 50 mm., 19 forms; at 51 mm., only 7 forms. There are a few scattering *normal forms* in these 52 *gully forms* and a few of the *gully forms* above 51 mm., up to 54 mm., making the number distinguished as *gully forms* up to 55. The 12 *extinct* specimens collected range from 54 to 60 mm. in width.

The curve of the heights does not serve so well to sort out the four types, for exclusive of the *extinct* type there is not so much range in height among the specimens except those of the *gully* type, which vary in height from 28 mm. to 23 mm., though mostly falling between 27 mm. and 25 mm. The curve shows a rapid rise from $19\frac{1}{2}$ mm., of which only one was recorded through 20 mm., of which only 2 examples were measured to 23 mm. as a maximum where the number recorded was 54. Between the heights of 22 mm. and 25 mm. there are included 108 specimens. As has been stated, a small number of characteristic examples of each of the three living types were selected for measurement by whorls and all of the perfect specimens of the *extinct* type collected were used; these measurements were employed in the descriptions which follow.

1. Somerset Extinct (Plate VIII, figs. 1, 2).—Shell rather more elevated than in the *Somerset gully forms,* consisting of $5\frac{3}{4}$ whorls, of which the first two belong to the embryonic shell; with an acute periphery which continues to the end of the last whorl; slightly concave next the periphery below up to the beginning or sometimes the middle of the last whorl, somewhat concave next the periphery above to the end of the last whorl; labrum with one outer tooth on the lower side, and sometimes with a second inner tooth; umbilicus normally closed by expansion of the lip. Average height 31 mm.; width 58 mm.; index .535; mean divergence about 115°.

About 60 per cent. of the shells had one tooth, the remaining 40 per cent. had two more or less well-developed teeth. This is a difference from the other Somerset forms now living, which showed 170 out of 209 with one tooth and ten with no teeth, against 29 with two teeth, of which the second inner tooth was often only a trace.

These *Somerset extinct* were found in several favorable localities, but were only collected from one cockpit on the little hill of honeycombed limestone that has been already mentioned. A few specimens were taken (about a dozen), although hundreds were seen here and elsewhere on the estate. It is assumed that they are extinct, as no fresh shells of this large high type were observed; but a protected gully may be found where they are still alive, and they may be living in the Balaclava district. They closely approach 2, *Somerset gully forms*, which are no doubt their descendants.

2. SOMERSET GULLY FORMS (Plate IX, figs. 3, 4).—This is the largest living *P. a. goniasmos* of this region. The shell consists of about $5\frac{1}{8}$ whorls, the spire being somewhat lower than in the *Somerset extinct* form. The embryonic shell occupies about $1\frac{3}{4}$ whorls. In form of shell and concavity next to the periphery, as well as in the keeled character of the latter, this shell resembles the *extinct* form; but in many shells the whorl next the periphery is convex below and even above near the end of the last whorl. This convexity of the whorl next to the periphery above is an accompaniment of diminution in size, and is common to almost all of the smaller forms of this species examined from each of the localities mentioned. As this type passes into the next (3), this character becomes normal in the entire last whorl. The labrum has the outer tooth developed in above 80 per cent. of the specimens, but the inner tooth is only present in some 14 per cent.; and somewhat less than 5 per cent. are destitute of teeth. Average height 23.5 mm.; width 50 mm.; index .47; mean divergence about 130°.

The form varies with the convexity or concavity of the whorl next to the periphery above; the more typical forms—those present in the largest numbers—are convex at this point on a part of the last whorl. An examination of the young shells shows that up to 4 whorls the form of the shell is that of *P. ingens* C. B. Ad. or of *P. acuta patina* (C. B. Ad); between 4 and $4\frac{1}{4}$ whorls it passes into the form of *P. a. acuta* and then rather rapidly into the typical *P. a. goniasmos* form.

3. SOMERSET NORMAL (Plate IX, figs. 5, 6).—These forms resemble the more convex type of the gully form and differ principally in size and in having a somewhat higher index, about .52. They are actually higher than the gully form by one or two millimeters when the width is some three millimeters less. The shell consists of $5\frac{1}{4}$ whorls, or a trifle more than in the gully, but the diameter of the whorls is less in every case and the fifth whorl has a diameter of 41 mm., as against 45 mm. in the gully form. The smaller shells, as a rule, are typically convex next to the periphery above, but wherever this character is well-marked the form is flatter and the index slightly less than in those with a concavity of the whorl at this point. Such more convex and less keeled forms generally measure about as given above, the more acute forms measure 24 mm. by 48 mm. to 25 mm. by 50 mm., with an index of .50, and thus pass into the gully type. They are then the intermediate stage between the present *gully* form living

under the most favorable conditions and the *hill-top* form living under the most unfavorable conditions. They were generally encountered on the sides and near the top of the slope in the hills capped by the broom-palm or in small, somewhat isolated hills, where in both cases the moisture was somewhat deficient and the food, therefore, not so plentiful as in the gullies. An average size was: height 24.5 mm.; width 47 mm.; index .52; mean divergence 125°.

4. Somerset Hill-top (Plate IX, figs. 7, 8).—These are the smallest form of this subspecies living at this locality, but they are simply a diminutive form of the *normal*. The portion of the whorl next to the periphery above is generally convex, and the height is slightly greater proportionately to the width than in the normal forms. This makes the index somewhat higher than in the normal, but not higher than in the *extinct* forms. There are $5\frac{1}{8}$ whorls normally, the same as in the form 2. An average size is: height 22 mm.; width 42 mm.; mean divergence 115°–120°; index .525.

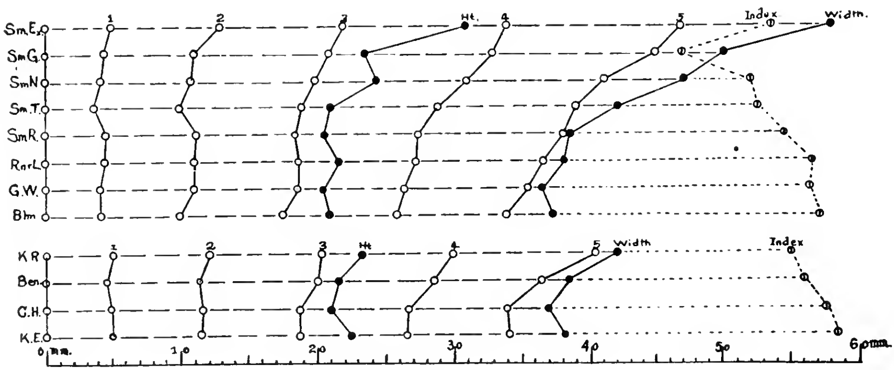

Fig. 6.—*P. a. goniasmos.* Comparison by whorls.

A most satisfactory comparison of these four types may be had by comparing their dimensions whorl by whorl, and such a comparison is given in the table below.

Comparison of the Average Dimensions from Selected Typical Specimens of the Four Types of P. a. goniasmos A. D. B. from Somerset Colony.

Type.	Whorl 1. mm.	Whl. 2. mm.	Whl. 3. mm.	Whl. 4. mm.	Whl. 5. mm.	Height. mm.	Width. mm.	Index.	Mean diver-gence.
Extinct	5	13	22	34	47	31	58	.535	115°
Gully	4.5	11	21	33	45	23.6	50	.47	130°
Normal	4.15	10.8	20	31	41	24.5	47	.52	125°
Hill-top	3.75	10	19	29	39	22	42	.525	118°

These may be plotted and will be found in fig. 6 along with the series from other colonies. The measurements of all the specimens from the Somerset colonies are plotted in fig. 5. Here the distribution of the hill-top, normal, gully and extinct forms is shown as regards frequency. The frequency curve for width shows distinctly the separation of these four types. Thus at width 42–43 mm. we have the limit of the hill-top forms and their blending into the normal forms; at 48 mm. the drop in the curve shows the passage from the normal to the gully forms, while between 52 and 53 mm. the extinct forms begin. Their (apparent) relative infrequency is simply due to the fact that comparatively few of the extinct shells were taken. In this diagram all measurements are to the nearest whole millimeter, the number of coincident measurements for any size of shell being indicated by the small numbers enclosed in the circles, whose centers indicate the dimensions.

Pleurodonte acuta goniasmos A. D. B. Plate X, figs. 1, 2.

At Somerset Road colony.

Shell varying from even flatter than the Somerset *normal* type to considerably more elevated; consisting of 5 whorls, the last whorl next to the periphery convex above and more so below, but with a distinct angle at the periphery; generally more elevated than in the Somerset forms and with an average index of .545, which is higher than even that of the Somerset *hill-top* shells. The index varies, however, from .473 to .612, being in general higher in the smaller shells, and only one of the larger specimens showing an index as high as .585; this was an old, weathered shell, perhaps representing an extinct form. The umbilicus is normally closed by an expansion of the lip, but in about 25 per cent. of the shells it was only partially closed. This is a one-toothed race like the Somerset shells—95 per cent. of the shells showed but a single tooth, and in only one was there a poorly developed second inner tooth. The diameter ranged from 35 to 44 mm. Average dimensions were: width 38.4 mm.; height 20.8 mm.; mean divergence 115° (110° to 120°); average index .545. Number of examples, 21.

This race, while smaller, closely resembles the forms from the Somerset colony. They are smaller than the smallest of these, however, the *hill-top* forms, and are somewhat higher in the spire also; the average index of the Somerset *hill-top* type is .525 as against .545 in this colony. In the young shells up to the second whorl the size is about the same as in the *normal* Somerset shells of the same developmental stage; from that point on the forms from this colony run smaller than any of the Somerset shells, compared whorl by whorl. Fig. 7 shows the measurements of the specimens from this colony, with their frequency curves of width and height.

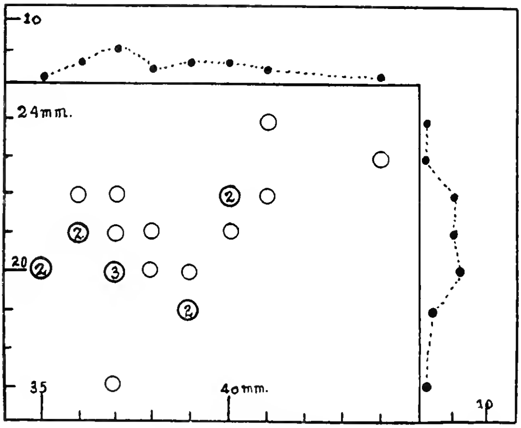

Fig. 7.—Somerset Road.

Pleurodonte acuta goniasmos A. D. B. Plate X, figs. 3, 4.

At the Ridge near Lincoln colony.

Shell varying from the form of the Somerset *normal* to much more elevated than those from Somerset Road and averaging higher than these in index; consisting of 5 whorls or often somewhat less ($4\frac{7}{8}$) and rarely of over $5\frac{1}{8}$ whorls; with a slight concavity next to the periphery above on the last whorl in most cases, but this is sometimes wanting; convex below next to the periphery on the last whorl. The index ranges from .50 to .634, but the average from typical specimens is .565. The umbilicus is completely closed by the expanson of the lip in all of the 40 adult specimens examined. The forms are both one-toothed and two-toothed in about equal proportions; with two teeth there were 18 specimens, but of these 13 had the second inner tooth small; in all 45 per cent. were two-toothed. Of the remaining 22 specimens 20 had only one tooth, 50 per cent.; the other two had no trace of teeth, though the lip was heavy and well developed. Average width 38 mm.; height 21.5 mm.; mean divergence 112°. Number of examples, 40.

The average width is slightly less than that for the Somerset Road colony, the height, on the other hand, is slightly greater; this makes the average index higher, .565 for this colony as against .545 at Somerset

Road colony. The measurements of the specimens from this colony are given in fig. 8.

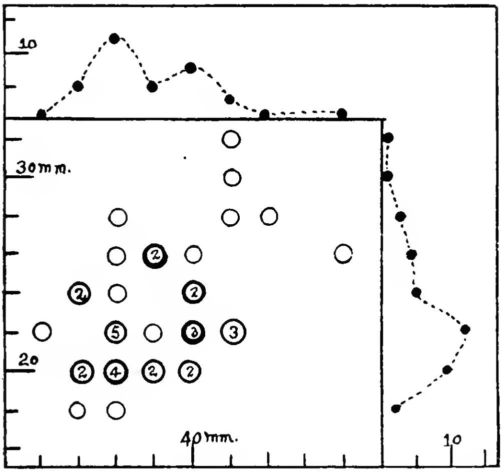

Fig. 8.—Ridge near Lincoln.

Pleurodonte aouta goniasmos A. D. B. Plate X, figs. 5–7.

At Garrett's woods colony.

Shell varying much in size and relative dimensions of height and width, but in general resembling the form of the higher shells from the Ridge near Lincoln colony; consisting of about 5 whorls, convex above and below the periphery on the last whorl; with a distinct angle along the periphery and, in some cases in the larger shells, with a slight concavity above the periphery in the last whorl. The index varies, the lowest being .48 and the highest .655, but a very large proportion of the specimens have an index of .55–.58 and the average for the typical specimens selected was .565. The plotting of the heights shows 22 specimens with a height of 19.5 mm., 20 with a height of 20 mm., 14 with a height of 20.5 mm., and 9 with a height of 21 mm.; the extremes of height range from 17 mm. to 27 mm. in the 83 examples measured, but these include 4 specimens which are semi-fossil, the largest of the series. The fresh shells run from 17 mm. to 23 mm. in height, these four semi-fossil ones from 24.5 mm. to 27 mm. The widths vary from 31.5 mm. to 40 mm. for the fresh shells and the four semi-fossil shells range from 40 mm. to 44 mm. The living forms show a sharp maximum in width at 36 mm., with 24 specimens (including those which measure 36.5); altogether 42 specimens range between 35 mm. and 37 mm. inclusive. The labrum shows a well-developed outer tooth in all but 5 specimens, which are toothless; of the toothed forms a less well-developed inner tooth appears in 38 specimens of the living form and 3 of the semi-fossil form, while 36 of the living form and one of the semi-fossil form have only the outer tooth. It will be seen, however, that the one-toothed and two-toothed forms are about evenly divided in this colony. The umbilicus is closed in all specimens by an expansion of the lip. Average dimensions are as follows: Width 20.4 mm.; height 36 mm.; mean divergence 109°; average index .565.

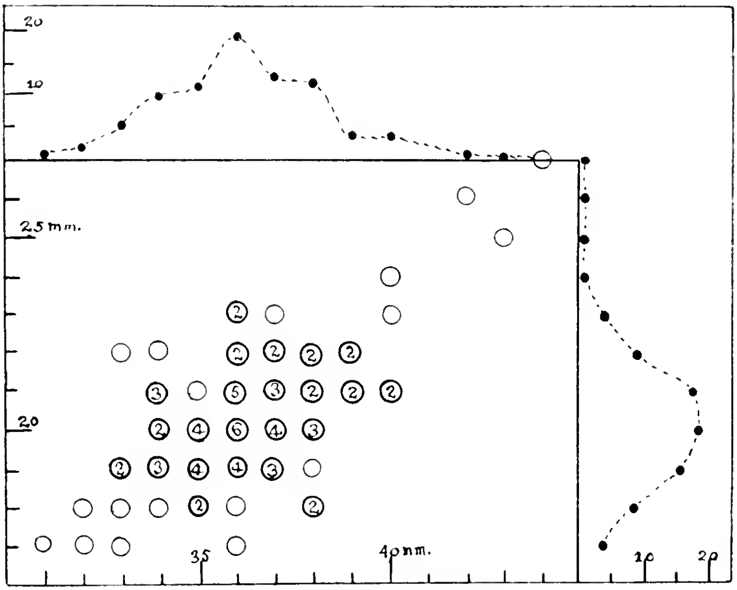

Fig. 9.—Garrett's Woods.

The form of the shell in this race is like that from the Ridge near Lincoln colony and somewhat higher in the spire than the shells from Somerset Road, but there are a great many small shells with very high spire. This is natural, for a large number of the specimens were taken from the hill-top, and, as at Somerset, so here, the hill-top forms run smaller than those found lower down on the slopes. The four semi-fossil forms are uniformly larger than the others, fig. 9, where the four highest shells are semi-fossil, and in these there is a slight concavity next to the periphery above in the last whorl. They probably represent the original race that reached this locality in the migration of the species, and that was subsequently modified to the present smaller form by being compelled to live under less favorable conditions, especially since the region has been under cultivation. They may have been driven to the shelter of this oasis in the cleared land by the cultivation, and even represent a form that lived under better conditions than those obtaining in the woods.

Pleurodonte acuta goniasmos A. D. B. Plate X, figs. 8–10.

At the Bloomfield colony.

A. *Old or Semi-fossil Shells, 9 examples.*—Shell with rather elevated spire consisting of 5 to $5\frac{1}{4}$ whorls and with, in most of the specimens, a concavity above, next to the periphery on the last whorl; in several of the specimens the shell is excavated or concave above the suture on the third and fourth whorls also, so that the very acute periphery persists up to the end of the fourth whorl where the excavation below the periphery disappears. The dimensions vary from 38 x 20.5 mm. to 43.5 x 25 mm.; the indices range from .515 to .612, but average .56. With the exception of two specimens, these old shells are uniformly larger than those now living in this colony. This is easily seen to be due to the fact that the woods at Bloomfield are disturbed and there is no possibility of migration from the lower ground as was doubtless the case when these semi-fossil shells were alive. Across the road from this woods the ground falls away into a long valley or pocket in the hills where the conditions of food and moisture must have been much more favorable when the country was uniformly forested than those obtaining in the colony at present. The forms are both one- and two-toothed, about equally divided, 4 have the outer tooth well developed and the inner one rather rudimentary, 5 have only the outer tooth. Average dimensions: width 40.5; height 22.7; index .56; mean divergence 110°.

B. *Living Race, 25 examples.*—Shell with rather elevated spire, consisting of 5 to $5\frac{1}{4}$ whorls; almost uniformly convex both above and below the periphery, which is not very sharp, in a few examples slightly excavated above next to the periphery. The dimensions range from 35 x 21 mm. to 39 x 23 mm.; the index varies from .53 to .625. They are about equally divided between two- and one-toothed forms; of the 25 specimens 12 have one tooth and 13 have two, but the inner tooth is only rudimentary in about one-third of these. The size varies, on the whole, considerably less than that for the old shells, but one is above 38.5 mm. in width, and that was 39 mm. Average dimensions: height 21 mm., width 37.3 mm., index 57 mm.; mean divergence 107°.

The dimensions of these two sets of specimens are given in the accompanying plot, fig. 10, in which all forms with a width of 39 mm. or over (with the exception of one, 39 x 23 mm.) belong to group A.

The shells in this colony were plentiful, and both in February and March and also in May living forms were collected in abundance. In March the young were perhaps somewhat more plentiful, but a good series were collected in May, when the suites above described were taken. The young ranged from 3 whorls to $4\frac{1}{2}$ whorls in diameter, they move actively about above the surface of leaves and probably

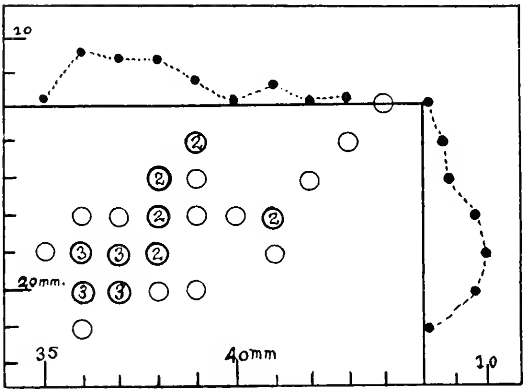

Fig. 10.—Bloomfield.

most of the migration occurs between a size of $2\frac{1}{2}$ whorls and of 4 whorls. At about 4 whorls the adult characters begin to appear, and the umbilicus to contract as the size of the opening of the shell expands, but the development of the shell will be given in another place.

Pleurodonte acuta goniasmos A. D. B. Plate XI, figs. 1–3, 5.

At the Kendal Road colony, $3\frac{1}{2}$ miles from Mandeville.

Shell varying from rather high in the spire to as flat as the Somerset *normal* forms, consisting of $5\frac{1}{4}$ to $5\frac{1}{2}$ whorls; only 2 out of the 18 examples (Plate XI, figs. 3 and 5) had a depressed spire, so that the index fell below .50 (.455 and .487), but in 5 others it was below .53 (.51, .512, .512, .524, .525). On the other hand, 4 had a much elevated spire, above .60 (.607, .61, .62, .62). The average index for the whole series was .55. They include shells that range in index below the lowest from Benmore woods, and some are also nearly as high in index as the highest from this colony. The outline of the spire runs from nearly linear to somewhat convex, but all show a slight excavation above the periphery on the last whorl and the angle is rather pronounced, one or two have this angle at the periphery much rounded.

The two extremes of form are so different that they may well represent two successive migration waves, but the high-spire forms predominate. Two of the shells were probably semi-fossil (Plate XI, fig. 1), but their index is near the average for the group and they were not larger than many taken at this colony. In actual size the two flat shells above mentioned are probably as large as many *Somerset normal* forms, measuring, height 21 mm. by width 46 mm. and 23 x 42½ mm., respectively, with indices of .553 and .541. This colony was at a lower level above sea than any other examined in this region; it is, as noted above, the most northerly point of the *second* migration line which seems to be indicated in the specimens of this collection. The dimensions of the entire 18 specimens are given in the diagram, fig. 11, but,

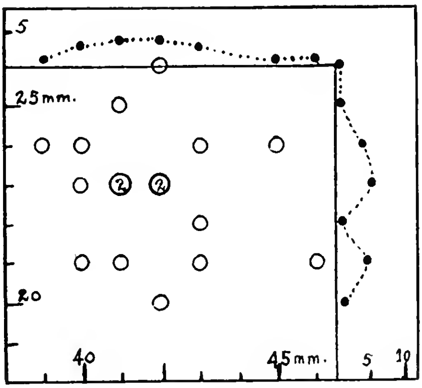

Fig. 11.—Kendal Road.

as will be seen, they are rather scattered. Average dimensions by whorls were measured for a small selected series of these specimens, they show that up to 2 whorls the diameter is equal or rather more than that of the *normal Somerset* forms, at whorl 3 about the same size and at whorls 4 and 5 somewhat smaller. When fully grown they are about the diameter of the Somerset *hill-top* forms. The index is higher than that of any of the Somerset forms, though near that of the Somerset Road forms. The average dimensions of the adult shell may be stated as, height 23.1 mm.; width 42 mm.; index .55; mean divergence in the flat forms 130°, in the forms with high spire 95°.

These forms are mostly one-toothed, 13 of the series had only the outer tooth and the other 5 had only a rudimentary inner tooth in addition. All have the umbilicus completely closed by an expansion of the lip.

The irregularity shown in the frequency curve of heights in fig. 9 is no doubt due to the fact that but a small series was taken at this station.

Pleurodonte acuta goniasmos A. D. B. Plate XI, figs. 4, 6, 7.

At the Benmore woods, Mandeville.

Shell ovate conical, rather higher than the last, consisting of $4\frac{3}{4}$ to $5\frac{1}{2}$ whorls, of which the last has a distinctly angled periphery, but is convex above and below and not excavated above the periphery, as is commonly the case in the Kendal Road colony. They do not include any very much depressed forms in the 42 specimens measured, these run above .53 in index, with the exception of 10 specimens whose indices range from .495 to .525; of the rest, 15 are above .575, and 8

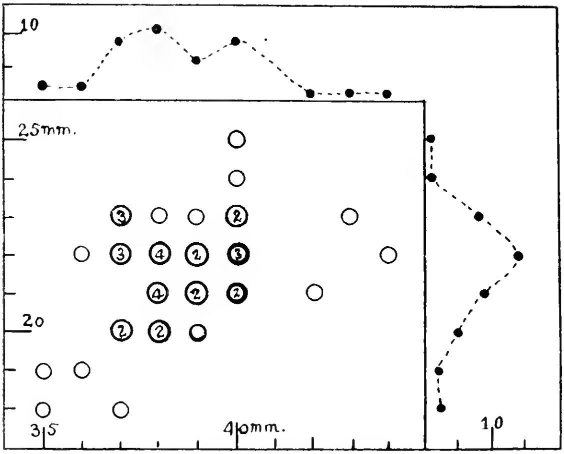

Fig. 12.—Benmore Woods.

of these are above 60. The average index for the entire series is .56. The heights vary considerably, but average about 21.5 mm., with an average width of 38.4 mm.; the mean divergence ranges from 120° to 110°. The highest index measured, .635, was in a shell of medium size, of which the dimensions were 23.5 x 37 mm.

The shells of this colony are prevailingly two-toothed, though the outer tooth is the only one that is strongly developed, and in the 25 that show two teeth ($59\frac{1}{2}$ per cent.) the inner tooth is rather small in most of the specimens. The other 17 specimens ($40\frac{1}{2}$ per cent.) only show one tooth, with no trace of the second, inner one. The umbilicus is normally closed, but is partly open in *one* specimen which is smaller than the average, although it does not seem to be abnormal or injured in any way. The only semi-fossil shell among the Benmore woods specimens has the highest spire of any measured, it gives 25 x 40½ mm.

The shells in this colony are smaller than those in the Kendal Road colony, and they are higher in the spire proportionately, or the index is slightly higher. There are none of the dimensions of the largest from Kendal Road colony, but one approaches it (22 x 44½ mm., as against 21 x 46 mm. from Kendal Road) and this has an index of .495, the only one with an index under .50.

Fig. 12 shows the distribution of size in this colony, the dimensions of the 42 specimens measured being given to the nearest whole millimeter. The frequency curve for widths shows that the majority range from 37 mm. to 40 mm., with a slight drop in the curve at 39 mm. The curve of heights shows a strong maximum at 22 mm.

Pleurodonte acuta goniasmos A. D. B. Plate XI, figs. 8, 9.

At Cedar Hill wood colony.

Shell generally rather elevated, consisting of 5 to 5½ whorls, in some cases slightly excavated above the periphery on the last whorl, especially in the higher forms otherwise convex at this point; with an index varying from .472 to .656, but in 69 per cent. of the specimens

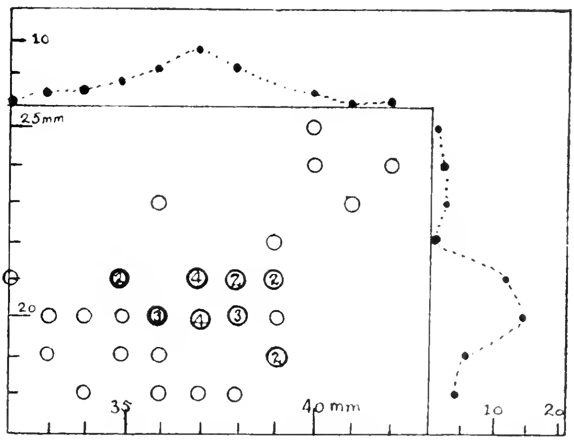

Fig. 13.—Cedar Hill.

it runs between .50 and .60 and is distributed as follows: under .50 in 4 specimens, .50–.55 in 13, .55–.60 in 16 and above .60 in 7 specimens. Three of these 7 specimens are very large semi-fossil shells, measuring 40 to 41½ mm. in diameter, the other 4 are small, very high shells of the fresh, living series, and range in size from 21 x 32 mm. to 225 x 36 mm. In the diagram of the measurements of this colony (fig. 13) the six semi-fossil shells are readily picked out, as they are seen to be the largest in the series. There are all gradations between the very high spired type and those which are moderately elevated only, but, as will be seen from the indices given above, only a very small number, less than 10 per cent., have an index near that of the *Somerset normal* forms or the flatter ones from Kendal Road colony.

Average dimensions are height 21 mm., width 37 mm., index .568; mean divergence varying from 90°–95° up to 105°–110°. The widths vary from 32 mm. to 43½ mm., but 29 of the shells (69 per cent.) have widths varying from 35 mm. to 39 mm. The heights also fluctuate widely, depending upon whether the shell has the more depressed or more elevated form.

The shells of this colony are both one-toothed and two-toothed forms, but the one-toothed form predominates and where two teeth are present they are of very unequal size, the outer one being well-developed and the inner one very rudimentary. More than 67 per cent. of the specimens have only the outer tooth developed, the rest have the outer quite large, but the inner one small. The number of examples studied was 42, and their dimensions are given, with their frequency curves, in fig. 13.

Pleurodonte acuta goniasmos A. D. B. Plate XI, figs. 10, 11.

At King Edward Hotel wood colony.

Shell more uniformly elevated than in any other colony, consisting of 5 to 5¼ whorls; the last whorl convex above and below, next to the periphery; very rarely is there a trace of excavation at this point. The whorls are somewhat convex above in those inside of the fifth whorl in some cases, in others the spire is more straight on the slope. The index runs uniformly higher than in the shells from the other colonies examined; in only one case out of 63 specimens does the index fall below .50 (to .487) and only 12 are below .55; that is, only 19 per cent. of the specimens examined. Of the rest, 31 specimens, or 49 per cent., are between .55 and .60; 19 specimens, or 30 per cent., have an index between .60 and .65, and one exceeds .65, being .658. In all, 81 per cent. show an index of .55 or above, and the average index for the colony is .585, much higher than any other examined. The shells of this colony do not vary in size quite so much as in some others; the extreme range of size is between 20 x 32 mm. and 23 x 42 mm.; most of them run between 21 x 35 mm. and 23 x 40 mm. The shells are prevailingly two-toothed, of the entire number examined in regard to this character, 68 in all, those with two teeth number 55 or 81 per cent. and the two teeth are both well-developed, although the inner tooth is somewhat smaller than the outer. The remaining 19 per cent. had only one tooth. Average dimensions are: height 22.4 mm.; width 38.2 mm.; index .585; mean divergence 98° to 102°.

This colony, the King Edward woods, is near the Benmore woods and the Cedar Hill woods, but is at present completely isolated from either as well as from other patches of woodland. From the proprietor of the King Edward Hotel I learn that it has been in its present condition for a generation, and is nearly untouched virgin woods. The constant character of a higher spire seems to have been fixed since the isolation of the colony, as the forms must have migrated in from the direction of Benmore woods or of Cedar Hill, judging from the topography.

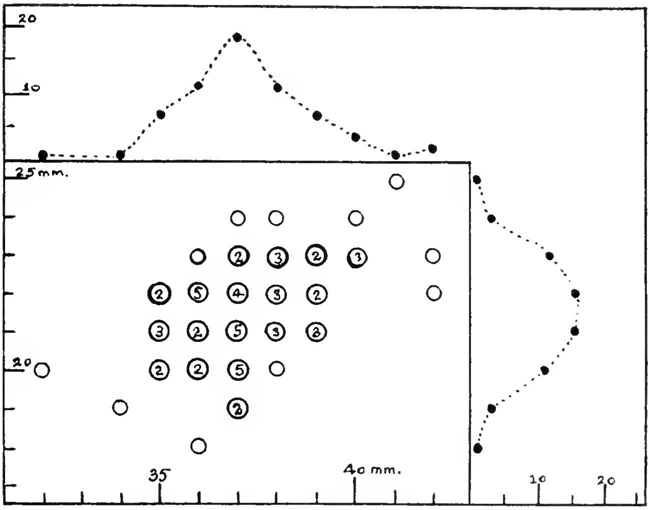

Fig. 14.—King Edward

Fig. 14 gives the individual dimensions of the shells of this colony and shows distinctly, in the regularity of the frequency curves of the two different dimensions, the unity of the colony and its undisturbed character. The curves here are progressive to the maxima and symmetrical, they do not indicate any admixture of foreign individual to disturb the integrity of the race, but they do appear to indicate an equilibration of the forms to the environment. The maximum of width is rather sharp, that of height is more gradually attained. As there seems to be in all of this stock a high and a low form intermingling, this isolated colony would seem to have nearly attained an equilibrium and fixed the characters of the new high-spired race. Topographically, this woods is lower in altitude than the Benmore or Bloomfield stations, but the old high-spired form shown on the Bloomfield diagram in the extinct shells is probably here found surviving in a more diminutive form. It is a hill-top race, for the King Edward woods is all hill-top, while the neighboring Benmore woods is cleared at the hill-top and the Cedar Hill woods includes hill-top and slopes and is much more wet than King Edward Hotel woods, so that stunting due to dry conditions is not so operative there. The species is still very plentiful here, another indication of adjustment of the forms to their environment. But, if such an adjustment as seems to be indicated has really taken place, it must have been accomplished since the isolation of this patch of woodland by the encroaching cultivation; that is, since the settlement and clearing of the adjoining lands, and probably within 20 or 30 years. That such change of conditions due to the influence of man in clearing the forest has resulted in smaller races in some species is easily demonstrated in the case of other Jamaican land mollusca, and some examples of it I intend to consider in a subsequent paper.

A comparison of the forms from these nine colonies, including the four types described from Somerset, whorl by whorl, as was done in the case of *Pleurodonte bainbridgei* from the five colonies compared under that species, shows a very definite gradation in the dimensions. For the purpose of this comparison a small number of specimens, five to ten, chosen as typical examples of each type or colony and representing the variation in size, were selected, making twelve groups of specimens, or some 75 specimens in all. Each one of these was then measured for its diameter at the end of the first, second, third, fourth and fifth whorl, also for its greatest diameter and height. The number of whorls and fractions of a whorl were noted. In measuring the diameters at the end of the first, second, etc., whorls all measurements started at the protoconch origin. In the larger snails the beginning of the suture is generally straight for half a millimeter or more and this straight part prolonged becomes a tangent to the curving suture line. From the beginning of the suture a line was drawn radially, and tangent to the first part of the suture; where this line crossed the suture was taken as the end of the whorls. The series of measurements thus obtained are strictly comparable, being all made on the same basis. With the heights and greatest widths they amounted to some 500 measurements in twelve series; and in nearly all cases represent 7 measurements for each shell. These were then taken in each series or type, whorl by whorl, and the corresponding measurements averaged, giving for each of the twelve types or series the average width at each whorl, the average greatest width and height. The same method was employed in measuring the dimensions of *P. bainbridgei* shown in fig. 4. Upon plotting and comparing these measurements (fig. 6), it was seen that when the colonies or types represented were arranged geographically they were at the same time sorted out into two series in which the gradation of size was continuous from one end to the other in each. These two series are (1) the four types from the Somerset colony, Somerset Road, Ridge near Lincoln, Garrett's woods, Bloomfield; and (2) Kendal Road, Benmore, Cedar Hill woods and King Edward Hotel woods. The first has eight members, from five colonies, the second represents four colonies. The first group (1) represents a line from Somerset and Ridge near Lincoln, approaching Mandeville from the northwest, and terminating at Bloomfield on the western outskirts of the town; the second group (2) reaches from Kendal Road on the northeast to the King Edward Hotel woods on the east of the town. They may very well represent two migration lines, as the forms probably migrated into this region from the north. The two ends near the town are separated by a high ridge and much cleared land, but the forms may have mingled in the past. These two groups of measurements are represented in fig. 6. The first at the top of the diagram is the Somerset-Bloomfield group, the lower is the Kendal Road-King Edward woods group.

The Somerset-Bloomfield Group.

The largest form of *P. a. goniasmos* found in the Mandeville district is the extinct race at Somerset, designated as Sm. Ex. in the diagram, with an average of $5\frac{3}{4}$ whorls and measuring 31 x 58 mm., with an index of .535. Then follows the gully forms (Sm. G.), the normal Somerset forms (Sm. N.), and the hill-top forms (Sm. T.). The successive whorls are marked 1, 2, 3, 4, 5; the height (Ht.) and the width are marked in black dots. It will be noticed that there is a gradual decrease in size in these four types in each whorl; even the first whorl showing this decrease, which indicates that the dwarfing begins in the egg. The irregular variation in height, and therefore in index, shown in the Somerset gully form (Sm. G.) is an expression of the observation that this form does not have the shape of the others and is probably another race, though closely related. The diminution in size for the whorls is accelerated after the third whorl and becomes very pronounced in the fifth whorl, but the width varies much more rapidly (as shown by the greatest width) than the height (Ht.). The index of the extinct form is, however, higher than that of the hill-top form, .535 as against .525. Comparing with these the other members of this series we see that the dimensions continue to decrease on the whole and the indices to increase, at least as far as Garrett's woods, which is really beyond Mandeville; though the Ridge near Lincoln forms (R. nr. L.) average somewhat higher than those of Garrett's woods (G. W.) and Bloomfield (Blm.), they are also higher than the wider form at Somerset Road colony (Sm. R.). The index of the Ridge near Lincoln form is then somewhat higher than that of the Garrett's woods form, but not higher than that of the Bloomfield form. There is hence a slight irregularity in the curve of heights and indices. The topography of the country renders it very probable that Garrett's woods and Bloomfield are in a migration line from the north, in which the Somerset and Somerset Road colonies would be the first stations represented on this diagram, or in this collection; the Ridge near Lincoln colony would probably be a station on another line from the Somerset region. That the forms migrated from the north, the high backbone of the island, after the last submergence of the island, is almost certain from the topography; therefore the forms whose measurements are given on this diagram, being arranged geographically, might represent the variation in a stock along a migration line.

The Kendal Road—King Edward Hotel Woods Group.

A similar migration line is probably represented in the lower part of fig. 6, which gives the measurements for the Kendal Road (K. R.), Benmore woods (Ben.), Cedar Hill woods (C. H.) and King Edward Hotel woods (K. E.). In this series, again, variation begins with the third whorl, and becomes more pronounced in the succeeding whorls. The height and width decrease for the first three stations, but rise again at the fourth. This series was arranged geographically, but also to show a constant rise of index, as the Cedar Hill woods and King Edward Hotel woods are about equally distant from the Kendal Road Station. The rise in the index from the Kendal Road to King Edward woods is, as the diagram shows, from .55 to .585; although both width and height diminish from the one station to the other, the index rises, that is, the spire rises proportionately to the width. The index, therefore, gives a direct means of comparison of the relative heights of the spires; as it rises, the spire becomes higher. As has been stated above, this change in form is observed in passing from station to station in each of the series represented in fig. 6; that is, a geographical arrangement of the forms is also a morphological one.

Variation in the Two Groups.

At Somerset, in passing from the base of the hills or from the valleys to the hill-tops, the form is observed to change, and the rise is quite noticeable as the tops of the hills are reached. From Somerset to the Ridge near Lincoln the rise in the spire is still continued, and this latter locality is a hill-top. At Garrett's woods and at Bloomfield the spires are higher than at any of the Somerset stations and as high or higher than at the Ridge near Lincoln. In the other series, from Kendal Road to the woods at King Edward Hotel, there is a similar rise in the spire. This change in the form cannot be correlated with change of altitude measured from sea level, but is directly connected with a diminution in size; as the size of the shell diminishes the shape changes, and the ratio of height to width increases, or the spire rises. Examined locally, as at Somerset, this change may be seen in passing from the base to the top of a hill, so that it may be stated that valley forms and those living at the base of the hill are lower in the spire than those living at the hill-top. The only place where valley and gully forms were seen in a natural, undisturbed condition was at Somerset. In passing from the gullies and shaded valleys, with their wealth of rank tropical vegetation and the ground covered with a thick moist layer of dead leaves, to the stony hill-top, with its hardwood trees and broom-palm, the number of specimens encountered became greatly reduced. On some hills at Somerset, scarcely a ground-living shell, such as *Pleurodonte*, was seen at the top of the hill, yet the shade of the woods was often very dense. But an examination of the ground showed that the surface coating of leaves was dry, it was mostly the fallen leaves of the broom-palm, which decay very slowly and do not form a good material for the growth of the fungus upon which the *Pleurodontes* appear to feed. The palm leaves form a sort of thatch on the ground and shed the water on the hill-top, hence the leaves are dry; and the loose stone on most of these hill-tops makes a porous layer, through which what water penetrates the palm thatch soon drains away. Comparing these Somerset hills with those examined elsewhere in the more cultivated regions, the comparatively small number of individual specimens encountered upon the hill-tops was very noticeable. But the molluscan population throughout all of this undisturbed region on the Somerset plantation was much less dense than in the majority of places that were examined in the more disturbed regions, and probably represents the original condition in these more cultivated parts. In such places as the localities in the cleared and cultivated region near Mandeville, as Garrett's woods.

Bloomfield, Benmore woods, King Edward Hotel woods and Cedar Hill woods, many of the forms probably were driven to the hills by the advancing cultivations, and the molluscan population hence became more dense in these places. This would mean a mingling of the lower-ground forms with the hill-top forms, yet the general hill-top character is more pronounced here than in the hills at Somerset. The larger forms were absorbed by the hill-top races in these cases, and the clearing killed off the lower-ground forms that did not migrate, so that the smaller hill-top races were no longer strengthened by the constant mingling with the lower-ground forms and hence the reduced size became a fixed character. These isolated hill-tops, therefore, became isolated colonies, and strict equilibration of the forms within contracted environment, both as to the external influences and the mixture of substance due to hybridity, without mingling of the blood from the larger lower-ground forms, the supply of which was now cut off by their extinction due to advancing cultivation, could begin. The result is the development of the small hill-top forms now characteristic of these colonies near Mandeville, or what may be called the *Mandeville race* of *P. a. goniasmos.* They differ from the lower-ground forms, as has been shown, by being of smaller size and by having a proportionately higher spire; but, in the colonies near Mandeville, these characters are accentuated, as compared with the hill-top forms found in the Somerset region, where mingling with the larger, and in general flatter, forms is still possible.

The Migrations.

Comparing all of the forms from all of the colonies, as is done in fig. 6, shows not only apparent migration lines, but indicates two waves of migration into the region from the north. The first was probably represented in the extinct Somerset race, and these as they moved south towards Mandeville became differentiated, as I have pointed out. The very old dead shells of the Mandeville region are generally rather high in the spire, higher than the living forms at Somerset of the same diameter. The Somerset gully forms I take to represent a second migration, they are the lower-spired form. At Somerset, the normal race has come from a mingling of these two stocks by long-continued hybridity, and the Somerset hill-top form with its reduced size is the result of this mingling. The same flat forms that resulted from this hybrid stock were seen at the Kendal Road and at the Somerset Road colonies; this hybrid, migrating into country occupied by the older, higher-spired forms, and mingling with them, produced the present Mandeville race. But this Mandeville race, as we see it now in the hill-top colonies that remain, is a development from this mingling of the older, high-spired form, and the later hybrid of this with the lower-spired gully form, this hybrid having come into the Mandeville district as a second migration wave. And the result of this mingling here to the south of Somerset has become, on account of its isolation in the hill-top colonies, a smaller, still higher-spired race than the ancestral one.

Causes of the Variation.

The rise of the spire from the bottom to the top of the hill or from the valley or gully to the top of the hill has been noted in other cases, but the cause assigned for the change of form has generally been the hypsometric change of pressure. Thus Arnauld Locard, in his *Etudes sur les variations malacologique du Bassin du Rhone*, published in 1881, says that the elongation of the spire is one of the effects of change of altitude upon molluscs. This had been noted previously by A. C. Recluz, in the case of *Helix pomatia* in the mountains of the Auvergne, and also in *Helix aspersa* in the region of the Midi. Locard made similar observations in the case of *H. pomatia* in passing from Lyons to Grenoble. Both observers noted a rise in the spire in passing from the lower to the higher altitude and both attribute this change in form to the diminution of air pressure in the higher altitude. In a paper published in 1904[3] Raffaelo Bellini reiterates this view that the elongation or rise of the spire is to be attributed to the influence of the diminished atmospheric pressure. Bellini's observations were on species observed on the island of Capri, and are embodied in a previous paper entitled, *Alcune osservazioni sulla distribuzione ipsometrica dei molluschi terrestri nell' isola di Capri*,[4] in which he notes the elongation of the spire in passing from the base to the tops of the hills, and attributes it to the diminution of the atmospheric pressure. That this is not the predominant cause in the case of the species considered in this paper the foregoing descriptions will make clear, for here we find at Somerset, some 2,250 feet in elevation, the lowest-spired forms of *P. a. goniasmos* encountered, while at the Somerset Road colony the spire is higher, but the altitude above sea level lower, less than 2,000 feet. At the Ridge near Lincoln the elevation is about 2,800 feet, but the form of *P. a. goniasmos* found here is lower in spire than that

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[3] R. Bellini, L'influenza dei mezzi come causa di variazione e di disperzione nei molluschi, *Bolletino del Societa da naturalisti in Napoli*, XVIII, 1904, p. 159.

[4] *Rendiconto del II Cong. Zool. Italiano*, Naples, 1901.

collected at the King Edward woods at an elevation of less than 2,000 feet, probably nearly one-third nearer the sea level than the Ridge near Lincoln colony. But the diminution in size in passing from the valleys and bases of the hills to the tops, which accompanies the rise of the spire, is an undoubted fact, although diminished atmospheric pressure is not here the controlling factor. That it should ever be a controlling factor does not seem likely, as the variation from day to day in barometric pressure at a given point may, in this latitude, at least, amount to what would be equivalent to a difference in elevation of 1,000 feet or even as much as 1,500 feet inside of 24 hours. The diminution in size and the rise in spire are independent of absolute altitude above sea level, but are noted in passing from the bottom to the top of one hill. There is in *P. a. goniasmos* a direct connection between these two characters, the size and the height of spire vary inversely. The cause of the diminution in size may well be the cause of the rise of the spire also. From the observations that I have made upon these Jamaica mollusks this diminution in size, which accompanies the rise in the height of the spire, appears to be controlled mainly by the distribution of moisture. Variations in the conditions of moisture may occur quite independently of the altitude, and I expect in a subsequent paper to discuss this influence in connection with some other species where altitude is not a factor, and where the distribution of moisture is not controlled by the altitude nor by the topography.

On the hill-tops, as has been pointed out, the amount of moisture found in the ground, in the leaf cover in which these Pleurodonts live, is less than on the slopes of the hills, and, from the wooded valleys and gullies to the hill-tops, this moisture in the leaf cover steadily diminishes, so that, as has been shown, the available food for the molluscs diminishes from the lower ground to the hill-top. Quite as important is the fact that the hill-tops are only moist and the conditions of moisture favorable for the growth of the mollusks at intervals following rains. In the gullies and wooded valleys the supply of moisture and food is continuous, on the hill-tops it is intermittent. The forms living in the hollows and lower ground at any place are, therefore, continuously supplied with the necessaries of life, while those living on the hills are supplied intermittently. Growth is continuous in the lower-ground forms, but it proceeds with many stoppages on the hill-tops. In a given period of time, therefore, the lower-ground forms can grow on more days, perhaps often on twice as many days or even more, than those living in the higher slopes and hill-tops. In a given time the valley and gully forms can attain a much larger size than the hill-top forms.

There is one dry season in the island and, in general, in the West Indies, during the months from December until the "spring rains" begin, in April or May, and during this dry time the showers are rare. For the rest of the year they may occur at any time, with maximum rainfall in May and November in most years. During the dry season, all of the *Pleurodontes* are more or less inactive; when the rains begin in April, they at once begin to pair. The young born one summer have grown to the adult state and pair the next summer. Those which have had the greater number of days of activity or of growth—the gully and lower-ground forms—will hence reach a larger size than those which have had, say, half as many growing days during the wet season; all have been inactive during the dry season. In the two cases the growing days may stand as one to two, the inactive period of the dry season is common to both, and after the same lapse of time in each case the animal becomes adult. Naturally the form that could grow on the greater number of days and the form that had the most abundant food supply will attain the larger size. The diminution in size on the hill-tops can thus be connected with the conditions of moisture, the supply during the growing season being less in these situations.

The rise of the spire is effected by a closer coiling of the whorl or the suture line drops more rapidly as the spire rises, and the diameter of the coil, the cross section of the aperture, does not increase so rapidly as when the spire is flatter. In a subsequent paper on the growth of the shell I hope to treat this matter more at length. Any mechanical injury to the shell results in the dropping of the whorl below the periphery and a consequent rise of the spire. Lessened vitality, due to insufficient food supply or mal-nutrition of any kind, or in general what may be considered pathological conditions, seems to produce the same effect—a dropping of the coil and a consequent rise of the spire. Frequent stoppages of the growth of the animal due to periodic times of dryness would probably have the same tendency. On the hill-tops we find these conditions of periodic dryness and mal-nutrition during the season when the forms living in the lower ground are growing continuously under optimum conditions of moisture and food supply, and these conditions seem to me to be the controlling factors in the variation in size and form of shell observed, aside, of course, from the effects of isolation on hybridity.

Isolation under such conditions as obtain upon the hill-tops results eventually in an adaptation of the substance of the organism to its environment, however, and the equilibration produces a race that can live under such conditions, so that the number of individuals does not diminish in a given area, but rather increases with the diminution of size; by which a given food supply will serve for a larger number of smaller individuals.

Explanation of Plates VII–XI.

Plate VII.—*Pleurodonte (Eurycratera) jamaicensis* Gmel.

Figs. 1, 2.—The rather large forms from the Somerset colonies.

Figs. 3, 4.—A larger and smaller form from the Ridge near Lincoln colony; these are quite as large as the Somerset race.

Figs. 5, 6.—The small race from Garrett's woods colony.

Plate VIII.—*Pleurodonte bainbridgei* Pfr.

Figs. 1, 2.—The form of the shell of this species at the Somerset colonies; it is the *P. bainbridgei pretiosa* of C. B. Adams.

Figs. 3, 4.—Two shells showing the form of the species at the Ridge near Lincoln colony, which somewhat approaches the *P. b. pretiosa* of Adams.

Figs. 5, 6.—Two shells from the Garrett's woods colony, showing the very slight depression of the suture line, much less so than at the Ridge near Lincoln.

Figs. 7, 8.—Two shells from the Benmore woods colony showing the depression of the suture at a minimum.

Figs. 9, 10.—Two shells from the Cedar Hill woods colony, showing their close resemblance to those from Benmore woods.

Plate IX.—*Pleurodonte acuta goniasmos* A. D. B. At Somerset.

Figs. 1, 2.—The extinct race at Somerset which shows the rather high spire of this type.

Figs. 3, 4.—The Somerset gully race, with its acute periphery and moderately elevated spire.

Figs. 5, 6.—The normal Somerset form found nearly everywhere except in the gullies and on the hill-tops.

Figs. 7, 8.—The Somerset hill-top form, a small race of the normal form.

Plate X.—*Pleurodonte acuta goniasmos* A. D. B. The Somerset Road to Bloomfield series.

Figs. 1, 2.—Forms from the Somerset Road colony, the present race is of the general type of the normal Somerset forms.

Figs. 3, 4.—The living forms from the Ridge near Lincoln colony.

Fig. 5.—The extinct race at Garrett's woods colony, showing the relatively high spire.

Figs. 6, 7.—Living forms from the Garrett's woods colony.

Fig. 8.—The extinct race at the Bloomfield colony, showing the rather high spire of this type.

Figs. 9, 10.—Living forms from the Bloomfield colony.

Plate XI.—*Pleurodonte acuta goniasmos* A. D. B. The Kendal Road to King Edward Hotel woods series.

Fig. 1.—The extinct race at the Kendal Road colony.

Fig. 2.—Living form of high-spire type at the Kendal Road colonies.

Figs. 3, 5.—Living forms of the flat type at the Kendal Road colonies.

Figs. 4, 6, 7.—Living forms from the Benmore woods colony. Fig. 4 is a two-toothed form and 6 is a one-toothed form.

Figs. 8, 9.—Living form from the Cedar Hill woods colony.

Fig. 10.—Living form from King Edward Hotel woods colony of average size; the highest-spired forms were found here. They closely resemble *Pleurodonte abnormis* Pfr.

Fig. 11.—Living form from same locality as 10, about the smallest specimen taken at this locality.

Note.—All figures in Plates VII–XI are natural size.

SCAPHOPODA OF THE JAMAICAN OLIGOCENE AND COSTA RICAN PLIOCENE.

BY HENRY A. PILSBRY.

Extensive collections of the fossils of the Upper Oligocene beds at Bowden, Jamaica, were made for the Academy some years ago by the late Uselma C. Smith and Mr. Silas L. Schumo. While preparing a monograph on the recent *Scaphopoda* for the *Manual of Conchology*[1] in 1897–8, the writer determined the species of these beds, and prepared the following descriptions and figures. Through oversight they were not published at that time.

Of nine species in our collection from the Bowden bed, two are represented by fragments too incomplete for characterization. Two are identical with forms from the Oligocene of Santo Domingo,[2] but the number of species common to the two beds may be increased when the smaller species are collected in Santo Domingo.

The occurrence of rich Oligocene faunas *of strictly littoral and sublittoral facies* at levels but little above the modern sea level, in both Jamaica and Santo Domingo, indicates emphatically that there was no such general and profound or total submergence of that area during the upper Oligocene as has been assumed by Dr. Schuckert.[3]

It is, moreover, inconceivable to students of the land-snails of the West Indies that the peculiar special faunas of the several islands could have been evolved since the Oligocene.

Dentalium costaricense n. sp. Fig. 3.

D. dentale Gabb, Journ. Acad. Nat. Sci. Phila., n. ser., VIII, p. 369 (in part).
D. costariceense Pilsbry, Manual of Conchology, XVII, p. 254 (name only).

Shell moderately curved, solid, moderately tapering. Surface sculptured with numerous somewhat unequal longitudinal rounded cords, separated by interstices as wide as themselves, with threads in some of the intervals, about 28 cords at the larger end, not counting the interposed threads; towards the smaller end alternate cords become more prominent, especially on the concave side; there are moderate, oblique growth-striæ throughout. Aperture oblique, with thin peristome. Both orifices circular.

[1] *Manual of Conchology*, vol. XVII.
[2] Scaphopoda of the Santo Domingo Oligocene, *Proc. A. N. S. Phila.* for 1897, pp. 465–476.
[3] *Paleogeography of North America*, plate 97.

Length 25½ mm. (posterior end broken); greatest diam. 3.7 mm.

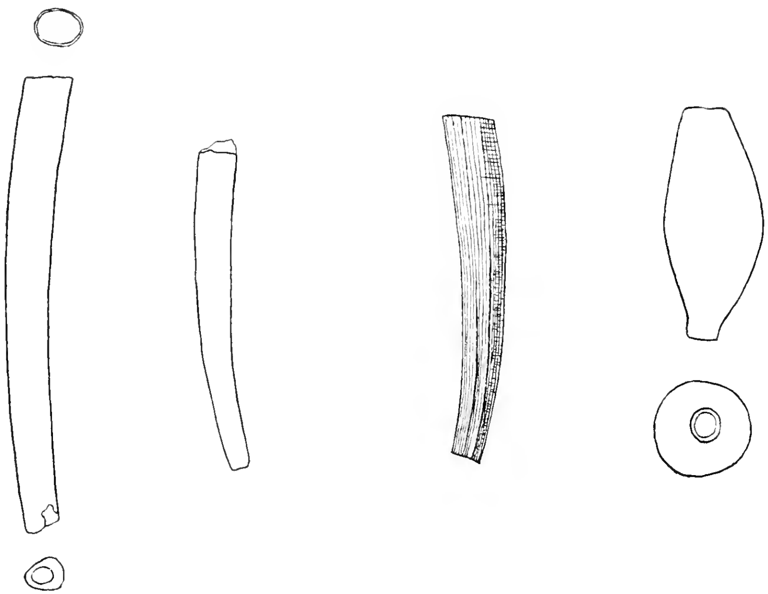
Pliocene(?), Costa Rica, William M. Gabb.

This species was referred to the European *D. dentalis* by Gabb, but it is not closely allied to that species.

Dentalium (Tesseracme) dissimile Guppy.

Proc. Acad. Nat. Sci., 1897, p. 469, pl. XI, figs. 3–5 (January 18, 1898).

A common form in the Bowden bed, and the largest Jamaican species.



Figs. 1, 2. *Dentalium macilentum.* Fig. 3. *D. costaricense.* Fig. 4. *Cadulus simrothi.*

Dentalium (Episiphon) macilentum n. sp. Figs. 1, 2.

Shell small, moderately curved, *excessively slender*, slightly tapering; surface *smooth*, somewhat glossy, with slight growth-lines only. Tube *very strongly compressed laterally* throughout, wider and thicker along the concave than the convex side. Both apertures oval or oblong. Young stage acicular.

Dimensions of largest (though imperfect) specimen: Length 8.8, antero-posterior diameter at aperture 9.1, at apex 0.7 mm.; lateral diameter at aperture 0.7, at apex 0.6 mm.

Bowden bed.

An abundant form, very strongly compressed laterally, sometimes actually flattened on the sides. The shell-wall along the concave side is decidedly thicker than that opposite along the convex side.

Another *Episiphon*, of very slender form, thin shell and circular section, occurs in the Santo Domingo Oligocene beds. As the material is not very abundant, only one being presumably adult, the species was omitted from my account of the Scaphopods of that deposit. The largest specimen seen has a length of 13 mm. and a greatest diameter of 0.9 mm., and is almost smooth.

Dentalium (Episiphon) schumoi n. sp. Fig. 5.

Shell small, slightly curved, *excessively slender*, the adults but slightly tapering, young shells acicular; rather thin; surface finely striated circularly, becoming on the posterior half strongly annulated *by rather regularly spaced, close grooves, slightly oblique,* and *cutting the surface into narrow segments* much as in *D.* (*Fustiaria*) *circinatum.* Tube *strongly compressed laterally* throughout; apex simple or with a short projecting pipe or tube.

Length 8.2, antero-posterior diameter at aperture 0.78, at apex 0.56 mm.; lateral diam. at aperture 0.6, at apex 0.46 mm. The specimen has evidently lost in length by breakage.

Bowden bed, not uncommon.

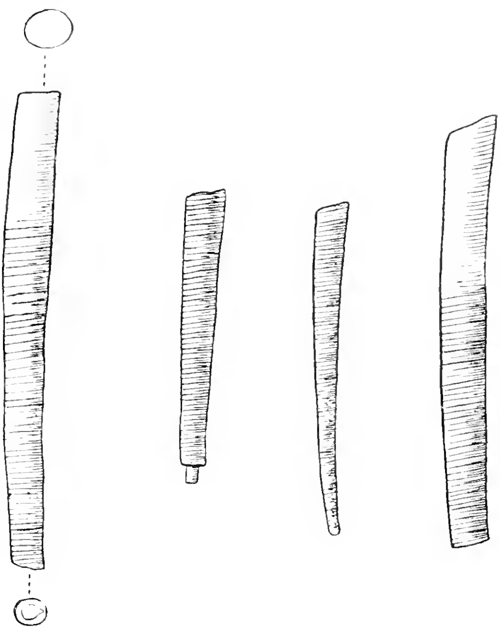


Fig. 5.—*Dentalium schumoi,* specimens of various ages.

Strongly compressed laterally, and readily distinguished by the circular sculpture. It is named in honor of Mr. Silas L. Schumo, who collected the material.

Dentalium (Rhabdus) sp. undet.

Numerous fragments of a slowly tapering species, circular in section, glossy, and very thin throughout, occur in the Bowden beds. The largest measures 3.6 mm. in diameter. The thinness of the entire tube and the circular section of the smaller end readily distinguish the species from *D. dissimile* Guppy, but the fragments at hand are too imperfect for definition of the species.

Cadulus depressicollis Pilsbry and Sharp.

Proc. Acad. N. S. Phila., 1897, p. 473, pl. 11, figs. 25–27.

Characteristic fragments of this species, originally described from Santo Domingo, are found in the Bowden beds.

Cadulus dentalinus (Guppy).

Pilsbry and Sharp, Manual of Conchology, XVII, p. 190, pl. 36, figs. 21, 22.

Bowden beds, abundant. This is the type locality. Specimens received from Mr. Guppy have been figured in my volume on recent Scaphopods, where the relationships of the species are discussed (*l. c.*, pp. 188–190).

Cadulus annulatus n. sp.

Rather a large, slender species of the group of *C. dentalinus*. The swelling is only slight and near the anterior end; tube subcircular in section, a trifle flattened on the convex side at the oblique aperture; sculpture of very fine, close, oblique wrinkles throughout. The length is about 7½ mm., greatest diameter 1 mm.

Bowden, Jamaica.

This species is represented by imperfect specimens only. It may be recognized by the very fine wrinkles and slight swelling.

Cadulus sp. undet.

A *Cadulus*, of the subgenus *Polyschides*, occurs in the Bowden beds, but only fragments are in the collection. There are several species belonging to the same group in the Eocene and Oligocene of the southern United States.

Cadulus simrothi n. sp. Fig. 3.

Shell minute, smooth, slightly arcuate, *biconic, strongly swollen in the middle*, rapidly tapering toward both ends, produced in a short tube posteriorly; greatest diameter contained about $2\frac{1}{3}$ times in the length of the shell. Outline of the most convex side irregular, the contours being but slightly convex above and below the "equator," and sometimes a little concave near the posterior orifice; outline of the opposite side similar, but less convex. *Tube circular in section at "equator" and aperture, decidedly oval at posterior or anal orifice,* being compressed on the convex and less so on the concave side. Aperture much larger than the other orifice, oblique, the peristome thin. Anal orifice oval, decidedly wider than long, obstructed by a circular callus within; edges unslit.

Length 2.1 mm.; diameter at aperture 0.37, at greatest swelling 0.9 mm.; antero-posterior diameter at apex 0.27, lateral diameter 0.3 mm.

Bowden, Jamaica.

This is, I believe, the earliest member of the typical group of *Cadulus* yet known. It is not unlike the recent *C. exiguus* Watson, but this species is a little broader, the diameter contained $2\frac{1}{3}$ times in the length. In *C. exiguus* the shell is "contracted into a tube at either end." In *C. simrothi* the posterior end only is tubular and the shell is a little larger.

March 7.

The President, Samuel G. Dixon, M.D., LL.D., in the Chair.

Fifty-three persons present.

The death of Benjamin Chew Tilghman, a member, March 6, 1911, was announced.

The Committee on the Hayden Memorial Award was elected as follows:

Richard A. F. Penrose, Jr., Henry F. Osborn, Amos P. Brown, Frederick Prime and Edgar T. Wherry.

The Council reported that Mr. George Vaux, Jr., had been appointed Solicitor of the Academy, and Mr. Frank J. Keeley Curator of the William S. Vaux Collections.

Dr. Henry Tucker made a communication on the dangerously poisonous snakes of the United States. (No abstract.)

March 21.

Henry Skinner, M.D., in the Chair.

Nineteen persons present.

The death of Amos R. Little, a member, December 16, 1906, was recorded.

Thomas H. Montgomery, Ph.D., read a paper on the extension of the usefulness of natural history museums. (No abstract.)

Remarks on New Cirripedes.—Dr. H. A. Pilsbry spoke of certain barnacles of the genus *Alepas* living attached to large Discomedusæ. The history of the genus was recounted. *Alepas* is remarkable for the lightness of its organization. The external tunic is very thin; the cirri are short, weak, and but slightly chitinized. The genus was instituted by Sander Rang for a form obtained off the Strait of Gibraltar about the year 1817. No modern account of this Atlantic *Alepas* has been published, but subsequent authors referred to the same genus a long series of nude barnacles living attached to a solid substratum, but which differ in important features from the true *Alepas*. For these discrepant forms the speaker has erected the genera *Heteralepas* and *Paralepas*. A true *Alepas* has been found in the eastern Pacific, *A. pacifica* Pils. Figures were exhibited of two additional species, obtained by the U. S. Fisheries Steamer "Albatross" in the Philippines.

Among other barnacles commensal on decapod crustacea, obtained at the Johns Hopkins tropical laboratory at Montego Bay, Jamaica, and submitted by Dr. John Paul Givler, there is a new form of *Octolasmis*, remarkable for the completely calcified plates. In all other known species of the genus the calcified portions of the plates have been reduced. This is therefore a form retaining archaic or ancestral features. It was found on a spider crab, and may be described as follows:

Octolasmis prototypus, n. sp. (figs. 2, 3).—The capitulum is acutely ovate, almost entirely covered by the well-calcified plates, which have the white color and dense texture of the plates of *Lepas*. The scutum is divided by an arcuate slit into a longer occludent and a shorter, triangular lateral segment. The latter is acute above, rounded at the two basal angles, and nearly as high as wide. Like the tergum, it has faint sculpture of concentric and radiating striæ. The tergum is very large, about as long as the carina, and nearly as long as the scutum. The lower end tapers, and extends between scutum and carina; the upper end is truncated, and the scutal margin a little hollowed to receive the apex of the scutum. The carina is but little curved and only shortly forked at the base. It is somewhat separated from the other plates. The peduncle is finely annulated in preserved examples, whitish, and decidedly longer than the capitulum, often 1½ times its length.

Length of capitulum 3.6, width 2.5 mm.; length of peduncle 3.5 to 4 mm.

The cirri resemble those of *O. forresti*. The first pair is very short, widely removed from the second, its rami consisting of 6 and 7 segments, which are densely hairy. The sixth pair has rami of 14 segments, armed comb-like with spines, 9 or 10 pairs on a segment, as figured by Stebbing for *O. forresti* (*Ann. and Mag. Nat. Hist.* (6), XIII, pl. 15, upper right-hand figure).

Maxillæ as in *O. forresti*. Mandibles having long spines on the lower side below the lower point.

This barnacle differs from *Pœcilasma* (*Temnaspis*) *fissum* Darwin, and the forms subordinated thereto by Annandale,[1] by the much wider occludent segment of the scutum, especially wide at its tergal extremity, and by the larger tergum. It is also a much smaller barnacle. In *P. fissum*, Darwin has shown that the cirri have a special arrangement of spines, which arise in transverse linear groups at the distal end of each segment, as in *Paralepas* or *Alepas*, whereas in *Octolasmis prototypus* the spines stand along the anterior side of the segments like the teeth of a comb, as in most other barnacles. Barnacles with

[1] *Særtryk af Vidensk. Meddel. fra den naturh. i Kbhvn*, 1910, p. 216.

the cirri armed in this manner might be designated as *ctenopod;* those with cirri in transverse brushes as *lasiopod* forms.

Octolasmis antiquæ Stebbing[2] (which Annandale[3] considers to be a form of *O. hocki* Stebbing), differs by the longer, very strongly arched carina and smaller tergum. It is from the maxillipeds of Palinurids.

Octolasmis occlusa Lanchester, from Kelantan, is not unlike these species, but the segments of the scutum are more separated, of somewhat different shape, the carina is much more bowed, and the smaller terga are acute above.

"*Pœcilasma*" *tridens* Aurivillius is evidently a member of this group of *Octolasmis*, and not a *Pœcilasma*.

By its fully calcified plates, *O. prototypus* is the most primitive of its group.

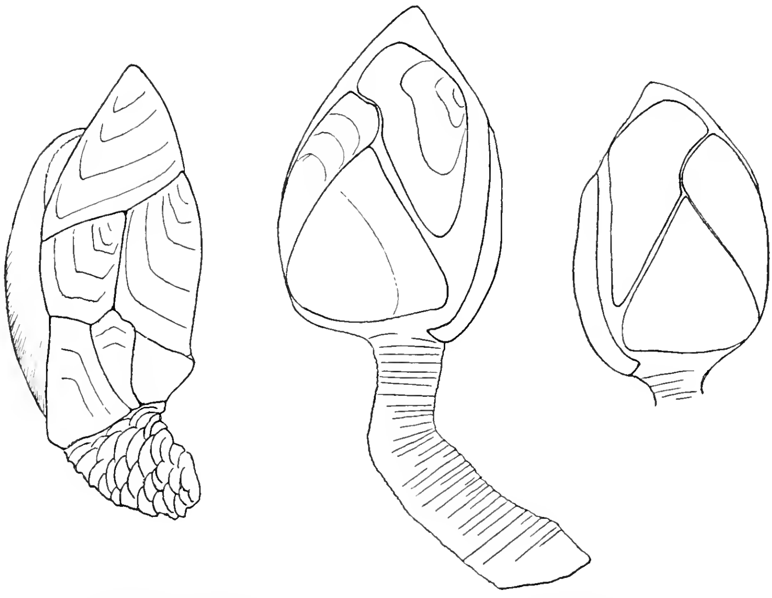


Fig. 1.—*Scalpellum hendersoni*. Figs. 2, 3.—*Octolasmis prototypus*.

In the course of dredging along the northern border of Florida Strait, in the yacht "Eolis," cruise of 1910, Mr. John B. Henderson obtained the new *Scalpellum*, here described.

Scalpellum hendersoni n. sp. Fig. 1.—The capitulum is compressed above, swollen across the lower whorl of plates; white; the length slightly more than double the width; both margins are arched, but the carinal more than the occludent. Plates fully calcified, marked with concentric growth-lines and on the scutum, tergum and upper latus, a few weak radial striæ.

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[2] *Annals and Magazine of Natural History* (6), XV, p. 18, pl. 2.
[3] *l. c.*, p. 217.

The scutum is trapezoidal, the occludent and carinal borders subparallel, upper and basal margins about equally oblique; umbo terminal. The tergum is triangular; occludent and carinal margins nearly straight and subequal; occludent margin convex.

The carina is arcuate, more so in its upper third, the umbo apical, slightly above the middle of the carinal margin of the tergum; roof strongly convex, the plate being U-shaped in section. It widens rapidly towards the base, which enters V-like between the carinal latera. Intraparietes very narrow, bounded by a ridge, and visible only in the upper part of the plate.

Upper lateral plate trapezoidal with apical umbo; the scutal margin is longest, concave above; the tergal next, arcuate; the carinal and basal margins are straight, equal, and at their junction form a right angle.

The rostral latera are triangular, obtuse at the rostral angle, widening rapidly to the other end. There is no visible rostrum.

The inframedian lateral plate is narrow and high, contracting perceptibly at the lower fourth, where the umbo is situated. Carinal lateral plates large, irregular, with the umbo at the lower carinal angle. The carinal margin is concave and longest; basal margin about equal to that opposed to the inframedian latus; upper margin, against the upper latus, and shortest. The two latera meet in a very short suture below the carina.

The peduncle is extremely short, densely covered with large scales in about 7 vertical rows.

Length of the capitulum 5, width 2.5 mm. Length of the carina 3.75 mm.

Habitat and Station.—Ten miles south of Key West, Florida, in 125 fathoms, on spines of a sea urchin, *Dorocidaris*, associated with *Verruca nexa alba* Pils. Types No. 1890, A. N. S. P., collected by John B. Henderson, Jr.

Numerous specimens taken of nearly uniform size show it to be adult; a view confirmed by the swollen shape of the lower part of the capitulum. It has much in common with *S. gracilius* Pils., but the rostral latera are quite different in shape, the carina does not extend so high on the terga, the capitulum is less elongate, and the peduncle has more rows of scales. Nearly all other species which are otherwise related differ by having a flat-roofed carina.

The following were elected members:

John Howard McFadden,
Edwin S. Stuart,
Bayard Long.

The following were ordered to be printed:

MOLLUSCA OF THE SOUTHWESTERN STATES, V: THE GRAND CANYON AND NORTHERN ARIZONA.

BY HENRY A. PILSBRY AND JAMES H. FERRISS.

Prior to 1906 the work on southwestern mollusks of the mountain region had been confined to southern and central New Mexico and Arizona. Between this region and the districts in Colorado and northern Utah which have been explored for snails, a great area, including the Grand Canyon of the Colorado, remained unworked. To obtain some knowledge of this region, the authors spent the month of October, 1906, in the Grand Canyon; also collecting on Bill Williams Mountain (elevation, 9,000 feet), on the plateau of northern Arizona, 64 miles south of the Grand Canyon. In the canyon we collected at the terminus of the Grand Canyon Railroad, a branch of the Santa Fé, at El Tovar, the Bright Angel Trail,[1] and at many localities reached from Bass Trail (also known as the Mystic Spring Trail), 24 miles west of the railroad, and on both sides of the river. Most of our stations here are shown on the accompanying map (fig. 1).

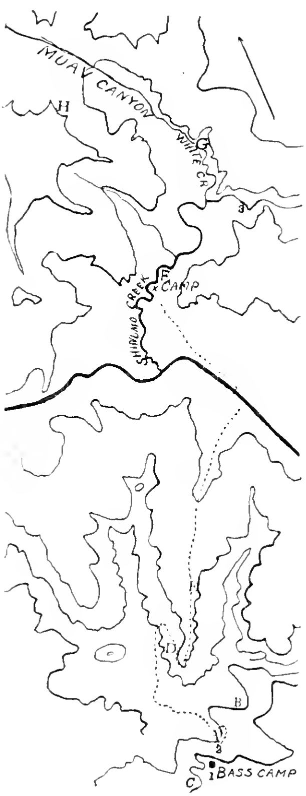

Fig. 1.—Grand Canyon in the vicinity of Bass Trail and Shinumo Creek, showing collecting stations, expedition of 1906. Reduced and simplified from U. S. Geol. Surv. Topographic map, Shinumo quadrangle, edit. of August, 1908.

We did not visit John Hance's trail, the Red Canyon Trail so-called, which lies east of Grand Canyon, the railroad terminus. One species, *Sonorella coloradoensis*, was taken here by Dr. C. Hart Merriam in 1889, but otherwise the snail fauna is unknown. The Grand View Trail is also unvisited by collectors of shells. The Oreohelices and Pupillidæ of the upper and intermediate slopes will doubtless prove interesting

[1] We are indebted to Dr. C. Montague Cooke, of Honolulu, for several species taken by him at the "Indian Gardens," Bright Angel Trail.

and well worth investigation on these two trails, both of which are easily accessible.

In 1909 (August 19 to October 25) Messrs. Ferriss and L. E. Daniels extended the work to the region north of the Grand Canyon, exploring the Powell Plateau and the western side of the Kaibab Plateau, going as far north as Kanab, Utah. A long and hard trip was also made westward to Mt. Trumbull. The route and stations are partly shown in fig. 2. The northward extension of the route, to Fredonia, Ariz. (Station 38), and Kanab, Utah, is not shown on the map. From Fredonia the route led southwest to Pipe Spring, Vermillion Cliff (Station 39), to Yellowstone Spring, southward across Antelope Valley (Station 40), to Mt. Trumbull, where the following stations were occupied:

43, Base of northwestern part of mountain, 6,700 feet.

44, Spring at northwestern part of mountain, 7,000 feet.

45, Northwestern part of mountain, 6,700 feet.

46, Hurricane Fault, 8 miles from Mt. Trumbull, 6,000 feet.

Station 41 is close to the figure 6, on the Kaibab Sheet

Fig. 2.—Part of route and collecting stations, expedition of 1909, north of the Grand Canyon. 1000 ft. contours traced from U. S. Geol. Surv. topographic map, Kaibab sheet, edition of March, 1886, reprinted January, 1900.

Powell Survey, long. 113°, lat. 36° 27′, on a limestone ridge between Finley's reservoir and Mt. Trumbull. Station 42, ant-hills on same road westward.

North of the northern rim of the Grand Canyon only one species of large size was found,—*Oreohelix strigosa depressa* (Ckll.); but this occurs in a multitude of colonies and in great variety of size and color. So far as we know, this form does not occur in Arizona south of the Colorado River in the Grand Canyon. The small shells are for the most part generally distributed on both sides of and in the Grand Canyon. Special to the Grand Canyon, so far as we know, are the following forms:

Sonorella coloradoensis (Stearns).

Oreohelix yavapai, subspecies *extremitatis*, *angelica* and *profundorum* P. and F.

Pupilla syngenes avus P. and F.

Only the first of these is generally distributed, being found on both sides of the river, and for at least 30 miles along its course; also on the plateau south of the canyon at Bass Station.

The work of collecting in the Grand Canyon is severe. The trails, except the Bright Angel or tourists' trail, are narrow and very steep. You will dig snails on taluses ending in cliffs dropping hundreds of feet; no sound comes back from the rocks your work dislodges. Also, the sandstone and metamorphic rock is hard on the hands. *Oreohelix*, in restricted localities, is sometimes very abundant, but *Sonorella* is always rare, and living ones can be obtained only by hard work. Satisfactory work along the south side can de done from the camps or hotels at the several trails. For work in the lower levels and on the north side of the river a camp outfit and pack animals are required. These may be obtained at the Bright Angel, Bass, Grand View or Hance Trails.

The most productive horizons in the Grand Canyon are the Kaibab Limestone, which forms the slope immediately below the rim, and the talus at the foot of the Cross-bed or Coconino Sandstone, in sheltered recesses where a talus from the overlying limestone terrain has accumulated. The deeper levels are comparatively unproductive, though *Sonorella* penetrates in suitable places nearly to the river.

The molluscan fauna of the Grand Canyon, with the sole exception of *Sonorella*, consists of species inhabiting northern Arizona on one or both sides of the canyon or of forms evidently derived from such species. It must, therefore, so far as mollusks are concerned, be considered a part of the Transition zone. *Sonorella* is the sole Upper Austral genus. It inhabits both sides of the river, up to and even upon the rim.

The canyon forms a barrier to the distribution of *Oreohelix*, the widely spread Arizonian species *O. yavapai* not extending north of it, though very abundant in several subspecies on the southern side, while *O. strigosa depressa*, very abundant north of the canyon, does not to our knowledge occur in the canyon or in Arizona south of it. Some of the smaller species may prove to be similarly restricted, but more copious data are required to prove that this is the case. The minute species, here as elsewhere, are widely distributed, probably owing to the facility with which they may be carried by cyclonic storms.

In a former paper of this series[2] we discussed briefly the relation of desert snails to their environments, concluding that the direct influence of desert climate had been overestimated basing this opinion upon the fact that these animals are quiescent except during the brief periods of damp or rainy weather; and accounting for the opaque and chalky texture of exposed snails as a protection against sunlight, probably brought about by selection. A recent letter from Dr. Wm. H. Dall, giving his somewhat diverse views upon the same topic, is here printed, by permission, so that those interested in these questions from the standpoint of molluscan study may have both views before them.[3]

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[2] Mollusca of the Southwestern States, IV: The Chiricahua Mountains, *Proc. Acad. Nat. Sci. Phila.*, 1910, pp. 47–50.

[3] "In regard to direct action of sunlight and other factors of climate on desert snails (among which I reckon only those really exposed to it, and not those like *Ashmunella*, which by descending into the rock piles reach a moderately humid climate), my reasoning would be something like this: We know irritation of the surface in snails causes exudation of mucous matter (mixed with lime in the case of shell bearers), which tends to thicken and incidentally to contract or corrugate new growth, this irritation may be alkali in fresh waters, sand or infusoria in pearl oysters, alkali dust on arid windy volcanic islands, like the Galapagos or St. Helena, and scorching sunlight in desert places. Now the first result would be to thicken the shell and exclude the irritant, otherwise the animal will die. Assuming that before reaching the point of absolute exhaustion the amount of mucus has a limit, this means a retardation of growth in the spiral direction, and if (assuming that the color glands have also a limited amount of color to give the general secretion) it would be, in the case cited, abnormally diluted; with the result that the shell would tend to be whiter than the normal, *not as a protection*, but because of the dilution. This explains the white Bulimini, Clausilias and Pupas, so conspicuous on hot rocks in South Europe. Then comes in Natural Selection by killing off those which did not or could not sufficiently thicken themselves to ward off the light, and you have by the most simple direct action, without any heredity being called into play (unless through some transmission of acquired characters, which I regard in this case as very doubtful) all the characteristics of desert snails over the whole world developed in the individual by direct action.

"In the Galapagos snails the young nepionic whorls are normal, and I believe would continue so except for the direct action of the environment. This affects those on the ground, grass and low shrubs. Those living on the higher trees escape (by my hypothesis) the dust and continue or remain normal in their growth."

List of Species.

HELICIDÆ.

Sonorella coloradoensis (Stearns). Pl. XII, figs. 26–30.

Helix (*Arionta*) *coloradoensis* Stearns, Proc. U. S. Nat. Mus., vol. XIII, p. 226, pl. 15, figs. 6, 8, 12, 1890.

Sonorella coloradoensis Stearns, Pilsbry, Proc. Acad. Nat. Sci. Phila., 1900, p. 560. 1901. Bartsch, Smithsonian Misc. Coll., vol. XLVII, p. 189, pl. 32, fig. 3 (shell of type), 1904.

The type specimen of this species measures: alt. 10, diam. 16.4 mm., umbilicus about 1.8 mm. The locality given by Stearns and repeated by Bartsch,[4] Grand Canyon of the Colorado opposite the Kaibab Plateau, alt. 3,500 feet, is somewhat indefinite, on account of the considerable extent of the Kaibab Plateau. Dr. C. Hart Merriam, to whom we applied for further details, writes: "I collected the type of *Helix coloradoensis* Stearns in September, 1889, in the Grand Canyon below the tank then known as Canyon Spring, not far from where John Hance afterward built what is known as the Hance Trail. At that time neither the Bright Angel nor Bass's Trail had been heard of."

This locality is, properly speaking, opposite what is now known as the Walhalla Plateau, not the Kaibab Plateau.[5] As the river flows, it is about 13 miles east of the Bright Angel Trail, and 30 miles east of Bass's Trail. Owing to the sinuosity of the sides of the canyon, the actual distance along any level above the river gorge and below the rim would be at least three or four times as great.

The specimens from the Bright Angel and Bass's Trails and from the north side differ from the type by having the umbilicus slightly larger.

The soft anatomy of the type was not described. One of us has dissected specimens from both sides of the river at Bass's Trail. The genitalia of a shell from "Spectacle Cove" (Station A) figured (fig. 3A) show the species to be a true *Sonorella*, related about as nearly to the forms found in the region immediately south of Tucson, as to any southern species. The penis (*p.*) is swollen distally, narrow in its basal half, where it is enveloped in a rather long muscular sheath. It contains a tapering papilla (*p.p.*), not quite half as long as the penis. The epiphallus (*epi.*) is about equal to the penis in length, slightly larger than the vas deferens. There is no flagellum. The penis

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[4] The localities for *S. coloradoensis* in Inyo and San Diego Counties, California, which Dr. Bartsch credits to Pilsbry and Johnson, were taken by them from a paper by Dr. Stearns, *Nautilus*, VIII, p. 29. This paper was not noticed by Dr. Bartsch, who has shown that the shells in question are not *S. coloradoensis*.

[5] See U. S. Geol. Survey Topographic Map, Vishnu Quadrangle.

retractor muscle inserts on the epiphallus. The vagina is rather short and slender. Atrium longer than usual in *Sonorella*. Length of the penis, 4.5 mm.; penis-papilla, 2 mm.; vagina, 3 mm.; spermatheca and duct, 21.5 mm.

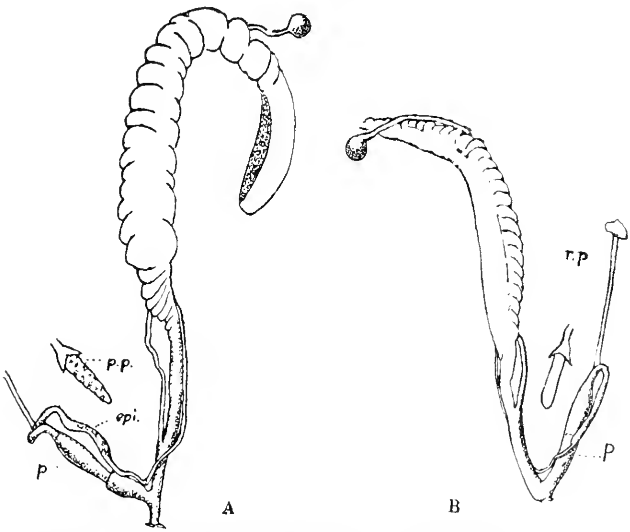

Fig. 3.—Genitalia of *Sonorella coloradoensis*. *A*, Spectacle Cove. *B*, bandless form from White Creek, Station G.

A specimen of the bandless form from White Creek, a branch of Shinumo Creek, shows only slight differences in the genitalia from the "Spectacle Cove" form. The atrium is shorter; penis-papilla more cylindric and blunter. Length of penis, 5 mm.; epiphallus, 4.7 mm.; penis-papilla, 2 mm.; vagina, 3.8 mm.

While *S. coloradoensis* seems to be generally distributed in the Grand Canyon, the colonies, except near the rim, are isolated and mostly small. Except during wet weather, the snails adhere to eruptive or metamorphic rocks, making white circles thereon like other Sonorellas. Specimens were taken by us at the following places:

(*South side of the Colorado River.*)

(1) Bass's Station, on the Grand Canyon R. R., about four miles south of the Grand Canyon. The shells vary from alt. 10.5, diam. 16 mm., to alt. 9.8, diam. 15 mm.

(2) Upper talus along the Bright Angel Trail from 100 to 400 feet below the rim. The specimens are like those from Spectacle Cove, noticed below.

(3) Station C: Upper talus-slope in the bay about ½ mile west of Bass Camp, a few hundred feet below the rim. The shells here are small, alt. 8, diam. 13, width of umbilicus 2 mm. None found alive. In some examples the shoulder-band is extremely faint, but in most of them it is distinct.

(4) Station A: "Spectacle Cove," an embayment at the foot of the cross-bed or Coconino sandstone, in a talus resting upon the Aubrey red sandstone, with *Oreohelix yavapai profundorum*.

Specimens measure:

Alt. 10, diam. 16.0, umbilicus 2.1 mm.
" 9, " 14.8, " 2.0 "

All have a band at the shoulder. Very few living adults were taken, but, unlike the *Oreohelices*, the shells are entirely normal.

(5) Seep Spring, 2 miles west of Bass Trail, at base of the cross-bed sandstone. Shells like the preceding lot from the same level.

(6) Station B: Head of Starvation Tank Wash, around the point to the right from Bass Trail, at about 5,800 feet elevation (Pl. XII, figs. 29, 30).

(7) Station D: Bass Trail, on the Red Wall, 5,000 feet.

Alt. 10.1, diam. 16, umbilicus 2.1 mm.
" 9.5, " 16, " 2.1 "
" 9.1, " 15, " 2.1 "

The shoulder-band is wanting in about half of the shells taken.

(8) Station E: Foot of Red Wall, on Bass Trail, elevation about 3,850 feet. Like the preceding, diam. 15 to 16.3 mm. A few "bones" were taken still lower, at about 3,000 feet, in a talus of the Red Wall limestone.

Alt. 8.9, diam. 15.0, umbilicus 2.0 mm.
Fig. 29. " 9.0, " 14.3, " 2.0 " ; whorls 4½.
" 8.5, " 13.6, " 1.9 "
" 8.2, " 13.5 mm.

The corneous, brown shell is more or less streaked with white and invariably has a narrow band at the shoulder.

(North Side of the Colorado River.)

(9) Station F: Shinumo Creek, near camp, elevation about 2,500 feet.

Alt. 10.8, diam. 16.9, umbilicus 2.1 mm.; whorls 4½.
" 10.8, " 16.5, " 2.1 "
" 9.3, " 15.1, " 2.0 "

Similar shells occurred at Station 3, Shinumo Box, 2,750 feet.

the largest, alt. 12, diam. 17.2, umbilicus 2.5 mm. (F. and D. 1909). Some of these shells are the largest taken up to this time, exceeding the types. The shoulder-band is faint or wanting on some shells.

(10) Station G: White Creek, about 1 mile above its confluence with Shinumo Creek (Pl. XII, figs. 26–28). Seven per cent. of the shells taken show a chestnut band. In the rest there is an ill-defined whitish band in its place. Bandless shells are rare in all other localities. The aperture is also more ample in this lot, *somewhat trumpet-shaped*, the lip is rather more thickened and rusty, and the parietal callus is generally thick at the edge.

Alt. 10,	diam. 17.0,	umbilicus 2.6	mm.;	aperture 8.8 x 10.0	mm.
" 10,	" 16.2,	" 2.1	"	" 8.2 x 9.5	"
" 9,	" 15.2,	" 2.25	"	" 8.0 x 8.8	"

The genitalia of a specimen of this lot are figured, fig. 3*B*.

(11) Muav Box, Station 9, elevation 4,000 feet (F. and D., 1909). Diam. 15–16 mm. All taken have the shoulder-band.

(12) Station H: Mojave Amphitheatre below the red-wall sandstone (west side of Muav Canyon, near Dutton's Point). The shells are all banded, measure 14 to 16 mm. diameter, and do not seem to differ from those taken on the Shinumo at a much lower elevation. At this point the authors made a dry camp in 1906, being unaware that there was water a few miles beyond. In 1909 Ferriss and Daniels took a fine lot of unusually large and dark colored Sonorellas at Station 107, about two miles farther up Muav Canyon, but they were lost before reaching home.

(13) Station 104, 6,700 feet, and Station 9, 7,500 feet, east side of Powell Plateau (west of Muav Wash). Small, 13.5 to 14 mm. diam.; banded; *aperture dilated*, as in the shells described under (10). This colony and those following were taken by Ferriss and Daniels, 1909.

(14) Station 5, east of Muav Canyon, near the Kaibab Saddle, 6,717 feet. Small shells, diam. about 13.5 to 15 mm., with the mouth less dilated than in the preceding lot, nearly normal. All are banded.

(15) Station 25, west side of Powell Plateau, 6,700 feet. The shells are small, diam. about 14 mm., with thickened lip and somewhat dilated mouth, as in Nos. (13) and (19).

(16) At Station 23, Horse Tank Canyon, on the west side of Powell Plateau, 7,000 feet, the shells are like those from No. (12). Some bandless individuals were also taken.

(17) Station 101, north end of Powell Plateau, 6,700 feet. Only dead and bleached shells, normal in shape.

(18) Station 100, third amphitheatre north of the Kaibab Saddle,

6,700 feet. Shells 14 to 15 mm. diameter, normal in shape and color, similar to lot No. (10). This is farthest north for the species.

Oreohelix yavapai profundorum n. subsp. Pl. XII, figs. 1–14.

The shell is *opaque-white* with some brownish, corneous streaks and often two fleshy, brown bands, the inner whorls more or less flesh-tinted; *solid;* with sculpture of rather wide, irregular, subobsolete growth-wrinkles, but *no spiral striæ.* Whorls 4½ to 5, the last angular or subangular in front, *descending* moderately or deeply to the aperture, often becoming shortly free. Aperture very oblique or subhorizontal, the peristome slightly thickened and brownish, continuous and free or in contact with the preceding whorl for a short distance.

Fig.	1.	Alt.	12.0,	diam.	14.8	mm.
"	2.	"	12.2,	"	13.8	"
"	3.	"	11.5,	"	16.7	" ; umbilicus 3 mm. wide.
"	4.	"	11.2,	"	17.3	"
"	5.	"	9.5,	"	17.2	" ; umbilicus 4.5 mm. wide.
"	10.	"	9.0,	"	13.2	" " 2.9 " "

Adult shells measure from 13 to 17½ mm. diameter.

The genitalia are figured (fig. 4). The lower half of the penis is much swollen, the upper half slender and cylindric, the retractor muscle inserted at its apex. The short epiphallus is rather stout. Vagina short and very large. The uterus in the individual figured contained four embryos; the shells 4.7 mm. in diameter, with 2¾ whorls and acutely carinate periphery. The podocyst is larger on the upper embryos, but present in all.

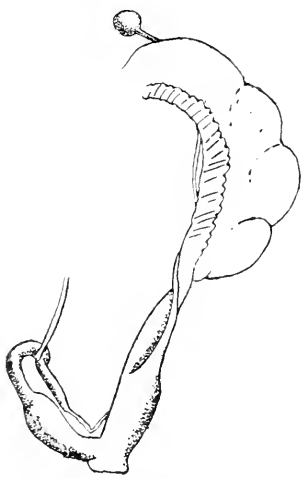

Fig. 4.—*Oreohelix yavapai profundorum.*

Length of penis, 6.7 mm.; epiphallus, 3 mm.; vagina, 4 mm.; spermatheca and duct, 17 mm.

Out of 100 shells from the type locality, taken at random, 56 per cent. resemble figs. 1–3, 44 per cent. being like figs. 4, 5. The race is therefore markedly senile.

Grand Canyon, in "Spectacle Cove," Station A, the head of a recess in the cross-bed sandstone south of where the Mystic Spring or Bass Trail zigzags down, in a talus resting on the red sandstone forming the Le Conte Plateau. Elevation about

5,700 feet. Cotypes, No. 103.234 A. N. S. P., collected by Ferriss and Pilsbry, October, 1906.

The embryonic shell, of $2\frac{1}{4}$ whorls, shows fine subregular ripples along the lines of growth, and in places some fine, very faint spiral striæ may be traced; on the base these spirals are more distinct. They continue there during the first part of the neanic stage, but disappear after a diameter of 8 or 9 mm. has been attained. The main spirals are widely spaced, as in *O. yarapai*, but at all stages of growth they are very weak. The embryonic shell is light brown. Some maculæ and streaks of opaque cream-white appear after the third whorl. In the adult stage the surface becomes dull white and somewhat chalky from loss of the very thin cuticle, which is present in the embryonic and early neanic stages.

O. y. profundorum and the allied races, *extremitatis* and *angelica*, differ from *O. yarapai* by the very weak spiral striation of the embry-

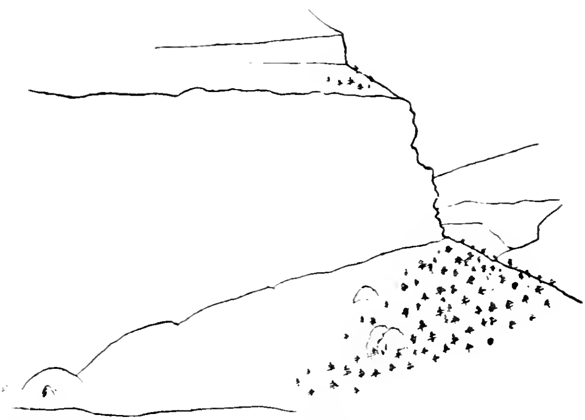

Fig. 5.—Spectacle Cove (Station A), from opposite side below Bass Trail. Type locality of *Oreohelix yarapai profundorum* on the mound at left end of talus slope.

onic shell. *O. profundorum* resembles *O. yarapai*, *O. y. neomexicana* and *O. barbata* in having a very short penis, its length about half the diameter of the shell or less. In the *strigosa* group, so far as known, the penis is long, two-thirds the diameter of the shell or more, in alcoholic examples. *O. yarapai*, *neomexicana* and *profundorum* are alike in genitalia, but *O. barbata* differs by having the retractor muscle inserted on the epiphallus, whilst in the others it is inserted at the apex of the penis.

The type locality of *O. y. profundorum* is in an embayment of the cross-bed sandstone, where a talus at its foot rests upon the red sandstone. Living specimens were taken only on the last mound of the talus at the head of the wash, shown on the left in fig. 5. This mound is about 30 or 40 feet high, about 100 feet long, and has a great rock in the middle. Dead shells were scattered over the talus for about 200 yards westward, nearly as far as the large rocks shown in the edge of the piñons. Except where piñons are shown, the slope is covered with shrubs. The Oreohelices live among moss and grass, around and under stones in great profusion. With them live *Cochlicopa*, *Pupilla*, etc., and *Sonorella coloradoensis*, the latter found over the whole talus shown in fig. 5, but everywhere very scarce. Numerous other taluses at and below the same level were searched, but no other colony of *Oreohelix* was found. All other colonies of *Oreohelix* seen are on the upper slopes only a short distance below the rim of the canyon.

In the absence of any source on the lower levels, *O. y. profundorum* must have been derived from *O. y. extremitatis*, which inhabits the slope above the cross-bed sandstone, whence individuals have fallen into the abyss. The considerable divergence of the race on the lower level, and the fact that only one colony was found at that level, seem to indicate that most snails which are carried or fall over the cliff do not survive the terrific drop of several hundred feet.

In the series of several thousand shells taken there was one sinistral example.

That the colony of *O. y. profundorum* is decadent seems to be indicated by the fact that dead shells were found over an area many times greater than that now inhabited by living snails. The markedly senile character of the shells also foretells approaching extinction. Yet the local conditions appear altogether favorable and living individuals are very abundant in a limited area.

Oreohelix yavapai extremitatis n. subsp. Pl. XII, figs. 15–21.

At Station 2, near Bass's Trail, about 200 feet below the rim of the Grand Canyon, the Oreohelices (pl. XII, figs. 18–21) are *more depressed* than *O. y. profundorum*, less solid and less calcareous, invariably two-banded. The surface is more or less suffused with light brown, especially on the spire, and the very thin pellucid cuticle is retained, so that the shell has a slight luster. The embryonic whorls are like *profundorum;* the first third or half of the last whorl is *acutely carinate* in front, and the latter part descends very little (as in fig. 18, 67 per cent. of the shells examined) or somewhat deeply (fig. 19, 33 per cent.). *Widely spaced granose spirals* (such as are characteristic of *O. yavapai*) are visible on the base in front of the aperture in most of the shells. The aperture is contracted less than in *O. y. profundorum* and the peristome is not thickened. The largest examples measure, alt. 8.2, diam. 16 mm., the smallest alt. 8.3, diam. 14 mm. About 60 adults examined.

Fig. 18.	Alt. 8.0,	diam.	15.8	mm.;	width of	umbilicus	4.7 mm.
“ 19.	“ 7.8,	“	14.5	“	“	“	4.0 “
“ 19.	“ 8.7,	“	14.2	“	“	“	4.0 “
“ 20.	“ 8.5,	“	16.0	“	“	“	4.3 “
“ 21.	“ 8.0,	“	15.5	“	“	“	4.3 “

Cotypes are No. 103.236 A. N. S. P., collected by Ferriss and Pilsbry, 1906.

Similar shells occur on the upper slope at the same level, in a bay of the rim, about a half-mile west of Bass's Camp, on the southern rim of the canyon (pl. XII, figs. 15, 16, 17).

Fig. 15.	Alt. 9.2,	diam.	15.5	mm.;	umbilicus	4.0	mm. wide.
“ 16.	“ 8.1,	“	15.1	“	“	4.1	“ “
“ 17.	“ 9.0,	“	16.9	“	“	4.9	“ “

Oreohelix yavapai angelica. Pl. XII, figs. 22–25.

On the Bright Angel Trail, at Grand Canyon, from 100 to 400 feet below the rim, which has here an elevation of 6,866 feet, the shells resemble *O. y. extremitatis* in contour, except that the last whorl is somewhat more inflated. The color is light brown, usually with a brown band below the periphery, sometimes with another above, but this is often wanting. It is thinner and larger than *extremitatis*, and spaced spirals are more distinct, being well-developed on both the base and upper surface. The embryonic whorls have faint spiral lines. The first part of the neanic stage (up to at least 11 mm. diam., with nearly 4 whorls in some individuals) bears *spiral rows of cuticular scales* readily visible to the naked eye. There are about 8 spirals above, 10 below the periphery on the last whorl. The last whorl is but slightly deflexed in most examples, rarely (8 per cent.) more or less deeply so, approaching fig. 25, which is an extreme individual.

Fig. 22.	Alt. 9.0,	diam.	17.0	mm.;	width of	umbilicus	4.5 mm.
“ 23.	“ 9.2,	“	17.0	“	“	“	4.9 “
“ 24.	“ 9.2,	“	17.9	“	“	“	4.8 “
“ 25.	“ 10.2,	“	16.0	“	“	“	3.8 “

Individuals with deeply descending last whorl occurred chiefly at the lower level.

Alt.	9.5,	diam.	18.3 mm.
"	10.2,	"	17.0 "
"	8.0,	"	16.0 "
"	9.8,	"	16.0 "

This race occupies the same zone as *O. y. extremitatis* in the Kaibab limestone. The stations are about 20 miles apart, but including the windings of the canyon, as the snail travels, the distance would be far greater. The embryonic stage is very much alike in *O. y. profundorum*, *extremitatis* and *angelica*, but the neanic and adult stages differ.

Cotypes No. 103,239 A. N. S. P., collected by Pilsbry and Ferriss, 1906.

Oreohelix strigosa depressa (Ckll.). Pls. XIII, XIV.

[*Patula strigosa*] var. *Cooperi* Binney, Manual Amer. L. Shells, p. 166, fig. 153 (teste Ckll.).
Patula strigosa cooperi var. *depressa* Ckll., Nautilus, III, p. 102, January, 1890, canyon near Durango, Colo.
Oreohelix strigosa Gld., Pilsbry, Proc. A. N. S. Phila., 1905, p. 272, pl. XXV, figs. 45–47 (shell); pl. XI, figs. 14, 15 (embryonic shell); pl. XIX, fig. 3 (genitalia); pl. XXII, figs. 1–3 (teeth); pl. XXIII, fig. 25 (jaw).

New Mexican examples of *O. s. depressa* have been fully described and figured in a former paper of this series. In the country north of the Grand Canyon it is an abundant snail, varying widely in size, form, color, and to a less degree in sculpture not only in different colonies, but frequently among individuals of one colony.

In some districts, as along the western escarpment of Powell Plateau, there is a marked tendency to lose the dark bands. In some other places beautiful albino shells occur in colonies composed chiefly of well-colored shells. There is a tendency in many places to produce more compactly coiled shells than typical *depressa*, the spire being higher and the total diameter and the umbilicus smaller in some of the shells. This culminates in a form of shell which is not distinguishable from *O. cooperi*, found in a few stations.

In some arid situations, especially the head of Quaking Asp Canyon, the shells are conspicuously dwarfed, their development arrested. No colonies are markedly gerontic, though in a few there is a tendency towards senile characteristics in occasional individuals.

The spiral sculpture is generally distinctly developed, and sometimes some larger, widely spaced spirals can be seen on the base of the shell.

Specimens are illustrated on Plates XIII and XIV. Some comment on the several lots follows, beginning at the northern stations.[6]

(1) Jacob's Canyon (Pl. XIII, figs. 1–5). Oreohelices were taken at Stations 68, 69, 70, 71. The typical form and coloring (fig. 1) prevail, but there is also one color-form not elsewhere encountered, in which the bands are purple-brown and very wide, the upper one spreading to the suture or leaving a white belt below the latter (figs. 2–4). There are also some pearl-white and dirty white shells (fig. 5). The same color-forms occurred at Station 67, below the mouth of

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[6] Only one of us (Ferriss) collected *P. S. depressa* north of the Grand Canyon, being accompanied there by Mr. L. E. Daniels. His impressions concerning the relations of shell-characters to the environmental factors of elevation, humidity and direction of slope are given below. It must be remembered that the conditions in the Kaibab region are less accentuated than in the more arid mountains of the south.

"At the time our observations in 'Mollusca of the Southwestern States, No. IV,' were written, environment seemed the controlling factor in the determination of size of the shell, northern exposures, with an abundance of shade and plant life and a longer growing season, would produce the larger shells. In the region north of the Grand Canyon many apparent exceptions to this rule were noted. Often colonies of the same species but 100 feet apart varied 100 per cent. in size. In a gulch facing north in the Powell-Kaibab saddle, in a box canyon with perfect snail conditions, the *Oreohelix* average 20 mm. in diameter. Above the box, in a more open country, they average 24 mm. and were more plentiful.

"In the canyons and amphitheaters of these plateaux, with the same exposure, moisture, shade, elevation—mineral, plant and all other conditions equal so far as we could understand—each colony stood out by itself in color, size and shape of the spire. These qualities seemed subject to mutation rather than controlled by environment.

"Thus, in Two-Spring Canyon, the shells in a colony on one side of a rock were 25 per cent. larger than those of the colony upon the other side, less than 100 feet distant; and a colony on the west side of the stream, no farther away, was larger than either. In the center of a colony on Powell Plateau, a 'family' of larger shells was found.

"Until we crossed the Kaibab Plateau, the collections of 1909 were at about the same elevation, in the limestone section. In Two-Spring and Quaking Asp Canyons, both heavily wooded, the Oreohelices at the top, among the quaking asp, were 14 mm. in diameter, gradually increasing in size, as we descended, to 25 mm., as would naturally be expected.

"In Snake Gulch, however, the largest shells were at the top, on slopes facing either north, west or south, the diameters running 25 and 26 mm. at Castle Springs and vicinity. At Big Springs, with abundance of shade and humidity the year around, and a warm *southern* exposure, the largest measurements were 21, and at the lowest colony in the gulch less than 18 mm.

"In Warm Springs Canyon, running from east to west parallel with Snake Gulch, the smaller colonies were midway in the canyon, those at both the top and bottom of the canyon being unusually large and robust, and it was the same in Jacob's Canyon, another parallel canyon of this group running to the west.

"We collected Oreohelix at 22 stations, elevation about 6,700 feet, in the saddle region of the Powell and Kaibab Plateaux; at 19 stations in Two-Spring and Quaking Asp Canyons in the Kaibab Plateau, at elevations between 6,500 and 8,250; at 20 stations in Snake Gulch, Kaibab Plateau, from 5,000 to 7,000 feet elevation; at 16 stations in Warm Spring and Jacob's Canyons, Kaibab Plateau, from 6,000 to 6,750 feet elevation."

Jacob's Canyon, in the second gulch north of Warm Spring Canyon. It was not noticed at Station 68.

Fig.	1.	Alt.	12.8,	diam.	23.0,	umbilicus	5.9	mm.
"	2.	"	11.8,	"	22.3,	"	6.1	"
"	3.	"	11.3,	"	22.7,	"	6.0	"
"	4.	"	12.5,	"	21.8,	"	6.0	"
"	5.	"	11.8,	"	24.0,	"	6.1	"

(2) At Station 66 (Pl. XIII, figs. 6, 7), in the first gulch facing west, north of Warm Spring Canyon, the shells are smaller and usually more elevated, the last whorl at the aperture generally falling well below the lower band. Color and sculpture are normal.

Fig.	6.	Alt.	12.0,	diam.	19,	umbilicus	5.0	mm.
"	7.	"	10.5,	"	17,	"	4.6	"

(3) In the head of Shinumo Canyon (Pl. XIII, figs. 10, 11, 12), Stations 50, 51, 52, the shells are typical in form, but a majority of them have the bands weak, or one or both may be absent (figs. 10–12, Station 50, 5,500 feet elevation). Farther west, at Station 53, the bands are somewhat stronger. Beyond this, going west, the shells are smaller (Stations 54, 55, 56, 57), the last whorl falls more, and the ends of the lip approach—senile characters, doubtless indicative of unfavorable conditions leading to decadence of the race (Pl. XIII, figs. 13, 14, Station 55, at 5,500 feet).

Fig. 10, diam. 20 mm. Fig. 11, diam. 19 mm. Fig. 12, diam. 17.7 mm. (Station 50).

Fig.	13.	Alt.	9.2,	diam.	15.7	mm.	(Station 55).
"	14.	"	7.8,	"	14.5	"	umbilicus 4 mm.
"	15.	"	9.2,	"	15.7	"	

(4) Moquitch Gulch, Stations 75, 76 (Pl. XIII, figs. 16–18). The shells are of medium size, more or less brown, with typical bands. An albino form, white with greenish, translucent bands, appears here.

Fig. 16. Alt. 11.7, diam. 18, umbilicus 3.9 mm. (Station 76). Fig. 17. Diam. 17.3 mm. Fig. 18. Diam. 18.8 mm. (Station 75).

(5) Continuing southward on Snake Gulch, we encounter snails essentially like those from Stations 49, 50 and 37 in Stations 35, 34, 33. At Station 78, boldly marked two-banded shells and beautiful albinos occur, as already figured from Moquitch Gulch. At Stations 32 and 77 most of the shells are large and dark, but a few are small.

(6) Warm Spring Canyon (Pl. XIII, figs. 8, 9). Finely developed shells occur at Stations 59, 60, 61, 62, 64, 65 and 73 or 74, mostly with the normal color-pattern, but sometimes the bands are weak or almost absent, chiefly in shells from Station 61.

At Station 60 only fossil examples were taken.

Fig. 8. Alt. 9.8, diam. 21.0, umbilicus 6.5 mm. (Station 62).
" 9. " 11.0, " 22.7, " 6.3 " (" 61).

(7) At Snake Gulch, below the Coconino Smelter, Station 49, the shells resemble those from Station 66, having a low conoidal spire and depressed last whorl which falls decidedly at the aperture. Bands narrow, rather pale.

(8) At Station 37, Snake Gulch, at the north side of the mouth of Smelter Gulch, elevation 5,750 feet, the shells resemble those from Station 50 (see fig. 11).

(9) At Castle Springs, Station 79, the shells are large and dark, two-banded or more or less clouded (Pl. figs. 19–21, 6,750 feet elevation). Similar examples are found at Riggs Spring, Station 81.

Fig. 19. Alt. 11.8, diam. 2[illegible].0 mm. (Station 79).
" 20. " 13.5, " 23.8 " umbilicus 6.2 mm. (Station 79).
" 21. " 12. , " 23.2 " " 5.3 " (" ").

Between the preceding and following stations there is an interval of about 13 miles over the watershed in which no Oreohelices were found.

(10) Quaking Asp Canyon penetrates the Kaibab Plateau from the west, where it drains into Tapeats Creek. Two-Springs Canyon is a branch of the head of Quaking Asp. From the lower end of Quaking Asp Canyon, Station 98, 6,500 feet elevation, to the head, Station 83, 8,250 feet, there is a gradual diminution in size of the shells, no doubt due to increasing aridity of the higher stations westward.

At Station 98 the shells are very large, diam. 22 to 26 mm., but typical in form and color (Pl. XIII, figs. 24–26). At Station 97 the size averages smaller, and there are some albino shells, white with translucent, greenish bands. At Stations 99, 96, 94, 93, 92, 91, 90, 89, 87, 88 there are similar shells, the size diminished a little (Pl. XIII, figs. 22, 23, Station 91, 7,000 feet).

Stations 86, 85, 84 and 83 show shells still further diminished, adults measuring, alt. 9 diam. 14 to alt. 7, diam. 11.5 mm., with $4\frac{1}{2}$ whorls (Pl. XIII, figs. 27, 28, Station 84). The color is typical; the periphery angular in front and the last whorl descends only very little to the aperture. These colonies show no senile features. Their development has been arrested, the small number of whorls and the angular periphery being characters of youth.

At Two Springs, Station 27, the shells resemble those from Station 91. Farther up the canyon, Station 26, the shells became smaller.

adults measuring 12 to 15 mm. diam., as in the head of Quaking Asp Canyon.

Fig. 22.	Alt. 12.0,	diam. 19.3,	umbilicus 4.5	mm.	(Station 91).
" 23.	" 11.2,	" 16.8,	" 3.8	"	(" ").
" 24.	" 14.0,	" 24.5,	" 6.3	"	(" 98).
" 25.	" 13.0,	" 21.0,	" 5.8	"	(" ").
" 26.	" 15.0,	" 25.0,	" 6.0	"	(" ").
" 27.	" 7.0,	" 11.5,	" 2.9	"	(" 84).

(11) At Station 100, Kaibab-Powell Saddle, 6,700 feet, the shells resemble those figured from Station 98, but are smaller, diam. 17.5 to 21 mm.

(12) Off the north end of Powell Plateau, at Station 17 (Pl. XIV, figs. 1–4), there is wide color-variation in the colony, the following forms occurring:

Figs. 1, 3. Typical two-banded form, diam. 18 to 21 mm.

Fig. 2. Upper band obsolete, the lower are weak same sizes.

Fig. 4. White, with greenish, translucent bands, diam 19 mm.

(13) In other stations at the northern end of Powell Plateau, 13, 14, 15 (but not Station 16), and Station 105, near Oak Springs, the prevalent form (Pl. XIV, figs. 6, 7, 8) Station 15, 6,500 feet) is rather less depressed than typical *depressa*, though the depressed form also occurs (Pl. XIV, fig. 5, same station). At Stations 13, 15 and 105 some examples are not distinguishable from *O. cooperi* (Pl. XIV, fig. 9, Station 15; fig. 23, Station 105); yet some examples seem to connect with normal *depressa*. At Station 18, at 6,700 feet, two adult shells (Pl. XIV, figs. 10, 11) are of the *cooperi* form.

Fig. 10.	Alt. 12.0,	diam. 18.7,	width of umbilicus 4.5	mm.
" 11.	" 11.9,	" 18.0,	" " 4.0	"

The material from these stations (13, 15, 18) is too scanty to decide with certainty whether the series is divisible into *cooperi* and *depressa* or whether the globose specimens are inextricably connected with the *depressa* stock of the region. Except at Station 18, the *cooperi* form occurs with undoubted *depressa*, as at Station 105, where figs. 22 and 23 of Pl. XIV occurred together.

(14). The west side of Powell Plateau, Stations 25, 24, 22, 21, 20, 19, and Station 16 at the north end, have a somewhat different race. There are typical two-banded *depressa* (Pl. XIV, figs. 13, Station 16) and also specimens lacking one or both bands (Pl. XIV, figs. 14, 15, Station 16, 6,700 feet; fig. 16, Station 19).

The specimens vary from quite large, diam. 25, to medium size, diam. about 19 mm. At Station 16, 80 per cent. of the shells are bandless.

(15) On the east side of the Powell Plateau, Stations 10, 103, 8, 12, the shells are typical two-banded *depressa* (Pl. XIV, figs. 17, 18, 19, Station 103, 6,700 feet) varying to forms with the spire higher (figs. 20, 21, same station). Fig. 21, alt. 12.3, diam. 18, umbilicus 4 mm.

Thysanophora ingersolli (Bld.).

Bill Williams Mountain; Two-Spring Gulch, Kaibab Saddle.

Thysanophora hornii (Gabb).

Shinumo Creek, on the north side of the Grand Canyon. Farther north than this species has been reported hitherto.

ENDODONTIDÆ.

Pyramdula (Gonyodiscus) cronkhitei (Newc.).

Bill Williams Mountain. It was not found in the Grand Canyon, but north of it was taken at Castle Springs and Rigg's Spring, Snake Gulch, Kaibab Plateau; Mt. Trumbull; also Deception Lake and Crocodile Lake near Kanab, Utah, 5,500 feet elevation.

ZONITIDÆ.

Vitrina alaskana Dall.

V. Pfeifferi Newc. not of Desh.

Living specimens were taken on Bill Williams Mountain. Numerous dead shells were found near a small spring in the Grand Canyon below the cross-bed sandstone, 2 miles west of Mystic Spring Trail. This spring is called Seep Spring on the topographic map, Shinumo quadrangle. The average size of adults here seems to be about 6 mm. diam., but one shell measures 7.4 mm. We did not find *Vitrina* elsewhere in the Grand Canyon, but northward it occurred at Warm Spring Canyon and Rigg's Spring, Kaibab Plateau, and at Mt. Trumbull.

The living animal observed October 15, at Bill Williams Mountain, is far less voluminous than *V. limpida*. There is one small shell-lobe, covering the termination of the suture. In progression the tail does not project behind the shell.

Vitrea indentata umbilicatac 'Singl.' Ckll.

Bill Williams Mountain. Grand Canyon along the Bright Angel Trail from just below the rim to the base of cross-bed sandstone and at the Indian Gardens; Bass Station, Grand Canyon R. R.; Station H, on the north side of the canyon. Also taken on the north side of the Grand Canyon on Powell Plateau; Kaibab-Powell Saddle; Castle Springs, Snake Gulch; Two Springs, Kaibab Plateau.

Euconulus fulvus alaskensis (Pils.).

Bill Williams Mountain. Grand Canyon, Bright Angel Trail, from just below rim to base of cross-bed sandstone. Mystic Spring Trail about 200 feet below rim, and Station C, about a half-mile west of Bass's Camp; "Spectacle Cove," Station A. North of the Grand Canyon; Powell Plateau, Station 18; Kaibab Saddle and plateau at Stations 5, 7, 12, 66, 100; Riggs Spring, Snake Gulch; Castle Springs; Warm Spring Canyon; spring on the northwest side of Mt. Trumbull.

Zonitoides milium meridionalis Pils.

Bill Williams Mountain.

Zonitoides minuscula (Binn.).

Bill Williams Mountain. Base of Mt. Trumbull.

Zonitoides arborea (Say).

Bill Williams Mountain. Snake Gulch, Station 11½.

LIMACIDÆ.

Agriolimax hemphilli ashmuni P. and V.

North of the Grand Canyon in Snake Gulch at Big Spring and Station 49, below the Coconino Smelter; also Station 48.

SUCCINEIDÆ.

Succinea avara Say.

Bass Station, Grand Canyon R. R.; Grand Canyon on the Mystic Spring Trail along the slope a few hundred feet below the rim, and in the amphitheatre ½ to ¾ mile west of Bass's Camp, on the upper slope; "Spectacle Cove" and Seep Spring, 2 miles west of trail, below cross-bed sandstone; red wall sandstone at 5,000 feet. On the north side of the river we found it along Shinumo Creek, in the box of White Creek, and Ferriss and Daniels took it on the Kaibab Saddle, at Oak Springs, Snake Gulch, Station 11½, at Warm Spring Canyon, Station 59, and the Hurricane Fault, Station 46, 6,000 feet, near Mt. Trumbull.

It lives in a great variety of stations, a large form occurring in humid places, smaller shells in arid situations.

Succinea retusa Lea.

The Greens, 6 miles west of Kanab, Utah; Deception Lake, northwest of Kanab.

Succinea hawkinsi Baird.

The Greens, 6 miles west of Kanab, Utah. The specimens seem to be typical of this very rare and distinct species, here first reported from so far south.

Succinea grosvenori Lea.

North of the Grand Canyon at Big Spring, Snake Gulch, Station 78; Antelope Valley, Station 40, on ant hills; Finley Reservoir near Mt. Trumbull, and at the northwest base of the same mountain.

FERUSSACIDÆ.

Cochlicopa lubrica (Müll.).

Grand Canyon: Bright Angel Trail, from a short distance below the rim to the foot of the cross-bed sandstone and at the Indian Gardens. Mystic Spring Trail on the Spectacle Cove talus, Station A, and near Seep Spring, about 2 miles west of the trail, both places at the base of the cross-bed sandstone.

PUPILLIDÆ.

Pupoides marginata (Say).

Finley's reservoir near Mt. Trumbull.

Pupoides hordacea (Gabb).

Spring on the northwestern side of Mt. Trumbull and at Finley's reservoir; Antelope Valley.

Pupilla syngenes (Pilsbry).

Pupa syngenes Pils., Nautilus, IV, p. 3, May, 1890; V, p. 39, pl. 2, figs. 1, 2. Proc. Acad. Nat. Sci. Phila., 1890, p. 296, pl. 5, figs. 1, 2 (Arizona); 1900, p. 606, with form *dextroversa* P. and V. (San Rafael, N. M.).
Pupa syngenes Dall, Nautilus, VIII, p. 35 (Beaver Creek, Montana).

This sinistral species was based on specimens from Arizona, the exact locality unknown, fully described and figured in these PROCEEDINGS for 1890. Ten years later a dextral form was noted. Specimens of *P. syngenes* are before us from San Rafael and Grants, N. M., and Holbrook, Jerome, Purtyman's ranch on Oak Creek, and the Grand Canyon, Arizona. Dall has reported it from Beaver Creek, Mont., but none are known from Wyoming, Colorado or Utah.

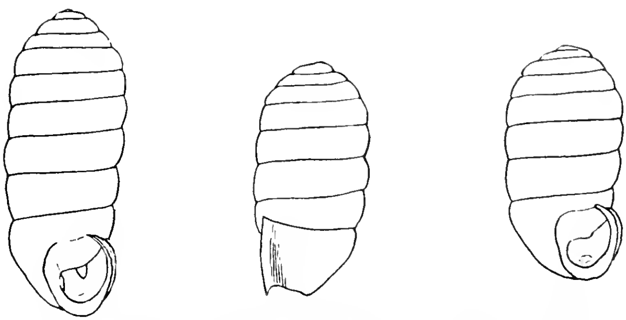


Fig. 6.—*Pupilla syngenes dextroversa*. San Rafael, N. M.

In *Pupilla* it is obvious that dextral forms are the more primitive, the sinistral forms derived from them. *P. syngenes dextroversa*, therefore, perpetuates the original stock of the species, of which *P. syngenes* is a divergent branch.

P. s. dextroversa (fig. 6) is subcylindric, a little wider near the upper end. The last whorl is flattened laterally, with a strong rounded crest and a deep constriction behind the lip, which is thin and very narrowly expanded. The parietal lamella is slightly over one-fourth of a whorl long; the columellar lamella small and deeply immersed and the lower palatal nodule well-developed or weak, but invariably present in adult shells. The size varies.

Length 4, diam. 1.7 mm., whorls 9.
" 3, " 1.6 " " $7\frac{1}{2}$.

P. s. dextroversa differs from *P. blandi* by its larger, comparatively narrower and more cylindric shape, and the greater number of whorls. The two forms were doubtless of common ancestry.

Types of *P. s. dextroversa* are No. 79,460 A. N. S. P., from San Rafael, N. M., collected by E. H. Ashmun. Also taken at Holbrook, Ariz. (Ashmun), at Grants, N. M. (Joshua Baily, Jr., and Albert Baily), and in the Grand Canyon of the Colorado, see below.

The specimens from San Rafael and Holbrook are mirror images of the sinistral *P. syngenes* found with them. At Grants very few were found, no sinistral ones with them.

It appears, therefore, that some colonies of the older dextral form occur unmixed with sinistral, and sometimes the sinistral form is found unaccompanied by dextral.

Our records of *P. syngenes* in the Grand Canyon follow.

North of the Grand Canyon Ferriss and Daniels took *P. syngenes* at Station 25, Powell Plateau; Stations 100, 5 and 7 on the Kaibab-Powell saddle; and at Station 66, Kaibab Plateau. It was associated with form *dextroversa* at Stations 5 and 7, near the "Stone House."

Grand Canyon at the Bright Angel Trail, about 100 feet below the rim. *P. syngenes* and *P. s. dextroversa*, 19 of the former, 12 of the latter, normal in shape, most adults having a palatal tubercle. *P. syngenes* was also taken near the base of the cross-bed sandstone, one specimen.

Mystic Spring or Bass Trail. At Spectacle Cove (Station A), on the *Oreohelix* talus, below the cross-bed sandstone, 103 examples of *P. syngenes* from half-grown to adult were taken, all of them sinistral. Adults vary from 3 mm. long with 7 whorls to 3.7 mm. with 8 whorls. Most of them are triplicate, the columellar lamella and lower palatal fold distinct. The larger ones from this place are typical in shape; the smaller are shorter than *syngenes* from any other locality in our series.

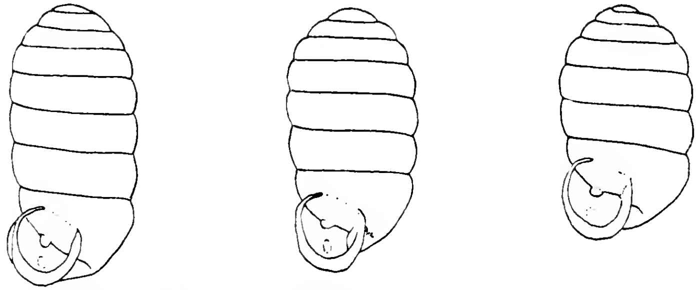


Fig. 7.—*Pupilla syngenes* Pils. Spectacle Cove, near Bass Trail. Lengths 3.8, 3.5 and 3.2 mm.

Along the upper slope of the Bass or Mystic Spring Trail, Station 2, there is an extensive colony of syngenid forms. We found them most abundant in the humus, among low brushwood, about 200 feet below the rim. Two forms occur here together, a dextral form, *P. s. dextroversa*, and a sinistral, *P. s. avus*, described below, in about equal numbers, 272 of the former and 256 of the latter in the lot collected.

The *P. s. dextroversa* are typical in shape, but larger than the types; the crest is wide and rather far from the lip-edge; a lower palatal tooth is developed. Specimens measure:

Length 4.5, diam. 1.8 mm., whorls 10.
" 3.7, " 1.8 " " 9.

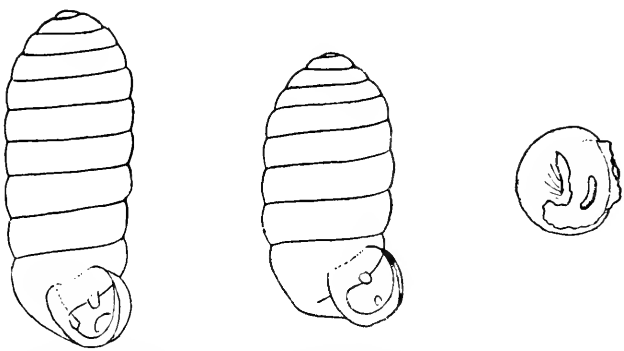


Fig. 8.—*Pupilla syngenes* form *dextroversa* P. and V. Bass Trail, about 200 feet below the rim. Lengths 4.5 and 3.75 mm.

The last is the smallest adult seen from this place; most examples are over 4 mm. long. Specimens of this lot are figured, fig. 8.

At about the same elevation about $\frac{1}{2}$ or $\frac{3}{4}$ mile west of Bass's Camp a similar specimen of *dextroversa* was taken.

Pupilla syngenes avus n. subsp. Fig. 9.

Shell sinistral, the last whorl deviating tangentially and ascending; teeth deeply immersed; *parietal lamella much longer* than in *P. syngenes* or *dextroversa*, about a half-whorl long.

Length	5.2,	diam.	1.8 mm.,	whorls	$10\frac{1}{2}$.
"	4.3,	"	1.7 "	"	$9\frac{1}{2}$.
"	4.0,	"	1.7 "	"	$9\frac{1}{2}$.

Types No. 94,220 A. N. S. P., from upper slope of the Grand Canyon along the Mystic Spring or Bass Trail, about 200 feet below the rim, Station 2; abundant with *P. s. dextroversa*.

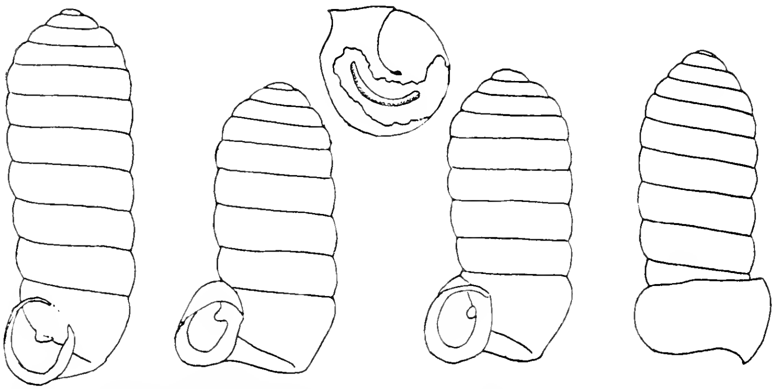


Fig. 9.—*Pupilla syngenes avus,* Cotypes. Lengths 5.2, 4, 4 and 4.2 mm.

The special characters of this race, being those of senility, are unequally developed in different individuals. The figures give a fair idea of the variations. Finding these shells associated with about an equal number of *P. s. dextroversa* of about the same size, we at first were disposed to think them all one race in which the shell was indifferently dextral or sinistral; but on closer study it appears that the dextral forms never have the last whorl and aperture abnormal nor are the teeth so deeply immersed, or the parietal lamella so long, while almost every sinistral shell collected in this colony is markedly distorted. It seems, therefore, that although the two forms are of common origin and live together, the different direction of the coil probably prevents interbreeding, thus segregating the sinistral stock, which in this colony is now in a late stage of senile degeneration.

Pupilla hebes (Anc.).

Pupa hebes Anc., Pils. and Van., Proc. Acad. Nat. Sci. Phila., 1900, p. 589, pl. 22, figs. 9, 10.

Bill Williams Mountain.

Pupilla hebes kaibabensis n. subsp.

The shell is constantly much shorter than the typical form, length 2.7 to 2.8, diam 1.5 mm., whorls 5½. Kaibab Saddle, Station 100, types No. 103,283 A. N. S. P., collected by Ferriss and Daniels, 1909. Also Station 105 in the same region.

Bifidaria quadridentata Sterki.

Bill Williams Mountain.

Bifidaria pellucida hordeacella (Pils.).

Near the Mystic Spring Trail at Station A, on the *Oreohelix* talus, Spectacle Cove.

Bifidaria pilsbryana Sterki.

Bill Williams Mountain. Grand Canyon at the Bright Angel Trail about 100 feet below the rim; Mystic Spring Trail, Station A. Also north of the Grand Canyon at Stations 7, 12, 100 in the region of the Powell-Kaibab Saddle; Station 66, north of Warm Spring Canyon; and at a spring on the northwestern side of Mt. Trumbull.

Bifidaria ashmuni Sterki.

Bright Angel Trail, about 100 feet below rim. North of the Grand Canyon at Stations 7 and 12, Kaibab-Powell Saddle; Station 100, near Oak Springs; and at Mt. Trumbull. These places are all far north of its previously known range.

Vertigo concinnula Ckll.

Bill Williams Mountain.

Vertigo coloradoensis arizonensis Pils. and Van.

Bill Williams Mountain.

VALLONIIDÆ.

Vallonia cyclophorella Anc.

Bill Williams Mountain. Grand Canyon about 200 feet below the rim and at the Indian Gardens, Bright Angel Trail. North of the Grand Canyon at Stations 1, 12, 106 and Oak Springs on the Kaibab-Powell Saddle; Quaking Asp Canyon; Rigg's Springs, Snake Gulch; Warm Spring Canyon; spring on the northwest side of Mt. Trumbull. A common shell in Arizona north of the Grand Canyon.

Vallonia perspectiva Sterki.

Grand Canyon at Seep Spring two miles west of the Mystic Spring

Trail, below the cross-bed sandstone, and in "Spectacle Cove," Station A, at about the same level. It was not taken north of the Grand Canyon.

LYMNÆIDÆ.

Lymnæa parva Lea.

Pipe Spring, Ariz.

Lymnæa obrussa Say.

Deception Lake near Kanab, Utah, small, slender specimens.

Planorbis tenuis Phil.

Reservoir back of Williams, Ariz.

Planorbis deflectus Say.

Fredonia, Ariz., Station 38, near the Utah boundary.

PHYSIDÆ.

Physa virgata Gld.

Reservoir back of Williams; Pipe Springs, Vermilion Cliffs, Station 39. *Physa traskii* Lea and *Ph. orbignyana* Lea are synonymous with *virgata*.

Physa humerosa Gld.

Indian Gardens on the Bright Angel Trail in the Grand Canyon (C. M. Cooke). A small form, evidently referable to this species.

Physa gyrina Say.

The Greens, near Kanab, Utah. Another small *Physa* of uncertain identity was taken in Deception Lake, Utah.

SPHÆRIIDÆ.

Pisidium sp. undet.

The Greens, Kanab Creek, near Kanab, Utah.

Explanation of Plates XII, XIII, XIV.

Plate XII.—Figs. 1–14.—*Oreohelix yavapai profundorum* P. and F. Cotypes. Spectacle Cove. No. 103,234 Acad. Nat. Sci. Phila.

Figs. 15–17.—*Oreohelix yavapai extremitatis* P. and F. Station C, Upper talus, west of Bass Camp. No. 103,237.

Figs. 18–21.—*O. y. extremitatis* P. and F. Cotypes. 100–400 feet below the rim along the trail near Bass Camp. No. 103,236.

Figs. 22–24.—*Oreohelix yavapai angelica* P. and F. Cotypes. 100–400 feet below the rim. Bright Angel Trail. No. 103,239.

Fig. 25.—*O. y. angelica.* Same locality. No. 103,241.

Figs. 26–28.—*Sonorella coloradoensis* (Stearns). Whitish, bandless form from White Creek, 1 mile above its junction with Shinumo Creek, Grand Canyon, north side. No. 103,255.

Figs. 29, 30.—*Sonorella coloradoensis* (Stearns). Head of Starvation Tank Wash, Grand Canyon, south side.

PLATE XIII.—*Oreohelix strigosa depressa* Ckll.—Figs. 1, 3, 5.—Jacobs Canyon, Station 69. No. 103,208 Acad. Nat. Sci. Phila.

Figs. 2, 4.—Jacobs Canyon, Station 70. No. 103,143.

Figs. 6, 7.—First gulch opening west above Warm Spring Canyon, Station 66. No. 103,141.

Fig. 8.—Warm Spring Canyon, Station 62. No. 103,138.

Fig. 9.—Warm Spring Canyon, Station 61. No. 103,116.

Figs. 10–12.—Shinumo Canyon, Station 50. No. 103,148.

Figs. 13–15.—Shinumo Canyon, Station 55. No. 103,197.

Fig. 16.—Moquitch Gulch, Station 76. No. 103,205.

Figs. 17, 18.—Moquitch Gulch, Station 75. No. 103,204.

Figs. 19–21.—Castle Spring, Snake Gulch, Station 79. No. 103,172.

Figs. 22, 23.—Quaking Asp Canyon, Station 91. No. 103,226.

Figs. 24–26.—Quaking Asp Canyon, Station 98. No. 103,157.

Figs. 27, 28.—Head of Quaking Asp Canyon, Station 84. No. 103,161.

PLATE XIV.—*Oreohelix strigosa depressa* Ckll.—Figs. 1–4.—North end of Powell Plateau, Station 17. No. 103,186.

Figs. 5–9.—North end of Powell Plateau, Station 15. No. 103,179.

Figs. 10, 11.—North end of Powell Plateau, Station 18. No. 99,158.

Figs. 12–15.—West side of Powell Plateau, Station 16. Nos. 94,159 and 103,188.

Fig. 16.—West side of Powell Plateau, Station 19. No. 103,180.

Figs. 17–21.—East side of Powell Plateau, Station 103. No. 103,188.

Figs. 22, 23.—North end of Powell Plateau, Station 105. No. 103,177.

A NEW FLAT FISH FROM NEW JERSEY.

BY HENRY W. FOWLER.

Citharichthys micros sp. nov.

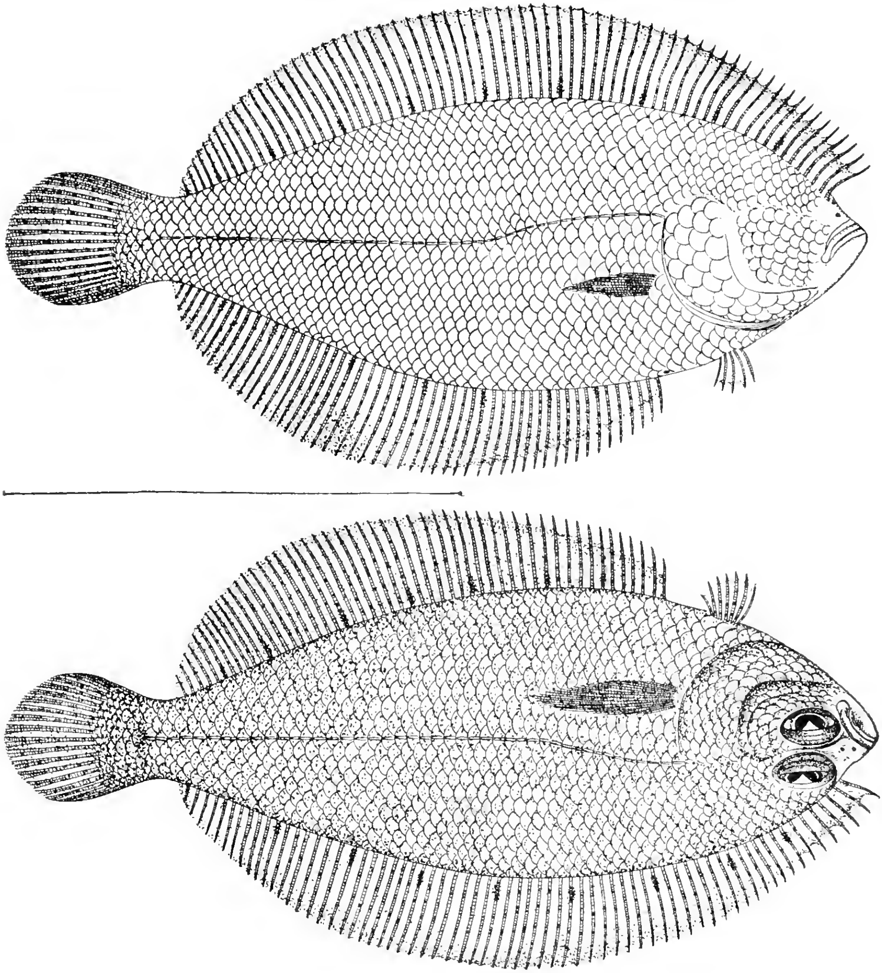
Head $3\frac{3}{5}$; depth $2\frac{1}{2}$; D. 67; A. 52; left P. 16; right P. 10; left V. 7; right V. 5; scales 43 in l. l. to caudal base; 11 scales above l. l. at depressed pectoral tip; 12 scales below l. l. at depressed pectoral tip; about same squamation on blind side also; snout tip to lower eye front about $5\frac{1}{4}$ in head, measured from upper jaw tip; eye $3\frac{1}{3}$; maxillary $3\frac{1}{2}$; longest dorsal rays about 2; longest anal rays about 2; least depth caudal peduncle $2\frac{2}{5}$; caudal length $1\frac{1}{5}$; left pectoral $1\frac{1}{3}$; right pectoral $2\frac{1}{8}$; interorbital about 6 in eye.

Body strongly compressed, thin, contour elongately ovoid, with greatest depth about opposite depressed pectoral tip. Caudal peduncle well compressed and only a little free.

Head moderate, greatly compressed, profiles similar or rather obtuse in front. Snout short, blunt. Eyes close together, only separated by narrow trenchant ridge, lower trifle large and but slightly extending before upper, its center about first third in head. Mouth small, inclined vertically, slightly curved. Lips fleshy, moderate. Maxillary bent a little, extends back trifle beyond front eye edge, though not to that of pupil, distal expansion about 4 in eye. Teeth in jaws uniserial, close-set, minute, slightly larger in front, sharp-pointed, conic, erect. No teeth on roof of mouth or tongue. Latter inconspicuous, fleshy, small, far back, end free. Mandible well protruded, rami well elevated inside mouth. Lower nostrils well separated, posterior over lower eye front and anterior a little before. Upper nostrils on front edge of snout well separated. Interorbital narrowly constricted. Preopercle ridge and edge slightly inclined forward.

Gill-opening forward about midway in head. Rakers 2 + 6 firm denticles, longest about $\frac{1}{3}$ of filaments, pointed, conic and apparently smooth. Filaments $1\frac{3}{5}$ in eye. Pseudobranchiæ a little less than filaments. Branchiostegals 4, membrane forming fold over isthmus. Latter truncate and trenchant in front, both sides constricted.

Scales rather small, cycloid, disposed in rather even longitudinal series parallel with l. l. on blind side, similar on upper side except some on the trunk inconspicuously ctenoid. Apparently none of fins scaly basally except caudal, and on that fin scales small. Head scaly, except jaws, snout and maxillary. Scales on cheek in 6 rows. L. l. complete, a trifle deflected anteriorly and then straight or median



Citharichthys micros Fowler.

along upper side, tubes simple and each one extending over entire exposure of scale.

Dorsal origin or base of first ray directly above front of lower eye, ends of anterior rays free, simple, and fin highest near last third in its length. Anal well separated from ventral, its origin a little behind pectoral base, front rays free distally and simple, and fin highest near last third its length. Caudal elongate, rounded. Pectoral on left simple, upper median rays longest, its origin little below middle in body depth at that point. Right pectoral shorter, lower median rays longest, fin otherwise similar. Left ventral inserted a trifle behind right ventral, though former a little larger. Vent close to anal origin, presented on lower side.

Color in alcohol pale sandy-gray on upper side, with scattered inconspicuous areas or patches of slightly darker mottlings. Dorsal and anal pale grayish with dusky blotch basally about every five or six rays, intervening rays and membranes mottled with paler dusky. Caudal grayish with indistinct transverse pale dusky lines. Left pectoral similar. Lower side whitish and transparent, darker variegations along dorsal, anal and caudal showing through distally. Peritoneum white.

Length $1\frac{13}{16}$ inches (47 mm.).

Type, No. 37,841, A. N. S. P. Corson's Inlet, Cape May County, N. J. September 17, 1910. Dr. Richard J. Phillips.

Also Nos. 37,842 to 37,850, A. N. S. P., paratypes with same data. These show: Head $3\frac{1}{2}$ to $3\frac{3}{4}$; depth $2\frac{1}{5}$ to $2\frac{2}{5}$; D. 62 to 67; A. 45 to 53; scales 37 to 43 in l. l. to caudal base; usually 11 scales above l. l. at depressed pectoral tip, frequently 10; usually 12 scales below l. l. at depressed pectoral tip, frequently 11; snout tip to lower eye front $4\frac{1}{8}$ to 5 in head measured from upper jaw tip; lower eye 3 to $3\frac{1}{3}$; maxillary 3 to $3\frac{1}{4}$; left pectoral $1\frac{1}{3}$ to $1\frac{2}{3}$; length $1\frac{1}{2}$ to $1\frac{3}{4}$ inches.

Two examples of *Citharichthys arctifrons*, kindly loaned by the United States National Museum through Mr. B. A. Bean, differ at once in their larger scales, their longer maxillary and more inclined upper profiles, besides such extent of variation as is shown in the following note. Head 4; depth $2\frac{4}{7}$ to $2\frac{3}{4}$; D. 74 or 75; A. 61 or 66; scales in l. l. to caudal base 36 to 38 + 2? to 4; about 8 scales (damaged) above l. l. at greatest depth of body; about 8 scales (damaged) below l. l. at greatest depth of body; snout 5 in head measured from upper jaw tip; eye $3\frac{2}{5}$; maxillary 3; pectoral $1\frac{1}{2}$; length $3\frac{1}{8}$ to $3\frac{3}{8}$ inches. These examples quite agree with Goode and Bean's figure,[1] and though in rather poor shape, all the important characters may be made out. They were secured off Martha's Vineyard, Mass., by the schooner Grampus, July 10, 1892. In pointing out the differences

[1] *Oceanic Ich.*, 1895, pl. 106, figs. 366*a–b*.

between the present species and *C. arctifrons*, it is only necessary to emphasize those above, though I also find it has much fewer gill-rakers, or about 2 + 6, while *C. arctifrons* shows 4 + 9. It seems, therefore, hardly likely my examples are the young of *C. arctifrons*, or *C. spilopterus*, of which I have West Indian material, or *C. unicornis*. These other species are readily distinguished; in the case of *C. spilopterus*, by its larger maxillary and smaller scales and in that of *C. unicornis* by the broad interorbital.

Found associated with *C. micros* were young *Prionotus carolinus*, *Brevoortia tyrannus*, *Trachinotus falcatus* and *Eucinostomus gula*, all of which were collected. Dr. Phillips noted on this occasion and the preceding day the greatest variety of species during the year. They were: *Mustelus mustelus*, *Eulamia milberti*, *Anguilla chrisypa*, *Anchovia mitchilli*, *Fundulus majalis*, *F. heteroclitus macrolepidotus*, *Tylosurus marinus*, *Syngnathus fuscus*, *Menidia menidia notata*, *Mugil cephalus*, *Pomatomus saltatrix*, *Centropristis striatus*, *Cynoscion regalis*, *Leiostomus xanthurus*, *Menticirrhus americanus*, *M. saxatilis*, *Sciænops ocellatus*, *Tautogolabrus adspersus*, *Tautoga onitis*, *Spheroides maculatus*, *Opsanus tau*, *Paralichthys dentatus* and *Pseudopleuronectes americanus*. An examination of the stomach contents of *C. micros* showed remains of small crustacea.

I may also note here that *Citharichthys spilopterus* Günther has been recorded from New Jersey by Jordan and Goss, a fact I had neglected to mention in my account of the fishes of that State.

(*Μικρός*, small.)

NOTES ON CLUPEOID FISHES.

BY HENRY W. FOWLER.

The clupeoid Isospondyli contained in the collection of the Academy of Natural Sciences of Philadelphia, unless stated otherwise, are listed in the present paper. As many of the localities are interesting records of distribution, all are given with the number of specimens examined. Several apparently new species are also described.

ELOPIDÆ.

Tarpon atlanticus (Valenciennes).

Florida 3. I examined 2 adults in the care of Mr. D. McCadden, not the property of the Academy, from Fort Meyer, Fla.

Megalops cyprinoides (Broussonet).

Apia, Samoa 3.

Elops saurus Linnæus.

Nantucket, Mass. 1; S. Carolina 1; W. Palm Beach, Fla. 1; E. coast U. S. 1; no data 1; Santo Domingo 1; Surinam 1; Jamaica ? 2; Rio Janeiro 1.

Elops hawaiensis Regan.

Honolulu, H. Is. 1. Formerly I confused this with *E. saurus*.

ALBULIDÆ.

Albula vulpes (Linnæus).

Santo Domingo 2; St. Martin's 2; Port Antonio, Jamaica 1.

Dixonina nemoptera Fowler.

(Proc. Acad. Nat. Sci. Phila., 1910, p. 651, fig. Santo Domingo.)

Type No. 1,597, A. N. S. P.

HIODONTIDÆ.

Hiodon alveoides (Rafinesque).

Beaver R. 1, Youghiogheny R. 2, Pa.; Battle Cr., upper Mo. R. 2; Creek Country, Ind. Ty. 2; St. Joseph, Mo. 1; Yellowstone R. 1; "N. Am." Bonaparte Coll. 8; L. Minnetonka (also skull of *Amiatus calvus*), Minn. 2.

Hiodon tergisus Le Sueur.

L. Erie 1; Erie, Pa. 1; Venice, O. 1.

CHIROCENTRIDÆ.

Chirocentrus dorab (Forskål).

Padang, Sumatra 3, of which 1 is now in Stanford University.

NOTOPTERIDÆ.

Notopterus chitala (Hamilton-Buchanan).

Dried skin without locality.

DUSSUMIERIIDÆ.

Stolephorus delicatulus (Bennett).

Bacon, Philippine Is. 7.

Dussumieria elopsoides Bleeker.

Padang, Sumatra 2, of which 1 is now in Stanford University.

Jenkinsia stolifera (Jordan and Gilbert).

Hailer's Rock, Fla. Keys 17; Culebra, Porto Rico 4.

Etrumeus micropus (Schlegel).

Honolulu, Hawaiian Is. 6.

CLUPEIDÆ.

Clupea harengus Linnæus.

Eastport, Maine 1; Newport, R. I. 2; Corson's Inlet, N. J. 1; Sweden 1.

Clupea pallasii Valenciennes.

(*Clupea mirabilis* Girard, Proc. Acad. Nat. Sci. Phila., 1854, pp. 138, 154. San Francisco, Cal.
Spratelloides bryoporus Cope, Proc. Amer. Philos. Soc., 1873, p. 25. Sitka, Alaska.)

Nos. 1,319 and 1,320, A. N. S. P., cotypes of *C. mirabilis* Girard.

No. 1,211, A. N. S. P., type of *S. bryoporus* Cope, in bad preservation.

Clupanodon cœruleus (Girard).

(*Meletta cœrulea* Girard, l. c. San Francisco, Cal.)

Nos. 1,252 and 1,240 to 1,243, cotypes of *M. cœrulea* Girard.

Clupanodon brunnichii (Schneider).

Adriatic Sea 6; Italy 6 (all in Bonaparte Coll.).

Clupanodon phalerica Risso.

(*Clupea papalina* Bonaparte, Cat. Met. Pesc. Eur., 1846, p. 271. Adriatic. No description).

Nos. 1,263 to 1,267, A. N. S. P., cotypes of the nominal *C. papalina* Bonaparte.

Clupanodon neopilohardus (Steindachner).

Melbourne, Australia 5.

Clupanodon pseudohispanicus (Poey).

Rio Janeiro, Brazil 1.

Pomolobus chrysochloris Rafinesque.

Wabash R., Indiana 2; Hayden Expedition 1.

Pomolobus mediocris (Mitchill).

Cape Cod, Mass. 1; Newport, R. I. 1; Barnegat Pier 1, Seaside Park 1, Corson's Inlet 1, N. J.; Potomac R. 3.

Pomolobus pseudoharengus (Wilson).

Portland, Maine 1; Cape Cod 2, Wood's Hole, Mass. 1; Newport, R. I. 3; Jersey City 1, May's Landing 20, Cedar Swamp Creek 1, Delaware Bay 1, N. J.; Bristol 15, Holmesburg 5, Pa.

Pomolobus æstivalis (Mitchill).

Wood's Hole, Mass. 1; Jersey City 1, Beesley's Point ? 1, Sea Isle City 5, N. J.

Alosa sapidissima (Wilson).

Martha's Vineyard, Mass. 2; Noank, Conn. 1; Duck I. 21, Bordentown 1, Newbold's I. 35, Washington Park 1, N. J.; Dingman's Ferry 25, Bristol 7, Holmesburg 9, Falls of Schuylkill 1, Pa.; Ft. Delaware, Del. 8; Delaware R. ? 1; Potomac R. 13.

Alosa fallax (Lacépède).

Italy 11, in Bonaparte Coll.

Sardinella granigera Valenciennes.

Beirut, Syria 1.

Sardinella atricauda (Günther).

Tahiti 3.

Sardinella perforata (Cantor).

Bacon, Luzon I., Philippines 1.

Sardinella hypselosoma (Bleeker).

Padang, Sumatra 4, of which 1 is now in Stanford University.

Sardinella humeralis (Valenciennes).

Newport, R. I. 2; Marquesas Keys 27, Hailer's Rock 1, West Palm Beach 2, Fla.; New Providence, Bahama Is. 6; Santo Domingo 7; Boqueron 2, Hucares 2, Porto Rico; Port Antonio, Jamaica 2; St. Martin's 43, Santa Cruz 20, W. I.; Rio Janeiro, Brazil 1.

Sardinella sardina (Poey).

Hailer's Rock, Fla. Keys 2.

Sardinella macrophthalma (Ranzani).

New Providence, Bahama Is. 6; Port Antonio, Jamaica 3; St. Martin's 3, Santa Cruz 3, W. I.

Sardinella stolifera (Jordan and Gilbert).

Mazatlan, Mex. 47.

GUDUSIA subgen. nov.

Type *Clupanodon chapra* Hamilton-Buchanan.

Differs from the other subgenera included in *Sardinella* by its small scales, which are about 80 to 120 in a lateral series.

(*Gudusa*, the native name.)

Sardinella chapra (Hamilton-Buchanan).

Ganges R., India 6.

Opisthonema oglinum (Le Sueur).

Beesley's Point 4, Sea Isle City 3, N. J.; N. America 5 (in Bonaparte Coll.); Santo Domingo 3; Port Antonio, Jamaica 1; Hucares 1, San Juan 1, Porto Rico; Santa Cruz, W. I. 1; Rio Janeiro, Brazil 2.

Brevoortia tyrannus (Latrobe).

Waquoit 3, Nantucket 24, Wood's Hole 3, Mass.; Seaside Park 1, Atlantic City 1, Great Egg Harbor Bay 5, Beesley's Point 2, Corson's Inlet 1, Washington Park 1, N. J.; Ft. Delaware, Del. 6; Chestertown 1, Big Bohemia Creek 2, Patapsco R. 3, Potomac R. 1, Md.; Ft. Macon, N. C. 2; S. Carolina 3; N. America 1 (Bonaparte Coll.).

Brevoortia tyrannus patronus (Goode).

Mississippi Sound at New Orleans, La. 2; Grand Plains Bayou, Miss. 3.

Brevoortia tyrannus aurea (Agassiz).

One without data, probably from Brazil ?

Brevoortia tyrannus dorsalis (Valenciennes).

Gaboon R., W. Africa 2.

HERINGIA gen. nov.

Type *Clupea amazonica* Steindachner.

Body strongly compressed, with trenchant serrated abdomen formed by bony scutes. Head small, well compressed. Mouth small. No teeth. Mandible protruding. Maxillary broad. Cheek normal. Gill-rakers slender, numerous. Branchiostegals about 5. Scales large, narrowly imbricated, cycloid, edges entire. No lateral line. Dorsal moderate, inserted behind ventral base, and fin entirely before anal. Anal rays few. Caudal forked. Pectoral low, not reaching ventral. Ventral depressed less than half space to anal. Coloration silvery.

Small herrings resembling *Pellonula* Günther, but differing in the absence of teeth. Some species of *Pellonula* are also credited with having the dorsal inserted behind the ventral origin. Possibly *Pomolobus melanostomus* Eigenmann is a member of this genus ?

(Named for Dr. Constantine J. Hering, who collected fishes in Surinam many years ago, for the Academy.)

Heringia amazonica (Steindachner).

Surinam 14 (Hering).

Ilisha narragansetæ sp. nov. Fig. 1.

Head $3\frac{1}{2}$; depth 3; D. IV, 13, I; A. IV, 41, I; P. I, 15; V. I, 5; scales about 44 in lateral series to caudal base (squamation damaged) + 5 (according to pockets); about 14 scales (squamation injured) between dorsal and anal origins; predorsal scales 20 (according to pockets);

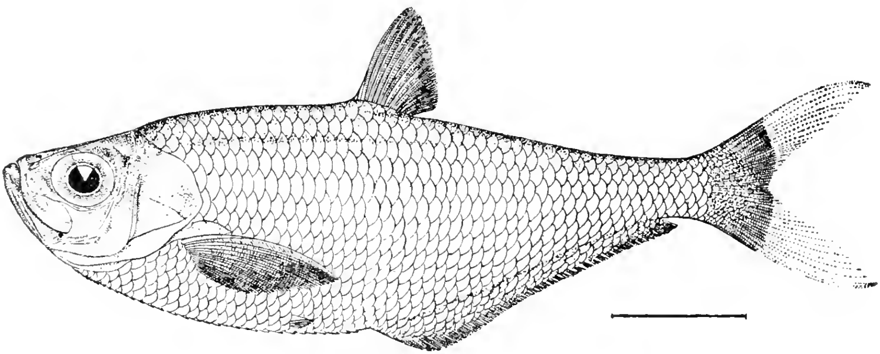


Fig. 1.—*Ilisha narragansetæ* Fowler. Type.

head width $2\frac{4}{5}$ its length; head depth at occiput $1\frac{1}{4}$; mandible $2\frac{1}{6}$; length of dorsal base 3; least depth of caudal peduncle $3\frac{2}{5}$; pectoral about $1\frac{2}{7}$; snout $4\frac{2}{7}$ in head measured from upper jaw tip; eye 3; maxillary $1\frac{9}{10}$; interorbital $6\frac{1}{4}$.

Body greatly compressed, thin, deepest at ventral origin, edges slightly trenchant, abdominal edge trenchant with 25 + 7 serræ, upper profile slightly convex and lower decidedly more so anteriorly, posteriorly lower straight. Caudal peduncle compressed, length trifle less than its least depth.

Head compressed, sides not especially flattened, but approximated below, upper profile little inclined, slightly concave, and convex lower greatly inclined. Snout surface convex, broad as long. Eye large, rounded, trifle before center in head. Apparently no adipose eyelid. Maxillary greatly inclined, reaches beyond front pupil edge till about opposite first third in eye, its lower edge finely dentate and greatest expansion about half of eye. Mouth rather small, superior. Scarcely median emargination to upper jaw front. Mandible well protruded, rami well elevated inside mouth. A series of small premaxillary teeth, narrow, median largest and others graduated externally. Small similar series on each side of symphysis of mandible. A double series of minute teeth on each palatine longitudinally. Tongue narrow, depressed, surface above roughened medianly, pointed tip free. Nostrils small pores, together, about midway in snout. Interorbital constricted, slightly elevated, depressed. Preorbital width about half of eye, slipping over upper anterior portion of maxillary. Postero-infraorbital about half of eye. Preopercle ridge oblique, and hind edge slightly inclined forward. Opercles and cheeks smooth, striæ or lines inconspicuous or obsolete.

Gill-opening forward about opposite last fifth in snout. Rakers 12 + 22, compressed, pointed, 2 in eye. Filaments about $\frac{3}{4}$ of rakers. Pseudobranchiæ $2\frac{1}{4}$ in eye, much larger than filaments. Isthmus slender, swelling but slightly behind. No depression on shoulder-girdle.

Scales large, cycloid, each with as many as 6 vertical striæ, edges entire, disposed in longitudinal series, and of about uniform size. Dorsal and anal depressible within basal scaly sheaths composed of scales small in size. Caudal base covered with small scales. Free axillary scaly pointed pectoral flap $\frac{2}{5}$ of fin. An axillary ventral scale.

Dorsal inserted about midway between mandible tip and caudal base, graduated down from first branched ray which is longest (damaged), depressed fin $3\frac{1}{3}$ to caudal base. Anal inserted slightly behind dorsal or about midway between front eye edge and caudal base, first few branched rays little longest, others all short and fin low, base straight. Caudal (damaged) forked, lobes apparently pointed and equal. Pectoral falcate, rather broad, reaching far back as ventral tip. Ventral small, inserted much nearer anal than pectoral origin. Vent close before anal.

Color in alcohol brownish on back and upper surface of head behind, sides and lower regions silvery-white. Fins all pale brownish. Iris brassy.

Length $5\frac{7}{8}$ inches (caudal damaged).

Type No. 15,314, A. N. S. P. A single example from Newport, R. I. Samuel Powell.

Only the above example is known to me, and it would appear undoubtedly to have been obtained at Newport as a waif of the Gulf

Stream, probably from some tropical region in America? It seems to be most closely related to *Pellona bleekeriana* Poey,[1] but according to the incomplete account of that species I am unable to consider them identical. Still further, I am obliged to allow them as separable, for Poey's account in some respects seems to strikingly disagree. Poey's fish was 100 mm. long and had the eye $3\frac{1}{2}$ in its head, while in my specimen, which is larger and consequently would be expected to have an equally small eye at least, it is 3 in its head. The greatest body depth in the total length of my example could not possibly be over $3\frac{3}{4}$ (even when its damaged caudal is allowed), while Poey alleges $5\frac{2}{3}$. According to Poey, the thickest part of the body is $\frac{2}{5}$ its greatest depth, while my example shows this clearly less than $\frac{1}{3}$. Poey says the maxillary reaches opposite the hind pupil edge, while in my example it does not even reach opposite the middle of the eye. Poey gives the teeth as somewhat long and curved, with a canine above and 2 below each side. My example shows no canines whatever. Poey says no teeth on the tongue, though my example shows it as asperous medianly. Poey gives the serratures as 25, while my example shows 32. Poey's example is said to have very caducous scales, while in mine they are largely adherent. Poey describes his fish as white, with a little pronounced silvery streak, which latter is not at all evident in my example. *Pristigaster flavipinnis* Valenciennes[2] differs in having much smaller scales, about 65. *Pellona castelnæana* Valenciennes,[3] which has been considered a synonym of the last, is too imperfectly described for positive identification. The occurrence of this fish, as far north as Rhode Island, is the most northern point at which any species of *Ilisha* has yet been found.

(Named for the country of the Narraganset Indians, now largely Rhode Island, where the type was secured.)

Ilisha hoeveni (Bleeker).

Padang, Sumatra 3, of which 1 now in Stanford University.

Ilisha brachysoma (Bleeker).

Padang, Sumatra 1.

Opisthopterus macrognathus (Bleeker).

Padang, Sumatra 1.

Odontognathus mucronatus Lacépède.

Surinam 2.

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[1] *Repert. Fis. Nat. Cuba*, II, 1866–68, p. 242. Matanzas.
[2] *Voy. Am. Mér. Orbig. Poiss.*, 1847, p. 8, Pl. 10, fig. 2. Buenos Aires.
[3] *Hist. Nat. Poiss.*, XX, 1847, p. 222. Mouth of the Amazon.

DOROSOMATIDÆ.

Dorosoma cepedianum (Le Sueur).

(*Chatœssus insociabilis* Abbott, Proc. Acad. Nat. Sci. Phila., 1860, p. 365. Trenton, N. J.)

Nos. 23,030 and 23,031, A. N. S. P., cotypes of *C. insociabilis* Abbott. Torresdale, Pa. 1; Potomac R. 1; Bayport, Fla. 3; Ohio ? 2; Wabash R., Indiana 1; Ft. Riley, Kansas 18; Davenport, Iowa 6; St. Joseph, Mo. 11.

Dorosoma cepedianum exile Jordan and Gilbert.

San Diego, Tex. 1.

Dorosoma petenensis (Günther).

Panama 1 (J. A. McNiel).

Signalosa mexicana (Günther).

Volusia, Fla. 1.

ENGRAULIDIDÆ.

Anchovia clupeoides (Swainson).

Santo Domingo 1; Rio Seco, Porto Rico 1. These both agree with Swainson's account, though likely *Stolephorus surinamensis* Bleeker may be different. *Engraulis productus* Poey is evidently a synonym of the present species.

ANCHOVIELLA subgen. nov.

Type *Engraulis perfasciatus* Poey.

This differs from the subgenus *Anchovia* Jordan and Evermann in the fewer gill-rakers, usually much less than 100 or about 35 to 50. Prof. E. C. Starks has kindly examined the gill-rakers of *Anchovia macrolepidota* (Kner and Steindachner), the typical species of *Anchovia*, and finds them about 106 + 135. *Anchoviella* includes the majority of species of *Anchovia*.

(*Anchoviella*, diminutive of *Anchovia*, as most of the species are of small size.)

Anchovia perfasciata (Poey).

Port Antonio, Jamaica 5; Aguadilla, Porto Rico 3.

Anchovia scitula sp. nov. Fig. 2.

Head $4\frac{1}{4}$; depth $6\frac{1}{3}$; D. III, 13; A. III, 16, I; P. I, 13; V. I, 6; scales about 40 in lateral series (counted by pockets) + 2 more on caudal base; about 9 scales (pockets) between dorsal origin and middle of belly; about 22 predorsal scales; head width $2\frac{1}{4}$ its length; head depth at occiput $1\frac{3}{5}$; dorsal base $1\frac{3}{4}$; least depth of caudal peduncle

$3\frac{1}{6}$; anal base $1\frac{4}{7}$; pectoral (damaged) 2; ventral (damaged) $2\frac{1}{5}$; snout 4; eye $3\frac{1}{2}$; maxillary $1\frac{1}{4}$; interorbital 4.

Body elongate, slender, well compressed, profiles similar, apparently deepest at dorsal origin, edges rounded? Caudal peduncle compressed, its least depth about 3 in its length.

Head well compressed, profiles similar and slightly convex, flattened sides a little approximated below so that lower surface much narrower than upper and not keeled medianly. Snout conic, profiles convex, protruding, length about equals its basal width. Eye rather large, rounded, a little elevated, at first $\frac{2}{5}$ in head. Adipose eyelid thin, covers eye entirely. Mouth large, front above with scarcely median depression. Maxillary straight, slightly expanded distally about $3\frac{1}{3}$ in eye, reaches hind preopercle edge, though not quite to articulation of mandible. Maxillary teeth uniserial, close-set, anterior slightly

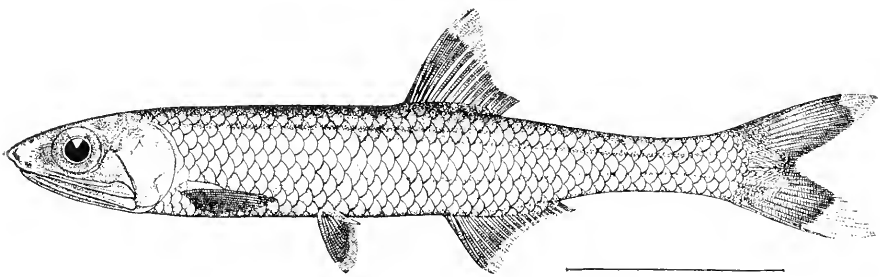

Fig. 2.—*Anchovia scitula* Fowler. Type.

bent back and posterior slightly inclined forward, throughout greater median extent of about uniform size, though anteriorly and posteriorly graduated down a little smaller, not continuous over front of upper jaw, and extending to hind end of bone. Similar more minute erect mandibular teeth, not connected across symphysis. Apparently no palatine or vomerine teeth, and pterygoids hardly roughened. Tongue smooth small knob, attached in front of mandible, from behind its upper surface and length of basibranchial shaft above a narrow area of minute asperities. Mandible convex over surface, constricted to point at symphysis, rami not elevated or only sloping gradually toward articulation behind. Mandible tip extends forward about opposite anterior nostril. Nostrils small, together, a trifle nearer eye than snout tip. Interorbital broadly convex. Each supraoccipital ridge distinct, flaring out a little over each eye anteriorly. Cheek would nearly form an equilateral triangle. Cheek and opercle smooth.

Gill-opening forward about opposite front eye edge. Rakers 19 +

26, slender, pointed, compressed, inner edges minutely denticulated, $1\frac{1}{5}$ in eye. Filaments 2 in eye. Pseudobranchiæ $2\frac{1}{2}$ in eye. Isthmus long, slender, narrowly compressed, and lower edge level, not trenchant. Branchiostegals 13, membranes united anteriorly only very short distance, forming narrow free fold over isthmus.

Scales caducous, or most all having fallen, according to pockets apparently narrowly imbricated, disposed in even longitudinal series, more or less uniform in size. Caudal base scaly, scales becoming small on bases of lobes, and inner bases of lobes each with an area of crowded elongated or horizontal scales. Dorsal and anal basal scaly sheaths? Long pointed distally free axillary pectoral scaly flap at least $\frac{3}{4}$ length of fin. Axillary ventral scaly flap ?

Dorsal origin midway between hind pupil edge and caudal base, graduated down from first branched ray (damaged) which apparently longest. Anal inserted about opposite middle of dorsal base or a little nearer pectoral origin than caudal base, anterior branched rays longest and others graduated down. Caudal forked, lobes (damaged) pointed and apparently equal. Pectoral small, low, and apparently (damaged) $1\frac{1}{2}$ to ventral. Latter inserted a little nearer anal origin than pectoral, and apparently (damaged) not quite half-way to anal. Vent close before anal.

Color in alcohol largely dull brownish on trunk, scarcely paler below. Head a little pale brownish above, sides and below silvery-white. Iris similar. A leaden-white band along side, from shoulder to caudal base, rather indistinct along costal region, above anal its width about $1\frac{1}{2}$ in eye and along side of caudal peduncle becoming still narrower. Fins all pale or dull brownish-white.

Length 4 inches (caudal tips damaged).

Type No. 1,576, A. N. S. P. San Diego, Cal. W. N. Lockington.

Only the above-described example known to me, and received many years ago. It appears to be related to *Anchoria exigua* (Jordan and Gilbert), but differs in a number of characters, such as the shorter maxillary, complete mandibular dentition, longer gill-rakers, slightly more posterior insertion of dorsal, more slender body and more pronounced silvery lateral band. *Anchoria miarcha* (Jordan and Gilbert), based on young examples, differs from *Anchoria scitula* in its fewer anal rays being 12 to 14, dorsal origin midway between snout and caudal, and no distinct lateral silvered band. It would hardly appear likely they are the young of the latter. *Anchoria starksi* (Gilbert and Pierson) differs in its more anterior dorsal origin, more posterior anal origin and longer maxillary.

(*Scitulus*, slender.)

Anchovia perthecata (Goode and Bean).

One example without locality.

Anchovia purpurea (Fowler).

(*Stolephorus purpureus* Fowler, Proc. Acad. Nat. Sci. Phila., 1900, p. 497, Pl. 19, fig. 1. Hawaiian Islands.)

Nos. 23,329 and 23,330, cotypes of *Stolephorus purpureus* Fowler. Also 16 examples from Hawaiian Islands.

Anchovia lepidentostole sp. nov. Fig. 3.

Head $4\frac{1}{4}$; depth 4; D. III, 12, I; A. III, 22, I; P. I, 12; V. I, 5; scales 35 in lateral series to caudal base and 3 more on latter; 9 scales obliquely forward from dorsal origin to that of ventral; predorsal scales 18; head width $1\frac{3}{4}$ its length; head depth at occiput $1\frac{1}{4}$; dorsal base $1\frac{1}{2}$; least depth caudal peduncle $2\frac{1}{5}$; pectoral $1\frac{3}{5}$; ventral 3; snout 5; eye $3\frac{1}{6}$; maxillary $1\frac{1}{4}$; mandible $1\frac{2}{7}$; interorbital $3\frac{1}{4}$.

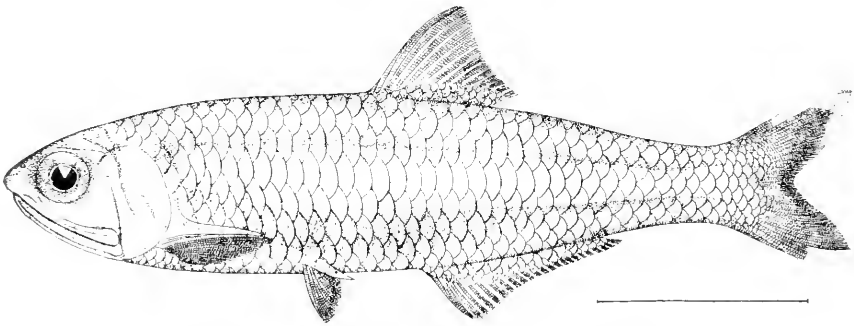

Fig. 3.—*Anchovia lepidentostole* Fowler. Type.

Body elongate, rather plump, compressed, fusiform or profiles rather evenly and similarly convex, greatest depth at dorsal origin, a slight dorsal and abdominal median keel and other edges convex. Caudal peduncle compressed, least depth $1\frac{1}{2}$ its length.

Head compressed, profiles slightly convex or similarly inclined, sides flattened and constricted well below so that lower surface formed much narrower than upper. Snout convex over surface and in profile, well protruded, length $\frac{3}{4}$ its basal width. Eye large, rounded, a little elevated, first third its length. Adipose eyelid covers eye, well developed. Mouth large, front above with scarcely median depression. Maxillary slightly curved, a little expanded distally till about $3\frac{1}{2}$ in eye, and not quite reaching preopercle ridge or mandibular articulation. Maxillary teeth fine, sharp-pointed, close-set, uniserial, all directed slightly forward, graduated down from front to end of bone, not continuous over front of upper jaw, and extending to hind end of bone. Similar more erect and uniform mandibular teeth, not connected over symphysis. Apparently no vomerine, palatine or pterygoid teeth. Tongue small rounded smooth knob in mandible anteriorly. Upper surface of basibranchial shaft finely asperous. Mandible convex over surface, constricted to point at symphysis, rami not elevated inside mouth, sloping gradually toward articulation behind. Mandible included within upper jaw, so that snout protruded a little, and its tip extends little beyond anterior nostril. Nostrils small, together, a little nearer eye front than snout tip. Interorbital broadly convex. Each supraorbital ridge distinct, flaring slightly over each eye anteriorly. Cheek would form an equilateral triangle. Cheek and opercle smooth, except for a number of transverse mucous arborescent channels or tubes.

Gill-opening forward to front eye edge. Rakers about 18 + 25, slender, pointed, compressed, inner edges minutely denticulated, $1\frac{1}{3}$ in eye. Filaments $1\frac{1}{5}$ in eye. Pseudobranchiæ 3 in eye. Isthmus long, slender, narrowly compressed, lower edge level and not trenchant. Branchiostegals about 10, membranes apparently scarcely united anteriorly.

Scales largely adherent, narrowly imbricated, disposed in even longitudinal series, more or less uniform in size. Each scale with 2 to 4 vertical striæ, and about 3 anterior horizontal. Caudal base scaly, scales becoming small on bases of lobes, and inner bases of lobes each with an area of crowded elongated or horizontal scales. Dorsal and anal with basal scaly sheaths. Long pointed distally free axillary pectoral scaly flap but trifle less than fin in length. Similar axillary ventral scaly flap.

Dorsal origin midway between snout tip and caudal base, anterior rays elongate and graduated down from first branched. Anal origin about opposite first third in dorsal length, anterior rays elongate and graduated down from first branched rays, fin low posteriorly. Caudal emarginate (damaged), and lobes apparently pointed and equal. Pectoral $\frac{4}{5}$ to ventral. Ventral origin nearer that of anal than of pectoral, fin about half-way to anal. Vent close before anal.

Color in alcohol generally pale brownish, everywhere with traces of silvery sheen. Head largely silvery on sides and below. A broad silvery lateral band, about equals vertical eye-diameter, becomes a little constricted at shoulder and along caudal peduncle side. This well defined. Iris silvered white. Fins all pale brownish-white.

Length (caudal tips a little damaged) 4 inches.

Type No. 1,346, A. N. S. P. Surinam. Dr. Constantine J. Hering.

Also No. 1,347, A. N. S. P., paratype, same data. Head $3\frac{7}{8}$; depth 4; D. III, 12; A. III, 21, I; scales 38 (largely according to pockets) + 3; 9 scales (pockets) between dorsal and anal origins; predorsal scales (pockets) 18; snout $4\frac{1}{2}$ in head; eye $3\frac{1}{8}$; maxillary $1\frac{1}{4}$; interorbital $3\frac{1}{3}$; length 3 inches.

This species appears related to *Anchovia brevirostris* (Günther) from Bahia, but seems to differ in the more numerous anal radii, that species having but 18. *Anchovia januarius* (Steindachner) is also a closely related species, but it differs as the origin of the dorsal is said to lie about an eye-diameter nearer the caudal base than the snout tip. In both of my examples it is about midway between the snout tip and the caudal base, and there is no trace of a dark gray cross-streak on latter.

(*λεπίς*, scale; *ἐντός*, within; *στολή*, stole; with reference to the median lateral row of scales in the silvery lateral band.)

Anohovia brownii (Gmelin).

Ocean City 57, Corson's Inlet 5, N. J.; Ft. Macon, N. C. 1; Hailer's Rock 28, Marquesas Keys 25, Tortugas 2, Fla.; Santo Domingo 1; Mayaguez, Porto Rico 1; Rio Janeiro, Brazil 1.

Anchovia platyargyrea sp. nov. Fig. 4.

Head $3\frac{1}{4}$; depth $4\frac{3}{5}$; D. III, 12; A. III, 19, I; P. I, 12; V. I, 6; scales about 35 (according to pockets) in lateral series to caudal base + 3 on latter; about 7 scales (pockets) between dorsal and ventral origins; about 15 predorsal scales (pockets); head width $2\frac{4}{5}$ its length; head depth $1\frac{3}{5}$; snout $4\frac{4}{5}$; eye $3\frac{4}{5}$; maxillary $1\frac{1}{8}$; interorbital 4; dorsal length $1\frac{3}{5}$; least depth caudal peduncle $3\frac{1}{2}$; caudal length $1\frac{2}{7}$; anal base $1\frac{3}{7}$; pectoral length 2; ventral 3; mandible $1\frac{2}{5}$.

Body well compressed, moderately long, profiles similarly and rather evenly convex, edges all rounded and predorsal scarcely trenchant, greatest depth about dorsal origin. Caudal peduncle well compressed, its least depth about $1\frac{1}{2}$ its length.

Head well compressed, profiles similarly inclined, though upper little more convex, flattened sides a little approximated below so that lower surface much narrower than upper and not keeled medianly. Snout conic, well protruding, basal width about equals its length. Eye rounded, rather high, a little before first third in head. Adipose eyelid well developed, covering eye entirely. Mouth large, front above with slight median depression. Maxillary straight, distally attenuated beyond mandibular articulation though not quite to gill-opening, its distal width $3\frac{1}{2}$ in eye. Maxillary teeth uniserial, close-set, fine, only most anterior slightly bent back and greater extent posteriorly slightly bend forward, though still more anteriorly and posteriorly graduated down a little smaller, not continuous over front of upper jaw, and extending to distal end of bone. Similar more erect mandibular teeth, not connected across symphysis, more minute. A small asperous process each side of vomer, asperities very minute. Similar palatine and pterygoid asperities. Tongue smooth small knob, attached in front of mandible, from behind its upper surface and length of basibranchial shaft above minutely asperous in narrow area. Mandible convex over surface, constricted to point at symphysis, rami not elevated inside mouth or only gradually sloping to articulation behind. Mandible tip extends forward about midway in postnasal. Nostrils small, together, about last $\frac{2}{5}$ in snout. Interorbital broadly convex. Each supraorbital ridge distinct, flaring out a little over each eye anteriorly. Cheek would form an isosceles triangle, its base being nearly half its height. Cheek and opercle smooth.

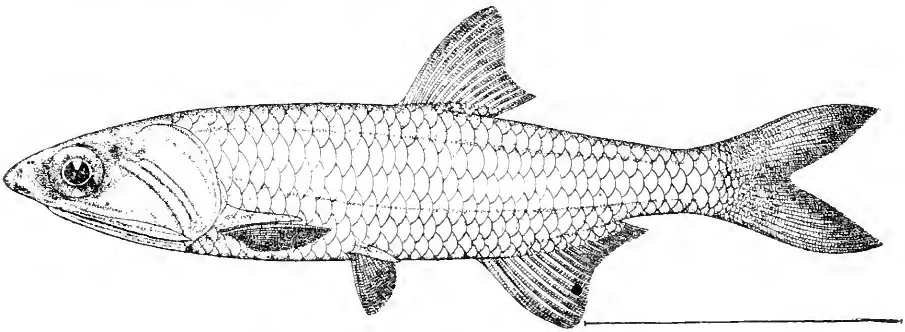

Fig 4.—*Anchoria platyargyrea* Fowler. Type.

Gill-opening forward till about opposite middle of eye. Rakers about 15 + 20, slender, pointed, compressed, inner edges minutely denticulated, $1\frac{1}{3}$ in eye. Filaments $1\frac{1}{3}$ in eye. Pseudobranchiæ 2 in eye. Isthmus long, slender, compressed, lower edge convex. Branchiostegals 12, membranes united anteriorly only very short distance, forming narrow free fold over isthmus.

Scales caducous, mostly fallen, narrowly imbricated, disposed in even longitudinal series, each with about 5 vertical striæ, and all of more or less uniform size. Dorsal and anal depressible within basal scaly sheaths somewhat. Caudal base scaly, inner edges of lobes each with an area of small crowded elongated or horizontal scales, and lobes basally with fine scales. Long pointed distally free axillary pectoral scaly flap $\frac{2}{3}$ length of fin. Similar axillary ventral scaly flap but little less than fin.

Dorsal origin midway between front pupil edge and caudal base, graduated down from first branched ray which is longest, and tips of anterior depressed rays extending but little behind last rays. Anal origin about opposite base of eleventh branched dorsal ray or a little nearer caudal base than pectoral origin, graduated down from first branched or longest ray. Caudal well forked, pointed lobes about equal. Pectoral about $\frac{4}{5}$ to ventral. Ventral inserted a trifle nearer pectoral origin than anal origin, and barely reaching half-way to latter. Vent close in front of anal.

Color in alcohol largely dull brownish, becoming paler about region of peritoneum. Head brownish above, sides and below, also iris, silver-white. A broad well-defined lateral silvery band, expanding to greatest width over anal where it equals $1\frac{1}{4}$ eye-diameters. Fins all pale brownish, dorsal and caudal minutely dotted with dusky.

Length 3 inches.

Type No. 1,416, A. N. S. P. St. Martin's, West Indies. Dr. R. E. Van Rijgersma.

Also Nos. 1,417 to 1,503, A. N. S. P., paratypes, same data. Ten of these examples, besides 9 from Fojardo, Porto Rico, identified by Evermann and Marsh[1] as *Anchovia chærostoma* (Goode), show: Head $3\frac{1}{5}$ to $3\frac{1}{2}$; depth $4\frac{1}{2}$ to $5\frac{2}{5}$; D. usually III, 12, I, frequently III, 11, I; A. usually III, 18, I, often III, 17, I or III, 19, I, rarely III, 16, I or III, 20, I; scales in lateral series usually about 33 or 34, often 32 or 35, seldom 30, 31, 36 or 37 + 2 or 3; usually about 9 scales transversely between dorsal origin and ventral origin; usually 17 predorsal scales, frequently 16, often 15 or 18, seldom 14; snout 4 to $4\frac{2}{3}$ in head; eye $3\frac{7}{8}$ to $4\frac{1}{2}$; maxillary but little less than head; interorbital $3\frac{1}{8}$ to $4\frac{1}{8}$; length $1\frac{5}{8}$ to $2\frac{3}{4}$ inches.

From *Anchovia chærostoma* (Goode) it differs in the maxillary not reaching the gill-opening, dorsal origin before depressed ventral tips, pectoral not reaching ventral and lateral silvery band wider than eye. *Anchovia argentivittata* (Regan) has fewer anal rays. *Anchovia astilbe* (Jordan and Rutter) is without a silvery lateral band. *Anchovia cubana* (Poey) has a longer maxillary.

(*Πλατύς*, broad; *αργυρος*, silver; with reference to the broad silvery lateral band.)

Anchovia commersonnii (Lacépède).

Padang, Sumatra 5, of which 2 are now in Stanford University.

[1] Bull. U. S. F. Com., 1900, p. 88.

Anchovia delicatissima (Girard)

San Diego, Cal. 15.

Anchovia eurystole (Swain and Meek).

Dr. R. J. Phillips secured a single example at Corson's Inlet, N. J., on October 24, 1909, which is now in the collection. This is the first specimen I have examined.

Anchovia cayorum (Fowler).

(*Anchovia chærostoma cayorum* Fowler, Proc. Acad. Nat. Sci. Phila., 1906, p. 85, fig. 4. Hailer's Rock, Fla. Keys.)

No. 30,613, A. N. S. P., type of *A. chærostoma cayorum* Fowler. Also 17 others with same data.

Anchovia mitchilli (Valenciennes).

Wood's Hole, Mass. 2; Seaside Park 3, Beesley's Point 3, Corson's Inlet 12, N. J.; Fort Delaware, Del. 32; Tolchester Beach, Md. 1.

Goode's figure of *Engraulis vittatus*,[5] which has been allowed to represent this species, differs at once in having 13 scales transversely.

Anchovia compressa (Girard).

San Diego, Cal. 1.

Anchovia tapirula (Cope).

(*Engraulis tapirulus* Cope, Proc. Amer. Philos. Soc , XVIII, 1877, p. 45. Probably Pecasmayo Bay, Peru.)

No. 21,851, A. N. S. P., type of *E. tapirulus* Cope.

Anchovia duodecim (Cope).

(*Engraulis duodecim* Cope, Trans. Am. Philos. Soc. (2) XIII, 1869, p. 405. Beesley's Point, N. J.)

No. 1,363, A. N. S. P., type of *E. duodecim* Cope.

Anchovia encrasicholoides (Bleeker).

Padang, Sumatra 4.

Anchovia nasus (Kner and Steindachner).

Probably Pecasmayo Bay, Peru 1.

Engraulis encrasicolus (Linnæus).

Italy 5 (in Bonaparte Coll.); no data 1 (Cope).

Engraulis mordax Girard.

Santa Barbara 4, Point Lobos 1, Point Reyes 1, San Diego 1, Cal.; no data 5, probably Cal. ?

Engraulis ringens Jenyns.

Probably Pecasmayo Bay, Peru 1

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[5] *Nat. Hist. Aquat. An. U. S. Com. Fish and Fisheries*, 1884, Pl. 218. Noank, Conn.

Cetengraulis edentulus (Cuvier).

Rio Janeiro, Brazil 1.

Cetengraulis engymen (Gilbert and Pierson).

Panama (J. A. McNiel) 15.

Thryssa valenciennesi (Bleeker).

Padang, Sumatra 2, of which 1 now in Stanford University.

Pterengraulis atherinoides (Linnæus).

Surinam 1.

Telara telara (Hamilton-Buchanan).

Ganges R., India 1.

Lycengraulis grossidens (Agassiz).

Surinam 1.

GONORHYNCHIDÆ.

Gonorhynchus gonorhynchus (Linnæus).

Melbourne, Australia 4.

OSTEOGLOSSIDÆ.

Osteoglossum bicirrhosum Agassiz.

Manacapuru, Brazil 1; between Rio Negro mouth and Peru 1; Peruvian Amazon 1; Ambyiacu R. 2.

Scleropages guntheri (Castelnau).

Thirteen examples from "New Zealand" received from Dr. J. Haast. These examples differ from the account and figure of *Scleropages leichardti* Günther,[6] chiefly in the shorter maxillary, longer eye and longer pectoral, all points in harmony with *Osteoglossum guntheri* Castelnau,[7] a species which is not noticed by Saville-Kent. The latter apparently wrongly identifies *Scleropages leichardti*, as a glance at his distinctions for that species as compared with his *Osteoglossum jardinii*,[8] will show. Thus it appears *Osteoglossum leichardti* Saville-Kent is not of Günther, but really identical with *Scleropages guntheri* (Castelnau), and *Osteoglossum jardinii* Saville-Kent is identical with *Scleropages leichardti* Günther. It may be doubtful that my examples were indigenous to New Zealand, though they were all labeled with that locality. Their identity with Castelnau's species

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[6] *Ann. Mag. Nat. Hist.*, (3) XIV, 1864, p. 196, Pl. 7. Burdekin River, Queensland.

[7] *Journ. de Zool. Gervais*, V, 1876, p. 131. Northeast Australia.

[8] *Proc. Roy. Soc. Queensland*, VIII, pt. 2, 1890–91, p. 105. Northern Queensland.

is in every way established. They show the following variations in some of the principal characters.

Head $3\frac{7}{8}$ to $4\frac{2}{5}$; depth $3\frac{7}{8}$ to $4\frac{3}{7}$; D. usually 18, often 17, rarely 16 or 19; A. usually 29, often 28, seldom 27; scales in l. l. usually 32, seldom 30, 31, 33 or 34 + usually 4, often 3; usually 4 scales above l. l., sometimes 5; usually 5 scales below l. l., frequently 4, rarely 6; predorsal scales usually 23 or 24, sometimes 21, 25 or 26; snout $4\frac{1}{4}$ to 5 in head, measured from snout tip to hind bony opercle edge; eye $5\frac{1}{5}$ to $6\frac{1}{5}$; maxillary $1\frac{3}{4}$ to $1\frac{7}{8}$; interorbital $3\frac{2}{5}$ to $3\frac{7}{8}$; length $11\frac{1}{2}$ to $23\frac{1}{4}$ inches.

ON SOME COLLECTIONS OF REPTILES AND BATRACHIANS FROM THE WESTERN UNITED STATES.

BY WITMER STONE.

Members of the Academy museum staff have taken part in several expeditions to various parts of the western United States during the last few years, more especially for the collecting of insects and mollusks, but in nearly every instance a certain number of reptiles and batrachians were procured. While no serious efforts were made to obtain complete collections at any one point, nevertheless a number of interesting specimens were taken, including one species of snake, *Elaphe chlorosoma*, new to our fauna. The exact localities accompanying the specimens will be of value in tracing the distribution of the various species, and the writer, who has had the privilege of studying the several collections, presents the following list mainly with that object in view. The several collections are as follows:

Fifty-five specimens obtained by Dr. Henry Skinner in Carr Cañon, Huachuca Mountains, Arizona, in August, 1905.

Thirty-six specimens obtained by Dr. Henry A. Pilsbry and Mr. J. H. Ferriss, of Joliet, Ill., who accompanied him, in various parts of Arizona, September to November, 1907, and sixty-five obtained in Arizona and New Mexico, August to October, 1910.

Three collections presented by Mr. Morgan Hebard, who, accompanied by Mr. J. A. G. Rehn, of the Academy staff, made trips to the West in 1907, 1909 and 1910.

The 1907 collection comprised thirty-seven specimens from Arizona, New Mexico and Texas.

The 1909 collection, fifty-nine specimens from Nebraska, Montana, Wyoming, Oregon, California, Nevada, Utah and Colorado.

The 1910 collection, eighty-one specimens from Wyoming, Idaho, Oregon, California, Arizona, New Mexico and Nevada.

The number given opposite each specimen is that of the Academy's Herpetological Catalogue, and is attached to each individual.

The writer begs to acknowledge his indebtedness to Dr. L. Stejneger, of the United States National Museum, who kindly examined several specimens of which the identity was in doubt.

BATRACHIA.

Ambystoma maorodactylum Baird. Long-toed Salamander.

18,032. La Grande, Union County, Ore. August 15, 1910. Hebard and Rehn.

This was the only salamander obtained by any of the parties.

Scaphiopus couchii Baird. Couch's Spadefoot.

17,475–6. Roeble's Ranch, near Coyote Springs, between Tucson and the Baboquivari Mountains, Arizona. July 24, 1907. Hebard and Rehn.

17,891–3. Mesa east of Big Hatchet Mountains. Dr. H. A. Pilsbry.

Scaphiopus hammondi Baird. Western Spadefoot.

17,491–4. Alamogordo, Otero County, N. Mex. July 13, 1907. Hebard and Rehn.

Bufo boreas Baird and Girard. Northwestern Toad.

17,841–3. Siskiyou, Siskiyou Mountains, Jackson County, Ore., 4,100 feet. August 13, 1909. Hebard and Rehn.

Bufo cognatus Say. Great Plains Toad.

17,477. Roeble's Ranch, between Tucson and the Baboquivari Mountains, Arizona. July 24, 1907. Hebard and Rehn.

17,905. Tucson, Ariz. 1910. Dr. H. A. Pilsbry.

Bufo alvarius Girard. Desert Toad.

17,890. Maricopa, Pinal County, Ariz. 1910. Dr. H. A. Pilsbry.

This specimen came hopping in at the door of a restaurant. Messrs. Hebard and Rehn saw several in a rain-water barrel at Sentinel, Ariz., in October, 1910.

Bufo punctatus Baird and Girard. Spotted Toad.

17,913–6. Agua Caliente Cañon, Santa Rita Mountains, Arizona, 5,000 feet. 1910. Dr. H. A. Pilsbry.

17,949–51. Otero (?) Cañon, Baboquivari Mountains, Arizona. 1910. Dr. H. A. Pilsbry.

17,532. North side Grand Cañon, Mystic Spring Trail, Coconimo County, Ariz., 1907. Dr. H. A. Pilsbry.

Bufo lentiginosus americanus Le Conte. American Toad.

17,834. North Platte, near Casper, Natrona County, Wyo. July 17, 1909. Hebard and Rehn.

18,039–1. Sidney, Cheyenne County, Neb. July 30, 1910. Hebard and Rehn.

Bufo lentiginosus woodhousei Girard. Rocky Mountain Toad.

17,879–80. Caliente, Lincoln County, Nev. September 3, 1909. Hebard and Rehn.

Hyla arenicolor Cope. Sand-colored Tree Toad.

17,533–64. North side of Grand Cañon, Mystic Spring Trail, Coconino County, Ariz. October, 1907. Dr. H. A. Pilsbry.

17,920. East of saddle of "Old Baldy," Santa Rita Mountains, Arizona, 7,500 feet. 1910. Dr. H. A. Pilsbry.

Chorophilus triseriatus Wied. Swamp Tree Frog.

17,876–8. Las Vegas, Lincoln County, Nev. September 2, 1909. Hebard and Rehn.

18,034. Nampa, Cañon County, Idaho. August 9, 1910. Hebard and Rehn.

Rana pipiens brachycephala Cope. Mountain Leopard Frog.

18,011–14. Mountain Home, Elmore County, Idaho. August 9, 1910. Hebard and Rehn.

Rana pipiens Shreber. Leopard Frog.

17,899. Agua Caliente Cañon, Santa Rita Mountains, Arizona. 1910. Dr. H. A. Pilsbry.

17,904. Santa Cruz River, Tucson, Ariz. Dr. H. A. Pilsbry.

17,933. Santa Cruz River, Tucson, Ariz. Dr. H. A. Pilsbry.

17,907. Tucson, Ariz. Dr. H. A. Pilsbry.

Rana fisheri Stejneger. Fisher's Frog.

17,873–5. Las Vegas, Lincoln County, Nev. September 2, 1909. Hebard and Rehn.

These specimens are from the type locality and seem in every way like the originals. They were not observed elsewhere.

REPTILIA.

Dipsosaurus dorsalis (Baird and Girard). Crested Lizard.

Three specimens collected by Messrs. Hebard and Rehn as follows:

17,857–8. Lyons, San Bernardino, Cal. September 1, 1909.

18,027. Yuma, Ariz. October 1, 1910.

Crotophytus collaris baileyi Stejneger. Bailey's Lizard.

Three specimens obtained by Messrs. Hebard and Rehn.

17,512. Mesa south of Franklin Mountains, El Paso, Tex. July 9, 1907.

18,033. Mesa at El Paso, Tex., 2,800 feet. August 9, 1910.

18,006. Mason, Lyon County, Nev., 4,500 feet. September 5, 1910.

Crotophytus wislizeni Baird and Girard. Leopard Lizard.

Eight specimens collected by Messrs. Hebard and Rehn.

17,511. Desert east of Franklin Mountains, El Paso, Tex. July 10, 1907.

17,864. Lyons, San Bernardino County, Cal. September 1, 1909.

17,954. Snyder's Hill, Pima County, Ariz. October 11, 1910.

18,004–5. Mason, Lyon County, Nev., 4,500 feet. September 5, 1910.

18,015–17. Mountain Home, Elmore County, Idaho. August 9, 1910.

Callisaurus ventralis (Hallowell). Zebra-tailed Lizard.

17,472–4. Roeble's Ranch, Pima County, Ariz. July 24, 1907. Hebard and Rehn.

17,482. Yuma, Ariz. July 27, 1907. Hebard and Rehn.

17,859–63. Lyons, San Bernardino County, Cal. November 5, 1909. Hebard and Rehn.

17,986. Palm Springs, Riverside County, Cal. September 29, 1910. Hebard and Rehn.

17,987–8. Warren, Kern County, Cal., 3,500 feet. September 17, 1910. Hebard and Rehn.

17,994–6. Slope east of Mina, Esmerelda County, Nev., 4,800 feet. September 3, 1910. Hebard and Rehn.

18,000–3. Mason, Lyon County, Nev., 4,500 feet. September 5, 1910. Hebard and Rehn.

Holbrookia maculata maculata Girard. Spotted Lizard.

17,832–3. Sandhills, Halsey, Thomas County, Neb. July 11, 1909. Hebard and Rehn.

17,884 and 17,886. Sterling, Logan County, Colo. July 15, 1909. Hebard and Rehn.

17,966. Sand Hills of North Platte. July 28. Hebard and Rehn.

Holbrookia maculata approximans Baird. Allied Spotted Lizard.

16,490–1. Carr Cañon, Huachuca Mountains, Arizona. August, 1905. Dr. H. Skinner.

17,479. Sonora Road Cañon, Tucson Mountains, Pima County, Ariz. July 25, 1907. Hebard and Rehn.

17,925 and 17,927. Gija River, Pima County, Ariz. 1910. Dr. H. A. Pilsbry.

17,928–30. Mesa, near the Baboquivari Mountains, Arizona. Dr. H. A. Pilsbry.

17,999. Sycamore Cañon, Baboquivari Mountains, Arizona. August 6, 1910. Hebard and Rehn.

Holbrookia maculata flavilenta Cope. Cope's Spotted Lizard.

16,492. Carr Cañon, Huachuca Mountains, Arizona. August, 1905. Dr. H. Skinner.

17,500. East of Alamogordo, N. Mex. (Greasewood belt). July 13, 1907. Hebard and Rehn.

Holbrookia texana Troschel. Texan Zebra-tailed Lizard.

17,495. Greasewood Belt east of Alamogordo, N. Mex. July 13, 1907. Hebard and Rehn.

17,515–17. Mesa east of the Franklin Mountains, El Paso, Tex. July 10, 1907. Hebard and Rehn.

17,908. Mineral Hill, 19 miles south of Tucson, Ariz. 1910. Dr. H. A. Pilsbry.

Uta stansburyana Baird and Girard. Stansbury's Swift.

17,497–9. Greasewood belt east of Alamogordo, N. Mex. July 13, 1907. Hebard and Rehn.

17,510. Mesa east of the Franklin Mountains, El Paso, Tex. July 10, 1907. Hebard and Rehn.

17,855. Roscoe, Los Angeles County, Cal. August 23, 1909. Hebard and Rehn.

17,868–72. Las Vegas, Nev. September 2, 1909. Hebard and Rehn.

17,970–2. San Jacinto Mountains, Riverside County, Cal. September 30, 1910. Hebard and Rehn.

17,973–7. Beaumont, Riverside County, Cal. September 28, 1910. Hebard and Rehn.

17,979–80. Mt. Lowe, Los Angeles County, Cal. September 25, 1910. Hebard and Rehn.

17,989–91. Warren, Kern County, Cal. September 17, 1910. Hebard and Rehn.

18,009–10. Mason, Lyon County, Nev., 4,500 feet. September 5, 1910. Hebard and Rehn.

18,023–26. Sentinel, Maricopa County, Ariz. October 2, 1910. Hebard and Rehn.

18,028. Yuma, Ariz. October 1, 1910. Hebard and Rehn.

17,956. Mohave, Kern County, Cal. September 15, 1910. Hebard and Rehn.

Uta symmetrica Baird. White-bellied Swift.

17,484–5. Yuma, Ariz. July 28, 1907. Hebard and Rehn.

17,941–2. Baboquivari Mountains, Arizona. 1910. Dr. H. A. Pilsbry.

Uta ornata Baird and Girard.[1] Ornate Swift.

16,506–9. Carr Cañon, Huachuca Mountains, Arizona. August, 1905. Dr. H. Skinner.

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[1] Dr. Stejneger writes me that his record of *U. symmetrica* from the Huachuca Mountains (*Proc. U. S. Nat. Mus.*, vol. 25, p. 150) was a lapsus for *U. ornata*.

17,488. Luna County, N. Mex., north side of Florida Mountains. July 19, 1907. Hebard and Rehn.

17,496. Greasewood belt, east of Alamogordo, M. Mex. July 13, 1907. Hebard and Rehn.

Sceloporus clarkii Baird and Girard. Clark's Swift.

16,534–40. Carr Cañon, Huachuca Mountains, Arizona. August, 1905. Dr. H. Skinner.

16,524. Carr Cañon, Huachuca Mountains, Arizona. August, 1905. Dr. H. Skinner.

17,952. Baboquivari Mountains, Arizona. 1910. Dr. H. A. Pilsbry.

Dr. Skinner states that they were found among rocks along the stream, and sought refuge under them when pursued.

Sceloporus magister Hallowell. Hallowell's Swift.

17,471. Roeble's Ranch, near Coyote Springs, Pima County, Ariz. July 24, 1907.

17,483. Yuma, Ariz. July 28, 1907. Hebard and Rehn.

Sceloporus jarrovii Cope. Yarrow's Swift.

16,510–13. Carr Cañon, Huachuca Mountains, Arizona. August, 1905. Dr. H. Skinner.

16,515–23. Carr Cañon, Huachuca Mountains, Arizona. August, 1905. Dr. H. Skinner.

16,525–27. Carr Cañon, Huachuca Mountains, Arizona. August, 1905. Dr. H. Skinner.

16,489. Carr Cañon, Huachuca Mountains, Arizona. August, 1905. Dr. H. Skinner.

17,529. Cave Creek Cañon, Chiracahua Mountains, Cochise County, Ariz. 1907. Dr. H. A. Pilsbry.

17,898, 17,900 and 17,912. Santa Rita Mountains, Arizona. 1910. Dr. H. A. Pilsbry.

19,923–4. Cochise Stronghold, Dragoon Mountains, Arizona. 1910. Dr. H. A. Pilsbry.

Found among rocks, according to Dr. Skinner: entering miners' cabins and everywhere the most common species in the regions visited by Dr. Pilsbry.

Sceloporus consobrinus Baird and Girard. Yellow-banded Swift.

17,506–7. Three miles southeast of El Paso, Tex., on the Rio Grande. July 10, 1907.

17,829–31. Sandhills, Halsey, Thomas County, Neb. July 11, 1909. Hebard and Rehn.

17,885. Sterling, Logan County, Colo. July 15, 1909. Hebard and Rehn.

Sceloporus biseriatus Hallowell. Western Swift.

17,965. Reno, Nev., 4,500 feet. September 1, 1910. Hebard and Rehn.

17,976 and 17,978. Beaumont, Riverside County, Cal. September 28, 1910. Hebard and Rehn.

17,981. Mt. Lowe, Los Angeles County, Cal. September 25, 1910. Hebard and Rehn.

17,993. Tahachapi, Kern County, Cal. September 16, 1910. Hebard and Rehn.

18,007. Mason, Lyon County, Nev. September 5, 1910. Hebard and Rehn.

Sceloporus graciosus Baird and Girard. Sage-brush Swift.

17,835. Billings, Yellowstone County, Mont. July 28, 1909. Hebard and Rehn.

17,838. Siskiyou, Jackson County, Ore. August 13, 1909. Hebard and Rehn.

17,845-6. Sugar Loaf, near Sisson, Siskiyou County, Cal. August 15, 1909. Hebard and Rehn.

17,882. Milford, Beaver County, Utah. September 5, 1909. Hebard and Rehn.

17,887. Iron Mountain, Garfield County, Colo., 6,500 feet. September 9, 1909. Hebard and Rehn.

17,959-61. Pemberton, Umatilla County, Ore., 1,100 feet. August 16, 1910. Hebard and Rehn.

17,964. Table Mountain, Green River, Wy., 7,500 feet. August 3, 1910. Hebard and Rehn.

17,981. Mt. Lowe, Los Angeles County, Cal. September 23, 1910. Hebard and Rehn.

Sceloporus occidentalis[2] Harlan. Pacific Swift.

17,839-40. Siskiyou, Jackson County, Ore., 5,000 feet. August 13, 1909. Hebard and Rehn.

17,853. Mt. Tamalpais, Marin County, Cal., 1,100 feet. August 18, 1909. Hebard and Rehn.

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[2] I take opportunity to state that the specimen of *Sceloporus couchi*, reported by me from Devil's River, Texas (*Proc. A. N. S.*, 1903, p. 540), proves to be the subsequently described *S. merriami* Stejneger. I was misled by Baird's statement of the number of femoral pores, which Stejneger finds to be erroneous upon a careful examination of the type.

Phrynosoma douglassii brevirostre Girard. Short-nosed Horned-toad.

17,566–7. Springfield, Bingham County, Idaho. August, 1906. Dr. Skinner.

17,958. Green River, Sweetwater County, Wyo. August 3, 1910. Hebard and Rehn.

Phrynosoma hernandezi Girard. Hernandez's Horned-toad.

16,495–8. Carr Cañon, Huachuca Mountains, Arizona. August, 1905. Dr. H. Skinner.

17,486. Silver City, Grant County, N. Mex. July 21, 1907. Hebard and Rehn.

17,489–90. Cloudcroft, Otero County, N. Mex. July 15, 1907. Hebard and Rehn.

18,029. Sidney, Cheyenne County, Neb. July 30, 1910. Hebard and Rehn.

Phrynosoma hernandezi ornatissimum Bell. Ornamented Horned-toad.

17,931. Bisbee, Ariz. 1910. Dr. H. A. Pilsbry.

Phrynosoma regale Girard. Regal Horned-toad.

17,528. Greasewood Plain, Northeast of Tucson, Ariz. July 26, 1907. Hebard and Rehn.

17,918–19. Las Gijas, Pima County, Ariz. September 28, 1910. Dr. H. A. Pilsbry.

17,948. Baboquivari Mountains, Pima County, Ariz. Dr. H. A. Pilsbry.

17,957. Tucson, Ariz. October 12, 1910. Hebard and Rehn.

17,906. Mineral Hill, 19 miles south of Tucson. 1910. Dr. H. A. Pilsbry.

Phrynosoma frontale Van Denburgh. California Horned-toad.

17,962. Del Monte, Monterey County, Cal. September 9, 1910. Hebard and Rehn.

Phrynosoma cornutum Harlan. Texas Horned-toad.

17,508. Three miles southeast of El Paso, Tex. July 10, 1907. Hebard and Rehn.

Phrynosoma modestum Girard. Little Horned-toad.

17,513. Mesa east of the Franklin Mountains, El Paso, Tex. July 9, 1907. Hebard and Rehn.

17,589. Guzman, Chihuahua, Mex. August 6, 1906. Dr. P. P. Calvert.

17,911. El Paso Co., Ariz. August 18, 1910. Dr. H. A. Pilsbry.

17,935–7. Sheridan Cañon, Hachita Mountains, N. Mex. 1910. Dr. H. A. Pilsbry.

Gerrhonotus principis Baird and Girard. Keeled Lizard.

17,836–7. Glendale, Douglas County, Ore. August 12, 1909, 1,900 feet. Hebard and Rehn.

Gerrhonotus burnettii Gray. Burnett's Keeled Lizard.

17,522–7. Mt. Tamalpais, California. September, 1907. Hebard and Rehn.

17,844. Sisson, Siskiyou County, Cal., 3,500 feet. August 15, 1909. Hebard and Rehn.

17,854. San Miguel Hills, San Francisco, Cal., 700 feet. August 19, 1909. Hebard and Rehn.

Gerrhonotus kingii Gray. King's Lizard.

16,486. Carr Cañon, Huachuca Mountains. August, 1905. Dr. H. Skinner.

Cnemidophorus sexlineatus Linn. Six-lined Lizard.

17,501–2. Greasewood belt east of Alamogordo, N. Mex. July, 13, 1907. Hebard and Rehn.

17,503–5. Three miles southeast of El Paso, Tex. July 10, 1907. Hebard and Rehn.

Cnemidophorus gularis Baird and Girard. Spotted Race Runner,

16,501–5. Carr Cañon, Huachuca Mountains, Ariz. August, 1905. Dr. H. Skinner.

17,934. Dragoon Station, Cochise County, Ariz. 1910. Dr. H. A. Pilsbry.

Cnemidophorus grahamii Baird and Girard. Graham's Lizard.

17,514. Mesa, east of the Franklin Mountains, El Paso, Tex. July 10, 1907. Hebard and Rehn.

Cnemidophorus tigris Say. Tiger Lizard.

17,478. Sonora Road Cañon, Tucson Mountains, Arizona. July 25, 1907. Hebard and Rehn.

17,481. Yuma, Ariz. July 27, 1907. Hebard and Rehn.

17,487. Deming, N. Mex., dry bed of Rio Mimbres. July 18, 1907. Hebard and Rehn.

17,509. East of the Franklin Mountains, El Paso, Tex. July 10, 1907. Hebard and Rehn.

17,865–7. Las Vegas, Lincoln County, Nev. September 2, 1909. Hebard and Rehn.

17,856. Lyons, San Bernardino County, Cal. September 1, 1909. Hebard and Rehn.

17,969. San Jacinto Mountains, Riverside County, Cal. September 30, 1910. Hebard and Rehn.

17,985. Palm Springs, Riverside County, Cal. September 29, 1910. Hebard and Rehn.

18,018–22. Sentinel, Maricopa County, Ariz. October 2, 1910. Hebard and Rehn.

Cnemidophorus tigris melanostethus Cope. Black-throated Tiger Lizard.

17,466–70. Roeble's Ranch, Coyote Springs between Tucson and Baboquivari Mountains, Arizona. July 24, 1907. Hebard and Rehn.

Eumeces obsoletus Baird and Girard. Sonora Skink.

16,487. Carr Cañon, Huachuca Mountains, Arizona. August, 1905. Dr. H. Skinner.

16,493–4. Carr Cañon, Huachuca Mountains, Arizona. August, 1905. Dr. H. Skinner.

Diadophis regalis Baird and Girard. Sonora Ring-necked Snake.

17,889. Baboquivari Cañon, Baboquivari Mountains, Pima County, Ariz. 1910. Dr. H. A. Pilsbry.

17,953. Otero Cañon, Baboquivari Mountains, Pima County, Ariz. 1910. Dr. H. A. Pilsbry.

17,998. Sycamore Cañon, Baboquivari Mountains, Pima County, Ariz. October 6, 1910. Hebard and Rehn.

Bascanion semilineatum Cope. Arizona Whip Snake.

16,488. Carr Cañon, Huachuca Mountains, Arizona. August, 1905. Dr. H. Skinner.

Bascanion flagellum Shaw. Whip Snake.

17,896. Between Baboquivari Mountains and Las Gijas, Arizona. 1910. Dr. H. A. Pilsbry.

Bascanion constrictor venustum Baird and Girard. California Black Snake.

17,852. Sisson, Siskiyou County, Cal. August 15, 1909. Hebard and Rehn.

Elaphe chlorosoma (Günther). Mexican Green Snake.

17,895. Santa Rita Mountains, Arizona. 1910. Dr. H. A. Pilsbry.

17,909. Agua Caliente Cañon, Santa Rita Mountains, Arizona, 6,000 feet. 1910. Dr. H. A. Pilsbry.

The identity of these specimens was confirmed by Dr. Leonhard Stejneger who kindly examined one of them. The species was not previously known from north of the Mexican boundary.

Lampropeltis pyrrhomelæna Cope. Arizona Ringed Snake.

16,531–3. Carr Cañon, Huachuca Mountains, Arizona. August, 1905. Dr. H. Skinner.

17,910. Madera Cañon, Santa Rita Mountains, Arizona. 1910. Dr. H. A. Pilsbry.

Pituophis catenifer deserticola Stejneger. Desert Bull Snake.

16,514. Carr Cañon, Huachuca Mountains, Arizona. August, 1905. Dr. H. Skinner.

17,531. North side of Grand Cañon, Arizona. 1907. Dr. H. A. Pilsbry.

17,894. Las Gijas, Pima County, Ariz. 1907. Dr. H. A. Pilsbry.

Thamnophis parietalis (Say). California Garter Snake.

17,851. Sisson, Siskiyou County, Cal. August 15, 1909. Hebard and Rehn.

Thamnophis eques (Reuss). Brown Garter Snake.

17,997. Sycamore Cañon, Baboquivari Mountains, Arizona. October 6, 1910. Hebard and Rehn.

Elaps euryxanthus Kennicott. Sonora Coral Snake.

17,932. Mineral Hill, 19 miles south of Tucson, Arizona. 1910. Dr. H. A. Pilsbry.

Crotalus oregonus Holbrook. Pacific Rattlesnake

17,848–50. Sugar Loaf, near Sisson, Siskiyou County, Cal. August 15, 1909. Hebard and Rehn.

Crotalus molossus Baird and Girard. Black-tailed Rattlesnake

16,530. Carr Cañon, Huachuca Mountains, Arizona. August, 1905. Dr. H. Skinner.

17,897. Walnut Cañon, Santa Rita Mountains, Arizona, 6,000 feet. 1910. Dr. H. A. Pilsbry.

Crotalus lepidus Kennicott. Green Rattlesnake,

16,499–500. Carr Cañon, Huachuca Mountains, Arizona. August, 1905. Dr. H. Skinner.

17,903. Sheridan Cañon, Big Hatchet Mountains, Grant County. N. Mex. 1910. Dr. H. A. Pilsbry.

17,921. Cochise Stronghold, Dragoon Mountains, Arizona. 1910. Dr. H. A. Pilsbry.

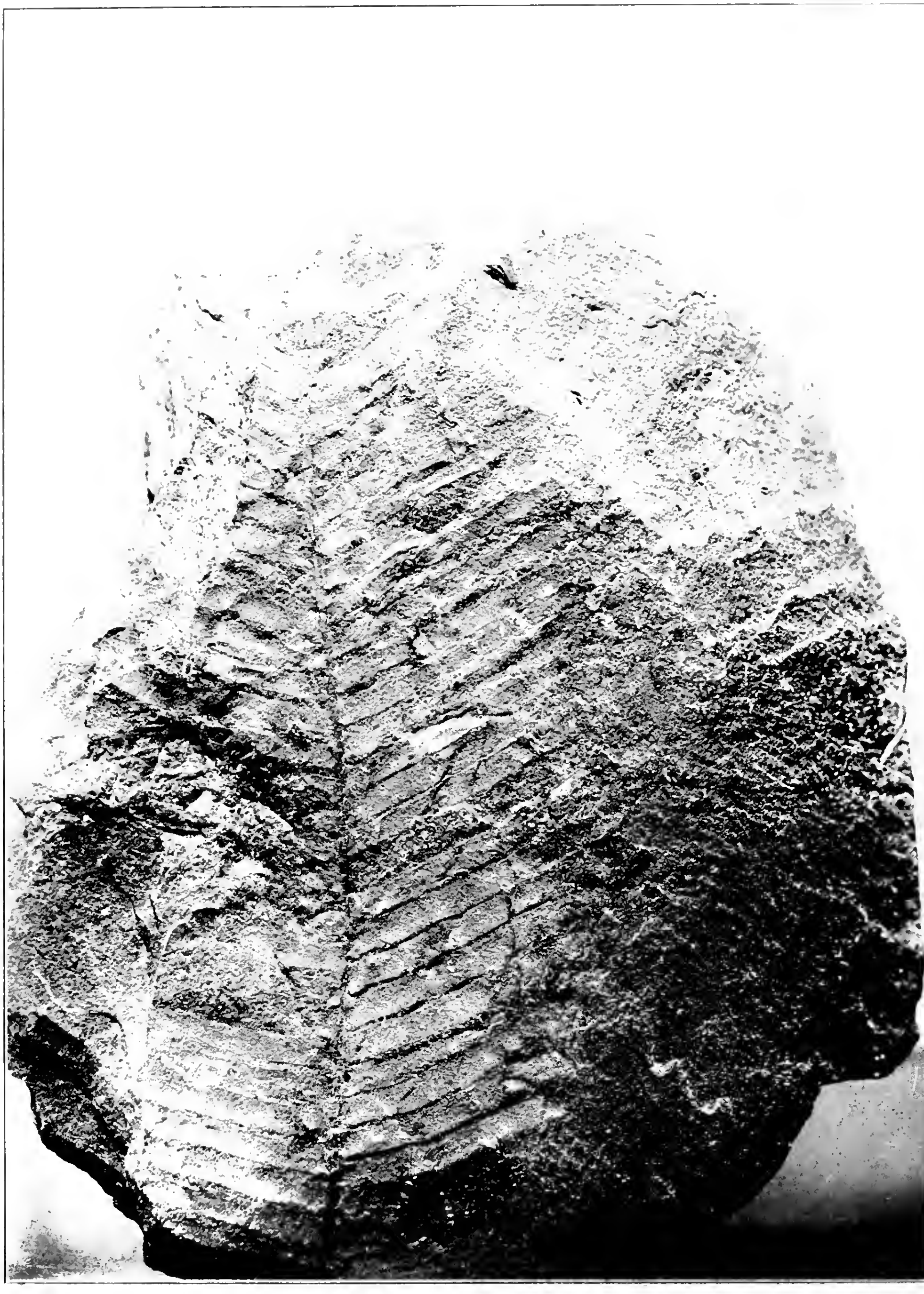
Dr. Skinner found them on the talus slide and they could often be heard rattling underneath stones that had been disturbed. Unlike most rattlesnakes, they invariably attempted to escape when approached.

Crotalus pricei Van Denburg. Price's Rattlesnake.

17,902. Northwest flank of Old Baldy, Santa Rita Mountains, Arizona, 7,500 feet. 1910. Dr. H. A. Pilsbry.

A typical specimen and the only one seen by any of the parties.

BLOWN: NEW CYCADS AND CONIFERS



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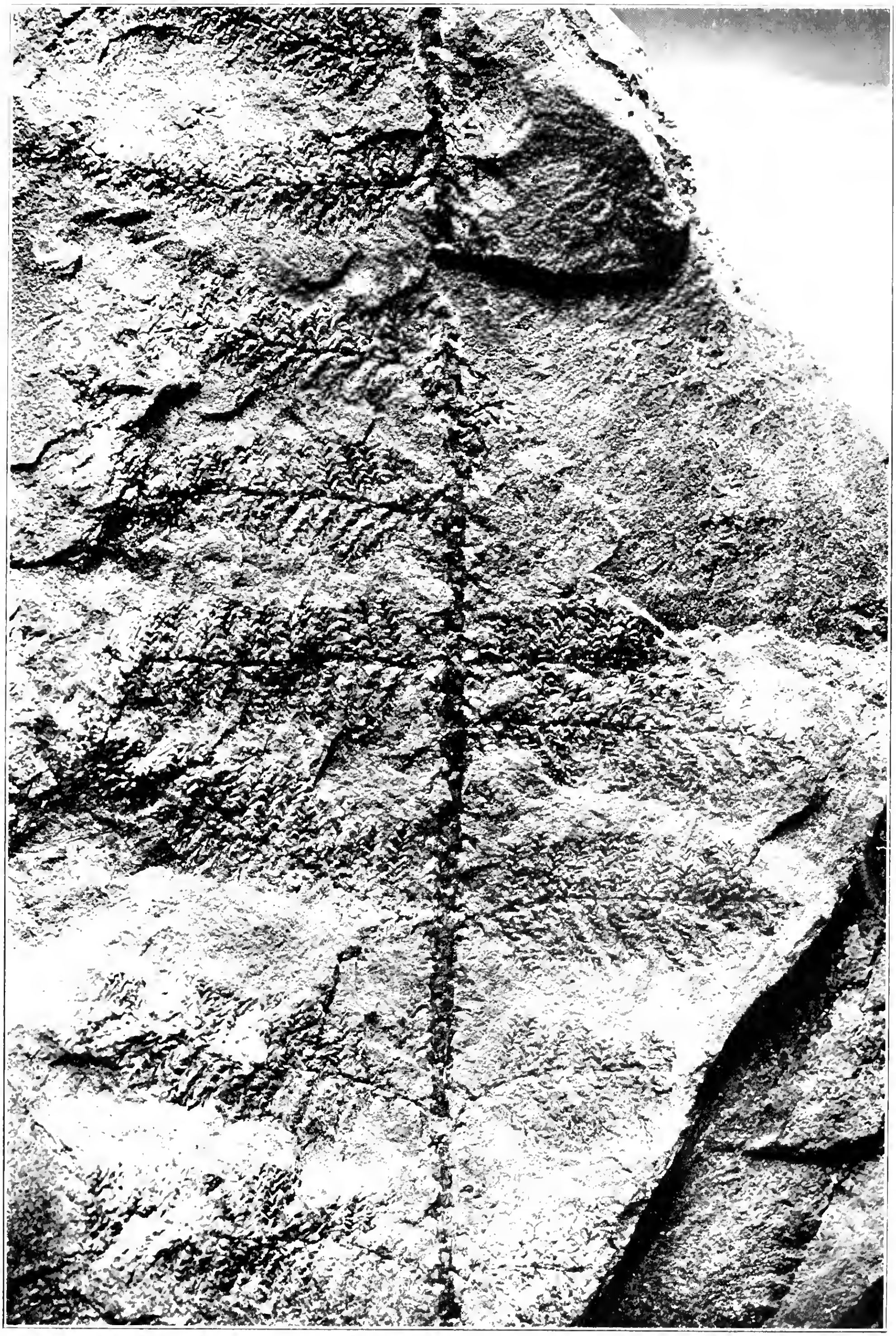

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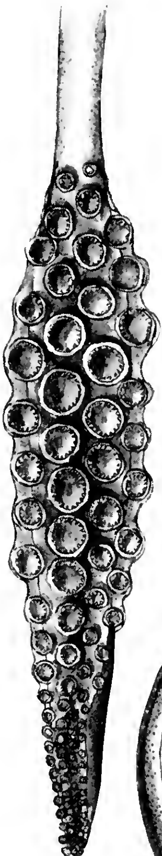

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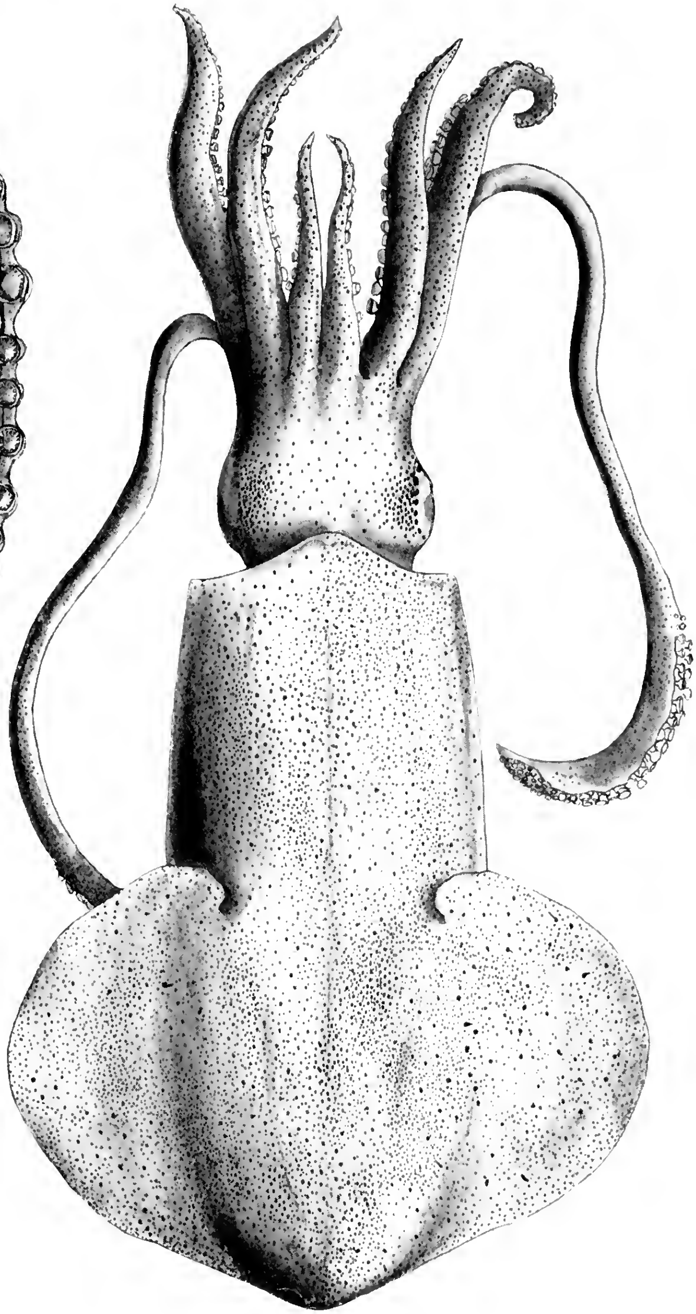

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BERRY ON LOLLIGUNCULA.


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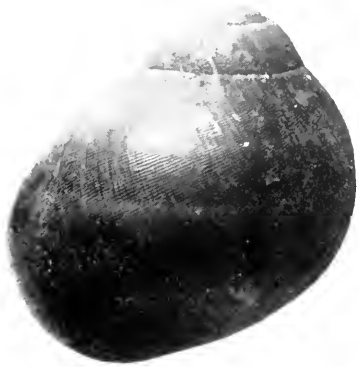
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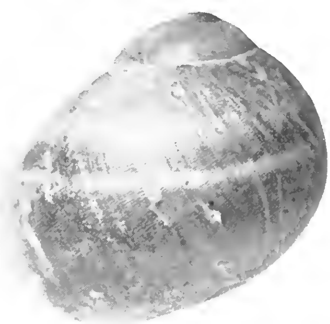
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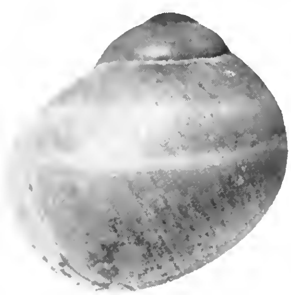
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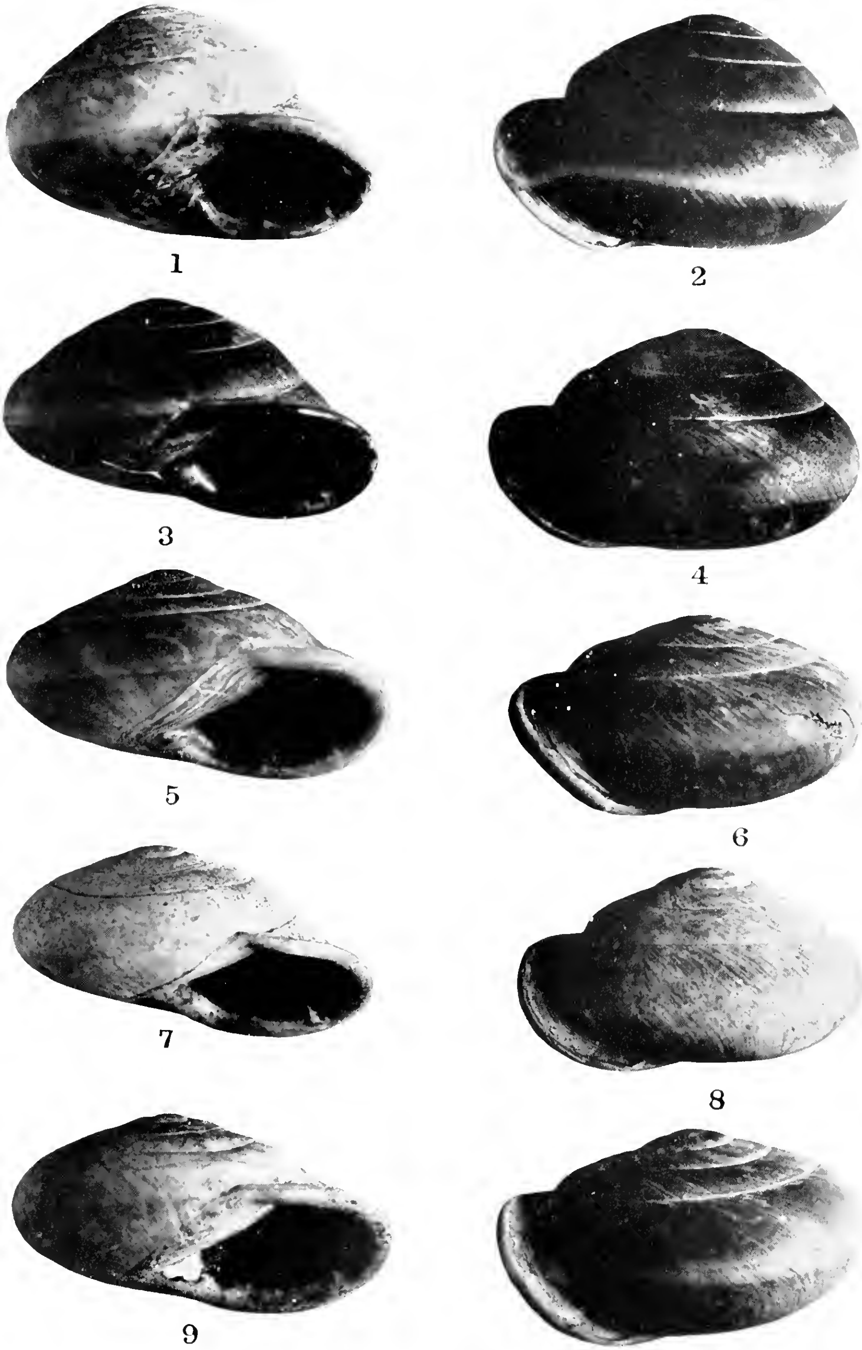
A. P. BROWN: JAMAICAN PLEURODONTS.



A. P. BROWN. JAMAICAN PLEURODONTS.

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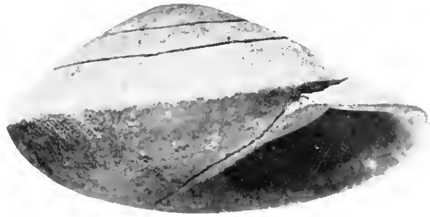

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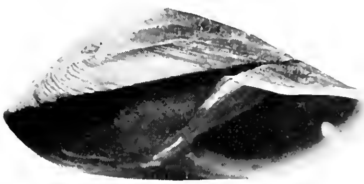

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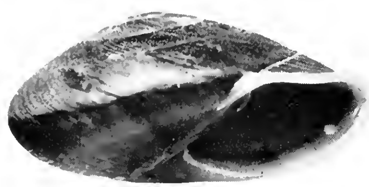

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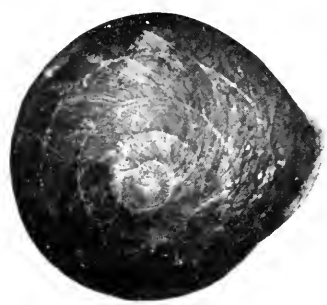

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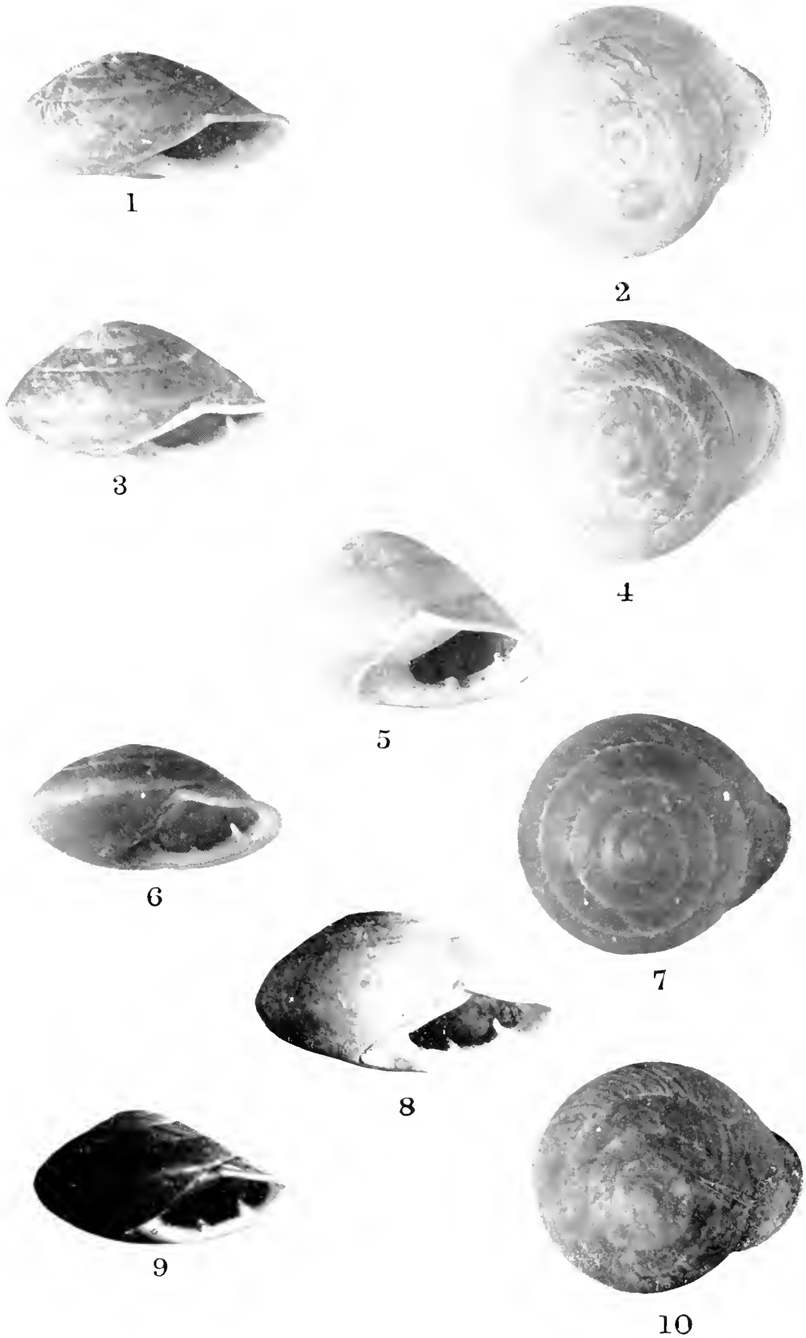
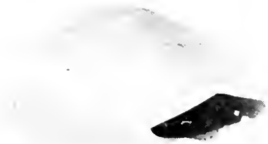
A. P. BROWN: JAMAICAN PLEURODONTS.



A. P. BROWN: JAMAICAN PLEURODONTS.



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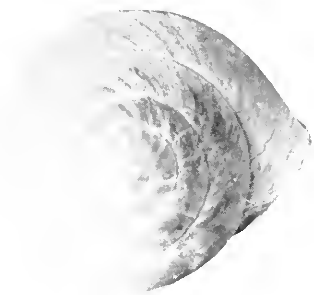

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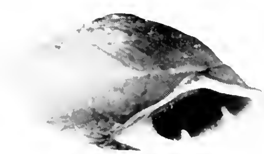

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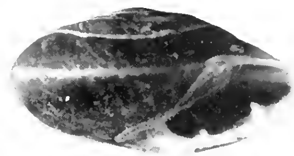

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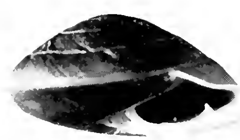

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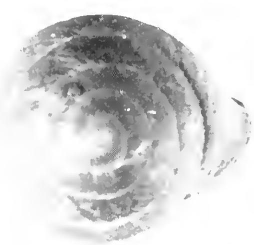

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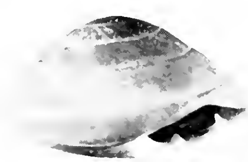

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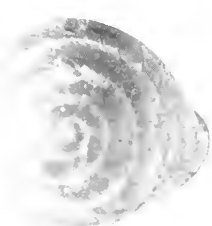

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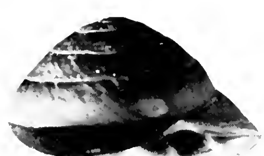

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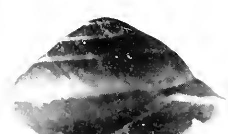

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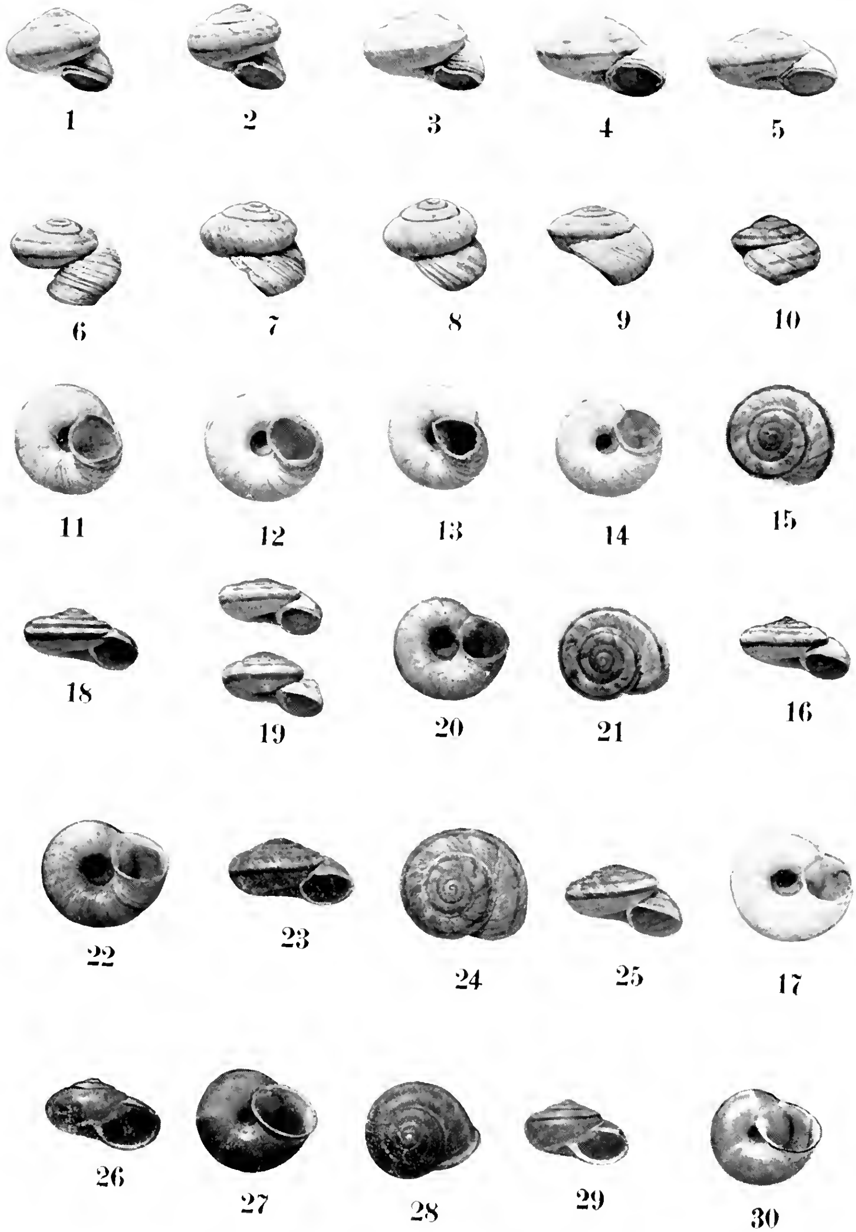
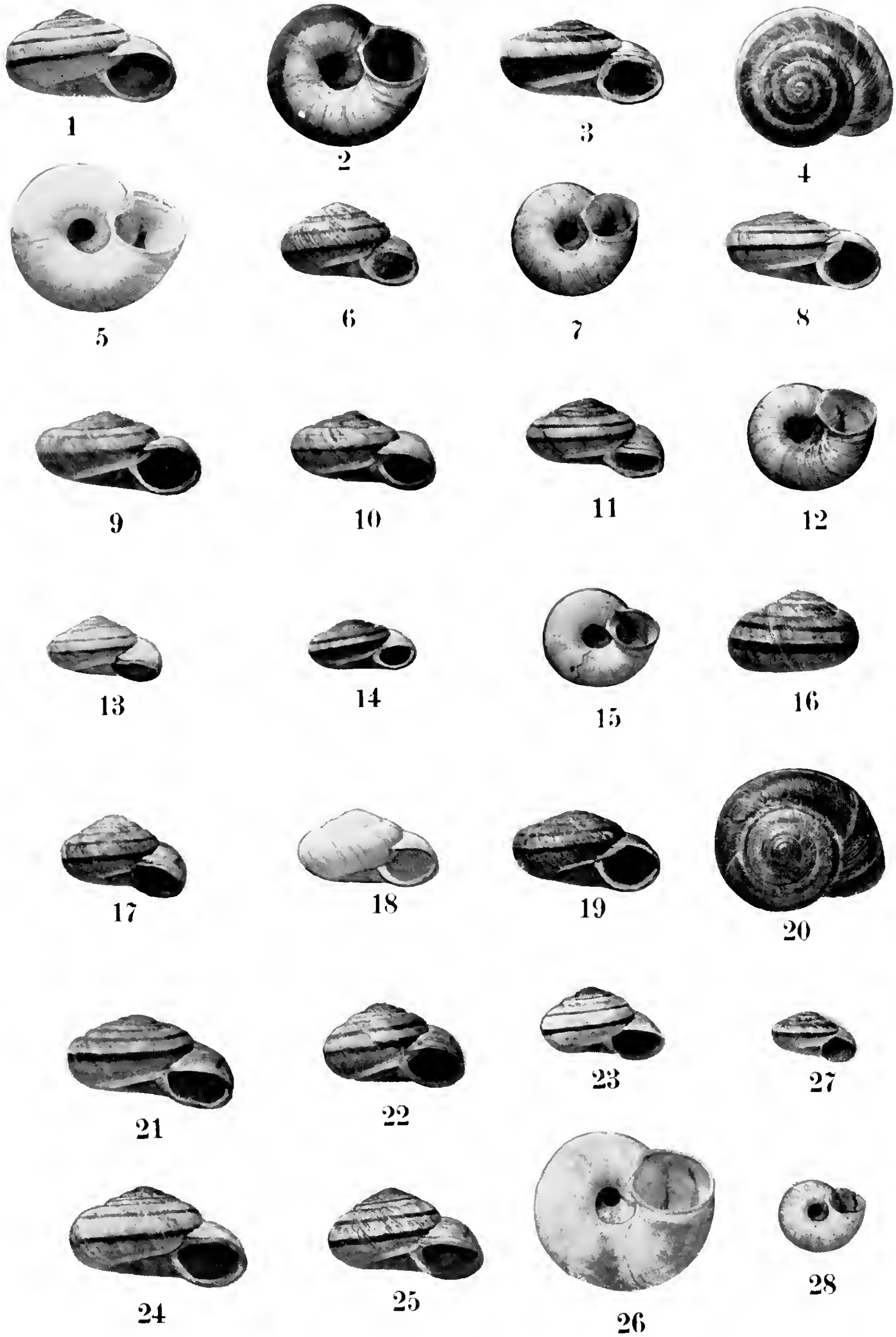
A. P. BROWN: JAMAICAN PLEURODONTS.



PILSBRY AND FERRISS: MOLLUSCA OF GRAND CANYON AND NORTHERN ARIZONA.



PILSBRY AND FERRISS: MOLLUSCA OF GRAND CANYON AND NORTHERN ARIZONA.

April 4.

Mr. Charles Morris in the Chair.

Twelve persons present.

The Publication Committee reported the reception of a paper under the title:

"Some Collections of Reptiles and Batrachians from the Western United States." By Witmer Stone (March 30).

The death of Charles H. Pennypacker, a member, April 3, 1911, was announced.

Prof. Edgar T. Wherry made a communication on the Eleventh International Geological Congress. (No abstract.)

April 18.

Mr. F. Lynwood Garrison in the Chair.

Thirty-six persons present.

The Publication Committee reported the reception of a paper entitled "Records and Descriptions of African Mantidæ and Phasmidæ (Orthoptera)." By James A. G. Rehn (April 10).

Spencer Trotter, M.D., made a communication on the men of the Barma Grande and certain other prehistoric Europeans. (No abstract.)

Henry Skinner, M.D., presented to the Academy, on behalf of Mrs. LeConte, an oil portrait of John L. LeConte, M.D., painted by L. G. Seybert.

George B. Wood, M.D., and David Gregg Metheny, M.D., were elected members.

The following were ordered to be printed:

THE POLYCHÆTOUS ANNELIDS DREDGED BY THE U. S. S. "ALBATROSS" OFF THE COAST OF SOUTHERN CALIFORNIA IN 1904: III. EUPHROSYNIDÆ TO GONIADIDÆ.

BY J. PERCY MOORE.

The present paper is in continuation of two parts already published under the same title and completes the Nereidiformia. Parts I and II were published in these Proceedings for June, 1909, and April, 1910, respectively. A fourth part dealing with the remaining Polychæta and completing the report is nearly ready for publication. The large number of species that it has been necessary to name and describe in this paper further illustrates the richness of the Polychæte fauna of California and particularly of Monterey Bay and emphasizes the incompleteness of our knowledge of the subject.

EUPHROSYNIDÆ.

Four species of *Euphrosyne*, two of which are previously undescribed, represent this family.

Euphrosyne bicirrata Moore.

Euphrosyne bicirrata Moore. Proc. Acad. Nat. Sci. Phila., 1905, pp. 532–534, Pl. XXXIV, figs. 8–12.

Two specimens of 7.5 and 15 mm. long, each having 26 segments. The setæ are remarkably long, the notopodials often exceeding the width of the body, and agree in character and distribution with the type. There are six or seven pairs of gills on each somite, each consisting of two filaments which are subequal on the larger specimen and mostly distinctly unequal on the other; rarely one or two smaller gills are added. The caruncle of the smaller specimen reaches to the anterior border of V. Median tentacle exceeds two-thirds the caruncle, the distal half being filamentous. Middle cirrus between second and third gills from dorsum.

Stations 4,339, off Point Loma Lighthouse, vicinity of San Diego, 241–369 fathoms, green mud; 4,549, Monterey Bay, off Point Pinos Lighthouse, 56–57 fathoms, coarse sand, shells and rock.

Euphrosyne hortensis Moore.

Euphrosyne hortensis Moore. Proc. Acad. Nat. Sci. Phila., 1905, pp. 534–536, Pl. XXXIV, figs. 13–16.

Two specimens of nine and ten millimeters long have 29 and 31 segments, respectively. The caruncle reaches the middle of VI. The branched and tufted gills form continuous rows of coarse filaments behind the palisades of setæ and occur in seven or eight pairs, of which the lowermost, occupying the interramal space, and the uppermost tend to split up. The middle cirrus is either opposite to the fourth or fifth gill or opposite the interval between them.

The setæ are somewhat more slender than on the original specimens, but agree with them in other respects. The dorsal ones project conspicuously above the gills and more or less cover the median dorsal area.

This species has much in common with *E. heterobranchia* Johnson, but lacks the smooth, cleft notopodial setæ of that species.

Stations 4,463, Monterey Bay, Point Pinos Lighthouse, 48–111 fathoms, rocky; 4,552, same locality, 66–73 fathoms, green mud and rocks.

Euphrosyne dumosa sp. nov. Pl. XV, figs. 12-17.

A stout but little depressed species with conspicuous gills and much of the aspect of an Arctian caterpillar. The type, having 34 segments, is 16 mm. long, with a maximum width, exclusive of the setæ, of 8 mm. and a maximum depth of about 4.8 mm., exclusive of the gills and setæ, and of 6 mm. including them. The cotype is 10 mm. long and 4 mm. wide with 32 segments.

Prostomial caruncle long and narrow, the tip of the crest reaching to or slightly beyond the furrow VI/VII, the base to the middle of VI only; base and crest well-differentiated and separated by deep longitudinal furrows; the crest smooth, not marked by distinct longitudinal grooves, continued forward by a low ridge to the furrow separating the palps. Eyes, two pairs; the dorsal immediately at the anterior end of the caruncle on each side of the median tentacle, conspicuous, black, round or slightly elongated; the ventral about one-half as large, very close together between bases of peristomial parapodia. Median tentacle situated at anterior end of caruncle, between dorsal eyes and composed of a short cylindrical ceratophore about as long as the basal width of the caruncle and a short style which is incomplete in both specimens. Paired tentacles minute papillæ immediately ventral to ventral eyes. Palps smooth, flattened, ovate pads, separated by a median fissure and continuous by their contracted anterior ends with the peristomial parapodia. A low facial ridge runs forward and downward to the fissure between the palpi. Mouth bounded by palps in front, somite IV at the sides and the furrowed lip of V behind.

Peristomium coalesced with prostomium and the anterior part of the latter largely concealed between its forwardly directed parapodia. Segments 32 to 34, strongly differentiated ventrally by deep furrows which are well-marked dorsally also, except in the median area where they become obsolete in a series of biconvex intersegmental areas. Median naked field about one-fifth total width of dorsum, the parapodial areas densely covered with rows of branchiæ and setæ and occupying the rest of the dorsum. Ventrally a slight neural groove runs from the posterior lip to the pygidium. Pygidium minute, situated between the last pair of posteriorly directed parapodia and bearing a pair of appressed vertical lamellar anal cirri with thickened borders.

Parapodia of the usual form, the notopodia sessile and dorsal; neuropodia lateral, slightly projecting, low lamellæ, overlapping the ventral end of the notopodia from behind. Cirri usually about equal to gills in length, but sometimes slightly longer or shorter, rather stout, gently tapered. Notocirrus usually the shortest of the three, reaching only slightly beyond the middle line and situated slightly mediad of the setæ palisade and a little anterior to the branchiæ. Middle cirrus in line with notocirrus and opposite interval between third and fourth or fourth and fifth gills from the dorsum. Neurocirrus similar, situated just within the postero-ventral margin of the neuropodial fascicle of setæ.

Branchiæ borne on all setigerous segments, usually ten (but sometimes nine or eleven) pairs on middle segments, the three ventralmost in the interramal area much crowded and often in actual contact or even with their stems partially coalesced. Each gill (Pl. XV, fig. 12) consists of a well-defined, stout stem bifurcated into a pair of nearly symmetrical trunks which divide dichotomously three or four times and end in rather slender, cylindroid, pointed filaments often half the total height of the gill. The angles of bifurcation are wide and the branching spreading in a plane so that the twigs of neighboring gills intercross. In the oral region the number of gills is somewhat reduced, and on somite I there are only six pairs with more or less coalesced bases and rather short filaments often thickened in the middle. The latter condition sometimes appears on other gills, but usually the filaments are extended and of regular diameter.

Notopodial setæ (Pl. XV, figs. 13–15) arranged in a long palisade of three rows running the entire length of the gill series. All are hollow, brittle, calcareous, translucent and white, or the granular contents of some of the larger ones slightly yellowish. All are relatively short and few project beyond the ends of the gills. Serrate bifid setæ are unusually numerous and appear not only to make up the anterior series completely, but to enter largely into the formation of the other rows, especially at the dorsal end. Their ends have the form shown in figures 15, 15*a*, both forks being gently curved, tapered and strongly serrated along the inner borders, the longer being about twice as long as the shorter and without a widened region. Such setæ appear to be absent from I, but are alike on other segments and are usually distinctly shorter than the gills. They seldom show any trace of internal annulation or cameration. Most of the setæ of the second and third rows are of the simple spurred form (Pl. XV, figs. 13, 14) with nearly straight, smooth tips, those of the second row being longer and stouter, many of them reaching beyond the gills, those of the third row shorter than the serrate setæ. At the extreme ventral end of the palisade is a small compact tuft of much shorter setæ with very short tips.

Neuropodial setæ (Pl. XV, figs. 16 and 17) arise in several rows from an elliptical area. Those in the dorsal part of the bundle are nearly twice as long as the neurocirrus, but ventrally they become shorter until the most ventral are scarcely one-third as long as the cirrus. They have the general form of the smooth notopodial cirri, but are rather more slender and have longer, more curved ends and longer spurs.

Except for a pair of dusky spots on each segment of the median dorsal field and some dusky suffusions elsewhere, both specimens are colorless.

Stations 4,410, off Santa Catalina Island, 178–195 fathoms, gray sand, gravel and rocks (type); 4,470, off Point Pinos Lighthouse, Monterey Bay, 61–69 fathoms, hard gray sand.

Euphrosyne limbata sp. nov. Pl. XV, figs. 7–11.

The single strongly curved specimen has a length of 17 mm., a maximum width of 7 mm., and a depth of 3 mm.; segments 36.

Prostomial caruncle short, beginning at posterior border of II and reaching barely beyond caudal border of IV; low, depressed rather than compressed, the base narrow and overlapped laterally by the spreading crest which reaches slightly beyond the base posteriorly also. Eyes two pairs, the dorsal black, somewhat elongated, slightly larger than the ventral, situated close together at the sides of the anterior end of the caruncle; ventral eyes smaller, nearly touching at median line, situated at ventral end of a low ridge which continues the caruncle forward and ventrad. Median tentacle situated as usual at anterior end of caruncle between dorsal eyes, consisting of a stout cylindrical ceratophore about one-third length of caruncle and a minute conical style about one-half as long as the ceratophore. Paired tentacles minute papillæ immediately ventro-lateral of the ventral eyes. Palps smaller than usual, irregularly ovate with narrower prolongations not continuous with the peristomial parapodia, but entering the cleft between them. Mouth bounded by rugous lips formed laterally by III and IV and posteriorly by IV and V.

Segments 36, all well defined, especially ventrally where they are superficially wrinkled. Neural furrow slight, median dorsal naked field slightly exceeding one-fifth of total width, the triangular intersegmental areas rather obscure. Caudal cirri short and thick, each folded longitudinally on itself so that the lamellar form is obscured.

Parapodia as in *E. dumosa*. Notocirrus arising just dorsad (mediad) and slightly caudad of the notopodial setæ, rather short, simple, tapered and reaching slightly beyond the middle line. Neurocirrus similar, arising just within ventro-posterior portion of setæ fascicle. Intermediate cirrus situated about three-fifths length of setæ palisade from its dorsal end or at least ventral to its middle, opposite interval between sixth and seventh or fifth and sixth gills from the dorsum and between the setæ palisade and series of gills.

Branchiæ (Pl. XV, figs. 7, 8), usually twelve pairs on each side of middle segments, but somewhat fewer toward the ends of the body. The nine dorsalmost form a straight row well behind the setæ and cirri, the three lowermost occupying the interramal space and usually separated from the others by a short interval. Each gill has a very short trunk soon divided into two, each of which is again divided dichotomously about four or five times to form thirty or more long terminal filaments. All parts of the gill are slender and the terminal twigs so numerous and long that they form a dense interlacing mass between the rows of setæ, the longest of which, however, rise well above and shelter them.

Setæ all colorless and transparent and of one type, none being serrate or strictly bifid. Notopodials (Pl. XV, fig. 9) erect in a narrow palisade of three irregular rows, those of anterior and posterior rows small and less than the gills in length; those of the middle row are fully twice as long and thick and rise conspicuously above the gills. All are alike hollow, calcareous and brittle, with rather long, slightly curved, smooth tips strongly annulated or camerated within and bearing a prominent, subterminal, divergent spur. Neuropodial setæ are of the same type and those in the ventral part of the bundle (Pl. XV, fig. 10) differ little except in length from the longer notopodial setæ. Dorsal neuropodials (Pl. XV, fig. 11), however, are much longer and more slender, with very acute, straight tips and, as stated above, project laterally as very prominent fringes.

No color remains.

The only specimen comes from station 4,420, off San Nicholas Island, 32–33 fathoms, fine gray sand.

This species is evidently closely related to *E. maculata* Horst from Timor, but lacks serrated, ringent dorsal setæ. Compared with *E. dumosa,* it appears remarkably broad and depressed, besides differing in many technical characters.

AMPHINOMIDÆ.

Chloeia pinnata sp. nov. Pl. XV, figs. 1–6.

A very pretty, small and slender species of a slightly depressed, fusiform shape, tapering most toward the caudal end. The type is 26 mm. long, 6.5 mm. wide at XI, where it is 5.5 mm. deep, and has a spread of setæ of 12 mm.; segments 26. Other specimens vary in length from 7 to 30 mm. and have from 17 to 28 segments.

Prostomium coalesced with peristomium, its broadly truncate anterior border produced laterally round the peristomial parapodia; ventrally it appears as a tumid elliptical pad divided by a median longitudinal cleft and reaching the mouth; dorsally somewhat T-shaped, the broad anterior end extending laterally, while posteriorly it is contracted between the parapodia of somites I and II. Caruncle arises from the prostomium and reaches to the anterior or occasionally to the posterior border of IV, but is entirely free from these segments, over which it passes like a flowing plume. Two longitudinal furrows divide it into a compressed crest with accordion-plaited sides and smaller basal ridge also divided by transverse furrows into twelve or thirteen deep crenulations, each marked, like the crest folds, with a small brown spot. Eyes two pairs, black, equally conspicuous, but the anterior slightly the larger, situated at sides of anterior end of caruncle, the anterior slightly in advance, the posterior slightly behind the anterior border. Median tentacle arising from a low, smooth elevation coalesced with anterior end of caruncle, the style moderately slender, tapered, smooth, suberect, about one-fourth longer than the caruncle, but fragile and seldom complete. Paired tentacles sessile, in contact between anterior eyes, similar in form to median tentacle and about one-half as long.

Peristomium and its parapodia completely coalesced with prostomium, not appearing as a distinct segment. Somite II well-differentiated, divided ventrally by the mouth and forming the rugous lateral lips. Mouth bounded behind by III which is united with IV to form the rugous posterior lip. Remaining segments few, large, distinct, strongly differentiated by deep furrows below and more shallow ones above; lateral borders deeply and coarsely serrated; entire ventral surface and median dorsal (interbranchial) field quite smooth. Segments increase in size to XI, then gradually decrease to the small bilobed pygidium which bears a pair of thick, truncate, cylindrical, appressed cirri about as long as the lateral tentacles.

Parapodia simple but rather prominent, lateral swellings producing the coarse lateral serrations, biramous, the notopodial and neuropodial tubercles widely separated and each bearing a large setigerous sac with elliptical orifice and an eversible rim, the notopodial orifice facing laterad and slightly dorsad and caudad, the neuropodial laterad and caudad. Toward the ends the parapodia become smaller and the setæ tufts gradually reduced; the anterior ones shift toward the dorsum, the first or peristomial foot being strictly dorsal; approaching the caudal end the setæ fascicles are directed more and more caudad.

Notocirri arise at the caudo-dorsal border of the notopodial tuft of setæ and reach to the base of the corresponding cirrus of the opposite side or on posterior segments beyond it. Cirrophores long, slender, terete, nearly as long as the segments to which they belong; styles flagelliform, three to three and one-half times as long as the cirriphores. Neurocirri arise within the lips of the setæ sacs on the ventral side of the neuropodial fascicle; they consist of short and obscure cirrophores and long, slender, fragile, flagelliform styles equalling the notocirri on middle segments, but diminishing in size posteriorly and also anterior to V. The first three parapodia have the cirri relatively short and stout, the notocirrus considerably shorter than the neurocirrus. They also possess a third much smaller cirrus situated immediately dorsal to the notocirrus and probably representing the gills; they are similar to the notocirri and that on the peristomium is longest.

Branchiæ begin on somite IV and continue, gradually diminishing in size, to the caudal end. They arise on the posterior border of the dorsum of their segments, separated by about one-third of the total width, and lie nearly flat on the dorsum, reaching caudad over the succeeding segment so that they are slightly imbricated. Form broadly suboval, lamellar, bipinnatifid; composed on middle segments of a tapered and somewhat sinuous axis bearing alternately on each side about eight simply pinnate branches diminishing in size and complexity distally, where the series is completed by two or three simple pinnæ. Toward the ends of the body they become smaller, with a diminished number of pinnæ.

Proboscis protruded on many specimens to varying degrees and presenting very different aspects. On the type it is a short truncate cylinder 3.5 mm. in diameter and equally long, divided by three furrows into as many zones: first, a soft, somewhat inflated basal zone which, because of the incompleteness of the furrows in a narrow medial dorsal region, here encroaches on the other rings to the end of the proboscis; second, a narrower, firm and muscular middle ring and, third, a still shorter terminal muscular disk of a deep brown color with a central rugous area and a slight vertical furrow dividing it to the margins. On other specimens the basal annulus is much larger and more inflated, the terminal disk is sometimes folded together along the vertical furrow in partial retraction, and sometimes in complete extension has the rugous area protruded as a prominent rounded mass turned toward the dorsum to conceal the mouth from below and marked by a slight median furrow and numerous, slightly sinuous, transverse raised lines. Still other specimens have this distal region much more extended to a length exceeding all the rest of the proboscis, and bearing the large orifice at the end of the flat, smooth and soft dorsal part, the deep spoon-shaped or ventricose sides and venter being completely formed by the rugous area.

Setæ all nearly or quite colorless, tubular, with soft, granular contents, very brittle. When massed the setæ are sometimes distinctly yellow and those of some of the younger specimens exhibit a beautiful satiny luster. Notopodials in somewhat whorled, suberect tufts, becoming longer and more recumbent toward the caudal end. They are rather stout, slightly curved and tapered to rather blunt points, below which, at a varying distance, is a spur, conspicuous on the more ventral setæ (Pl. XV, fig. 1) which are truly bifid, nearly obsolete on dorsal setæ (Pl. XV, fig. 3). Most notosetæ of middle segments are smooth or nearly so, but some (fig. 2) exhibit slight serrations, and this may be the normal state of unworn setæ. Posteriorly the setæ become longer and usually lack the spur; anteriorly contrary changes occur. Neuropodial setæ much more numerous, slender and elongated, forming very dense tufts which spread laterad, but posteriorly more caudad. Posterior setæ are more elongated and truly capillary, but on some examples they exceed the body width, even on the middle parapodia. They are of the same type as the notopodials, but the spur is close to the tip and small or obsolete (Pl. XV, figs. 4, 5). Toward the ends of the body modifications similar to those affecting the notosetæ occur (Pl. XV, fig. 6).

Color. Probably richly colored in life, but most of the preserved specimens are faded and colorless except for a wedge-shaped brown or purple spot in front of the lateral tentacles, a rich madder purple coloration of the notocirri and a brown spot at the end of each anal cirrus; others show traces of a more extensive purple coloration, especially on posterior segments. The under parts, including the neurocirri, are always colorless, as are the tentacles and one to three or four pairs of the anterior notocirri. Not infrequently also, the color is lost more or less completely from the styles of IV, V and VI, but the cirrophores always retain the deep purple color. A specimen from station 4,416 is of a fine rosy color above with a median series of white oval spots. Several specimens from station 4,454 have the notocirri brown and the ventral surface, proboscis and rarely portions of the dorsal surface spotted with sharply defined, quadrate, brown spots. Sometimes only three or four occur on the entire ventral surface, in which case some are likely to occur on the dorsum; sometimes they are much more numerous and in places crowded or even coalesced and rarely the spots are X-shaped.

Chlocia pinnata is one of the most abundantly represented and generally distributed species included in this collection. There are in all nearly three hundred specimens, about half of which came from stations 4,460, 4,475 and 4,552 and about twenty each from stations 4,349, 4,480 and 4,485, all of these being muddy bottoms. No less than ninety-seven were taken at station 4,475, from among which the type was selected.

The full list is as follows: Stations 4,309, Point Loma Lighthouse, vicinity of San Diego, 67–78 fathoms, fine sand, shells and rock; 4,310, same locality, 71–75 fathoms, fine sand and green mud; 4,322, off Point La Jolla, vicinity of San Diego, 110–199 fathoms, green mud and shells; 4,332, off Point Loma Lighthouse, 62–183 fathoms, gray and black sand with rocks; 4,339, same locality, 168–254 fathoms, green mud, fine sand and rock; 4,349, same locality, 75–134 fathoms, green mud and fine sand; 4,364, same locality, 101–129 fathoms, gray sand, mud and rock; 4,365, same locality, 130–158 fathoms, green mud; 4,366, same locality and bottom, 176–181 fathoms; 4,416, off Santa Barbara Island, 323–448 fathoms, dark green mud and rock; 4,418, same locality, 238–310 fathoms, dark mud, sand and rock; 4,420, off San Nicolas Island, 32–33 fathoms, fine gray sand; 4,423, same locality, 216–339 fathoms, gray sand with black pebbles and shells; 4,454, Monterey Bay, Point Pinos Lighthouse, 65–71 fathoms, green mud, sand and gravel; 4,460, same locality, 55–167 fathoms, green mud and gravel; 4,464, same locality, 36–51 fathoms, soft dark gray mud; 4,475, same locality, 85–142 fathoms, soft green mud; 4,480, Monterey Bay, off Santa Cruz Lighthouse, 53–76 fathoms, dark green mud and sand; 4,485, same locality, 39–108 fathoms, soft green mud and sand; 4,510, Monterey Bay, off Point Pinos Lighthouse, 91–184 fathoms, gray mud; 4,522, same locality, 130–149 fathoms, gray sand and shells; 4,523, same locality, 75–108 fathoms, soft dark mud; 4,552, same locality, 66–73 fathoms, green mud and rocks; 4,553, same locality, 65–74 fathoms, rock.

NEPHTHYDIDÆ.

Nephthys cæca (Fabricius) Oersted.

Nephthys cæca, Ehlers, Die Borstenwürmer, 1869, pp. 588–617, Taf. XXIII, figs. 10–34; Wiren, Vega Expeditionens, II, pp. 392–397, Taf. 30 and 31.

After puzzling a long time over the many specimens of *Nepthhys* in this collection, I have been unable to come to any satisfactory conclusion regarding the number of species actually represented, and have, therefore, tentatively begged the question and followed Wiren in listing all of the forms represented under the above name. As a matter of fact, scarcely a single specimen can be confidently said to be typical *N. cæca*, though a number differ from it only intangibly. Most of them, in having the neuropodial postsetal lip much larger than the corresponding part of the notopodium, resemble *N. hombergi* Aud. and M. E. (= *N. assimilis* Oersted, Malmgren). Here belong especially those from stations 4,443, 4,462, 4,482, 4,485, 4,510, 4,523 and 4,548, all in Monterey Bay. One lot (station 4,436), in the almost total absence of parapodial lamellæ, approaches very closely *N. ciliata* (Müller) Rathke and has the rami widely separated as in *N. incisa* Malmgren but all of them have more segments than the latter. Specimens from stations 4,306 and 4,549 also approach this type, but the lamellæ are better developed. Two small specimens (station 4,482) have the long setæ and long involute gills of *N. malmgreni* Theel (= *N. longisetosa* Malmgren *non* Oersted). Examples from many of the other stations present intermediate characters, and it is for this reason that I do not here separate the forms as I have done previously, though I am by no means convinced that more than one species may not be represented.

The specimens vary in size from little more than 1 mm. wide to 8 and 9 mm. wide, the largest invariably incomplete. Many of the smaller ones show a conspicuous color pattern in the form of an irregular brown or dusky spot on the prostomium and bars of the same color across many of the anterior segments.

Stations 4,306, off Point Loma Lighthouse, vicinity of San Diego, 207–497 fathoms, green mud, fine sand and gravel; 4,310, same locality, 71–75 fathoms, green mud and fine sand; 4,349, same locality, 81–134 fathoms, green mud and fine sand; 4,364, same locality, 101–129 fathoms, gray sand, mud and rock; 4,431, off Santa Rosa Island, 38–45 fathoms, varied bottom; 4,436 off San Miguel Island, 264–271 fathoms, green mud; 4,443, off Point Pinos Lighthouse, Monterey Bay, 32–37 fathoms, fine gray sand; 4,462, same locality, 161–265 fathoms, green mud; 4,464, same locality, 36–51 fathoms, soft dark gray mud; 4,475, same locality, 58–85 fathoms, soft green mud; 4,480, off Santa Cruz Lighthouse, 53–76 fathoms, dark green mud, sand; 4,482, same locality, 43–44 fathoms, soft green mud; 4,485, same locality, 39–108 fathoms, soft green mud, sand; 4,510, off Point Pinos Lighthouse, 91–156 fathoms, gray mud; 4,522, same locality, 130–149 fathoms, gray sand and shells; 4,523, same locality, 75–108 fathoms, soft dark mud; 4,526, same locality, 204–239 fathoms, soft gray mud; 4,538, same locality, 795–871 fathoms, hard gray sand; 4,548, same locality, 46–54 fathoms, coarse sand, shells and rock; 4,549, same locality and bottom, 56–57 fathoms.

NEREIDÆ.

The Nereidæ are represented less richly than in similar collections along the more northern shores of the Pacific side of North America. The absence of any of the large species of *Alitta* is especially noteworthy.

Nereis procera Ehlers. Pl. XV, fig. 18.

> *Nereis procera* Ehlers, Die Borstenwürmer, 1868, pp. 557–559; Taf. XXIII, fig. 2.

Represented by a number of small specimens, 21 to 45 mm. long, in the atokous phase and all sexually immature, which agree closely with Ehlers' description and also with larger mature examples already reported in these Proceedings for 1909 from the littoral zone at San Diego and Monterey Bay. The jaws and paragnaths conform generally to Ehlers' description, but group V may be absent or represented by either one or two paragnaths and the band VII–VIII varies much in width. The number of segments varies from 60 to 75.

The setæ, studied on one specimen, are disposed as follows: On anterior parapodia the notopodium bears six or eight homogomphs with slender "fish-bone" appendages, the neuropodial supra-acicular fascicle contains four or five similar homogomphs and usually two stout heterogomphs with short, scarcely falcate appendages, and the neuropodial subacicular fascicle two or three homogomphs and five or six heterogomphs like the above, together with a few heterogomphs with longer appendages. On middle segments the number of homogomphs increases, but the heterogomphs become stouter and fewer. By about XXXIX the slender notopodials are replaced by two stout homogomphs with short, stout, fusiform, nearly buried appendages. A specimen from station 4,425 has the parapodia longer with more pointed lingulæ than usual and the characteristic notopodial setæ apparently wanting, but in all other respects, including the paragnaths, is typical.

Several from station 4,496 have the color pattern well-preserved. The anterior end is ashy, marked with brown spots and streaks gradually fading out and disappearing at about XVIII, beyond which the cuticle exhibits a conspicuous iridescence on a pigmentless integument. A large triangular spot (formed of a central and two lateral lines) occupies nearly the entire dorsum of the prostomium with its base resting on the eyes. The segments are marked by a central transverse dash, a pair of paramedian dashes near the anterior end, a similar pair near the posterior end, and a pair of lateral spots. On the first few segments the anterior and posterior pairs of spots tend to unite into two lines.

Of greater interest are five male specimens in the epitokous phase, hitherto unknown, taken at station 4,355. All are small, varying from 17 mm. and 54 segments to 28 mm. and 67 segments. In the latter the anterior region is 10.6 mm. long. In all cases the anterior region has 14 setigerous segments besides the apodous peristomium.

Prostomium of the general form seen in the atokous phase, but rather shorter and more broadly rounded anteriorly and strongly bent ventrad so that the anterior eyes lie rather more than half beneath the posterior. Eyes of each side coalesced, but not especially enlarged, each being little more than one-fourth the prostomial width. Both have large lenses, the ventral looking ventrad and laterad, the dorsal dorsad and laterad. Tentacles about three-fourths as long as prostomium, but ventrad and regularly tapered. Palps directed ventrad, short, scarcely more than one-half length of prostomium, basal segment stout, distal minute.

Peristomium obscurely biannulate with a narrow, feebly separated anterior ring. Tentacular cirri all short, rather distinctly but irregularly articulated; posterior dorsal reaches to V, anterior dorsal to beyond middle of III, and the two very short ventral cirri scarcely beyond the anterior border of II. On the largest specimen, which has the anterior segments more extended, the cirri are relatively shorter.

Pygidium minute, top-shaped, bearing a pair of rudimentary parapodia, two pairs of short ventral subanal cirri and a whorl of slender papillæ.

Parapodia of anterior region similar in general characters and setæ to atokous type of corresponding segments. Notopodia of first seven with basal half much enlarged, the distal portion remaining filiform, but not strongly bent. Neurocirri of first five setigerous segments also thickened at the base. All remaining parapodia are modified to the natatorial type, there being no caudal region, but the serrated notocirri continue to about XLV only, behind which they are smooth. The form of the complex lamellæ and lingulæ is best understood by reference to figure 18 (Pl. XV). All setæ are of the usual natatorial type and none of the peculiar setæ so characteristic of the middle notopodia of atokous individuals are present.

One specimen has the proboscis protruded and exhibits the paragnaths and jaws in characteristic arrangement.

Stations 4,355, San Diego Harbor, surface; 4,405, off San Clemente Island, 654–704 fathoms, green mud; 4,415, off Santa Barbara Island, 302–638 fathoms, green mud; 4,417, off Santa Barbara Island, 29 fathoms, fine yellow sand and rock; 4,420, off San Nicolas Island, 32–33 fathoms, fine gray sand; 4,421, same locality, 229–298 fathoms, gray mud and rock; 4,425, same locality, 1,100–1,084 fathoms, green mud, fine sand and Globigerina; 4,427, off Santa Cruz Island, 447–510 fathoms, black mud and rock; 4,431, off Santa Rosa Island, 38–41 fathoms, varied bottom; 4,496, off Santa Cruz Lighthouse, Monterey Bay, 10 fathoms, fine gray sand and rock; 4,531, off Point Pinos Lighthouse, 26–28 fathoms, fine gray sand, rock.

Nereis paucidentata Moore.

Nereis paucidentata Moore. Proc. Acad. Nat. Sci. Phila., 1903, pp. 430, 431, Pl. XXIV, figs. 28–30.

A single small imperfect specimen from station 4,397, Lat. 33° 10′ 15″ N. Long. 121° 42′ 15″ W., 2,196 fathoms, gray mud. This is the first record of this species south of the Gulf of Georgia and the bathymetrical range is even more extended from 270 fathoms. The species is not uncommon in Alaskan waters.

Nereis cyclurus Harrington.

Nereis cyclurus Harrington, Trans. N. Y. Acad. Sci., XVI, 1897, p. 214.

Two fine specimens showing faintly the annular bands of color. "Commensal in Natica shell with hermit crab."

Station 4,560, off Santa Cruz Lighthouse, Monterey Bay, 10–12 fathoms, fine gray sand and rock.

Platynereis agassizi (Ehlers). Pl. XV, fig. 19.

Nereis agassizi Ehlers, Die Borstenwürmer, 1868, pp. 542–546, Taf. XXIII, fig. 1.

Besides several atokous individuals, two of which (station 4,559) contain eggs, a large number of sexually mature epitokous examples were taken at station 4,355 by means of a surface electric light and dip-nets. Of the latter 83 were males and only 5 females. As the latter have never been described, a brief description is here added.

In general appearance they agree closely with the males, but average somewhat larger, from 21 to 33 mm. long. The two regions of the body of the two extremes measure, respectively, 5 and 16 mm. and 11 and 22 mm. long, and the segments number from 93 (28 + 65) to 131 (28 + 103), the anterior region of the female comprising, therefore, seven more segments than that of the male, which has 21. One female has only 27.

The color is generally pale and faded, but shows indications of transverse brown lines and posteriorly more distinct transverse rows of spots. Some of the specimens exhibit the same yellow color anteriorly as shown by the males, but usually much paler.

Prostomium almost exactly as in the males, the eyes, coalesced on each side, scarcely perceptibly smaller, the palps and tentacles turned almost as markedly ventrad. Peristomial cirri, so far as preserved, have the same proportions as in the males and, also, as in the males, are easily detached, so that many of them are wanting. One specimen, however, in which all are present, has two dorsal cirri nearly equal, both reaching XV, and the anterior ventral reaching to VI. There is a very short caudal region of ten or twelve segments with few or no swimming setæ and a short, tapering, tubular pygidium often constricted into two rings, quite different from that of the male in that it bears four cirriform papillæ in place of the whorl existing in the latter.

The first five (on the smallest specimen four) notocirri only are thickened and the slender distal end much less abruptly hooked than on the males. First four neuropodia similar to those of the males. Parapodia and setæ of anterior region also as in the males. Posterior parapodia differ from those of the males chiefly in the total absence from both notocirri and neurocirri of the sense organs which cause them to appear serrated, the cirri in the females being therefore quite smooth, simple and tapered.

Most of the specimens have shed the greater part of their eggs, but one remains filled with them as far forward as the tenth setigerous somite, inclusive, and a few have escaped into more anterior somites.

They crowd the basal part of the parapodia as well as the cœlom. The character of the mature eggs is shown in figure 19, Pl. XV.

Stations 4,346, off Point Loma Lighthouse, 46–50 fathoms, dark green mud and fine sand; 4,347, same locality, 55–58 fathoms, fine gray sand (both epitoke and atoke); 4,355, San Diego Harbor, surface (many epitokes); 4,420, off San Nicolas Island, 32–33 fathoms, fine gray sand; 4,422, same locality, 31–32 fathoms, gray sand and shells; 4,559, off Point Pinos Lighthouse, Monterey Bay, 8–22 fathoms, fine gray sand.

EUNICIDÆ.

Eunice (Eriphyle) paloloides Moore.

Eunice (Eriphyle) paloloides Moore, Proc. Acad. Nat. Sci. Phila., 1909, pp 246–249, Pl. VII, figs. 5–7.

A much broken and macerated female specimen containing a few eggs in the posterior region. The sexual region begins at about segment CLXXXV. The tentacles and branchiæ are somewhat shorter than those of the type, but this probably results from the macerated condition of the specimen. In all other features studied it agrees with the type.

Station 4,420, off San Nicolas Island, 32–33 fathoms, fine gray sand.

Eunice multipectinata sp. nov. Pl. XV, figs. 20–23.

A fine, robust species which reaches a considerable size. The type is 205 mm. long with a maximum width of body of 7.5 mm. and between the setæ tips of 13 mm. Number of segments 181. Other complete specimens vary from 47 mm. long, 2 mm. wide, with 87 segments to 203 mm. long and 9 mm. wide. One 195 mm. long and 7 mm. wide has 177 segments. Incomplete specimens range all the way from 1 mm. to 11 mm. in width.

Prostomium in all except the smallest specimens retracted and deeply sunken into the peristomial collar to the tentacles; deeply incised and bilobed anteriorly to form the somewhat divergent, short, thick, bluntly rounded palps, slightly divided by a shallow transverse groove into a larger ventral and a smaller dorsal segment. Tentacles in a crowded transverse row, each with a small indistinct ceratophore; the styles more or less strongly and irregularly annulated or distinctly articulated; on the smaller specimens the median has about seven articulations and reaches to VII, the inner paired have but five articulations and reach to IV or V and the outer paired four articulations and reach III. Large specimens have shorter tentacles which have evidently worn away at the tips. Eyes always large and conspicuous, situated immediately behind the outer paired tentacles.

Peristomium very large, fully as long as the three succeeding segments and forming a prominent collar, into which the prostomium is retracted, most deeply in the larger specimens; on each side a shallow notch, below which it is produced forward more prominently to form a slightly crenulated lower lip with concave border. Somite II also apodous, not exceeding one-third length of peristomium with which it is coalesced at the sides. Nuchal cirri similar to cephalic tentacles but more slender, reaching to or nearly to the cephalic border of the prostomium. Metastomial podous segments well-defined, very regular, simple, 10–14 times as wide as long anteriorly, not over 8 times as wide as long posteriorly, strongly arched above, flattened, with neural furrow below. They increase in width gradually to about XL, then taper gently caudad.

Pygidium a short ring with a slight marginal thickening and bearing a pair of slender, little-tapered, stiff and smooth cirri as long as the last six segments and arising close together below the large anus. Immediately below and concealed by these is a second pair of minute and inconspicuous cirri.

Parapodia (Pl. XV, fig. 20) of simple form and exhibiting the changes in position and proportions usual in the genus. Notocirri four or five, or posteriorly (where the parapodia become shortened) even more, times as long as the neuropodia, slightly tapered and smooth or very slightly wrinkled, becoming much more slender posteriorly. Neurocirri prominent anteriorly, with thick, swollen, ovate bases and short, thick, cylindroid styles. Farther back the basal part is gradually reduced and finally becomes minute and the style becomes first short and conical and then slender and tapered, but always considerably exceeds the neuropodium in length.

Acicula all very dark brown and opake except that the tips are often pale; the neuropodial three or anteriorly sometimes two, projecting from the acicular tubercle at the dorsal level of the fascicle of simple setæ. They are simple, tapering rods with rather acute points on anterior parapodia and blunt, often bent or somewhat knobbed ends on posterior parapodia where they become very stout. Notopodial acicula a fascicle of slender brown fibers passing into the base of the notocirrus in connection with a heavy mass of brown pigment.

With the exception of the stout crochets which are brown, the setæ are colorless or pale yellow. Three kinds occur on all segments. Simple, slender, wingless capillary setæ form a small dorsal tuft in connection with the acicula. Among the bases of the capillary setæ are delicate pectinate setæ with slightly curved ends provided with a few indistinct teeth and a marginal mucron (Pl. XV, fig. 22). Most numerous are the compound setæ (fig. 21) which are arranged in about six rows, are pale yellow, with curved and distally thickened shafts and short, strongly hooked, and bidentate appendages with a delicate guard finely denticulated on the margin. The last become larger caudad. Beginning at about XXVII two (sometimes one) stout crochets appear projecting prominently obliquely from the neuropodium ventral to the compound setæ; they are slightly curved, with stout principal tooth and smaller more distal accessory tooth and provided with a split guard (fig. 23).

Branchiæ strictly unilateral pectinate throughout (Pl. XV, fig. 20), consisting of a tapered main stem arising from the base of the neuro-cirrus on its dorsal side and curving gently up the sides of the body, but remaining erect, leaving the dorsum uncovered; filaments arising nearly at right angles to the stem in a close rank and lying nearly parallel, slender, the longest not exceeding two-thirds the length of the notocirrus and the main trunk, exclusive of the terminal filament into which it is prolonged, not much greater. On the type the gills begin on somite IX with seven filaments, attain the maximum of twelve filaments and retain this number, with occasionally one or two more for a great many segments, then undergo gradual reduction posteriorly, the gill on the fourth preanal segment still being trifid.

With few exceptions the gills of all specimens begin on IX, the only departures being three specimens, on two of which the first on one side occurs on VIII and on another on X. The number of filaments varies greatly, increasing with the size of the specimen. The smallest example (1 mm. wide) has the first gill simple and most of the others bifid. A complete specimen, 47 mm. long and 2 mm. wide with 87 segments, bears gills on all podous segments beginning with IX, the first and the last two consisting of a single filament each and the maximum number of filaments being three. One 140 mm. long and 4 mm. wide lacks gills on the last four segments, the maximum number of filaments is seven and most of the gills caudad of the middle of the body are trifid. Another, 195 mm. long and 7 mm. wide, with 177 segments, has trifid gills on IX of one side, X of the other and attains a maximum of twelve or thirteen filaments, with the last three segments abranchiate. The largest complete specimen is 203 mm. long and 9 mm. wide and bears a small gill of two filaments on one side of VIII, the maximum number of filaments being fourteen and the last gill on the fourth preanal segment. Bifid filaments occur frequently.

Jaws (described from a cotype, station 4,431) hard and firm. Mandibles with stout, divergent, nearly black stems joined only slightly by an anterior isthmus; masticatory plates hard, white, oval, with smooth, entire anterior border. Maxillæ black or nearly so. Carriers of forceps-jaws nearly as wide as long, broadly rounded behind; the forceps of the usual falcate form; II very large and stout with five large teeth and one small one on each side; III on the right side is a long narrow piece with eleven teeth diminishing in size from before backward and is paired with two pieces on the left side with four and eight teeth, respectively; IV bears a single prominent tooth on each side; V is a small toothless plate. Two other specimens dissected agree in all essentials, the teeth being generally tipped with white and the border of the mandible in one case tridentate.

Color of the full-grown specimens pearl or gray with a beautiful and delicate iridescence. Two of the larger specimens have the dorsum finely mottled with brown. The smallest examples are moie distinctively colored: one is pale brown above with an obscure white zone on IV and V; another (the smallest) has the first three segments almost solidly orange-brown, IV and V pure opalescent white and several succeeding segments annulated with brown and white.

Stations 4,312, off Point Loma Lighthouse, vicinity of San Diego, 95–135 fathoms, fine gray sand and rock; 4,373, same locality, 95–225 fathoms, green mud, sand and rock; 4,377 (Type), same locality, 127–299 fathoms, green mud and sand; 4,420, off San Nicolas Island, 32–33 fathoms, fine gray sand; 4,431, off Santa Rosa Island, 38–41 fathoms, varied bottom; 4,463, off Point Pinos Lighthouse, 285–357 fathoms, green mud; 4,532, same locality, 30 fathoms, gray sand and rock.

This species is related to *E. bilobata* Treadwell, but is readily distinguished by several characters, especially by the notably smaller number of gill filaments. The type of *E. bilobata* is 5.5 mm. wide and the first gill (on IX) has nine filaments, the maximum reaching eighteen. A specimen of *E. multipectinata* of the same size has only two filaments on the first gill and a maximum of seven filaments.

Other species having pectinate gills for the entire length which have been reported from the Pacific Ocean are *E. antennata* Savigny, *E. microprion* v. Marenzeller and *E. flavo-fasciata* Grube. All of these have the gills beginning farther forward and diffei in other respects also.

Eunice hawaiensis Treadwell?

Eunice hawaiensis Treadwell, Bull. U. S. Fish Comm., XXIII (1906), Pl. III, pp. 1166, 1167, figs. 42–44.

The solitary incomplete example referred to here, while differing considerably from Treadwell's description, is certainly very closely related to, if not identical with, *E. hawaiensis*. It consists of 122 anterior segments having a length of 76 mm. and a width without parapodia of 5.5 mm. and with them, but excluding setæ, of 8.5 mm.

The prostomium with its tentacles, the parapodia, setæ (of which, however, Treadwell's figure does not show a full profile view), and maxillæ are practically identical with those of *E. hawaiensis*. The branchiæ, however, are fewer and much less complex than those of the type. They have the following distribution and number of filaments on the right side, the left being almost identical: 1 filament somite V, 2 filaments somite VIII, 5 on IX, 9 on X, 13 on XII, 15 on XV, 19 on XX, 15 on XXVI, 16 on XXXV, 8 on XL, 5 on XLII, 2 on XLIII and 1 on XLIV. Where best developed, from XV to XXX, the gills are very large with numerous long, parallel filaments equalling about one-third the body width. Although closely resembling the gills of *E. hawaiensis*, the stems are always gently curved, never abruptly bent. The first three consist of the main trunks only. The type of *E. hawaiensis* is larger, measuring 7 mm. in body width and has the gills beginning on IV with three filaments and continuing to beyond L, and when best developed possessing as many as thirty filaments. This is a greater difference than one would expect in two individuals of the same species differing no more in size than do these.

The hard, white masticatory plates of the mandibles, in addition to the large lateral tooth, bear three small teeth near the median line.

Eunice congesta v. Marenzeller may be mentioned as another closely related Pacific species.

Station 4,537, off Point Pinos Lighthouse, Monterey Bay, 1,062 fathoms, hard sand and mud.

Marphysa conferta sp. nov. Pl. XVI, figs. 29–34.

Known from a single specimen 24 mm. long and 1.9 mm. wide betwin tips of parapodia with 57 segments and a regeneration cone of about a dozen indistinct segments.

Prostomium (Pl. XVI, fig. 29) large, nearly as wide as the peristomium, suborbicular but bent downward so that in dorsal view it is foreshortened and appears much wider than long, depressed, with an anterior notch that is the termination of a ventral groove that slightly divides it into somewhat swollen rounded halves. Eyes one pair, large, conspicuous, brown, situated close to the posterior border immediately behind the lateral tentacles. Tentacles five, arising along a slightly curved transverse line near the posterior end of the prostomium, but passing in front of the eyes laterally. All slightly fusiform, tapered to distal end and transversely wrinkled or subarticulated, the median about one and one-third times the length of the prostomium, the others successively somewhat shorter.

Peristomium a simple, regularly cylindrical, smooth, apodous ring with a slight median ventral notch on the lip and no trace of nuchal cirri. Somite II scarcely more than one-half as long as I, but otherwise similar. The remainder of the body is terete, of nearly uniform diameter except that the posterior portion is somewhat enlarged and distended with ova. The segments become shorter to the branchial region, where they are about four and one-half times as wide as long; posterior to this the length again increases until at the posterior end they are only twice as wide as long. With the fourth (Pl. XVI, fig. 29) a small ring separates at the anterior end of each segment and increases until in the post-branchial region it forms a regular propodal annulus. Pygidium at the end of the regeneration cone a short tube bearing one cirrus about equal to one-fourth the body width and another half as long as the first.

Parapodia (Pl. XVI, figs. 30, 31) strictly lateral and in the probranchial and branchial regions prominent and outstanding, becoming smaller in the postbranchial region, strictly uniramous, there being no trace of a notopodium. Anterior parapodia consist of a low, rounded, slightly compressed setigerous tubercle, behind which is a compressed postsetal lip at the base as deep as the setigerous lobe, while its bluntly ending dorsal part is prolonged to about twice the length of the base. The notocirrus arises just above the foot and is about twice its length, somewhat enlarged at the base, slender and tapering distally and marked with obscure annular furrows. The neurocirrus has a thick, swollen base broadly attached to the ventral face of the neuropodium and bearing a small papilliform distal piece which is bent more or less ventrad. Posterior to the branchial region the parapodia and all of their parts become gradually smaller. The neuropodia become low, compressed cones (fig. 31), the apex of which is formed by the acicular process, while the postsetal lip becomes low and inconspicuous. The basal part of the neurocirri is much reduced, leaving only the short, bluntly rounded cirrus which reaches to the end of the acicular process. The notocirrus while undergoing reduction in size retains its characteristic form and proportions, having a basal enlargement and a slender style about three times as long as the foot.

Neuropodial acicula two or three simple, straight, tapered rods with the ends pale and the middle brown or black. Posteriorly there is only one of these, the distal end of which projects freely. No notopodial acicula.

Branchiæ (Pl. XVI, fig. 30) remarkable for their large size and restriction to nine segments (X–XVIII inclusive). The first on X has five fully developed filaments and the number on the others varies from five to seven. Each consists of a short, stout, tapered trunk arising from the dorsal side of the base of the notocirrus and curving dorsad over the back, its distal end abruptly bent to form the last filament, parallel and nearly equal to the others, which are slender and tapered and nearly equal in length to the notocirrus with which the ventralmost is coalesced at the base. The largest meet across the dorsum.

Setæ of four kinds, all but the crochets colorless. Compound setæ (fig. 32) form a dense subacicular fascicle of several rows, very numerous anteriorly, fewer behind. The shafts are slender, curved, with the ends enlarged, oblique and bearing a deep cleft or socket with finely serrated borders. Appendages loosely attached, tapered from the basal enlargement to the bidentate tip, remarkable for the length and wide separation of the teeth; detached front border finely denticulated or striated and continued into the delicate hood. Supra-acicular fascicle composed of a tuft of delicate simple capillary setæ, some of which are prolonged as far as the end of the notocirrus and associated with these on postbranchial parapodia a few very delicate pectinate setæ with 16 or 18 short mucronate teeth and one margin bearing a slender filament (fig. 33). Posterior parapodia bear a single ventral crochet of a yellow color and having the end bidentate and hooded (fig. 34).

Practically colorless and lacking notable iridescence, only a slight greenish shimmer anteriorly. Jaws not dissected.

The type, a female filled with ova, comes from station 4,431, off Brockway Point, Santa Rosa Island, 38–40 fathoms, coarse gray sand, yellow mud and rocks.

ONUPHIDÆ.

The large number of species representing this family is noteworthy, there being in the collection five species of *Nothria*, three of *Onuphis*, one of *Diopatra* and two of *Hyalinœcia*—no less than eleven in all.

Within areas of similar size and under similar conditions of collecting one usually finds not over four or five species. Three species were found each at station 4,387, in deep water off the Gulf of Santa Catalina, and 4,510, in Monterey Bay. With few exceptions, they occurred on muddy bottoms.

Nothria iridescens Johnson.

Nothria iridescens Johnson, Proc. Bos. Soc. Nat. Hist., XXIX, p. 408, Pl. 8, figs. 86, 87; Pl. 9, figs. 88–92.

The gills of this species begin on the first parapodium. Two points in Johnson's description require modification after a study of the large number of specimens in this collection. The biarticulate style of the posterior paired tentacles is accidental and inconstant. Similar breaks may occur on any of the styles; there may be several on one style or be asymmetrical on the two styles of a pair or, as is most usual, altogether absent. Neurocirri do not disappear on V, but remain quite prominent, though short and thick, to VII, and their thickened bases continue as glandular swellings to the middle of the body as in many other species of the genus. The posterior paired tentacles, although quite variable in length, seem always to exceed the median tentacle. The color is quite variable, but usually more or less blotched with deep purple and brightly iridescent anteriorly.

A tube of average size is 190 mm. long and 5.5 mm. in diameter, the outer end being slightly larger than the inner. The larger end is composed almost entirely of a very fragile wall of fine silt nearly 2 mm. thick and lacks the tough membranous lining that extends through the remainder of the tube.

This species occurs generally throughout the region covered by this report and was taken in abundance at stations 4,462, 4,485, 4,508, 4,510, 4,523, 4,525 and 4,526.

Stations 4,322, Soledad Hill, Point La Jolla, vicinity of San Diego, 110–199 fathoms, soft green mud; 4,339, off Point Loma Lighthouse, vicinity of San Diego, 289–369 fathoms, green mud; 4,433, off Santa Rosa Island, 243–265 fathoms, green mud; 4,436, off San Miguel Island, 264–271 fathoms, green mud; and the following stations in Monterey Bay: 4,446, 4,457, 4,461, 4,462, 4,463, 4,464, 4,475, 4,482 4,485, 4,508, 4,510, 4,522, 4,523, 4,524, 4,525, 4,526, 5,428 at depths varying from 36 to 357 fathoms, except in the case of the last station where the depth is recorded as 766–800 fathoms. The bottoms were muddy, usually "soft green mud," except at station 4,463, which was rocky and yielded a single specimen, and at station 4,522, which yielded ten specimens and is recorded as of gray sand and shells, though evidently adjoining a bed of green mud (station 4,523, etc.).

Nothria geophiliformis Moore.

Nothria geophiliformis Moore, Proc. Acad. Nat. Sci. Phila., 1903, pp. 445–448, Pl. XXV, figs. 57–59.

Gills may begin on either V or VI, usually the latter. A young specimen has a pair of minute eye specks. The small size of this species has probably caused it to be overlooked at some stations. The anterior articulated crochets differ strikingly from those of *N. pallida.*

Stations 4,445, off Point Pinos Lighthouse, Monterey Bay, 60–66 fathoms, green mud; 4,480, off Santa Cruz Lighthouse, Monterey Bay, 53–76 fathoms, dark green mud and sand; 4,510, off Point Pinos Lighthouse, 91–156, gray mud.

Nothria pallida sp. nov. Pl. XV, figs. 24–28: pl. XVI, 35–37.

A moderately elongated species, terete anteriorly, depressed for most of the length. The type—an incomplete specimen with the caudal end regenerating—consists of 166 segments and is 82 mm. long with a maximum body width of 4 mm. and a depth of 2.7 mm. at the end of the anterior third. A complete specimen 62 mm. long and 2.8 mm. wide has 266 segments. Another broken specimen has an aggregate length of 124 mm. and 290 segments.

Prostomium relatively larger than in *N. geophiloformis*, quadrate orbicular in outline, slightly wider than long, with the greatest width at the level of the posterior paired tentacles. No distinct eyes, though several obscure dusky spots appear on the prostomium. Frontal tentacles nearly in contact at the base, arising on extreme anterior border of prostomium, divergent, cylindroid with a lateral emargination about which they are bent into a bean-like shape; about twice as long as thick and one-half as long as the prostomium. Anterior or outer paired tentacles barely reaching to III, the annulated ceratophore of thirteen rings and a short, non-annulated end, about one and one-fourth times as long as the short, smooth conical style. Posterior lateral tentacles reaching XVI or XVII, the ceratophores nearly as long as the entire anterior tentacles and composed of seventeen rings and a smooth end-piece; styles flagelliform, much more slender than ceratophores and three and one-half times as long. Median tentacle reaching to IX, similar to posterior paired tentacles, but cerataphores only half as long with nine or ten annuli. A small specimen has the styles of the anterior paired tentacles nearly equal to the ceratophores and the median and posterior paired tentacles shorter than on the type, the latter reaching to XII only. Palps situated immediately in front of mouth, separated by a narrow cleft only, thick, quadrate, and divergent, about twice the size of the frontal tentacles.

Peristomium not longer than prostomium, continuing its regular outline and widening posteriorly; deeply cleft below for mouth and bearing the wide, bilobed, hammer-shaped, posterior lip. Nuchal tentacles arising from its extreme anterior border, separated by slightly more than their length and reaching extreme anterior endo-prostomium. Anterior region of body slender and terete, the segments about as long as wide and not much wider anteriorly than posteriorly. Beyond V the segments become gradually shorter, wider and more depressed until in the middle region they are very regularly about eight times as wide as long. Farther back they become gradually narrower and less depressed without change in length till near the pygidium. Pygidium short, cylindroid, abruptly truncated, bearing two pairs of slender divergent cirri, of which the dorsal is twice the length of the ventral and one-half the body width.

Parapodia (Pl. XV, figs. 24, 25, and Pl. XVI, fig. 35) exhibit the usual characteristics of the genus. The first five are widely separated and modified, but gradually become less so from before backward. The three cirriform processes (figs. 24 and 25) are present and moderately slender and elongated, the notocirrus the longest of the three and reaching the middle of the preceding foot in each case, the neurocirrus and the middle cirrus or postsetal lobe each from one-half to two-thirds as long on the different parapodia, the latter the stouter and flattened at the base. Just before and after the gills appear, the notocirrus exhibits a conspicuous constriction and distortion near the base. After the fifth parapodium the neurocirrus becomes rapidly reduced to an opake glandular ridge below the base of the parapodium which for a few segments bears at its lateral end a short blunt papilla which recedes into the ridge in the course of three or four segments. The postsetal lobe becomes reduced rapidly and completely; beginning with the sixth foot, it becomes shorter and blunt and continues to be changed until at the eleventh it becomes a small, blunt, rounded papilla lying ventral to the setæ and almost replacing the here obsolete neurocirrus, but postacicular instead of preacicular. Farther back (fig. 35) it totally disappears. The notocirrus remains well-developed for the entire length, but undergoes gradual reduction in size after the appearance of the branchiæ, appearing upon the largest of these as a much smaller lateral process. The neuropodium becomes rapidly shorter and simplified as in other species.

Branchiæ (Pl. XVI, fig. 35) simple throughout, the first appearing in connection with the fourth foot (V) or more rarely with the third on IV, in the latter case being usually quite small. They appear as the direct continuation of the base of the notocirrus, which they displace ventrally or toward the neuropodium. The first is always much more slender than the notocirrus, but nearly as long. By somite X the gill is three times as long as the notocirrus, and when, on middle segments, its maximum size is reached is fully four times as long and reaches well beyond the mid-dorsal line except on one specimen, on which they are strongly contracted. All of the gills, which continue nearly to the caudal end, are coarse round filaments apparently not at all ligulate and contain two large longitudinal blood-vessels connected by a large number of semiannular transverse vessels.

Neuropodial acicular three or four stout, tapered rods with mucronate tips projecting freely beyond the surface antero-ventral to the curved series of capillary setæ from which they are not sharply distinguished. Notopodial acicula a fascicle of a few very slender and delicate fibers passing through the notopodial base and far into the notocirrus.

Setæ are of five forms, all but the yellow posterior crochets being colorless. The first five neuropodia bear a nearly complete circle enclosing the acicula, of semi-articulated, tridentate, guarded crochets (Pl. XV, fig. 26) and simple capillarly setæ differing little from the acicula save only in their longer projecting points. The latter increase in number and in size and in parapodia immediately following the fifth (VI) replace the crochets. In the course of ten or twelve segments they gradually disappear. All parapodia, beginning with the sixth, bear a curved fascicle dorsal to the postacicular lobe of delicate, nearly straight, capillary setæ which, on anterior segments, are provided with a narrow limbus not discernible posteriorly. Among the bases of these are very delicate setæ ending in gouge-shaped expansions bearing eighteen or twenty regular mucronate teeth (fig. 27). Beginning at about XVII two large and stout crochets appear antero-ventral to the acicular papilla; their shafts are slightly curved and distally thickened and the little projecting ends bidentate and enclosed between a pair of guards (fig. 28).

Jaws described from a single dissection of a cotype (station 4,401). Mandibles (Pl. XVI, fig. 36) pale brown with pure white masticatory plates, soft, the two halves only very slightly joined by the bases of the masticatory plates, the long slender stems or carriers widely separated and of nearly equal width throughout. Masticatory plates white with a black trifid spot near the base of each, narrowly ovate quadrilateral with obscurely bidentate end. Maxillæ (fig. 37) rather soft, pale brown with certain very dark lines and thickenings as shown in the figure. Carriers of forceps jaws (I) only slightly united, widest at the middle, their posterior ends separated and pointed; forceps stout at base, the ends acute and strongly hooked. Large dentmal plates (II) stout and broad, the right with nine nearly equal stout teeth, the left with six teeth, of which the first is enlarged and separated from the others by a considerable gap. Left unpaired plate (IIa) with seven or eight teeth. Anterior pieces (III) with a narrow, curved, toothed ridge and a large flaring basal plate or wing, the left six- or seven-toothed, the right larger, with eight teeth. Small accessory jaws (IV) triangular, each bearing a single tooth.

Except for a small brown spot at the base of each notocirrus and smaller ones on the bases of the tentacles, the specimens are colorless.

The anterior ten or twelve segments of every specimen are strongly bent upwards so that the head is usually quite reversed.

Stations 4,352 (Type), off Point Loma Lighthouse, vicinity of San Diego Bay, 549–585 fathoms, green mud; 4,400, Lat. 32° 50′ 20″ N., Long. 118° 03′ 30″ W., 500–507 fathoms, green mud; 4,401, Lat. 32° 52′ 40″ N., 118° 13′ 40″ W., 448–468 fathoms, green mud, black sand; 4,415, off Santa Barbara Island, 302–638 fathoms, green mud.

Nothria sp.? Pl. XVI, figs. 38–40.

The anterior end of a rather small *Nothria* 1.6 mm. wide, probably representing another undescribed species. It has much of the aspect of *N. geophiliformis* and the setæ resemble those of that species, from all typical examples of which it differs, however, in the first appearance of the gills on VII. The cephalic tentacles are peculiar and may be abnormal. The median just equals the anterior or outer paired and its style is about two-fifths that of the posterior paired. The frontal tentacles are shorter than their diameter. All cephalic ceratophores are short and 5- or 6-annulate. No eyes. Nuchal cirri very short, only one-third or one-fourth of the distance separating them. Gills begin abruptly on VII, resemble those of *N. holobranchia* and in their full development reach to the opposite side. Jaws not dissected.

Taken from a simple mud tube from station 4,387, Lat. 32° 32′ 40″ N., Long. 118° 04′ 20″ W., 1,059 fathoms, green mud.

Nothria hiatidentata sp nov. Pls. XVI, XVII, figs. 41–50.

A very interesting species based on two specimens found in a jar of *Hyalinœcia tubicola*, to which species this bears a remarkably close superficial resemblance. Indeed, in most characters except the presence of nuchal cirri this species resembles *Hyalinœcia* more closely than ordinary *Nothriæ*. It is a noteworthy case of associative resemblance.

The type is a complete example of 94 segments, 112 mm. long, with a maximum body width at XXV of 4.8 mm. and a depth of 4 mm.

Prostomium (Pl. XVI, fig. 41) in the strongly up-bent position in which it occurs in both specimens nearly circular, the seven tentacles radiating very regularly about its margin and as usual increasing in length from before caudad. Frontal tentacles in contact medially on the extreme anterior border of the prostomium from which they are scarcely delimited, little divergent, nearly two-thirds as long as the prostomium, short ellipsoidal and slightly bilobate from a shallow lateral furrow. Probably the styles of none of the dorsal tentacles are quite complete, the ends of all being more or less worn and ragged. The ceratophores of all are short, scarcely longer than thick and divided into three or four annuli. The styles increase in both length and diameter from before backward, the anterior paired reaching to II, the posterior paired to XII or XIII and the median to XV. Palpi large, subgloboid, slightly bilobed processes bounding the mouth in front, in contact medially and projecting ventrad and laterally beyond the sides of the prostomium.

Peristomium reduced, scarcely half as long as the prostomium and not much wider. Nuchal cirri (fig. 41) arising slightly behind anterior border of peristomium in line with lateral border of base of posterior lateral tentacles, slender, tapered, not quite reaching base of one of opposite side. Posterior lip somewhat bilobed, furrowed, its antero-lateral margins continuous with mandibular cushions and not projecting freely as in many species. Somite II much enlarged, more than twice as long as I and nearly twice as wide, strongly convex and rising beyond I on all sides and embracing it completely laterally. Anterior region of body stout, not slender as in many species; III and IV rapidly reduced in length, V about normal; its width about six times length. These proportions are maintained throughout the middle region, but the width gradually decreases posteriorly until it becomes only three times the length. Dorsum very strongly arched, venter flat with neural groove. Body walls firm and muscular anteriorly, softer with translucent walls posteriorly. Caudal end tapered rather rapidly to a short tubular pygidium with expanded rim bearing a pair of very slender subanal cirri as long as the last eleven segments and one and one-third times the greatest body width.

Parapodia of anterior end much like those of *Hyalinœcia* (Pl. XVI, figs. 42, 43). The first (fig. 41) much enlarged, most modified and strongly bent forward at sides of prostomium to the level of its anterior border, cylindroid or subconical and truncate, much and deeply furrowed, terminating in a low, rounded acicular process and two broad, flat lips, the post-acicular one being much the longer and truncate distally. The short, simple notocirrus arises about the middle of its dorsal face and barely reaches the distal end of the neuropodium. Neurocirrus arises on ventral side close to mouth and fails to reach the bases of the setæ. Second parapodium (III) (fig. 42) is similar but much smaller and both the post-acicular process (middle cirrus) and notocirrus are much more slender and elongated, while the neurocirrus is enlarged and bluntly conical. The third foot is of more normal size and position and the notocirrus is still longer, reaching beyond the postacicular lobe. But the chief change affects the neurocirrus, which is no longer truly cirriform, but merely a small, rounded, cylindroid papillæ. The fourth parapodium (fig. 43) differs only in the complete suppression of the neurocirrus. After the fourth (somite V) the neuropodia are gradually reduced in size until they become low, compressed cones (fig. 44). The maximum size of the post-acicular lobe is attained at about VII or VIII, after which it undergoes gradual reduction, being still distinct at XV but obsolete at XXX. The notocirrus retains its length longer, at its maximum reaching about half-way to the middle line and exhibiting but little change until after the appearance of the gills, when it becomes rapidly reduced to a slender filament about one-third as long as the gill (fig. 44). Behind IV the neurocirri become small, rounded glandular elevations which gradually become smaller and finally disappear.

Gills begin on XIV, though a small prophetic papillæ occurs on one side of XIII of one specimen. They arise at a brown vascular knot on the dorsal side of the base of the notopodium, which, however, is not so abruptly displaced ventrad as in *Nothria pallida*, though, when the cirrus reaches its greatest reduction, it appears as little more than a lateral process of the gill (fig. 44). From the first they equal the notocirrus in length and seldom reach more than half-way to the middle line. They have the usual form and structure but, unlike those of *N. iridescens* and other species, become little flattened posteriorly.

Neuropodial acicula four or five, stout, slightly curved and tapered, the simply pointed tip apparently not reaching beyond the surface on anterior parapodia. Farther back there are three with abruptly tapered, acute, curved and often bent tips exposed for a short distance. There are no evident notopodial acicula.

Setæ are of four kinds. Large setæ on the anterior modified segments mostly broken, but several that are intact (Pl. XVI, fig. 45) are simple spines with the ends worn smooth as in *Hyalinœcia*. A single newly erupted smaller one on III (fig. 46) shows that they are bidentate and guarded at the tip, but apparently not articulated. Limbate setæ and pectinate setæ (fig. 47) begin on the second foot, on which the type specimen bears in a dorsal fascicle several of the former and one of the latter. Beginning with the fourth foot and continuing to the caudal end there are both dorsal and ventral small fascicles of limbate setæ. They have rather long stems and gently sigmoid, tapered and very acute ends bearing lanceolate, bilimbate blades. They become longer posteriorly. Delicate colorless pectinate setæ (Pl. XVI, fig. 47) occur among the bases of the dorsal limbate setæ from III to the caudal end and, except on the first two or three parapodia, form a dense cluster. The ends appear to be funnel-form with about one-third of the circle cut out and the border striated and finely denticulated. Ventral crochets begin on V, at first single and slender, but after about XV there are two or three. Two very stout yellow ones (fig. 48) are characteristic of the middle region. These have fibrous cores and slightly curved shafts, swelling distally, then rather abruptly contracted to the small head which is terminated by two rather long processes placed at nearly a right angle to the shaft and enclosed in a pair of narrow, subtriangular guards. The terminal teeth become shorter on anterior segments.

Jaws described from the cotype. Mandibles chiefly dark brown except the masticatory plates which are white with two or three very dark brown lines across the basal part (Pl. XVII, fig. 49). The two halves are very lightly united; the stems of nearly uniform width, with slightly expanded distal ends grooved to bear the masticatory plates which are elliptical with irregularly crenulated free margins. Maxillæ (fig. 50) massive, dark brown, hard. Carriers of forceps jaws very broad in posterior half, about one and one-fourth times length, the posterior border broadly rounded. Forceps rather long and slender, strongly hooked with acute tips. Maxilla II, left outer plate with nine teeth, of which the first is very large and widely separated from the second very small tooth by a wide bay fitting the anterior end of the left inner plate, which bears nine regular stout teeth; right plate very large with ten large, somewhat hooked teeth. Maxillæ III, narrow curved pieces, the left bearing ten, the right thirteen teeth. Maxillæ IV, small plates bearing a single tooth on each side.

Color all faded out with the exception of small brown spots at the base of the gills.

Described from two specimens (of which the cotype is filled with sperm balls) both from station 4,387, off San Diego, Lat. 32° 32′ 40″ N., Long. 118° 04′ 20″ W., 1,059 fathoms, green mud.

Onuphis parva sp. nov. Pl. XVII, figs. 51–57, and Pl. XVIII, figs. 98, 99.

A small, slender species of linear form, the type measuring 36 mm. long and, exclusive of the parapodia, about .6 mm. wide, with 104 segments. A large number of specimens are of similar size and only a very few larger, the maximum being about 45 mm. long and .9 mm. wide. Sexual maturity is attained at a length of 30 mm.

Prostomium longer than usual, about one and one-quarter times as long as wide, elliptical in outline. Frontal tentacles on ventro-anterior border, nearly their length apart, divergent, ovate in outline with a constricted pedicle, their length about two-fifths prostomium. Anterior paired tentacles on antero-lateral border, barely reaching IV; ceratophore about one-third style, 4-annulate. Posterior paired tentacles on dorsal face close to lateral margins and slightly in advance of middle, reaching IX or X; ceratophore slightly longer than those of anterior pair, its basal half of three distinct rings, the distal half not distinctly annulated. Median tentacle arising at almost exact center of prostomium, constantly slightly shorter than posterior paired tentacles, reaching only to VIII or middle of VII, its ceratophore similar to that of posterior pair. Eyes situated immediately caudad of base of posterior paired tentacles, usually two minute black specks (sometimes coalesced into one) on each side. Palps rather prominent, ovate lobes on ventral face of prostomium, projecting slightly beyond its margins.

Peristomium similar in size and proportions to immediately following segments, shortest above, where it is about one-half prostomium, the latter being much more extensively exposed than in most species. Nuchal cirri widely separated on extreme anterior border of peristomium, short conical, barely reaching to middle line or posterior border of peristomium. Somite II neither wider nor longer than succeeding segments, not embracing peristomium and its parapodia, not obviously enlarged nor strongly bent forward. The first three or four podous segments differ from the others only in having the walls somewhat firmer, the integuments more pigmented, in being more terete and in having the parapodia more ventral in position. Middle and posterior segments strongly depressed, with the parapodia and especially the gills carried high, the parapodial area thick and glandular and the dorsal and ventral field flat and translucent. They are remarkably uniform in size, but taper gradually in the posterior half.

Pygidium tubular with an obliquely truncate end having a thickened border and at the produced ventral margin a cluster of two pairs of very slender and delicate anal cirri, the dorsal about four times as long as the ventral and equal to the last seven segments.

Parapodia all small and little prominent, even the first, although slightly enlarged and somewhat modified as in other species, presenting none of the extreme modifications so often exhibited. The first has a low presetal and a much enlarged postsetal lip, the latter being broad and flat at the base. Both cirri arise far out and the notocirrus is tapered and reaches much beyond the end of the postsetal lobe; neurocirrus bluntly truncated and falls short of the tip of the latter. The second (Pl. XVII, fig. 51) and third differ chiefly in the shorter base, shorter and broader postsetal lobe, shorter neurocirrus and successively more dorsal position. With the fourth (fig. 52) the parapodia have about reached the dorsal position characteristic of this species and the neurocirrus has been lost in a low rounded infrapodal glandular swelling. The postsetal lobe continues to shrink, and by XV is quite inconspicuous and little longer than the presetal lip; the neuropodium becomes a broad, low, conical eminence (fig. 53) and the notocirrus, although gradually reduced in size, remains well-developed to the caudal end.

Branchiæ begin on the fourth foot (somite V) of the type, but although this is the most frequent beginning small simple ones may be detected on IV or even III of some specimens; more rarely the first occurs on VI. The first gill is simple or bifilar, the former being especially the case when they have the more anterior origin. The single filament (Pl. XVII, fig. 52) is erect and forms the main trunk of the gill, along the lateral side of which the secondary filaments arise on more posterior gills. The first few gills are no longer than the notocirri, but they increase as the latter diminish in size, the main stems often reaching to or beyond the dorsimeson. Characteristically, they are erect or semi-erect and pectinate (fig. 53) with a maximum of about seven filaments, though the number varies from five to nine according to the size of the specimen. On the type the last gill occurs on XXXVII. A cotype, on which the gills are more fully extended, has the gills arranged as follows: 3 filaments on VIII, 4 on XII, 5 on XIV, 6 on XV, 7 on XX–XXVII, 6 on XXVIII and XXIX, 5 on XXX, 4 on XXXI and XXXII, 3 on XXXIII, 2 on XXXIV, and one on XXXVI. This is about the usual distribution.

Neuropodial acicula usually four, little tapered until near the end where they taper abruptly to a slender exposed mucron, the longer of which project nearly to the border of the postsetal lobe. Farther back they become fewer. Notopodial acicula delicate fibers passing far into the notocirri.

Setæ all colorless. Setæ of first parapodium (Pl. XVII, fig. 54) exclusively (except perhaps the dorsalmost) semicompound, bidentate and guarded crochets with the articulation very imperfect and the guards much prolonged and very acute. None of these setæ is much enlarged and the dorsalmost is very slender and acute and may lack the hooked and bifid tip. The second and third parapodia have a few similar setæ in the anterior part of the fascicles, together with a few simple acute setæ in the dorsal part. On the fourth foot all setæ are of the latter type. Toward the distal end they become somewhat enlarged and minutely pilose, but not truly limbate and then taper to an acute tip. On the fourth parapodium there are only seven of these setæ, four being anterior and three dorsal, the latter more slender. Simple setæ of this type appear on all subsequent parapodia, but after a few segments are limited to a small dorsal fascicle of two to four and gradually become more slender and elongated toward the caudal end. Pectinate setæ (fig. 55) first detected on IX and present on all following segments as a small dorsal tuft of three to six. They are extremely delicate and have slightly curved asymmetrically expanded ends with the margin distinctly denticulated. Two large ventral crochets (fig. 56) appear on X, but become larger and more exposed farther back. They are peculiar in the length of the beak and small size of the accessory tooth and the somewhat unusual width of the guards. Toward the caudal end they become much smaller and one has the teeth reduced and the other more or less straightened out and the guards are frequently absent (fig. 57).

Jaws (Pl. XVIII, figs. 98–99) pale brown or yellow, translucent, soft, and flexible. Mandibles very delicate, the carriers slender, widening very little distally, feebly united, the masticatory plate narrowly elliptical, prolonged forward, a small tooth on the medial side. Maxillæ (fig. 99) with acute, strongly hooked forceps jaws, the carriers about two-thirds as wide as long, each half prolonged into a slender posterior process. Maxillæ II broad plates, the left outer with eight or nine teeth, the inner with seven or eight, the right with nine or ten larger teeth; III, left five or six teeth, right seven or eight teeth; IV rudimentary, edentulous.

Nearly all of those examined are practically colorless, the anterior end more opake and iridescent. Some examples from station 4,454 have the cephalic appendages dark or black and conspicuous quadrate blotches of black scattered over all parts of the body both dorsally and ventrally and on parts enclosed by the tubes as well as parts exposed.

Tubes generally about 45 mm. long and 2 mm. to 2.3 mm. in diameter, tapering off at one end to a thin membraneous portion. The thicker portions are composed mainly of fine silt, but sometimes with a few sand grains or minute pebbles.

This appears to be an abundant species, and were it not for its small size would doubtless have been collected at many more stations. It was especially abundant at stations 4,467 and 4,468, where several hundred tubes were taken, and at 4,475, where about fifty were obtained.

Stations 4,445, off Point Pinos Lighthouse, Monterey Bay, 60–66 fathoms, green mud; 4,446, same locality, 52–59 fathoms, green mud (type); 4,452, 4,453, 4,454, same locality, 49–71 fathoms, green mud and sand; 4,457, same locality, 40–46 fathoms, dark green mud; 4,464, same locality, 36–51 fathoms, soft dark gray mud; 4,467, off Santa Cruz Lighthouse, Monterey Bay, 51–54 fathoms, soft dark green mud; 4,468, same locality, fine sand; 4,475, off Point Pinos Lighthouse, 58–142 fathoms, soft green mud; 4,480, off Santa Cruz Lighthouse, 53–76 fathoms, dark green mud and sand; 4,485, same locality, 89–108 fathoms, soft green mud and sand; 4,510, off Point Pinos Lighthouse, 91–184 fathoms, gray mud; 4,522, same locality, 130–149 fathoms, gray sand and shells; 4,523, same locality, 75–108 fathoms, soft dark mud.

Onuphis vexillaria sp. nov. Pl. XVII, figs. 69-76.

A slender, elongated and very distinct species described from a single anterior end and four other pieces which are believed to form a single specimen, complete except for the caudal end. The aggregate length is 159 mm., the width without parapodia 3 mm. and including them 4.2 mm. in the middle region; and the total number of segments 242.

Prostomium small, nearly circular, with a slight posterior emargination, convex, its surface largely occupied by the bases of the tentacles, which are arranged in the form of an ellipse. Frontal tentacles short, thick and ovate, about one-half length of prostomium, short pedunculate, divergent and separated by a space exceeding their diameter. A pair of minute eye-spots at the medial side of their bases. Dorsal tentacles all with annulated ceratophores and slender smooth styles. Anterior pair reach to middle of III, the style three times the length of the ceratophore which has seven articulations. Posterior pair reaching X, the ceratophore as long as the anterior but with a smooth distal part in addition to seven articulations. Median reaching VIII with much shorter ceratophore of six annuli. Palps immediately anterior to mouth, strongly divergent, stouter and somewhat longer than frontal tentacles and divided by a shallow cross-furrow.

Peristomium narrow, continuing outline of prostomium in a regular dome-like curve, but separated by a well-defined dorsal furrow. It is produced somewhat forward to embrace the prostomium at the sides and dorsally slightly overlaps it as a low, somewhat convex nuchal collar. Ventrally it is cut almost to the posterior furrow by the large mouth, which is partly covered by a broad lip with laterally produced angles. Nuchal cirri slender, tapered, simple, rising high up at the level of the inner lateral tentacles from the extreme anterior margin of the prostomium and separated by one-half their length. They reach to the caudal border of II or well beyond the anterior border of the prostomium.

Anterior metastomial region slender and nearly terete, the first five podous segments of nearly equal length and width, the ratio being about as two to two and one-half, the greatest width being at the anterior end where the parapodia arise. After VII the segments become gradually wider and rather abruptly shorter until by XX they are about five times as wide as long and distinctly depressed with the dorsum flattened. This depressed form continues throughout the middle and posterior region. Furrows generally rather weakly developed except between the parapodia. Integuments rather soft, semitranslucent and grayish except in the subparapodial region, where there are thick, opake, whitish glandular areas; surface very smooth with highly iridescent cuticle. Pygidium unknown.

Parapodia of anterior end prominent, beginning on II near the ventral level and gradually shifting dorsad until by XV they have attained nearly the dorsal level. Anterior parapodia (Pl. XVII, figs. 69 and 70) are remarkable for the great length of their parts. The first is situated at the extreme anterior end of somite II and is directed only slightly forward. Succeeding ones shift to a more caudal position and lose the forward slope until the sixth is on the middle of its segment and the third is directed straight laterad. They have a rather long pedicle bearing a notocirrus, neurocirrus and slender neuropodial setigerous lobe divided at the distal end into a scarcely perceptible presetal lip and a remarkably prolonged, attenuate cirriform postsetal lip. Neurocirrus arises near the base of the ventral surface and is of similar form and nearly equal length to the postsetal cirrus. Notocirrus arises dorsally nearly opposite to the neurocirrus from a thickened notopodial pedicle, into which the acicula enter, followed by a constriction and again by a swelling tapering into a long slender style one and one-half to twice the length of the neurocirrus, and the longest exceeding the diameter of the anterior segments.

(figs. 69 and 70). Little change takes place in the first five parapodia, but with the sixth the whole parapodium begins to diminish in size, the neurocirrus especially dwindling until by the ninth the entire style has disappeared and the base is represented only by the usual opake, somewhat swollen, whitish area ventral to the base of the foot, which becomes smaller but continues to the caudal end. The postsetal lip becomes smaller very gradually, but remains to the middle segments as a small conical process. Except that it becomes more slender and assumes the proportions of a gill filament, the notocirrus undergoes little change (fig. 71).

Branchiæ appear on both sides of somite V (fig. 70) as a single filament as long, but much more slender than the postsetal cirrus, arising from the notopodial base in common with and on the dorsal side of the notocirrus. On succeeding segments the filament becomes long and on IX a second appears; additional ones then appearing (symmetrically except as mentioned) up to the number of nine, as follows: three on XIII (XIV on right), four on XVI, five on XIX, six on XX, seven on XXI, eight on XXVII and nine at about XXXV. The last number (fig. 71) continues to at least L. The largest gills on pieces from the middle of the body, the segment numbers being undetermined, bear as many as twelve filaments and the most caudal segments represented bear unifilar gills. Until they possess upward of four filaments, the gills scarcely exhibit a main stem or pinniform structure which is always obvious on the more complex gills. The main stem curves rather sharply dorsad, tapering, and bearing along its lateral side the filaments, which diminish in size to the last. On anterior segments the filaments are shorter than the notocirrus, but farther back they are longer. New ones appear to be added from the growing point at the tip of the stem. Branch blood-vessels from the main trunk enter all of the filaments.

Neuropodial acicula, which on anterior parapodia are not very clearly distinguished from the setæ, are from three to five in a row, rather stout, tapered gently to near the end and then abruptly into slender, very acute projecting tips, appearing at the bases of the dorsal setæ. Notopodial acicula are very long and slender fibers which enter the base of the notopodium and continue far into the cirrus (fig. 71). Perhaps they would be more correctly described as buried setæ.

Except the large ventral crochets, all setæ are colorless or nearly so. All segments bear a small tuft of slender, acute, capillary setæ dorsal to the acicula, among the bases of which are a very few much more delicate and inconspicuous asymmetrical pectinate setæ with one margin prolonged (fig. 73). The first five parapodia bear in the anterior and ventral part of the fascicle a few larger setæ or hooded crochets (fig. 72) with two accessory teeth below the principal hook and the guards but little prolonged. Some of the larger ones show traces of an articulation near the end. Parapodia succeeding these have the crochets replaced by short setæ with mucronate tips and narrow limbæ. These gradually disappear and no trace of them remains at XXV. Somewhere between this point and somite L, the exact segment undetermined, appear two stout yellow bidentate guarded crochets (fig. 74) projecting slightly and obliquely from below the acicula.

The jaws are imperfectly chitinized, being soft and delicate and except at a few thickened points, pale brown. Mandibles probably abnormal, very small, the form of one half being shown in two pieces in (Pl. XVII, fig. 75). Maxillæ (fig. 76) have long, acute, strongly curved forceps jaws with nearly circular carriers. The two plates of II on the left side have, respectively, six and seven teeth, on the right side eight or nine teeth. Plate III of each side bears an unusually large basal wing and six small teeth; IV is small and bears a single tooth.

No color remains. This species is known only from the type and a small portion of the middle region of another specimen from station 4,401.

Stations 4,326, Soledad Hill, Point La Jolla, vicinity San Diego; 243–280 fathoms, soft green mud; 4,401, Lat. 32° 52′ 40″ N., Long. 118° 13′ 40″ W., 448–468 fathoms, green mud and black sand.

Onuphis nebulosa sp. nov. Pl. XVII, figs. 58–68.

This species has the anterior end slender with prominently outstanding parapodia, the remainder of the body, so far as known, depressed and of very uniform width and the small gills beginning on VIII or IX. The type, consisting of the prostomium and 83 anterior segments, is 25 mm. long and has a maximum width, exclusive of the parapodia, of 1.3 mm.

Prostomium about four-fifths as long as wide, elliptical with an anterior median emargination, strongly convex above. No eyes detected. Frontal tentacles ovate, about one-third longer than wide and about half as long as the prostomium, arising on the frontal border of prostomium separated by a space of one-half their diameter and bent strongly downward. Anterior paired tentacles arise from antero-lateral border immediately behind frontal tentacles; their ceratophores a out equal to frontal tentacles, quadri-annulate; styles two and one-half times as long as ceratophores and reaching to middle of II. Posterior paired tentacles arise on the dorsal surface opposite the middle of the prostomium and just within its lateral borders; ceratophores similar to those of the anterior pair; styles reach somite VII or VIII. Median tentacle behind center of prostomium, similar to posterior paired tentacles, but somewhat shorter, reaching only to VI or VII. Palps cushion-like, arising from posterior ventral surface close to mouth, diverging from median line, the broadly rounded ends projecting beyond the sides of the prostomium.

Peristomium very short above, in the median line only about one-half as long as the prostomium, nearly twice as long at the sides and carried forward to embrace the prostomium, the cephalic margin as a consequence being deeply concave. Ventrally it forms the usual tilobed lip, which is quite distinct from II. Nuchal cirri arise from extreme anterior border of peristomium in line with the posterior paired tentacles and separated by a distance of twice their length, very slender and tapered. Somites II and III equal and elongated, each as long as prostomium and peristomium combined but no wider than the latter. Both are simple segments, widest anteriorly. Behind III the segments gradually increase in width and decrease in length to X, from which they remain nearly uniform for the length of the piece, being quite simple and about five times as wide as long; dorsally they are flat, ventrally strongly convex, the parapodia arising high up. Furrows well-marked and clean-cut and the cuticle very smooth and highly iridescent.

Anterior parapodia (Pl. XVII, figs. 58 and 59) elongated and rather slender, prominently outstanding and fully equalling the width of their somites, from the anterior ends of which they arise. The first two are directed somewhat forward, but little more than those of *O. [illegible]*. From the ventral level of the first they gradually rise until the dorsal level is attained by the eighth. No important difference is noticeable among the first seven or eight. All have the somewhat prolonged, slightly flattened, neuropodial body terminated by a short and broadly rounded presetal lip and a moderately prolonged postsetal lip decidedly flattened at the base. Notocirri and neurocirri clavate, with thickened bases and more slender distal parts ending bluntly; the former are longer than the postsetal lips and more slender, and below their thickened bases, borne on a slightly constricted notopodial base; the neurocirri more proximal in origin and equal to or shorter than the postsetal lip. At the eighth foot the neurocirrus begins to undergo rapid reduction and by the eleventh its conical form and cirrus character are lost and it has assumed the form of a low, smooth, rounded, opake and whitish swelling, which increases in size to about XXV and then diminishes gradually, though it remains as a small whitish spot even at the end of the piece. The postsetal lobe retains its character longer, undergoing very gradual reduction after X and shifting more ventrad. Even at XX it is quite as long as the body of the parapodium and of a short conical or subtriangular form. At L (fig. 60) it is a minute blunt papilla, ventrocaudad of the seta tuft, and farther back disappears altogether. Notocirri become more slender, but retain their length, continuing to reach the middle line as far back at least as the eighty-ninth segment. In the middle region the bodies of the parapodia are reduced and somewhat compressed and bluntly rounded, and are situated near the level of the dorsum.

On the three specimens known the gills begin as single filaments on somites VIII or IX and never possess more than four filaments, and that number only rarely. Two filaments appear at from XXII to XXVI, three at from XXXIII to XL and continue to LVI or LXIX where the number is reduced to two again and so continues to the end of the several pieces. Not infrequently a segment fails to develop a gill on one or both sides and frequently the number of filaments is below the normal of the region. The gills, though of few filaments, are typically pinnate (fig. 60) and the filaments rather thick and short, the longest very constantly reaching just to the median line. They arise on the dorsal side of the notocirri on a common notopodial base.

Acicula of anterior neuropodia usually three, yellow, stout, tapered, gently curved and terminated by long freely projecting mucronate tips. On posterior neuropodia there are often only two acicula which are like the anterior ones except that they are rather abruptly bent near the distal end. Notopodial acicula are three or four delicate fibers which enter the base of the notocirrus.

Setæ are of vitreous structure and all more or less yellow, the more slender ones being very pale, the stouter ones deeper. The usual four kinds occur, but they present greater variation and more transition forms than usual. Articulated crochets (Pl. XVII, figs. 61, 62) are confined to the first eight parapodia. On the first three they occur in an irregular, open, vertical, preacicular series of three or four, one or two on the acicular tubercle beneath the aciculum and one postacicular—about six or seven in all. On the fourth foot (V) those in the dorsalmost part of the fascicle are replaced by simple acute setæ, but at least one compound crochet persists to the eighth foot and three to the seventh. They are rather slender, with well-developed articulation and distal pieces that vary much in length (figs. 61 and 62) the longest being dorsal, the shortest ventral. They end in a slender, acute, strongly hooked tip, beneath which are two prominent and acute spurs, the whole enclosed in a split guard closely fitting the terminal hook and scarcely prolonged beyond it. Simple, acute setæ are represented by one or two small ones on the first and second parapodia, but are not clearly distinguished from the acicula, above and behind which they lie. Farther back they become more numerous, longer, much more slender, and finally even the very narrow limbus that they present anteriorly disappears. On posterior parapodia the fascicle is composed exclusively of six or eight setæ of this type. In the subacicular region the articulated crochets are replaced by short, rather broad, acute setæ, more or less distinctly articulated (fig. 63). Such setæ continue to between somites XV and XX. The larger articulated crochet which appears in the acicular process of anterior parapodia seems to persist, become stouter, lose its articulation and gradually its terminal hook (fig. 65), thus becoming converted into a simple bidentate hooded crochet similar to those occurring on posterior segments. This transition is well shown up to somite XV of the mounted cotype. Apparently, however, there is a gap between the last of these and the first of the posterior simple crochets, two of which appear together ventral to the acicula at about somite XX of these specimens. Unlike the anterior crochets, they project only slightly. They are deep yellow, stout, bifid, with the main tooth below and have the end enclosed in the usual cleft hood (fig. 66). Pectinate setæ (fig. 64) occur in the dorsal fascicle of most segments, but their exact distribution was not determined. They are very delicate, with the widened end very little curved and bearing only a small number of rather long processes.

Jaws described from a single dissection. Mandibles (fig. 67) soft and thin, the carriers nearly colorless with a black streak distally, narrow, of nearly uniform diameter, lightly united at the distal end; masticatory plates white, irregularly trapezoidal, each divided by a deep anterior notch into two large teeth, each of which is again notched. Maxillæ (fig. 68) thin, very pale brown with narrow deep brown marginal lines and thickenings; carriers of forceps-jaws as wide as long, shield-shaped, with straight transverse hinge line; basal half of forceps thickened, distal slender, regularly tapered, moderately curved and acute. Maxillæ II large, subtriangular plates, each of the three bearing ten (or the outer left, nine) small, regular close teeth. Maxillæ III curved, ridge-like pieces, the left with six, the right with eight small teeth. Maxillæ IV very small, edentulous.

Color generally dull olive-gray, becoming purplish and more iridescent anteriorly, except on the parapodia and cephalic appendages. Dorsum and to a less extent the sides obscurely clouded, or on one specimen distinctly mottled with dusky. Except on the first ten or twelve segments, there is a more or less distinct double dorsal median dark brown line showing a tendency to break into metameric spots. A series of dorso-lateral spots above the parapodia. Like so many of the species taken at the same station, the surface is marked with strictly quadrate spots scattered over the head and its appendages, parapodia and body segments.

A complete tube is 152 mm. long and has an external diameter of 2.5 to 3 mm. Its foundation is a rather tough membraneous lining intermediate in character to that of ordinary *Nothria* and *Hyalinœcia* tubes and having a diameter of 1.4 mm. The tubes are very fragile and covered externally with a thick but irregular layer of sand grains and small pebbles. Many of them bear a few rather large pebbles, especially near the lower end, where they probably serve as anchors. One is peculiar in the development at one end of an expanded disk, from the margins of which radiate irregularly a number of hollow fibers or minute tubes probably the work of another than the rightful occupant.

Thirty tubes and three worms were taken at the only station, 4,454, off Point Pinos Lighthouse, Monterey Bay, 65–71 fathoms, green mud, sand and gravel.

Diopatra ornata sp. nov. Pl. XVIII, figs. 77–85.

So far as known, this species is below the size usual in the genus, but all of the four specimens are incomplete. The type and most complete one is in three pieces, having an aggregate length of 84 mm. and 121 segments. Maximum width (at XX) of body only 3 mm., between tips of parapodia 4 mm.; depth 1.8 mm.

As viewed antero-dorsally, the prostomium is nearly circular, being bent downward with a nearly vertical flattened frontal face, the seven tentacles almost in contact at their bases, radiating regularly from a point anterior to the center of the prostomium, the flattened circle enclosed by their bases scarcely exceeding the sectional area of any one of the tentacles, while the region posterior to the tentacles is strongly convex. Frontal tentacles almost in contact on anterior margin, about as long as prostomium, conical, obscurely annulated. Anterior paired tentacles situated slightly dorsal to margin, immediately behind and almost in contact with frontal tentacles, reaching to VII or VIII; the ceratophores slightly longer than frontal tentacles, divided to the end into eight or ten annuli; the styles smooth and slender. Posterior paired tentacles on dorsum well back from margin and immediately above and behind anterior paired, reaching to XV or XVI; ceratophores shorter and stouter than anterior paired, nine- to eleven-annulate. Median tentacle posterior to middle of prostomium, reaching XIV, with a shorter ceratophore having nine annuli. Apparently all of the tentacles have lost a short portion of the tip and each one is marked by a more or less distinct broad purple zone. Palps prominent, divergent and directed ventrad, bilobed by a shallow transverse furrow. No eyes detected and *pigmented* eyes certainly absent.

Peristomium nearly as long as prostomium, its anterior end scarcely wider, little concave and its sides continuous with prostomium, its dorsum strongly convex. Nuchal cirri on anterior margin of peristomium, slightly longer than prostomium and reaching two-thirds or three-fourths to base of opposite cirrus, regularly tapered from base to tip, often with a purple spot. Ventrally the peristomium forms a pair of thick folds behind the palps and a bilobed hinder lip. The next two segments, each about as long as peristomium, slightly carried forward at sides to bear parapodia and embrace the preceding segment, but not conspicuously enlarged. Succeeding segments become slightly wider to about XV, after which they remain practically unchanged. Those of middle region about four times as wide as long, smooth, simple, rather strongly depressed. Pygidium unknown.

Parapodia of the prebranchial region (Pl. XVIII, fig. 77) large and prominent, the undivided body alone of the first three exceeding one-half the width of their segments, projecting somewhat forward from the anterior ventro-lateral region of their segments. They have stout, slightly compressed, subtruncate, cross-furrowed, chiefly neuropodial bodies and the usual notocirrus, neurocirrus and postsetal lobe or middle cirrus, all of which are rather stout and subconical, the postsetal lobe being somewhat flattened and the notocirrus about one and one-half times as long as the others, with a basal constriction. The fourth foot (on somite V) is similar to the three preceding ones, but decidedly smaller. With the fifth a considerable reduction in size takes place and the parapodia have approached the dorsum, at which level all succeeding ones remain, the body becoming at the same time much reduced, short, truncate, subconical and directed somewhat dorsad. At the fifth parapodium the neurocirrus becomes much shorter and bluntly rounded at the apex; at the sixth it is replaced by an oval glandular swelling, which increases in area but becomes less elevated for six or seven segments and then undergoes gradual reduction in the post-branchial region. After the appearance of the gills on VI the notocirrus also undergoes reduction, but so gradually that a small cirrus is still present on the one hundred and twenty-first segment. The postsetal lobe becomes smaller simultaneously with the notocirrus, but much more rapidly, soon becoming minute and shifting to a post-setal position and practically disappearing by the end of the branchial region.

Gills begin on somite VI and continue to XLIX to LII on the several specimens. They arise on the dorsal side of the base of the parapodia by a stout base, on the ventral or lateral side of which the neurocirrus is borne (Pl. XVIII, fig. 78). Several anterior pairs are very large, the second in all cases exceeding all of the others and reaching quite to the tip of the notocirrus of the opposite side, the first being about seven-eighths and the third about three-fourths or more as long as the second. Succeeding ones diminish in length, at first rapidly, then slowly, the eighth equalling the body width, the twenty-first reaching the middle line, the forty-first being only as long as the notocirrus. Anterior gills are tall and slender when fully extended, being shaped much like Lombardy poplar trees. The trunks have stout, feebly annulated bases above which they taper and are spirally twisted, bearing numerous, rather short spirally arranged filaments which become smaller distally. This spiral arrangement of the gills persists to at least XXXV, the number of turns varying with the length of the gill, the second and longest having twelve. Beyond somite XXXV, the trunks have become so short and the filaments so crowded that the appearance is brush-like. At XL there are only three short filaments, and the last seven gills consist of a single filament, each of which gradually diminishes in length.

Neuropodial acicula three or four, tapered, curved, terminating in acute tips projecting beyond the end of the acicular process. Notopodials one or two delicate rods or a bundle of fibers.

Setæ of the first four parapodia (II–V) chiefly compound crochets (Pl. XVIII, 79 and 80) arranged in a loose vertical preacicular series of about six or eight, of which one, much stouter than the others, is subacicular and one more slender postacicular. The latter (fig. 80) has the appendage considerably longer than the rest. All have the articulation well-developed, the end very strongly hooked and provided with a prominent accessory spur and well-developed guard, the end of which is somewhat obliquely prolonged. On at least the first branchiate parapodium a few semicompound, sometimes acute (fig. 81), sometimes obscurely hooked setæ persist, but give place to true acute simple setæ on subsequent segments. A few short, simple setæ occur in the dorsal part of the supra-acicular region of the first foot, and they soon form a well-marked, curved, horizontal series dorsal to the acicular process. These setæ are slender with a very narrow limbus. On anterior branchiate parapodia, beginning with VI and continuing to about XXX is a vertical row of five or six short, stouter, thickened, but alimbate setæ forming a vertical preacicular fascicle. These disappear as the gills become short and the stout ventral crochets appear, leaving only the dorsal group of acute setæ, which become longer. Beginning somewhere between VI and X, and at first few in number, but increasing to a compact tuft clustered among the dorsal acute setæ and persisting with them to the end of the worm, are delicate gouge-shaped setæ with finely pectinate border (fig. 82). A stout yellow crochet (fig. 83) appears below the acicula at about XXX and a few segments behind is joined by a second; they have a strong beak, short, thick accessory tooth and a pair of small guards.

Mandibles dark brown with pale masticatory plates. Stems rather broad, of nearly uniform width, the distal end scarcely widened, the two sides very slightly united by a slender and short isthmus. Masticatory plates small, transversely elliptical, scarcely toothed (fig. 84). Maxillæ (fig. 85) dark brown, massive, opake. Forceps jaws (I) massive, the carriers broad, together nearly orbicular with a flexible median joint and a posterior median notch; hinge line short; forceps with basal half thick, tapered to the incurved subacute ends. Maxillæ II broad, triangular, the cotype figured with the inner left plate absent, the remaining pair nearly symmetrical, the left with seven, the right with eight teeth, the most anterior in each case being larger than the others. The type has the normal arrangement of two pieces on the left side and one on the right, each bearing seven teeth like those figured. Maxilla III large curved plates usually with eight unequal teeth on each side. Maxilla IV small plates bearing a single small tooth.

Color generally faded to a dull gray, the anterior end slightly purplish and purple zones on the cephalic tentacles and spots at the base of the nuchal cirri. Cuticle slightly iridescent.

Some fragments of the exposed ends of tubes have the usual structure, with a tough, parchment-like basis thickly covered with pebbles, bits of shells, coral and other hard bodies mostly arranged transversely.

They closely resemble the tubes of *Diopatra cuprea*, but are scarcely more than one-half their diameter.

Stations 4,457 (tubes only), off Point Pinos Lighthouse, Monterey Bay, 40–46 fathoms, dark green mud; 4,467, off Santa Cruz Lighthouse, 51–54 fathoms, soft dark green mud; 4,519, off Point Pinos Lighthouse, 27–35 fathoms, hard gray sand (type).

Hyalinœcia juvenalis sp. nov. Pl XVIII, figs. 86–95.

A small species represented by the anterior ends of two individuals, which, though mature, retain certain characters of setæ, etc., which are found in quite young examples only of *H. tubicola*. The cotype, comprising the head and 35 segments, is 19 mm. long and 1.9 mm. in maximum width. The type, of the same size, has 32 segments and a posterior regenerating cone.

Prostomium trapezoidal, the greatest width posterior and about one-third more than the length, the anterior and posterior sides convex, the converging lateral sides nearly straight. Frontal tentacles small, less than one-third length of prostomium, situated at antero-lateral angles, directed somewhat ventrad, but little divergent, subfusiform, about twice as long as thick, the pedicles much constricted. Median and posterior lateral tentacles situated well within posterior half of prostomium close together on dorsal face: anterior lateral tentacles farther forward on lateral margin. Ceratophores of anterior paired tentacles about as long as thick and 4-annulate, styles thickish and stout, barely reaching III. Ceratophores of median and posterior paired tentacles very short, obscurely divided into three annuli, the styles smooth, moderately slender, about one-half the diameter of the anterior pair, tapered, the median reaching to IX, the longest lateral to XI. Eyes black, very conspicuous, immediately behind the anterior and below the posterior paired tentacles. The type has but one pair about one-half the diameter of the base of the anterior tentacles; the cotype bears a second pair, almost as conspicuous and immediately dorsal to the first pair. Palps rather small, about one-third width of prostomium, globoid, directed ventrad immediately in front of mouth and only slightly in contact medially.

Peristomium small, scarcely wider than prostomium and less than one-half as long, bearing the bilobed posterior lip. Somite II very much larger, nearly twice as wide and three times as long as the peristomium, extending forward and embracing the sides of the latter. The next few segments diminish in length rapidly until the normal length to width ratio of one to four or five is reached at somite VI. Beyond this point the segments continue to increase in size and the maximum diameter is probably not quite attained in these pieces. The first few segments are firm-walled and bounded by deep furrows, but farther back they become softer and the furrows shallower. All are nearly terete, but slightly flattened and grooved ventrally. Pygidium a very small, short, truncate cone bearing a pair of very slender tapering cirri about one and one-fourth times the greatest diameter of the body.

Parapodia generally similar to those of larger species, but relatively less enlarged and prominent. First pair (on II) largest, projecting forward and slightly ventrad, but barely reaching level of anterior border of palps, truncate, conical, transversely furrowed and terminated by a broad, flat, prominent, preacicular lip and a slender but about equally long, more cirriform postacicular lip. Both notocirri and neurocirri are simple, conical styles without differentiated cirrophore and of similar form and size, not quite reaching the end of the terminal lips, the neurocirrus arising on the antero-ventral part of the base of the neuropodium close to the side of the mouth, the notocirrus nearly half-way out on the postero-dorsal aspect of the foot. The second foot (Pl. XVIII, fig. 86) is similar, but decidedly smaller and projects very little forward and ventrad. The third is modified still farther in these respects, and the fourth (fig. 87) has attained the typical position and nearly typical proportions and differs particularly from preceding parapodia in its much shorter, blunt neurocirrus. The one figured (fig. 87) has the postsetal lip abnormally bifid. On the first parapodium the postsetal lip is shorter than the presetal, but on the second this relation is reversed and the latter disparity becomes more pronounced on succeeding parapodia until at somite X the postsetal lip becomes again reduced to the length of the presetal lip and assumes the form of a small cylindroid papilla. This continues to diminish, shifts to a more ventral position and finally disappears, leaving only the short, broadly rounded presetal lip of the low, flat parapodia of middle segments (fig. 88). Notocirri undergo very regular and gradual diminution in size and with the appearance of the gills (about XX) have become quite minute and little longer than the presetal lip, appearing as small processes from the outer side of the base of the gills. Neurocirri remain the same for the first three parapodia and then very abruptly become altered to a small, thick papilla, which in the course of one or two more segments becomes absorbed into a low swelling and extensive glandular region ventral to the parapodium.

On the cotype gills begin symmetrically on XIX; on the type there is a small one on one side of XVIII, fully developed ones on both sides of XIX, none on XX and then from both sides of XXI caudad. On both specimens they continue to increase in length gradually and probably reach their maximum size at XXIII where they about reach the dorsimeson and are five to six times the length of the dorsal cirrus, the length of which, indeed, scarcely exceeds their diameter (fig. 88). They have the usual structure, being coarse filaments containing a large axial blood-vessel, and within the limits of the piece exhibit no indication of becoming flattened.

Neuropodial acicula pale yellow, generally three, but posteriorly only two, stout, tapered, slightly curved, the pointed apices projecting only slightly beyond the integument. Notopodial acicula a small fascicle of fibers.

Setæ of four kinds. The first three parapodia bear a few stout, compound crochets in a vertical series. They are especially large on the first and project freely forward. On the second and third parapodia (fig. 89) they become smaller and paler in color. None seem to be truly compound, but the oblique joint is imperfect and near the end. The shaft or portion of the setæ proximad of this interruption is slightly thickened in its distal portion and minutely roughened, partly with minute imbricated, antrorse scales and partly with minute hairs. The distal piece or appendage is somewhat recurved, tapered to the peculiarly formed bidentate tip, which is enclosed in a pair of broad obliquely truncate guards. It is possible that larger specimens (should such occur) would lose some of these characters through wear. Beginning on the fourth foot (V), the compound crochets (one or two of which may remain, though there are none on these specimens) are replaced by simple setæ which are characterized by a finely roughened enlargement beyond which they taper to an acute curved tip. Farther back these setæ are partly reduced in size, but chiefly transformed into small supra-acicular and subacicular fascicles of simple setæ with broadly bilimbate, lanceolate blades (fig. 91). Associated with these setæ in the dorsal fascicle, beginning on the second foot is a dense tuft of very delicate pectinate setæ, the abruptly widened end of which (fig. 92) is bent into semicircular form and bears about thirty regular and equal teeth and mucrons. On posterior segments they become much wider and flatter. Beginning at about somite XX, two stout, yellow, slightly clavate, bluntly rounded bidentate and guarded crochets appear in the subacicular fascicle of each crochet (fig. 90).

Jaws thin and fragile, but hard and well-chitinized. Mandibles (figs. 93 and 94) pale brown, with some dark streaks, the stems regularly tapered, slightly enlarged at the distal end where the two are feebly united. Masticatory plates white and hard, slender, ovate, with smooth or slightly wavy margins, borne in a distal depression of the stem which projects beyond the masticatory plate on the lateral side as a blunt tooth. The mandibles of the type are much larger than those of the cotype, though the two worms differ but little in size. Maxillæ (fig. 95) pale brown, the teeth and other thickened parts darker. Carriers of forceps-jaws (I) broad, together about four-fifths length, subquadrate, with a short, blunt projection at the postero-lateral angle; the forceps with basal half broad and nearly straight, the distal half slender, tapered and not very strongly hooked. Maxillæ II, outer left plate with thirteen large and one or more very small posterior teeth, inner left with twelve teeth, right plate with fourteen or sixteen or even more teeth. Maxillæ III, left with seven to nine small teeth, right with about ten teeth. Maxilla IV, delicate, with one small tooth or none.

Generally pale or colorless, a small, indefinite, median dorsal, purple spot on anterior dorsal part of prostomium, a pair of small ventral spots below outer lateral tentacles, small brown spots at base of notocirri and a few dark speckles on anterior segments. Cuticle only slightly iridescent.

A probably incomplete tube is 65 mm. long, slightly curved and tapered, the large end being 2.5 mm., the smaller 2.2 mm. The surface is rougher than that of small tubes of *H. tubicola* and the annulations are 2 mm. apart and obscure. Although translucent and nearly free of incrustations, it is not possible to determine the character of the valves.

An empty tube has living within it a small polynoid, not yet removed for examination, and, completely closing the larger orifice so that the annelid could not leave, is a small hermit crab (*Eupagurus* or *Parapagurus*) with very unequal chela, the right being much the larger and forming a symmetrical plug beautifully adapted to the form and size of the tube.

Type and only station 4,431, off Santa Rosa Island, 38–45 fathoms, varied bottom.

Hyalinœcia tubicola (Müller) Malmgren, **stricta** subsp. nov. Pl. XVIII, figs. 96, 97.

Hyalinæcia tubicola Malmgren, Öfversigt Kongl. Vetens-Akad. Förh., XXIV (1867), 181, 2. Taf. IX, fig. 49.

This is a form of large size, as indicated by the measurements of the tubes given below, somewhat exceeding *H. artifex* Verrill. In many respects it resembles *H. t. longibranchiata* McIntosh, from the vicinity of New Zealand, but has no eyes.

Ceratophores of cephalic tentacles, either not annulated or obscurely 3- or 4-annulate. Anterior paired tentacle reaches IV or V, posterior paired XIII to XVII on different specimens, and median tentacle usually to XX. Somite II is much enlarged, being fully double the length of the peristomium, and its very large stout parapodia bear three or four stout spines which reach quite to the anterior level of the prostomium. Neurocirri of the first parapodium lie close to the sides of the mouth; they diminish in size after the third foot (IV) and become obsolete after VII. On different specimens the gills begin on from XXVI to XXX and at their maximum development reach about three-fourths of the width of the dorsum. They continue to the twelfth segment preceding the pygidium, becoming rapidly reduced in size toward the caudal end. Pygidium ending in a furrowed circumanal ring directed dorsad and bearing a pair of subanal cirri arising in contact, flagelliform, very slender and as long as the last eleven segments or twice diameter of body.

The distinctive features of the subspecies are found mainly in the large posterior crochets and the jaws. The former (Pl. XVIII, fig. 97) have the terminal teeth continued nearly in the direction of the shaft and not placed at a considerable angle with it as in most forms. Pectinate setæ have the plates bent into two-thirds of a circle with very numerous denticulations. A young specimen (about 2 mm. in diameter) still retains on the large spines of anterior parapodia traces of terminal teeth and guards (fig. 96).

The maxillæ are long, with numerous teeth: II left side outer plate 18 teeth, inner plate 15 teeth, right side 17 teeth; III, left 9 teeth, right 10 teeth; IV rudimentary with one tooth on each side. Mandibles have the two sides entirely distinct.

The anterior end of the body and the head are minutely speckled with pigment.

A typical example of the more than thirty tubes in the collection is 198 mm. long, 4.5 mm. in diameter at the small and 6 mm. at the large end. Others vary from 72 mm. long and 3 mm. in diameter to 236 mm. long and 7 mm. in diameter, the great majority being about 200 mm. long. They are gently curved and tapered and toward the larger end elliptical, not circular, in section, the diameter in the plane of curvature being slightly less, indicating a dorso-ventral depression. The tubes have a quill-like texture, but are harder and more rigid than any quill of similar size and can be cut with a knife only with difficulty. The maximum thickness of more than $\frac{1}{2}$ mm. is at the middle, where the number of layers is greatest and diminishes most toward the large end where the last inch or so is rather soft and semicollapsible. For the entire length the tube is marked with annular lines which, on a tube 198 mm. long, are 6.5 mm. apart at the small and end 5 mm. apart at the large end. These annulations are formed by the exposed edges of the successive layers of material, which are laid down on the inside and project beyond the orifice to a distance equal to that between two rings. Thus a tube showing thirty-five rings has probably been constructed of as many successive layers of material.

Both orifices are guarded against intrusion by several sets of soft membraneous valves, usually three or four at the large end and probably as many at the small end. These are placed in pairs consisting of a wide dorsal and a ventral flap or pocket attached obliquely to the inside of the tube in such manner that the free borders directed toward the orifice meet in the middle and thus effectually bar against entrance, while yielding readily to pressure from within. Presumably, should a worm leave its tube it would itself be debarred from re-entering. One small tube (110 mm.) has the orifice ornamented with a few foraminifera shells, sea-urchin spines and small pebbles.

Evidently the tubes wear away at the small end, the worm occupying the newer parts and building extensions at the large end and at the same time removing old valves and replacing them by new pairs. It is evident also that the length of additions decreases as the tubes become larger and that there is much individual variation in this respect.

Old tubes are always covered with a friable black incrustation, except on the newer parts at the large end, and especially adherent at the rings. Some of them also bear growths of hydroids and an occasional barnacle (*Scalpellum proximum* Pilsbry) small tunicate (*Styela*) or small actinian (*Sagartia* sp.)

Found at only one station, but there in abundance: 4,387, vicinity of San Diego, Lat. 32° 32′ 40″ N., Long. 118° 04′ 20″ W., 1,059 fathoms, green mud.

LUMBRINERIDÆ.

This is another fairly well-represented family and from the point of view of geographical distribution is interesting because, more than any other family, it resembles the fauna of the southern Pacific coast of South America. This resemblance is seen not alone in the fact that the two regions possess two species in common, but also in the resemblance of other species which are distinct.

Ninoe gemmea sp. nov. Pl. XIX, figs. 101-109.

Form moderately elongated, slender and terete, the anterior branchiate region wider and depressed. A complete example (type) is 104 mm. long with a maximum width, exclusive of parapodia, of 2.4 mm. at XXX. Segments 146.

Prostomium small, slightly longer than wide, distinctly depressed, subovate, continuing the outline of the anterior end of the body forward to a subacute apex, very smooth and differentiated only indistinctly from the peristomium at the sides. The mid-dorsal portion of the pro-peristomial furrow forms a broad but shallow, semicircular or crescentic furrow, the horns of which end at a pair of small translucent spots marking the tips of the forward lateral projections of the peristomium. It is uncertain whether or not a minute obscure papilla exists at the bottom of this nuchal furrow. On the ventral surface is a pair of slight submarginal longitudinal grooves which meet the lateral furrows bounding the prominent quadrant-shaped palps which are separated by a deep medial furrow. No eyes.

The outline passing from the prostomium into the peristomium and body is very regular and unbroken. Peristomium and somite II apodous, together equalling the prostomium in length; the peristomium longer at the sides, but dorsally cut into by a deep re-entering bay, reducing it to the length of II. Ventrally they coalesce to form a deeply furrowed lip. Segments simple, very smooth and regular, and separated by deep, even furrows, the length to width ratio varying from one to four or five at the anterior end to one to two at the posterior end, toward which their length increases both relatively and actually. From the point of greatest diameter at about XXX, the body tapers very regularly and gently to the caudal end, being for most of the length strictly terete. Cuticle highly polished, with a pearly iridescence.

Pygidium a small, obliquely flaring ring, bearing at the sides of a small ventral platform a pair of conical cirri about as long as the diameter of the pygidium.

Parapodia strictly lateral, uniramous, with quite rudimentary notopodium. The first few are very small, slightly compressed tubercles with obsolete presetal lip and subfoliaceous, cuneate-ovate postsetal lip as long as the body of the foot (Pl. XIX, fig. 101). Farther back, in the branchial region, the presetal lobe becomes a hemispherical swelling, which is again lost posteriorly. At VI, or in one case, V, the postsetal lip bifurcates, the ventral lobe remaining as before, the dorsal being cirriform and slightly longer. On succeeding segments the latter becomes more distinct and larger than the other branchial filaments and curves somewhat dorsad into a suberect position (fig. 102). The remainder of the postsetal lip then divides into the filaments of the digitate gill, the ventralmost filament of which retains a trace of the foliaceous condition in a small basal wing. Otherwise the branchial filaments resemble the dorsalmost filament or cirrus, and where best developed only equal the foot in length and spread in a palmate fashion (fig. 103). On the type there are two filaments at X, three at XIII, continuing with three or occasionally four to XLIX. The filaments increase in length to about XL and then rapidly diminish without change in number to XLIX, at which segment the dorsal one alone remains. It bears a small basal wing and remains quite prominent for many segments and finally after reduction to a small postsetal papilla continues to the end. A slightly larger cotype has two branchial filaments at VIII, three at XVI, four or rarely five between XX and XLII and three from XLII to LII. In the postbranchial region the parapodia (fig. 104) are more slender and relatively more prominent, cylindroid with the end slightly cleft into presetal and postsetal lips, the latter a subconical papilla. A minute notopodial papilla at the dorsal base of the neuropodium of all segments.

Neuropodial acicula black with pale bases, usually four, slightly tapered to blunt tips which reach, but ordinarily do not project beyond, the surface. Notopodial acicular fine fibers which pass from the segments above the parapodia strongly ventrad, curving into the notopodial tubercle.

All setæ have black or dark brown stems and pale ends, which on the limbate setæ includes the entire blade. All setæ are simple, and limbate setæ and crochets occur together on all parapodia, the former being more numerous on anterior, the latter on posterior parapodia. All are very brittle and, owing to the frequency with which they are broken, the exact arrangement was not determined. At least one crochet occurs in the subacicular fascicle of III along with three or four limbate setæ, of which an equal number exist in the supra-acicular fascicle. At X there are four supra-acicular acute limbate setæ, six subacicular limbate crochets and below these two more acute setæ. At XXV the numbers are respectively seven, five and one. On posterior parapodia the usual arrangement is one acute seta and one crochet in the supra-acicular fascicle and four crochets in the subacicular fascicle.

The pointed setæ (Pl. XIX, fig. 105) are of the usual bilimbate type and either simply or sigmoidly curved. Some of those in the dorsal fascicle of anterior segments have the wings abruptly terminated and the shaft continued as a very long acute mucron. They differ considerably in length and proportions in the same bundle and posteriorly all become much elongated and slender. Anterior crochets (figs. 106, 106*a*) are transitional to the acute limbate setæ, having long, slender limbate ends passing into delicate rounded hoods which enclose the small, indistinctly toothed heads. Though gradually diminishing in length, they undergo no conspicuous change through the branchial region, but posteriorly become converted into true crochets (fig. 107) which are alimbate, somewhat stouter and have shorter, thicker ends and more inflated hoods enclosing a well-developed beaked and crested head.

Mandibles (Pl. XIX, fig. 108) delicate, flexible and nearly white, except that the tips of the masticatory plates and a pair of submedian lines are black. Carriers or stems long and slender, separated for about the posterior two-thirds of their length, firmly united anteriorly and widened into a broad plate bearing the narrow, strongly curved continuous masticatory plate which terminates in a strongly but irregularly toothed apex. Maxillæ (Pl. XIX, fig. 109) deep brown, opake, the forceps jaws with long bases or carriers nearly equal to the jaws in length, together having the outline of an urn, but not united medially; hinges well-developed and the jaws very strongly and regularly curved. The large dental plates (II) are massive, symmetrical and each provided with a series of eight regular stout teeth on the inner margin. Maxillæ III small, narrowly ovate with one large hooked tooth succeeded by a slightly curved, serrate margin. Anterior maxillæ (IV) large, with similarly serrate, medial margin, but the large tooth less well-developed. A pair of long, narrow, brown, chitinized bands lie at the sides of the large dental plates.

Integuments unpigmented, but cuticle with a beautiful pearly luster.

Known from three specimens, one each from stations 4,450 (type), off Point Pinos Lighthouse, Monterey Bay, 55–60 fathoms, dark green mud; 4,485, off Santa Cruz Lighthouse, Monterey Bay, 39–108 fathoms, soft green mud and sand; 4,523, off Point Pinos Lighthouse, 75–108 fathoms, soft dark mud.

Ninoë fusca sp. nov. Pl. XIX, figs. 110–118.

This species, described from a single incomplete specimen, has the general *Lumbrineris* build, but is stouter and more depressed than most species of the genus. The type, consisting of two pieces together comprising 120 anterior segments, is 48 mm. long and has a maximum width of 3.5 mm. at somite XXV.

Prostomium (Pl. XIX, fig. 110) nearly an equilateral triangle with bluntly rounded apex. A slightly elevated median dorsal field is bounded by a pair of shallow grooves which extend from near the apex to the nuchal fold where they include nearly one-half of the prostomial width between them. At these points the prostomium is attached to the peristomium by a pair of folds having almost the form of ball-and-socket joints, separated medially by a deep nuchal pit much wider than long and covered by a nuchal fold of the peristomium. No eyes. Ventral surface smooth with a deep transverse fissure just anterior to the palps. Palps subquadrate cushions separated by a median furrow, their lateral ends trilobate and partially united with the peristomial lip behind. Immediately behind them and anterior to the lip is a small fold guarding the end of the mandible.

Peristomium and II achætous, together not as long as the prostomium, but much wider; I slightly longer and wider than II and thickened below to form the lateral lobes of the lip. The anterior median region of the peristomium forms a nuchal fold which roofs the nuchal pit between it and the prostomium. When this is drawn back as in fig. 110, the posterior or peristomial face of the pit is seen to bear a vertical groove lodging a small and apparently retractile cirrus or papilla, the merest tip only of which is visible when the fold is in place. Anterior somites in general have the dorsum strongly arched and the venter flattened.

Except for the minute, scarcely noticeable notopodial tubercles, the parapodia are uniramous. Anteriorly they are very small and so near to the venter that they are scarcely visible from above. After about XV they are larger and lateral, but remain nearer to the dorsal than the ventral surface. They are short, thick, subcylindrical, somewhat thickened at the distal end, the presetal portion of which forms a hemispherical thickening. The postsetal lip is produced dorso-distally into a small, erect finger-like cirrus or gill containing a large vascular loop. This is fully developed on the first parapodium (III) and undergoes no marked change in the first forty segments (figs. 111, 112), after which it gradually diminishes in size, the thickened distal end of the foot undergoing simultaneous reduction. Toward the end of the piece the parapodia (fig. 113) are more slender and taper to simple blunt points.

Neuropodial acicula are three or four, stout, slightly tapered black rods with colorless bases, the tips bluntly pointed and either not projecting or projecting only slightly beyond the surface. Notopodial acicula obsolete, corresponding to the extreme reduction of the notopodia.

Setæ moderate in number, disposed in a supra-acicular and a subacicular fascicle, the former nearly horizontal, the latter vertical in arrangement. At somite XV there are eight in the former, fifteen in the latter, a number which is reduced posteriorly to three in each group, of which the subacicular are crochets. All are dark brown at the base, pale or colorless distally. Anteriorly acute setæ (Pl. XIX, fig. 114) alone occur. They are long, slender, narrowly bilimbate and slightly sigmoid with prolonged capillary tips. Those in the supra-acicular fascicle longer than the subacicular, but otherwise similar. On posterior parapodia they become shorter (fig. 115). It is impossible to ascertain from the type alone at just what segment crochets appear, but certainly none are present before somite L, and about LXX would appear to mark the point of their appearance. They are slightly stouter than the limbate setæ, with slightly curved, not thickened stems, ending in an imperfect small head enclosed in a delicate hood (Pl. XIX, fig. 116).

Mandibles (Pl. XIX, fig. 117) rather delicate, flexible, soft, white with black or dark brown apices and parallel dark brown lines on the masticatory plates and more delicate brown lines and a heavy median dark band on the carriers. The anterior half of the carriers is a broad solid piece, the posterior half a pair of slender slightly divergent stems. Masticatory plate a continuous, narrow, hard, curved band bordering the free end of the carrier and obscurely toothed at the apex. Maxillæ (Pl. XIX, fig. 118) dark brown or black, opake. Forceps jaws with base plate or carrier about two-thirds as long as jaws, ovate with a constricted anterior end and straight hinge; the jaws with stout bases and strongly curved ends. First dental plates (II) irregular and each with only two large teeth on medial border. They are possibly abnormal or much worn. The next plate (III) is small and narrow with one large apical tooth, and the anterior plate (IV) is remarkably large, triangular with a single stout tooth.

Color uniform brown.

This species is imperfectly known through a single specimen taken at station 4,397, off Santa Catalina Islands, 33° 10′ 15″ N., 121° 42′ 15″ W., 2,196 to 2,228 fathoms, gray mud.

Ninoë fusca is closely related to *Ninoë simpla* Moore previously described from Alaskan waters. Both have the nuchal papilla and simple unifilar gills and their setæ are closely similar, but they differ much in the form of the postsetal lip of the parapodia and of the maxillæ. These two species taken in conjunction with such species of *Lumbrineris* as *erecta* and *tetraura* largely break down the distinction based on the presence or absence of branchiæ that is usually made between the two genera. On the other hand, their possession of the nuchal papilla segregates them from the majority of species of both genera.

The species of *Lumbrineris* and related genera of this region are noteworthy because of their tendency to develop prolonged branchial processes of the parapodia. This tendency seems to be most marked in the fauna of the deeper waters of Monterey Bay and reaches its maximum in *L. bifilaris.*

Lumbrineris japonica v. Marenzeller, **index** subsp. nov. Pl. XIX, figs. 119-127.

Lumbriconereis japonica v. Marenzeller, Denkschr. K. Akad. Wissensch. (1879), XLI, pp. 137, 138, Taf. V, fig. 3.

This well-marked form presents a superficial resemblance to *L. erecta* of the littoral zone of the coast of California, but its technical characters so closely ally it with *L. japonica* that it is regarded as belonging to that species. The chief peculiarity is found in the noteworthy elongation of the postsetal lip of middle and posterior parapodia which is quite as pronounced as in *L. erecta.* The erectness and rigidity characteristic of these processes in the latter species is here absent; they are evidently more flexible and mobile and usually directed laterad in many cases (fig. 120), reminding one of a pointing finger. This feature does not appear on anterior parapodia, on which the postsetal lips are foliaceous, the digitiform or cirriform character usually becoming pronounced by about somite XXXV.

Articulated crochets occur as far forward as III on the type and persist to XXV; on other specimens they were not detected anterior to III, V or VIII, but continued as far as XXX, after which point simple crochets only occur. Limbate setæ may cease at LVI, as on the type, or continue to LXXV. The form of these crochets differs somewhat from those of Japanese examples of the species. (See Pl. XIX, figs. 124, 125.) There is a single chitinized area on each side in connection with the maxillæ, instead of two as in *L. bifilaris.*

The jaws (Pl. XIX, figs. 126, 127) agree very closely with v. Marenzeller's figures. The maxillæ are opake and very dark brown or nearly black, the mandibles pale brown marked with darker brown lines and the whitish masticatory plates tipped with a black edging.

The type (station 4,464) is 109 mm. long with a maximum width at XII of 2.8 mm. and between setæ tips of 5.7 mm. Segments 201.

Other specimens are slightly larger. Several specimens are marked with coarse pigment spots arranged in transverse bands.

Stations 4,325, off Point La Jolla, vicinity of San Diego, 191–292 fathoms, green mud and fine sand; 4,405, off San Clemente Island, 654–704 fathoms, green mud; 4,406, off Santa Catalina Island, 650 fathoms, green mud; 4,452, Monterey Bay, off Point Pinos Lighthouse, 49–50 fathoms, green mud and fine sand; 4,457, same locality, 40–46 fathoms, dark green mud; 4,464, same locality, 36–51 fathoms, soft dark green mud; 4,467, Monterey Bay, off Santa Cruz Lighthouse, 51–54 fathoms, soft dark green mud.

Lumbrineris inflata sp. nov. Pls. XIX, XX, figs. 128–134.

A small and apparently an immature form. At least none of the specimens contains genital products. It presents, however, so many peculiar features that it is probably not the young of any species already described from the Pacific. The type is 68 mm. long, with a maximum width in the proboscis region of about 1 mm. Segments 134. The largest specimen is an anterior end 1.5 mm. in diameter. Form linear, tapering gently to the caudal end, terete.

Prostomium thick and scarcely depressed, length equal to or slightly exceeding width, subgloboid or short ellipsoid, sides and front equally rounded, dorsum strongly convex, venter with a broad, shallow, median groove. Eyes totally wanting. Nuchal isthmus and pit narrow, the peristomium scarcely emarginated. Palps simple cushions, wider than long.

Peristomium distinctly longer than II, which is also apodous, the two together equalling or slightly exceeding the prostomium in length. Dorsally they are sharply differentiated by a distinct furrow and the peristomium is slightly emarginated at the nuchal pit; ventrally they are united to form the furrowed lip, II being produced forward and cutting into I. Succeeding metastomial segments remarkably well-differentiated by deep furrows and more or less biannulate or marked with a narrow, raised, whitish line; anterior segments about three times as wide as long, posterior nearly as long as wide. Pygidium a minute, slightly widened ring bearing four short, equal, symmetrical, conical cirri.

Parapodia (Pl. XIX, figs. 128, 129) arise nearer the ventral than the dorsal surface, especially toward the ends of the body, and are of simple, uniform structure throughout. Neuropodia slightly thickened distally, divided at the end into a very short presetal lobe and a longer, stiffly outstanding postsetal lobe about equalling the body of the neuropodium in length. Instead of increasing in length and becoming cirriform and highly vascular caudally, as is the case with most species of *Lumbrineris* inhabiting this region, the postsetal lobe, if changed at all, becomes somewhat smaller posteriorly and never shows any indication of becoming erect. A minute papilla at the dorsal side of the base of the neuropodium represents the notopodium.

Neuropodial acicula two or three, pale brown, of the usual tapering form, the tips not appearing beyond the surface. Notopodial acicula very delicate, their ends imbedded in a spherical opake mass.

Setæ all colorless, of the usual simple limbate and hooded crochet types, the former on the first thirty to forty segments only, the latter on all segments. The number of setæ is moderate, their distibution on the type being as follows: the first foot (III) has seven limbate setæ and two articulated crochets; X has five limbate setæ in the supra-acicular fascicle and four articulated crochets and one limbate seta in the subacicular fascicle; XXV has three supra-acicular limbate setæ and two subacicular crochets, of which the ventralmost is simple; middle parapodia have three or four simple crochets, with which a limbate seta may be associated as far as XL. Other examples have a practically similar distribution, but the last compound crochet may occur at XVIII and the first simple one at XVII. The limbate setæ (Pl. XIX, fig. 130) are in no way characteristic; they are rather sharply bent, very acute and the blades narrowly lanceolate. Crochets of anterior parapodia (Pl. XIX, fig. 131) are imperfectly compound, with an oblique articulation that divides the stem but not the hood, which is, however, adherent to the stem in such a manner as to produce a rather pronounced double inflation; the stem terminates in a high, finely divided crest. Simple crochets (fig. 132) have a short, strongly inflated hood and a long-beaked head surmounted by a crest of fine teeth.

Jaws much like those of *L. hebes* Verrill. Mandibles in one specimen rudimentary, in another (Pl. XX, fig. 133) colorless and delicate, stems long and slender, united by their anterior halves; masticatory plates very oblique, separated by a deep anterior cleft, each when intact with a large apical and a somewhat smaller internal tooth. Maxillæ (fig. 134) dark brown, carriers of forceps jaws (I) with halves very imperfectly united, slender, a deep incision on each side in anterior third, the part posterior to which is more than twice as long as wide and acutely pointed behind; hinge well-developed; the forceps moderately stout in basal third, strongly hooked distally. Large tooth plates (II), with stout body and large outstanding quadrate lateral wing and four or five stout teeth. The next anterior plate (III) has an oblong, lateral supporting plate and a curved dentigerous margin, bearing three or, in one case, four teeth. Anterior plate (IV) slightly larger than III, with ovate-quadrate supporting plate and a thick medial border bearing two stout triangular teeth.

All of the specimens are pigmentless with a delicate pale blue cuticular luster.

Stations 4,454, Monterey Bay, off Point Pinos Lighthouse, 65–71 fathoms, green mud, shells and gravel; 4,463, same locality, 36–51 fathoms, soft dark gray mud; 4,496 (type), Monterey Bay, off Santa Cruz Lighthouse, 10 fathoms, fine gray sand and rock.

Lumbrineris tetraura (Schmarda) Ehlers.

Lumbriconereis tetraura Ehlers, Festschr. K. Gesellsch. Wissensch. Göttingen, 1901, pp. 137–139, Taf. XVII, figs. 1–10.

A fine example of what is undoubtedly this far southern species was found among some *Aracoda semimaculata*. It is 114 mm. long and 1.6 mm. wide at XII, the spread between the tips of the parapodia at the same place being 3 mm. Segments 121. Compared with Ehler's figures, the prostomium is somewhat shorter and much more broadly rounded and the postsetal lobes somewhat longer and more erect.

The segments often exhibit a faint biannulation. Posteriorly they are somewhat depressed and the appearance of depression is considerably enhanced by the prominent outstanding parapodia which equal the width of the segments. Pygidium a short ring bearing two pairs of cirri, of which the dorsal is somewhat shorter and thicker, the ventral slightly divergent, longer and more slender. Crochets occur on all segments, the anterior being long and limbate with small heads, but they gradually assume the typical form which is attained by about XXXV. A single acute seta continues to at least C. Both setæ and jaws agree closely with Ehler's description, the three pairs of maxillæ having one, two and four teeth, respectively, and the mandible a very characteristic form. It is to be noted, however, that Ehler states that limbate setæ extend to about somite XXI only and that articulated crochets occur in the anterior seventeen segments of young worms.

Station 4,496, off Santa Cruz Lighthouse, Monterey Bay, 9–11 fathoms, hard sand.

Lumbrineris bifilaris Ehlers. Pl. XX, figs. 135–142.

Lumbriconereis bifilaris Ehlers, Festsch. K. Gesellsch. Wissensch. Göttingen, 1901, Math.-Phys. Kl., pp. 139–141, Taf. XVIII, figs. 1–10.

This interesting and abundant species resembles Ehler's south Chilean species very closely in every respect except the structure of the jaws. Ehler's figure of the latter differs in certain respects so greatly from the form usual in the genus that I have assumed that the single specimen available to him was abnormal or imperfect in these respects. Otherwise these specimens could scarcely be regarded as cospecific with his, notwithstanding their close external similarity. Even on this assumption there is by no means complete identity, and further study of Chilean material may necessitate subspecific or even wider separation.

A set of well-preserved jaws is represented in figures 141, 142, and several others which were dissected agree closely, the principal differences being in the occasional presence of a third large tooth in place of the first small tooth on one of the large-toothed maxillæ (II) and in the variable length of the stems of the mandibles.

The peristomium of Ehler's type is decidedly more elongated than that of the Californian examples, in which the basal width equals the length.

Parapodia of the anterior, middle and posterior regions are illustrated in figures 135–137. Those of the latter region with their two cirriform processes are very characteristic and bear a very close resemblance to Ehler's figure, which, however, is inverted. The ventral outstanding filamentous process is postsetal and the dorsal erect one, which contains a conspicuous vascular loop, is presetal in origin. The notopodial tubercle or rudimentary cirrus is quite distinct from the latter, but becomes obsolete on posterior segments. Parapodia exhibiting this extreme development of the lobes are confined to the posterior third or two-fifths of the body, those in the middle region having them digitiform and only about as long as the body of the foot (fig. 136) and in this respect these specimens differ somewhat from Ehler's, in which the filiform character becomes established farther forward. This difference, though somewhat indefinite, is quite striking and is equally true of large and small specimens alike. The resemblance of the bidigitate parapodia of the middle region to those of *L. bifurcata* McIntosh is striking and, indeed, the two species have much in common, but they diverge in the character of the posterior parapodia (fig. 137).

Although the setæ (Pl. XX, figs. 138–140) in general resemble those of the type in form and distribution, in respect to the latter there are some noteworthy variations and differences. Anterior parapodia bear both limbate setæ and crochets, the latter being themselves limbate, slender and with small imperfect heads; posteriorly only true hooded crochets with short bodies and strongly hooked heads occur. Ehlers states that crochets occur on all podous segments, the anterior being limbate and that acute limbate setæ cease at LV. On my material crochets may begin on the first foot (III), which is usual, or they may be absent for from four to twelve anterior parapodia. This is notably the case in three specimens from station 4,523, in which the first occurs in X, XII and XIV, respectively, the first two specimens being about 5 mm., the last 3 mm. in diameter. On two still larger specimens 5 mm. and 7 mm. in diameter, from stations 4,406 and 4,402, no crochets were detected anterior to XIX and XXI, respectively. The passage from limbate to true crochets is a gradual one, but typical crochets may usually be recognized at about the fortieth parapodium. The last limbate seta may occur anywhere from segment XLII to segment LXXXIX, the average of fourteen specimens on which this was determined accurately being LXIV. There is no relation between size and the position of the last acute seta, as there is in the case of the first crochet. The variation, however, is less than would appear, for in cases where a large number of parapodia contain acute, limbate setæ, the last twenty or thirty bear but one.

Few of the specimens are obviously pigmented. Most are of a dull gray or yellowish-brown color, one having a russet ground color is marked with narrow dark brown annulations, and one lot from station 4,454, like other species from the same station, is marked with quadrate black spots. The ground is pale slate color with cuticular iridescence. The spots are sharply defined, always confined to one segment, though those of adjacent segments may coalesce. They occur on both dorsal and ventral surfaces, somewhat more plentifully on the former, and apparently increase toward the middle region, leaving the ends of the body less maculated. Individuals differ greatly in the richness of the spotting, some having very few and widely scattered spots, while on others they are numerous and often confluent; some have the prostomium unspotted, while on others it bears from one to three spots.

In all seventy-seven specimens, ranging in diameter from .8 mm. to 7 mm., were examined, and although only a very few were complete all exhibited the characteristic alteration in the form of the parapodia from before caudad and the characteristic arrangement of the setæ. A complete specimen 155 mm. long has 312 segments and at the point of maximum diameter (XVII) the width is 3 mm. (exclusive of the parapodia) and the depth 2.4 mm. A medium-sized specimen from station 4,574 is packed with eggs.

Although taken at many stations throughout the whole range of the cruise, only a single one occurs at more than half of them and more than five specimens at 4,454, 4,548 (where thirteen occur) and 4,574 only. The bathymetrical range is great, being from 36 to 2,182 fathoms.

Stations 4,306, off Point Loma Lighthouse, vicinity of San Diego, 207–497 fathoms, green mud, sand and gravel; 4,322, off Point La Jolla, 110–199 fathoms, green mud and shells; 4,364, off Point Loma, 101–129 fathoms, green mud, sand and rock; 4,366, off Point Loma Lighthouse, 176–181 fathoms, green mud; 4,382, off North Coronado Island, vicinity of San Diego, 642–666 fathoms, green mud; 4,390, off Santa Catalina Islands, Lat. 33° 02′ 15″ N., 120° 42′ W., 1,350–2,182 fathoms, gray mud and fine sand; 4,402, off San Clemente Island, 542–599 fathoms, green mud; 4,406, off Santa Catalina Island, 650 fathoms, green mud; 4,416, off Santa Barbara Island, 323–448 fathoms, dark green mud and rocks; 4,431, off Santa Rosa Island, 38–45 fathoms, varied bottom; the following in Monterey Bay, 4,445, off Point Pinos Lighthouse, 60–66 fathoms, green mud; 4,450, same, 55–60 fathoms; 4,452, same, 49–50 fathoms, green mud and fine sand; 4,453, same, 49–51 fathoms, dark green mud; 4,454, same, 65–71 fathoms, green mud, sand and gravel; 4,457, same, 40–46 fathoms, dark green mud; 4,464, same, 36–51 fathoms, soft dark gray mud; 4,467, off Santa Cruz Lighthouse, 51–54 fathoms, soft dark green mud; 4,475, off Point Pinos Lighthouse, 58–142 fathoms, soft green mud; 4,482, off Santa Cruz Lighthouse, 43–44 fathoms, soft green mud; 4,485, same, 39–108 fathoms, soft green mud and sand; 4,507, off Point Pinos Lighthouse, 308–383 fathoms, green mud; 4,523, same, 75–108 fathoms, soft dark mud; 4,541, same, 381–633 fathoms, green mud and sand; 4,548, same, 46–54 fathoms, coarse sand, shells and rock: 4,549, same, 56–57 fathoms, same bottom; 4,550, same, 50–57 fathoms, green mud and rocks; 4,556, same, 56–59 fathoms, rocks; 4,557, same, 53–54 fathoms, rocks; 4,574, off Cape Colnett, Lower California, 1,400 fathoms, bottom ?.

Lumbrineris minuscula nom. nov.

Lumbriconereis minuta Treadwell, Bull. U. S. Fish Comm., 1906, p. 1171, figs. 57, 58 (nom. preoc. *L. minuta* Theel, 1879).

Three very poorly preserved anterior ends of a species that is much like Treadwell's *L. minuta,* but differ in several respects and especially in the great prolongation of the limbate setæ, which, coupled with the fact that the specimens, and especially one male, are filled with genital products, leads to the suspicion that they are an epitokous phase of that species.

All three examples have a diameter of about 1 mm. Prostomium relatively smaller and more slender than usual in the genus. Eyes apparently wanting, but a small median brown spot on the dorsum of the prostomium immediately beneath the border of the nuchal fold. Parapodia poorly preserved, but evidently small and inconspicuous, and evidently with the lips little produced, though the postsetal is somewhat the longer. Most interesting are the setæ. From somite III to XXV all setæ are of the capillary bilimbate type. A few segments beyond XXV crochets appear and continue to the end of the pieces or beyond C. On anterior segments the limbate setæ agree with Treadwell's description, being long and slender, bilimbate and bent. They number ten or twelve and the ventral four or five are longer than the others. Farther caudad, after the crochets appear, the number of limbate setæ is reduced to a single short one dorsal to the crochets and five to six ventral to them in subacicular bundle. It is the latter that become so greatly elongated, projecting far beyond the ends of the parapodia and in one specimen equalling the diameter of the body. They are nearly straight with greatly restricted limbæ and the shaft continued into an excessively tenuous end. Anteriorly the crochets are restricted to two in the supra-acicular fascicle, but farther back two more are added in the subacicular fascicle. They are little, if any, stouter than the setæ, anteriorly margined for a short distance below the small head. Within a few segments, however, they lose the margin and assume the form figured by Treadwell.

While the jaws in general resemble Treadwell's figure, there are some differences which it seems probable result from imperfections in Treadwell's specimen. The maxillæ are remarkably massive for so small a species. Forceps jaws characterized by the very small base; maxillæ II with five teeth on the right and four on the left side, the first tooth on each side being very large and well-separated from the others by a wide internal. The anterior pairs of plates (III) are both very large, triangular and bear a single apical tooth. Mandibles pale with dark tips and differing little in form from those of *L. bifilaris*.

Station 4,390, off Santa Catalina Islands, 33° 02′ 15″ N., 120° 42′ W., 1,359–2,182 fathoms, gray mud and fine sand.

Aracoda semimaculata sp. nov. Pl. XX, figs. 143–149.

Form slender, subterete, but owing to the prominence of the parapodia appearing widened and depressed in the middle and posterior regions. The type, in which the caudal end terminates in a small cone of regeneration, is 165 mm. long and 2.8 mm. wide, exclusive of the parapodia. Segments 278. Four other examples accompany the type. Three small complete ones are from 52–93 mm. long and have from 135 to 209 segments, and a larger one, lacking the caudal end, is 155 mm. long, 2 mm. wide and has 235 segments.

Prostomium as long or slightly longer than wide, subovate, slightly depressed, the ventral face with a slightly impressed median area bounded by a pair of parallel furrows which pass into the mouth. Eyes four in a transverse row near the posterior border. In the two larger specimens the eyes are obscure, especially the outer larger pair; on the smaller ones they are much more distinct and the middle always decidedly smaller. Peristomium and succeeding achætous segment together about as long as the prostomium, the former slightly the longer; lip but little furrowed and palpal pads at base of prostomium scarcely evident.

Segments all simple and sharply defined, varying from four to six times as wide as long, nearly terete, but the venter slightly flattened. Lateral or parapodial furrow slightly developed. Pygidium a minute cylinder bearing two or four very small padlike cirri.

Parapodia (Pl. XX, figs. 143–145) begin on III. The anterior are very small and inconspicuous, but they increase in size and become prominent farther back. The body is slightly flattened, cylindroid, constricted at the base and divided at the distal end by a vertical setigerous cleft into presetal and postsetal lips. The former is short and broadly rounded on all parapodia, the latter undergoes conspicuous change. On anterior parapodia (fig. 143) it is nearly as long as the body of the foot, moderately flattened and subtriangular, with the blunt apex directed upward and outward. It rapidly becomes longer, thicker and cylindroid and bends dorsad (fig. 144). Throughout the middle region it presents the appearance of a short finger crooked upward. Still farther back, continuing to increase in length and arising more from the ventral aspect of the foot, it takes a slightly spiral turn and a suberect posture and retains this character to the caudal end (fig. 145). On all parapodia the notopodium appears as a rather prominent but small angulated tubercle on the base of the dorsal face of the neuropodium.

Neuropodial acicula usually two or three, straight, tapered, pale, with the dark, bluntly pointed tips protruding a short distance beyond the surface. Notopodial acicula two or three slender fibers entering the notopodial tubercle.

Setæ few, from six to eight on anterior, diminishing to usually four on posterior parapodia. All are pale yellow, acute, bilimbate, more or less sigmoidly curved and geniculate at the first bend. The geniculum is directed dorsad and is most strongly developed on the dorsal-most setæ which are also the longest. On anterior parapodia the margins of the setæ are smooth or nearly so (fig. 146); farther back the serrations become more prominent, especially on dorsal setæ, which also have a few transverse pectinæ at the base of the geniculum (fig. 147).

Jaws of two specimens dissected. Mandibles (Pl. XX, fig. 148) dense opake black, the posterior half or two-fifths narrow and somewhat tapered, separated on the two sides by a wide median space, the anterior portion abruptly twice as wide, the two halves united by an extensive suture, the exposed tips slightly divergent with finely denticulated free margins. Maxillæ (Plate XX, fig. 149) also dense opake black, the forceps jaws supported by a pair of small triangular carriers prolonged into tapered filaments about one and one-third times as long as the series of jaws, the forceps with massive bases and short, strongly hooked ends, the left bearing on its medial margin eight or nine stout teeth of diminishing size, the right about seven smaller teeth. Maxillæ II asymmetrical, the left short and stout with eight teeth, the right long and narrow with about thirteen teeth diminishing in size from before backward. III[1] is a curved piece bearing two teeth on each side; IV is irregular with five or six unequal teeth; V is also irregular with four or five slender teeth and the most anterior (VI) is a small piece with one slender tooth and a bifid base. A long ribbon-like band of chitin exceeding the forceps filaments in length extends caudad from the posterior maxillæ ventral to the forceps carriers.

In color some are pale gray and unspotted, but three of the specimens are blotched with three dorsal series of dusky bluish spots and the peristomium is deeply pigmented above. The cuticle is more or less iridescent.

Known only from station 4,496, Monterey Bay, off Santa Cruz Lighthouse, 10 fathoms, fine gray sand and rocks.

From *Aracoda cerulea* Schmarda, as redescribed by Ehlers, this species is abundantly separated, particularly through the characters of the jaws, which in fact depart materially from the form typical of the genus.

Arabella attenuata Treadwell?

Arabella attenuata Treadwell, Bull. U. S. Fish Comm., XXIII, part III (1906), p. 1172, fig. 62.

A small portion of the middle of a large specimen about 3 mm. in

[1] Through an oversight maxilla III was overlooked in labeling fig. 149.

diameter which may belong to this species. The parapodia bear large, semierect respiratory postsetal lobes as in *A. spinifera* Moore and also possess the conspicuously protruding spine and the winged and toothed setæ of that species, though the latter are less distinctly geniculate.

Station 4,351, off Point Loma Lighthouse, Monterey Bay, 423–488 fathoms, soft green mud.

Drilonereis falcata sp. nov. Pl. XX, figs. 150–154.

A typical member of the genus known from incomplete worms only. The type consists of an anterior piece of 188 segments, and a posterior of 41 segments, possibly belonging to the same individual, the middle region of which is wanting. Together the pieces measure 121 mm. long and have a maximum width of 1.2 mm. and a depth practically the same. Form linear, terete.

Prostomium elongated, ovate-elliptical, one and one-half or more times as long as wide, strongly depressed, the depth about two-fifths width, the greatest width being at the posterior end where the prostomium is mortised into the peristomium. No distinct nuchal organs or longitudinal grooves and no eyes above; a shallow median longitudinal groove below.

Peristomium and II achætous, about equal above and together about two-thirds as long as prostomium. Peristomium broadly excavated for half its length above for the insertion of the prostomium, produced forward below to form a prominent but simple bilobed lip, not sharply differentiated from the small palps.

Body segments of nearly uniform diameter, subterete or slightly depressed, the venter very slightly flattened, very firm and wiry anteriorly, softer behind. Segments sharply defined and very regular, simple anteriorly, biannulate behind, generally about one-half as long as wide but exceeding this in middle region. Close to the caudal end the segments are abruptly contracted and depressed. Pygidium a minute ring, bearing four short, conical, equally divergent cirri. Cuticle very smooth, polished, iridescent. Color nearly uniform purplish-brown.

Parapodia (Pl. XX, figs. 150, 151) are set into slight lateral depressions and project straight out. Anteriorly (fig. 150) they are nearly as long as the segments, but gradually become smaller simultaneously with the elongation of the segments until they are only one-third as long, though near the caudal end they are again relatively longer. All are simple, short, truncated, cylindroid, setigerous tubercles with a small dorsal steplike tubercle representing the notopodium and a somewhat ventral, papilliform postsetal lobe which is as long as the setigerous tubercle and projects straight out beyond it. No noteworthy changes in form of the parapodia occur throughout its entire length.

True setæ are all of one form (Pl. XX, figs. 151, 152), simple, bilimbate, sigmoid, tapered to an acute point and with a finely serrate margin and distinctly striated stem. Those in the dorsal part of the fascicle are usually longer. Beginning at XIII, IX or X in the several specimens, they are accompanied by a single yellow, stout, blunt, rodlike aciculum (fig. 151) which projects obliquely far beyond the surface from the ventral border of the setæ bundle. Farther back it becomes even stouter and reaches nearly or quite to the tip of the postsetal lobe.

The most distinctive characters of the species are found in the jaws (Pl. XX, figs. 153, 154). Mandibles rather large for the genus, black, shaped like a pair of broad snow-shoes with the tapering heels behind and united anterior to the middle by a broad chitinous band (fig. 153). Maxillæ black; forceps jaws (I) very strongly falcate and hamate with acute tips, stout at the base with massive, quadrate masticatory plates, the inner margin of which bears only three or four distinct small teeth and some obscure crenulations. Hinge-pieces of carriers (fig. 154) very small and strongly divergent from an irregular horizontal plate with attached fringed chitinous tendons at the united anterior ends of the long, slender, attenuated filaments, which barely exceed twice the length of the series of jaws. Large tooth plates, narrow and nearly straight or oblong, with a supporting flange or plate running nearly their entire length and meeting at nearly a right angle in a ridge bearing a series of six or seven teeth, the first of which is enlarged and talonlike, the remainder equal, regular, acute and recurved. Anterior to this plate on each side is a group of three small crowded tooth plates, each bearing a single, long, slender, strongly curved and very acute tooth on a V-shaped base. These represent III, IV and V (fig. 154).

Stations 4,451, Monterey Bay, off Point Pinos Lighthouse, 47–51 fathoms, green mud and sand; 4,460 (type station) same locality, 55–167 fathoms, green mud and gravel.

GLYCERIDÆ.

Glycera capitata Oersted.

Glycera capitata Oersted, Grönl. Ann. Dorsibr., 1843, p. 44, Tab. VII.

What is undoubtedly a variety of this species, differing in only a slight and variable degree from typical examples from the Atlantic Ocean, is not uncommon throughout this region. The principal differences exhibited by these specimens is that the parapodia are longer with the postsetal lobes and neurocirrus much more elongated, slender and acute, and the appendages of the compound setæ longer and more slender. In all important respects, prostomium, parapodia, proboscis papillæ and jaws, the resemblance is very close.

All specimens are small, the largest varying from 40 to 46 mm. long with 98 to 109 segments and most being much smaller. All are largest in the proboscis region and tapered to a slender posterior region. Prostomium with eight rings beyond the enlarged base, the three terminal ones being very small. Body segments always distinctly triannulate.

The jaws are typical and the clavate proboscis thickly covered with slender conical papillæ and either eighteen or twenty longitudinal rows of larger ovate papillæ, both of which are exactly like those of Atlantic specimens.

Glycera nana Johnson is very closely related to *G. capitata*, the principal differences being that the segments of the former are only biannulate and that the lobes of the parapodia have slightly different forms. In this connection it should be noted that at least some of the specimens reported by me from San Diego under the name of *G. nana* (Proc. A. N. S., 1909, p. 259) are really small examples of other species. One of these is a young *G. robusta* Ehlers and the other a *G. rugosa* Johnson with completely retracted gills.

Specimens of *G. capitata* occur from the following stations: 4,343 off South Coronado Island, vicinity of San Diego, 60–155 fathoms, fine gray sand; 4,452, off Point Pinos Lighthouse, Monterey Bay, 49–50 fathoms, green mud and fine sand; 4,457, same locality, 40–46 fathoms, dark green mud; 4,464, same locality, 36–51 fathoms, soft dark gray mud; 4,485, off Santa Cruz Lighthouse, Monterey Bay, 39–108 fathoms, soft green mud and sand; 4,548, 4,549, 4,550 and 4,551, all off Point Pinos Lighthouse, Monterey Bay, 46–57 fathoms, coarse sand, shells and rock, except 4,550, where green mud and rock; 4,557, off Point Pinos Lighthouse, 53–54 fathoms, rock.

Glycera tesselata Grube.

Glycera tesselata Grube, Arch. Naturgesch., XXIX, I, p. 41, Taf. IV, fig. 4.

This second European species as nearly as frequent and, at southern stations, as generally distributed in the region as *G. capitata*. The only obvious respect in which these examples appear to differ from European ones is in the possession of a smaller number of prostomial rings, for, whereas Ehlers attributes thirteen and McIntosh seventeen rings to this region, these have only eleven or twelve nearly equal rings above the enlarged base.

All of the specimens are stout and more or less inflated anteriorly in the proboscidial region and taper rather abruptly into the slender and attenuated posterior half. All segments are biannulate. Several have the proboscis fully protruded, showing the very dense covering of very high slender papillæ, among which are a few somewhat stouter but otherwise similar papillæ. The jaw appendages differ from those of *G. nana* in having a much narrower basal wing.

The color is generally a rich orange-brown, most pronounced anteriorly, and only lacking on the smallest specimens, which are clear yellow.

This species has already been recorded from the North Pacific in the Gulf of Georgia and off Japan.

Stations 4,326, off Soledad Hill, Point La Jolla, vicinity of San Diego, 243–264 fathoms, soft green mud; 4,399, Lat. 32° 44′ 50″ N., Long. 117° 48′ 45″ W., 264–285 fathoms, fine gray sand and rock; 4,410, off Santa Catalina Island, 143–245 fathoms, gray sand, shells, gravel and rocks; 4,415, off Santa Barbara Island, 302–638 fathoms, green mud; 4,418, same locality, 238–310 fathoms, dark green mud, sand and rock; 4,430, off Santa Cruz Island, 197–281 fathoms, black sand, pebbles and rock; 4,431, off Santa Rosa Island, 38–45 fathoms, varied bottom; 4,463, off Point Pinos Lighthouse, Monterey Bay, 48–111 fathoms, rocky.

Glycera alba Rathke **macrobranchia** subsp. nov.

Glycera alba Rathke, Nov. Act. Acad. Nat. Cur., XX, p. 173, Tab. IX, fig. 9.

Represented by a single long, slender, nearly complete specimen. Length 99 mm., width 2.7 mm. Number of segments 129, probably 25 or 30 at the caudal end missing.

The segments are all strongly biannulate, with the middle or foot-bearing annulus somewhat larger. Parapodia small, in middle region about one-third as long as the body width. The dorsal gills begin at XXII and reach a very large size before L, remaining nearly unaltered to the end of the piece. Compared with European and Japanese examples of the species, the gills of this specimen are much larger and the postsetal lobe smaller.

The jaws are unknown, but the half-protruded proboscis was studied. Its surface is very finely granular from the presence of very numerous small, pediculated, oval papillæ, bearing inclined, winged, cuticular terminal plates, among which are scattered some much smaller subconical papillæ. Compared with typical examples of the species, these papillæ are distinctly larger, with relatively shorter stalks and less pronounced wings on the end plates.

The single specimen is labelled Beaver Shoal, San Diego Bay, mud, 7/19/'05.

Glycera branchiopoda sp. nov. Pls. XX, XXI, figs. 155-159.

A small, rather slender species, characterized by the well-developed ligulate dorsal and ventral gills. The type is 90 mm. long without proboscis; the maximum width, exclusive of parapodia, 2.8 mm., with parapodia 3.5 mm. Proboscis, not fully extended, 22 mm. long, 2 mm. in diameter at base and 3.5 mm. at the distal end.

Prostomium of the usual form, consisting of a broad, rugous, basal region constituting about two-fifths of its length and a slender, somewhat depressed conical portion divided into seven annuli decreasing in size regularly from base to apex, the basal three aggregating considerably more than one-half of its length. Terminal segment very small, dome-shaped, bearing the four minute apical tentacles which are divergent and all directed somewhat ventrad, the dorsal slightly longer than the ventral. There is a median dorsal and a median ventral groove, the latter being the better developed.

Peristomium closely united with prostomium, divided below by the large mouth. Metastomial region increases in diameter to about XL, from which the body tapers to the caudal end. Anterior segments very short and crowded, the first with modified parapodia closely crowded against the head. Remainder of the body nearly terete, the segments strongly arched above and slightly flattened below. Anteriorly they are at least eight times as wide as long, but increase gradually in length while decreasing in width until the ratio is two to one. All segments are strongly and completely triannulate and the annuli are of nearly equal width, only the third or postpodal being slightly larger than the others, especially posteriorly where they are marked above by a straight cross-furrow. On the short and crowded anterior segments the prepodal annulus is frequently united with the middle annulus laterally and partly bears the parapodia. Middle annulus, though never enlarged, is frequently conspicuous by reason of its paler color. Pygidium unknown.

Parapodia characteristic, the anterior short and deep, the posterior longer and more cylindrical. First two situated high by the sides of the mouth with the notopodium much reduced and notocirrus totally lacking, consequently consisting of a neuropodium bearing a short, rounded postsetal lip and a longer acute asymmetrical presetal lip. Remaining parapodia (Pl. XXI, figs. 158, 159) all biramous, the postsetal lip short, broad, and undivided, broadly rounded, often slightly emarginated on middle segments. Presetal lip deeply cleft into a dorsal and a ventral lobe. On anterior segments (fig. 157) these present no striking peculiarities; both are foliaceous at the base where the ventral lobe is much the larger, while the distal portion, which is separated by a slight constriction, is longer and acute in the dorsal lobe and usually obtuse in the ventral lobe. Neurocirrus prominent, attached to middle of ventral face of neuropodium, somewhat grooved and embracing the neuropodium at the base and tapered to an acute tip which usually diverges more or less from the foot. Notocirrus a small globoid or subcylindrical papilla situated on the side of the body well above the parapodium. Passing caudad, the foliaceous base of the dorsal presetal lobe is gradually reduced and the distal part enlarged to form a gill which becomes fully established at about XXXV (fig. 158). Throughout the middle region and nearly if not quite to the caudal end this lobe forms a prominent, subligulate, erect gill rising from the dorsum of the end of the foot and fully equalling or exceeding the latter in length (fig. 159). The ventral presetal lobe does not become branchiform, but elongates and finally takes a slender finger-like form (fig. 159). Simultaneously with the development of the dorsal gill a ventral gill develops from the modification of the neurocirrus. This is similar in form to the dorsal gill, but when fully developed (figs. 158, 159) becomes even larger, reaching beyond the end of the postsetal lip. Near the caudal end it undergoes considerable reduction in size. Both dorsal and ventral gills are thin-walled and sacular with large cavities communicating with the cœlom and a layer of longitudinal and slightly oblique muscle fibers by which they may be retracted.

Acicula two, corresponding to the two principal fascicles of setæ, both simple, nearly straight, tapered, pale rods, the ventral much the stouter. Setæ colorless, in three fascicles, a dorsal oblique row of very slender simple setæ, a middle horizontal and a ventral vertical series of compound setæ. The latter have slender shafts terminating in deep asymmetrical sockets and slender, tapered, finely punctated blades, with minute marginal denticulations. On the first two parapodia simple setæ are absent, but the dorsalmost compound setæ have very long slender blades. In general the blades of the compound setæ decrease in length from the dorsalmost ventrad and from the anterior end caudad.

Proboscis described from a cotype (station 4,517), this being the only one in which it is everted to the jaw pads. The nearly complete worm is 35 mm. long, the proboscis 12 mm. long, 1.5 mm. in diameter at the base and 3.2 mm. at the distal end. Clavate, the distal end domed and terminated by sixteen large, soft papillæ flattened against one another in a circle at the base of the still retracted jaws. Surface proximad of these papillæ thickly covered with small cutaneous papillæ of three forms and sizes. The most numerous are tall, slender cones (Pl. XX, fig. 155*a*), the second are larger, low, truncate cones (fig. 155*b*) arranged in eighteen or twenty longitudinal rows along the muscle bands; the third are a few scattered and smaller papillæ (fig. 155*c*). All three kinds have a similar structure, with an apical pore at which a pair of refringent fibers end, and containing a few large sensory cells and a supporting framework. Jaws of the usual falcate form, strong, black, clawlike with expanded, hollow bases and an appendage consisting of a rod and a large thin, triangular, basal wing supported by a thickened marginal rib (fig. 156).

Color as preserved pale yellow.

Stations 4,517, off Point Pinos Lighthouse, Monterey Bay, 750–766 fathoms, green mud and sand; 4,525, same locality, 222 fathoms, soft gray mud; 4,527, same locality, 183–337 fathoms, hard sand; 4,528, same locality, 766–800 fathoms, soft gray mud; 4,574 (type), off Cape Colnett, Lower California, Lat. 30° 35′ N., Long. 117° 23′ W., 1,400 fathoms.

Glycera rugosa Johnson.

Glycera rugosa Johnson, Proc. Bos. Sci. Nat. Hist., XXIX, pp. 409–411, Pl. 10, figs. 101, 102.

Owing to the complete retractibility of the branched gills of this species, their presence is easily overlooked as was done on a former occasion in hastily determining such a specimen from San Diego as *G. nana*. Careful examination in direct sunlight always renders visible the orifices through which the gills have been withdrawn. Those from station 4,454 are marked with quadrate black spots.

Stations 4,431, off Santa Rosa Island, 38–45 fathoms, varied bottom; 4,454, off Point Pinos Lighthouse, 65–71 fathoms, green mud, sand and gravel; 4,548, same locality, 46–54 fathoms, coarse sand, shells and rock.

Glycera longissima Arwidsson.

Glycera longissima Arwidsson, Bergens Museums Aabog for 1898 (1899), pp. 23, 24, Pl. I, figs. 15, 19; *G. chilensis* Arwidsson, *ibid.*, pp. 24, 25, Pl. I, figs. 20, 21.

Arwidsson's two species are probably identical, as Ehlers has already indicated. This species is represented by a very large, practically complete example 305 mm. long and 8 mm. wide exclusive of the parapodia. Segments 230, a few of the most caudal and the pygidium missing.

Prostomium 12-annulate, the four apical tentacles minute. Segments strongly biannulate. Gills begin at XIV in the same position as in *G. rugosa*, but are much more complex than in that species. All are branched, but the most anterior and posterior have only two or three slender divisions. The most are very large and complex, reaching from their place of origin at the posterior dorsal part of the foot over most of its posterior face. The largest divide immediately at the base into three or four large branches, each of which spreads vertically into a flat plane divided irregularly several times into slender filaments. Most of the larger gills consist of thirty or forty filaments. Proboscis 53 mm. long and 7 mm. in diameter, but jaws not exposed, thickly covered with papillæ of the same form as those of *G. rugosa*. This specimen agrees rather better with the description of *G. chilensis*, especially in the form of the jaw appendage and the mode of branching of the gills.

Station 4,322, off San Nicolas Island, 31–32 fathoms, gray sand and shells.

GONIADIDÆ.

Goniada annulata Moore.

Goniada annulata Moore, Proc. Acad. Nat. Sci. Phila., 1905, pp. 549–553, Pl. XXXVI, figs. 45–48.

A considerable representation of this species, usually only one example from each station, shows a wide range of color variation from yellow through light brown, gray and dark brown to purple, usually more or less distinctly annulated, but some of the most deeply pigmented ones nearly uniform. Some of them are sexually mature. Notopodial setæ begin on XXXIII or XXXIV, in the latter case the preceding parapodium being usually provided with a small achætous notopodium. The sexual region, characterized by long swimming setæ and neural eye-spots, begins on different specimens at LIV, LV or LVI. The proboscis and its jaws and papillæ agree very closely with the types.

Stations 4,307, off Point Loma Lighthouse, 490–496 fathoms, green mud and fine sand; 4,326, off Point La Jolla, vicinity of San Diego, 243–264 fathoms, soft green mud; 4,325, same locality, 275–292 fathoms, green mud and fine sand; 4,352, off Point Loma Lighthouse, vicinity of San Diego, 549–585 fathoms, green mud; 4,353, same locality, 628–640 fathoms, green mud; 4,366, same locality, 176–181 fathoms, green mud; 4,369, same locality, 260–284 fathoms, green mud, sand and rock; 4,462, off Point Pinos Lighthouse, Monterey Bay, 161–265 fathoms, green mud; 4,508, same locality, 292–303 fathoms, soft green mud; 4,524, 4,525, 4,526, same locality, 204–239 fathoms, soft gray mud; 4,574, off Cape Colnett, 30° 35′ N., 117° 23′ W., 1,400 fathoms.

Goniada brunnea Treadwell.

Goniada brunnea Treadwell, Bull. U. S. Fish Comm., 1906, p. 1174, figs. 67–69.

Several excellently preserved specimens of this species occur in the collection and permit some minor additions to Treadwell's description. The largest individual is 111 mm. long with a maximum width of body in the anterior region of 1.8 mm. and between the tips of the parapodia of about 3 mm., the corresponding measurements of the posterior region being 2.6 and 4.2 mm.

Prostomium shaped as in Treadwell's figure, composed of from seven to nine equal rings above the base, the higher numbers in small specimens. As Treadwell supposed from the appearance of his, in this respect imperfectly preserved, specimen, the apical tentacles are biarticulate, the larger basal joint clavate and the minute terminal piece retractile. Parapodia are as figured by Treadwell, but his figure 68 is inverted. Notopodia with setæ appear abruptly at XLIV or XLV. Treadwell says at L. The distinction between the two regions of the body is never sharply indicated. Usually the anterior region is of a paler color and neural eye-spots, having the form of short dashes, and swimming setæ begin at about LVI. Pygidium a minute obliquely truncate cylinder with a somewhat thickened marginal welt and no cirri in place. The color is pale brown or yellowish-brown, either with paler annulations at the furrows or dusky markings, paling to clear yellow posteriorly.

No specimen has more than a small portion of the proboscis protruded and the jaws were seen by dissection. The large jaws are black, with four large, stout, clawlike teeth and apparently no small teeth. Dorsal arc of small jaws absent. Ventral arc of nine small black jaws apparently all bidentate with bilobed bases. Chevron jaws on the largest specimen eighteen, on a very small one nine on one side ten on the other and on other specimens fourteen or fifteen. Soft papillæ in a circle of eighteen. The surface of the proboscis appears smooth under a pocket lens, but when more highly magnified is seen to be thickly covered with minute hemispherical papillæ with an asymmetrical basal pore.

Stations 4,366, off Point Loma Lighthouse, vicinity of San Diego, 176–181 fathoms, green mud; 4,381, off South Coronado Island, 618–654 fathoms, green mud; 4,457, off Point Pinos Lighthouse, Monterey Bay, 40–46 fathoms, dark green mud; 4,464, same locality, 36–51 fathoms, soft dark gray mud; 4,480, off Santa Cruz Lighthouse, 53–76 fathoms, dark green mud and sand.

Glycinde armigera sp. nov. Pl. XXI, figs. 160-171.

A slender species with the two regions not sharply differentiated. Length of type 81 mm., maximum width near middle, body only 1.8 mm., between tips of parapodia 3.1 mm. Number of segments 178. The largest example is 118 mm. long and has 191 segments.

Prostomium (Pl. XXI, fig. 160) much elongated, equal to the first seven segments, very slender and acutely conical, depressed. Base or oral region coalesced with peristomium, forming a somewhat swollen region wider than second setigerous segment and divided by an indistinct cross-furrow. Attenuated distal part divided very regularly into sometimes eight, sometimes nine, equal wings, the apical one bearing four small tentacles with clavate basal joints and minute cylindrical retractile distal joints. Median dorsal and ventral fields broad, smooth and continuous for entire length with the cross-furrows shallow, the lateral fields bounded by deep dorsal and ventral grooves and much more deeply cut by the interannular furrows. Mouth a small crescentic slit within the enlarged basal region and bounded laterally by the small palps. Eyes one pair, minute, black, widely separated on basal region, frequently indiscernible on larger specimens; no apical eyes.

Peristomium united with base of prostomium, forming the simple posterior lip and bearing a pair of small parapodia. Anterior end of body very slender, at first narrower than the oral region of head, terete; the segments well-defined, simple, slightly flattened below and in the parapodial field, strongly arched above with a narrow, somewhat softened dorsal field. The segments very gradually increase in both diameter and length to the point of greatest width (about LX), where they are about three times as wide as long. The two regions are less sharply differentiated than in many species, but a few segments behind the point of greatest width of the anterior region a slight constriction occurs, followed at somite LXX to LXXVI on different specimens by a more or less obvious increase in size of the parapodia accompanied by the presence, in mature examples, of genital products in the cœlom. The neural eye-spots, which take the form of short brown —s crossing the intersegmental furrows in the neural line, become conspicuous at the same place, but may be traced much farther forward, often to about L, gradually becoming fainter. Segments of posterior region somewhat depressed, relatively shorter and more crowded than anteriorly and gradually tapered to the caudal end.

Pygidium a minute wing bearing a pair of long, very slender, flagelliform subanal cirri at least equal to the greatest width of the body, including the parapodia, and often one-third longer.

Parapodia situated near the ventral level anteriorly, extending their entire depth on most of the posterior region, all long and slender, those at the anterior end of the anterior region and throughout the posterior region equalling the width of the segments or, near the caudal end, exceeding them. As far as somite XXIX they are uniramous. The first foot (fig. 160) is small, with a minute setigerous tubercle nearly concealed between the much longer dorsal and ventral cirri. Succeeding ones gradually enlarge and the next few have the neuropodium divided into presetal and postsetal lobes of nearly equal length, the former broad and with an axial prolongation, the latter narrow and tapered (fig. 160). Dorsal and ventral cirri are about one-fourth longer than the neuropodium, moderately slender and tapered to blunt points, the former with a pitlike depression and glandular swelling near the base, beyond which it is bent somewhat abruptly dorsad, the latter nearly straight. On still succeeding somites all parts of the parapodium become increasingly compressed and foliaceous and the neuropodium longer than or at least equal to the cirri. On typical parapodia of this region (Pl. XXI, fig. 162) the broadly ovate postsetal lip is longer than the presetal lip, which is broadly obcordate petalliform with a tongue-shaped prolongation arising from the sinus. Neurocirrus about as long as neuropodium, compressed, of nearly uniform width to near the bluntly triangular tip. Notocirrus always irregular and somewhat distorted in outline, the base somewhat contracted, the distal part subovate, somewhat foliaceous and more or less abruptly bent dorsad.

At somite XXX a small notopodium appears abruptly anterior to the base of the notocirrus and immediately consists of a small setigerous tubercle, a short presetal lip and a longer postsetal lip. Through the remainder of the anterior region the biramous parapodia undergo no marked change, but with the beginning of the posterior sexual region (about somite LXX to LXXVI) they become distinctly larger and the rami better differentiated. Typical parapodia of this region (fig. 163) are large and deep with the neuropodium much exceeding the notopodium, compressed, somewhat widened distally into a broadly rounded acicular tubercle enclosed between broadly foliaceous, more or less irregularly ovate, presetal and postsetal lips, of which the latter is somewhat the longer and the former marked by a slight constriction separating a distal portion corresponding to a much broadened lingulate process of anterior parapodia. Neurocirrus much shorter than neuropodium and divergent from it. The notopodium consists of a deep postsetal lip broadly attached to the notocirrus above with a slight emargination at the tip of the aciculum, and a small subovate presetal lip or process just ventral to the end of the aciculum. Notocirrus shaped much like neurocirrus, but shorter and lacking the basal depression and bending which characterizes anterior notocirri. Toward the caudal end the rami are relatively longer and more divergent.

Acicula in each ramus single, rather stout, straight, tapering rods ending in blunt points ending flush with the surface, the neuropodial being sometimes slightly bent at the tip. Neuropodial setæ in a broad spreading fan-shaped fascicle of one series, divided into nearly equal dorsal and ventral groups by a considerable interval at the aciculum into which the tonguelike prolongation of the presetal lip enters. On the type they are distributed as follows: somite X 16 supra-acicular and 14 subacicular, XXV 21 and 22, L 23 and 22, C 28 and 24. They are all of one kind, compound, capillary, slender and colorless, the gently curved shafts slightly enlarged at the distal end (fig. 164) to form a bifurcate socket with unequal limbs, the longer of which is faintly toothed. Appendages very delicate, slender, tapered, more or less curved, very finely punctate and along the edge finely fringed. They are shortest at the dorsal and ventral borders of the fascicles and gradually increase in length to acicular borders. Except that they are very long and slender on the middle segments, there is no obvious distinction between these setæ on the two regions of the body. Notopodial setæ (fig. 165) are few, three supra-acicular on XXX, three supra-acicular and two subacicular on L and four and three, respectively, on C. They are simple, colorless, delicate and very small, with a peculiar knoblike prominence on one side, beyond which they are prolonged into a very slender, acute tip. On more anterior parapodia these tips are exposed, but farther back they are shorter and concealed between the notopodial lips.

Proboscis, when fully retracted, reaches to somite XLIX, where the jaws lie. None of the specimens has it fully everted. It is most fully so on a cotype (station 4,480) on which it is 8 mm. long and 2 mm. in diameter, cylindroid, of uniform diameter, with four broad longitudinal ridges (one dorsal and one ventral pair) bearing four bands of horny papillæ or paragnaths. These bands extend for nearly the entire length of the eversible proboscis from the jaws nearly to the base, where they dwindle away. When the proboscis is everted the paragnaths become more or less erect and form a formidable and bristling armature. The ventral bands are borne on a pair of rather sharp ridges and each consists of two series of horny papillæ, those of the more medial series (Pl. XXI, fig. 167) being larger with broad crescentic, flat bases and somewhat bent, acute, conical tops. Those of the more lateral series are more complex (fig. 168), about one-third to one-half as high as the inner papillæ, truncate and bent and bearing on the convex side a thick, horny scale or plate with three short spines at its lower border. Both kinds have a subapical pore and both become smaller toward the jaws, to which the bands nearly reach. Papillæ of the dorsal bands are larger and stouter, especially those of the inner or more medial series, which are clawlike, directed toward the middle line, with a broad base and subapical pore (fig. 169). Supporting these, between and behind them, are three irregular rows of somewhat smaller papillæ similar to the principal ones, except that they are more or less bifid at the apex, a feature which is very obvious on the tall papillæ at the middle of the series (fig. 170). All of these papillæ are very hard and horny and continue to the jaws without material decrease in size, but in the opposite direction, toward the base of the proboscis, gradually become reduced. Between the four armed bands are a few minute spheroid papillæ with roughened summits (fig. 171).

The circle of soft jaw papillæ appears to comprise twenty. Jaws black, the principal pair (fig. 166*a*) ventral, the width of four or five soft papillæ apart, with three (sometimes four) large, clawlike teeth and on the medial side an additional very small tooth or none. No ventral arc of small jaws. Dorsal arch of about thirty small, double, quadridentate jaws consisting of a larger anterior and a smaller posterior pair mostly like *b* (fig. 166), but a few like *c*.

Color variable, pale yellow, light brown, often with bluish reflections, drab, etc., more or less mottled with dusky, and those from station 3,454 exhibiting a few quadrate black spots. The general color of the type is a clear amber-brown with the furrows and median dorsal field bluish-gray and the prostomium pale gray. In the posterior region the color is almost entirely blue-gray, except on the parapodia which retain the brown. Neural eye-spots dark brown, very conspicuous in the posterior region.

Represented usually by single specimens from the following stations: 4,309, 4,310, off Point Loma Lighthouse, near San Diego, 67–78 fathoms, fine sand, green mud and rocks; 4,332, same locality, 62–183 fathoms, gray sand and rock; 4,334, same locality, 514–541 fathoms, green mud and fine sand; 4,436, off San Miguel Island, 264–271 fathoms, green mud; 4,452, 4,453, 4,454, off Point Pinos Lighthouse, Monterey Bay, 49–71 fathoms, green mud, sand and gravel; 4,457, same locality, 40–46 fathoms, dark green mud; 4,464, 4,467, same locality, 36–54 fathoms, soft dark mud; 4,480, off Santa Cruz Lighthouse, 53–76 fathoms, dark green mud and sand; 4,548, off Point Pinos Lighthouse, 46–54 fathoms, coarse sand, shells and rocks; 4,550, same locality, 50–57 fathoms, green mud and rocks.

Aricia nuda sp. nov. Pl. XXI, figs. 172-176.

As usual in the genus, this is a very fragile worm, and no complete examples are known, but only four short anterior ends and a fragment from near the caudal end. The type comprises two pieces not certainly belonging to the same individual: an anterior piece of 41 segments, 31 mm. long, 5 mm. wide and 3.2 mm. deep at somite VIII, and a much more slender and gently tapered piece of 72 segments and evidently from near the caudal end.

Prostomium mammilliform or flattened dome-shaped, bearing a blunt, nipple-like apical palpode about one-half as long as the prostomium, the combined length of both being about equal to the basal width of the prostomium. An obscure, rather large pigment spot or eye at each side close to the base of the palpode. On the ventral side a pair of parallel longitudinal grooves include between them a slightly depressed area ending at the quadrate mouth which is bounded on the sides by the peristomium and behind by a lip derived chiefly from somite II.

Anterior end of body for the first fifteen segments depressed, distinctly wider than deep, both dorsal and ventral surfaces moderately convex. Segments increase rather rapidly in width to VIII or IX, then become more gradually narrower. They are generally from four to six times as wide as long. At XVI, coincident with the shifting of the parapodia dorsad, the segments become much shorter, deeper, much more strongly convex below and flatter above. These conditions are maintained in the slender posterior region. There is no trace of the pectinated ventral fold or ventral rows of papillæ characterizing the more typical species of the genus. Walls of anterior part of body firm, of posterior region rather soft and translucent. Pygidium unknown.

Parapodia begin on I and are biramous throughout, the first fifteen differing from the others in the lateral position and large size of the neuropodium and the fimbriated or pectinated postsetal membrane.

The first two or three are smaller and of simpler structure than the others, consisting of small contiguous notopodial and neuropodial setigerous areas and behind each a postsetal lobe of which the notopodial is narrow, erect and pointed triangular, the neuropodial a low, broad, feebly pectinated fold, corresponding to the larger size of the latter. The neuropodium increases in size rapidly and soon becomes a low platform rising toward the caudal margin and bearing the setæ in a close phalanx of several, gradually rising tiers. They attain the maximum size at IX to XIII on which the setæ palisade is about four times as deep as long, and the now conspicuous postsetal fold bears twelve to fourteen or fifteen marginal processes (Pl. XXI, fig. 172), of which the dorsal is frequently somewhat larger than the others and occupies a more detached position above the setæ. On somites XII to XV, inclusive, the ordinary palisade setæ are much reduced and in part replaced in the dorsal portion of the posterior row by a few stout spines, the dorsalmost of which is very large and provided with a special cirrus, at the base of which opens a large pyriform gland, sometimes visible to the naked eye as a whitish swelling on the surface of the postsetal fold (Pl. XXI, fig. 174). At the same time the entire neuropodium undergoes reduction from the ventral side and the postsetal fold becomes smaller with few marginal processes. Except that it gradually shifts dorsad and becomes larger, with a conspicuous asymmetrical wing on the ventral side of the base, the notopodial postsetal lobe undergoes no change in the anterior region. At somite XVI the neuropodium becomes abruptly reduced in size, turned dorsad as a narrow erect process, which may bear one or two small papillæ on its lateral margin but often lacks them, and is elevated upon a winglike compressed base which unites it to and also bears the notopodium. Just above its base the neuropodium is constricted, and distally is divided into a short, truncate, postsetal lip and a longer postsetal and ventral acute conical lip (Pl. XXI, fig. 173) between which the acicula end and the small tuft of setæ arises. The notopodium of XVI consists of a setigerous tubercle bearing a large spreading fascicle of setæ and provided with an erect, broad, lamellar, asymmetrical ovate, postsetal lip which is abruptly constricted at the end to a slender attenuated tip reaching nearly to the tips of the setæ. On succeeding segments parapodia (Pl. XXI, fig. 173) continue to change in the direction initiated on XVI, the thin basal plate rising higher and the notopodia and neuropodia becoming more slender and erect until they become strictly dorsal, with the two small erect rami elevated on a lamelliform pedicle. The lips of the neuropodium remain much as described, the presetal short and truncate, the postsetal longer and acute. The notopodial presetal lip is obsolete and the postsetal lip becomes much elongated, narrow and acute, with strongly constricted base. The postsetal lobes of both rami contain numerous irregular long, longitudinal vascular loops quite different in arrangement from those in the gills. Neurocirrus (fig. 173) a slender, pointed process rising a short distance ventral to the neuropodium, obsolete in the anterior region and becoming very small toward the caudal end. Notocirrus wanting unless represented by the gills.

Acicula of anterior parapodia apparently a large number of simple tapering rods not easily distinguished from setæ. On posterior segments there are two or three notopodial and usually one neuropodial acicula, both very slender and tapered. On segments XIII to XV, inclusive, appears a series of five to seven stout, brown spines in a vertical row at the cephalic margin of the much reduced palisade of setæ and which are probably to be considered as modified acicula. The dorsalmost (Pl. XXI, fig. 174) is much larger than the others and projects very prominently and obliquely upward across the interramal space. At its base, as noted above, is a cirrus and large pear-shaped gland. Like the largest of the others, only the tips of which are exposed, the dorsalmost spine ends in a thickened, spearlike, acute point. Among the large spines are some smaller ones with attenuate tips.

Setæ are all simple and of one type in both rami, though differing considerably in proportions and structural details. Omitting the above-described spines, all are more or less acute, tapered and flexible. Notopodial setæ are generally longer and more slender and arranged in dense fan-shaped fascicles on anterior somites and in delicate tufts of a few setæ on posterior somites. Neuropodials of the anterior region form dense phalanges of four to six ranks in which the setæ increase in length and change somewhat in structure from before backward. On the posterior region they form erect tufts of very few setæ similar in every respect to the notopodials. On the first few parapodia notopodial and neuropodial setæ differ only in length. Both are colorless and slender. The basal portion of the exposed part contains a conspicuous spiral canal (Pl. XXI, fig. 175) wound round a central fibrous axis and more capacious on one side than on the other, so that the axis is somewhat eccentric. Farther out the canal becomes reduced and then obsolete on the side upon which it was least developed, thus leaving an asymmetrical camerated structure, often accompanied by a very minute serrulation which gradually disappears, leaving nearly smooth, solid capillary tips. On the posterior region the more slender and elongated setæ have the structure of the more delicate parts of the anterior setæ, the basal region with its canal being absent and the shaft provided with minute appressed teeth. No bifurcate setæ, such as are present in *A. johnsoni*, can be detected in this species. In the neuropodium it is evident after a few somites that the shorter setæ of the first rank or two have become dark-colored and have lost both the external serrulation and internal cavity. These changes become emphasized for several segments. Setæ of the posterior rows are of the same type as the notopodial setæ, but have the basal canalization and cameration more evident and the slender solid tips less prolonged. At the ventral end of the fascicle is a small, somewhat isolated tuft of shorter setæ, some of which are simple spines finely serrulated along one margin and a few short blunt spines with the ends enclosed in a mucronate hood. All of these differentiations become more pronounced to somite XI, after which the stout acicular spines appear in association with a conspicuous reduction in the number and size of the other setæ, particularly those of the anterior rows. In this region the small ventral tuft is composed entirely of a few small hooded spines (fig. 176), below which is a second tuft of the largest canaliculated setæ remaining on the neuropodium. In the posterior region the neuropodial setæ have exactly the structure of the notopodial, but are fewer in number.

Branchiæ begin on somite V of all specimens, rising from the dorsal area as a pair of foliaceous, rather broadly lanceolate processes barely reaching to the notopodia and separated by a distance greater than their length. Proceeding caudad, they regularly increase in length and size (Pl. XXI, fig. 172) until by somite XL their length is about three-fifths the width of the body, their form foliaceous lanceolate and posture erect. On the posterior piece they have become fully one-and-one-half times the body width and taper to filamentous tips, being therefore much elongated and very conspicuous (Pl. XXI, fig. 173). They show no special areas of strong ciliation, but are very richly vascular, having a large axial vessel with a spacious bulbous expansion at the base and a complex bipinniform system of very numerous lateral branches extending to the margins. Anteriorly the gills are quite free from each other and from the notopodia, but as the parapodia assume the dorsal position they become united by a transverse membraneous fold that crosses the whole width of the dorsum.

Proboscis very imperfectly known, only the ends of a few of the lacinated divisions being exposed on any of the specimens.

Color at anterior end pale yellow, fading out and leaving the posterior end nearly colorless and much more translucent. A rather conspicuous series of median dorsal brown spots begins on VII and continues to the caudal end. On some of the specimens the anterior spots are double. The only other color is a slight anterior cuticular iridescence, the obscure eye-spot (?) on each side of the prostomium and a duskiness of certain of the palisades of setæ.

Most of the examples are sexually mature, both males and females occurring, the type being of the latter sex. A specimen from station 4,306 is noteworthy because of the occurrence of abnormalities, the gills of many of the anterior segments being bifid and the postsetal lobes more or less divided into slender often lacinated processes.

Stations 4,306, off Point Loma Lighthouse, vicinity of San Diego, 207–497 fathoms, green mud, fine sand and gravel; 4,327, off Soledad Hill, Point La Jolla, vicinity of San Diego, 263–330 fathoms, soft green mud; 4,339 (type), off Point Loma Lighthouse, 241–369 fathoms, green mud.

Explanation of Plates XV–XXI.

Unless stated otherwise, all drawings are made from the types.

Plate XV.—*Chloeia pinnata*, figs. 1–6 (from cotype, station 4,475).
Fig. 1.—Posterior ventral bifid notopodial seta from X, × 98.
Fig. 2.—Tip of serrated notoseta from X, × 250.
Fig. 3.—Tip of spurred anterior notoseta from near notocirrus of X, × 98.
Fig. 4.—*a* and *b*, respectively, tips of stout and slender neurosetæ from X, × 250.
Fig. 5.—Tip of anterior neuroseta from X, × 98.
Fig. 6.—Same of somite I, × 250.

Euphrosyne limbata, figs. 7–11.
Fig. 7.—Fifth gill from somite X, incomplete, × 40.
Fig. 8.—Main division of 3d gill from X, × 56.
Fig. 9.—Large notoseta of X, × 98.
Fig. 10.—Ventral neuropodial of X, × 98.
Fig. 11.—Dorsal neuropodial of X; *a*, end of another with wider angle of divergence of the spur, × 98.

Euphrosyne dumosa, figs. 12–17.
Fig. 12.—Gill from somite XV of cotype (station 4,470), × 56.
Fig. 13.—Large smooth notopodial seta from 2d row of X, × 98.
Fig. 14.—Small same from 3d row, × 98.
Fig. 15.—Bifid serrate notoseta from X, × 98; *a*, tip of same, × 250.
Fig. 16.—Ventral neuroseta from XV, × 98.
Fig. 17.—Dorsal same, × 98.
Fig. 18.—*Nereis procera*, parapodium L of male epitoke from station 4,355, × 40.
Fig. 19.—*Platynereis agassizi*, two mature eggs from cœlom of epitoke from station 4,355, × 56.

Eunice multipectinata, figs. 20–23.
Fig. 20.—Parapodium and gill from somite XXV, × 17.
Fig. 21.—Compound seta from XV, × 250.
Fig. 22.—Pectinate seta from L, × 440.
Fig. 23.—A rather slender ventral crochet from CL, × 250.

Nothria pallida, figs. 24–28.
Fig. 24.—Anterior view of 2d parapodium, × 24.
Fig. 25.—Posterior view of 4th parapodium, × 24.
Fig. 26.—Hooded crochet from IV, × 360.
Fig. 27.—Pectinate seta from LXXV, × 440.
Fig. 28.—End of crochet from XXV, × 250.

Plate XVI.—*Marphysa conferta*, figs. 29–34.
Fig. 29.—Head and first four segments.
Fig. 30.—Parapodium X with gill, × 56.
Fig. 31.—Parapodium L, × 56.
Fig. 32.—Compound seta from X, × 440.
Fig. 33.—Pectinate seta from L, × 440.
Fig. 34.—Crochet from L, × 360.

Nothria pallida, figs. 35–37.
Fig. 35.—Parapodium L, × 24.
Fig. 36.—Mandibles of cotype (station 4,401) from the venter, × 33.
Fig. 37.—Maxillæ of same from the dorsum, × 33.

Nothria species ?, figs. 38–40.
Fig. 38.—Parapodium XXV, × 24.
Fig. 39.—Compound crochet from III, × 440.
Fig. 40.—End of simple crochet from XXV, × 250.

Nothria hiatidentata, figs. 41–50.
Fig. 41.—Anterior end from the dorsum, × 5.
Fig. 42.—Anterior aspect of 2d parapodium, × 24.
Fig. 43.—Same of 4th parapodium, × 24.
Fig. 44.—Parapodium L, × 17.
Fig. 45.—Tip of a much worn large spine from III, × 250.
Fig. 46.—End of slightly worn crochet from IV seen in $\frac{1}{4}$ face, × 250.
Fig. 47.—End of a pectinate seta from IV, × 440.
Fig. 48.—End of a large hooded crochet from L, × 250.
Figs. 41–48 are all drawn from a cotype (station 4,387).

Plate XVII.—
Fig. 49.—Ventral view of mandibles of cotype, × 24.
Fig. 50.—Dorsal view of maxillæ of same, × 24.

Onuphis parva, figs. 51–57, all from cotype (station 4,446).
Fig. 51.—Posterior aspect of parapodium III, × 56.
Fig. 52.—Anterior aspect of parapodium V, × 56.
Fig. 53.—Same of parapodium XXV, × 56.
Fig. 54.—End of compound crochet of IV, × 600.
Fig. 55.—Pectinate seta from XXV, × 600.
Fig. 56.—End of hooded crochet from XXV, × 600.
Fig. 57.—Slender crochet without guard from L, × 600.

Onuphis nebulosa, figs. 58–68, all from cotype (station 4,454).
Fig. 58.—Anterior aspect of parapodium III, × 33.
Fig. 59.—Same of V, × 33.
Fig. 60.—Same of L, with gill, × 33.
Fig. 61.—End of a compound crochet from II, × 360.
Fig. 62.—End of a compound crochet from VI, × 360.
Fig. 63.—End of a transition compound seta from X, × 440.
Fig. 64.—Pectinate seta from X, × 440.
Fig. 65.—Transition hooded crochet from XV, × 440.
Fig. 66.—Hooded crochet from LXXV, × 440.
Fig. 67.—Ventral view of mandibles, × 33.
Fig. 68.—Dorsal view of maxillæ, × 33.

Onuphis vexillaria, figs. 69–76.
Fig. 69.—Anterior aspect of parapodium III, × 24.
Fig. 70.—Same of V, × 24.
Fig. 71.—Same of L with gill, × 24.
Fig. 72.—End of compound crochet from IV, × 440.
Fig. 73.—Pectinate seta from a posterior segment, × 440.
Fig. 74.—Tip of a crochet from L, × 360.

Fig. 75.—Ventral aspect of one-half of a probably abnormal mandible, represented cut in two, × 24.
Fig. 76.—Dorsal aspect of maxillæ, × 24.

PLATE XVIII.—*Diopatra ornata*, figs. 77–85.
Fig. 77.—Anterior aspect of parapodium III, × 24.
Fig. 78.—Anterior aspect of parapodium XV, with gill, × 24.
Fig. 79.—Large compound crochet from 1st foot, × 360.
Fig. 80.—A slender compound crochet from 3d foot, × 360.
Fig. 81.—A semi-articulated subacicular seta from somite VI, × 360.
Fig. 82.—A pectinate seta from C, × 360.
Fig. 83.—End of a large simple guarded crochet from C, × 360.
Fig. 84.—Ventral aspect of left half of mandible, × 24.
Fig. 85.—Dorsal view of maxillæ of cotype (station 4,519), × 17.

Hyalinœcia juvenalis, figs. 86–95.
Fig. 86.—Anterior aspect of parapodium of III, × 33.
Fig. 87.—Posterior aspect of parapodium of V, × 33.
Fig. 88.—Anterior aspect of parapodium XXV, with gill, × 33.
Fig. 89.—Crochet from III, × 360.
Fig. 90.—Crochet from XXV, × 250.
Fig. 91.—Limbate seta from ventral fascicle of XXV, × 360.
Fig. 92.—Pectinate seta from L, × 360.
Fig. 93.—Left mandible of cotype from venter, × 33.
Fig. 94.—Same of type, × 33.
Fig. 95.—Maxillæ of type from the dorsum, somewhat crushed, × 33.
Figs. 86, 87, 88 and 93 are from a cotype (station 4,431).
Fig. 96.—Unworn tip of a hooded crochet of a young specimen of *Hyalinœcia tubicola stricta*, seen in $\frac{1}{4}$ face, × 600.
Fig. 97.—Same from L of a full-grown specimen, × 250.

Onuphis parva, figs. 98, 99.
Fig. 98.—Cephalic end of mandible of a cotype (station 4,475), ventral aspect, × 56.
Fig. 99.—Dorsal aspect of the maxillæ of the same, × 56.
Fig. 100.—Dorsal view of anterior end of *Onuphis nebulosa*, × 9.

PLATE XIX.—*Ninoë gemmea*, figs. 101–109.
Figs. 101–104.—Parapodia of V, XV, XXV and CXXV, respectively, profile outlines as seen from in front, × 33.
Fig. 105.—Limbate seta from XXV, *a* and *b*, respectively, profile and $\frac{3}{4}$-face views, × 98.
Fig. 106.—Crochet from XXV, × 98; *a*, tip of another, × 250.
Fig. 107.—End of crochet from C, × 440.
Figs. 108, 109.—Ventral view of mandibles and dorsal view of maxillæ, respectively, of cotype (station 4,523), × 24.

Ninoë fusca, figs. 110–118.
Fig. 110.—Prostomium and peristomium from above, × 9.
Figs. 111–113.—Parapodia X, XXV and C, the first as seen from behind, the others from in front, × 82.
Fig. 114.—Supra-acicular limbate seta from X, × 250.
Fig. 115.—Same from C, × 250.
Fig. 116.—Crochet from C, × 250.
Fig. 117.—Dorsal view of mandibles, × 17.
Fig. 118.—Ventral view of maxillæ, × 17.

Lumbrineris japonica index, figs. 119–127.
Figs. 119–121.—Parapodia X, C and CXVII, outlines as seen from in front, from cotype (station 4,406), × 33.
Fig. 122.—Dorsal limbate seta from X, × 98.
Fig. 123.—Very slender dorsal seta from L of specimen from station 4,405, × 98.
Fig. 124.—Compound crochet from XX, × 250; *a*, head of same, × 440.
Fig. 125.—Crochet of somite XLVI, × 250.
Fig. 126.—Mandibles from dorsum, × 9.
Fig. 127.—Maxillæ from venter, × 9. All figures except 123 from cotype (station 4,406).

Lumbrineris inflata, figs. 128–132.

Figs. 128–129.—Outlines of parapodia X and C, as seen from in front, × 56.
Fig. 130.—Two limbate setæ from X in profile and face views, × 250.
Fig. 131.—Compound crochet from X, × 440.
Fig. 132.—Simple crochet from C, × 440.

PLATE XX.—*Lumbrineris inflata*, figs. 133 and 134 (cotype, station 4,496).

Fig. 133.—Ventral view of mandibles, × 83.
Fig. 134.—Dorsal view of maxillæ, × 83.

Lumbrineris bifilaris, figs. 135–142.

Figs. 135–137.—Outlines of anterior aspects of parapodia X, C and CCL, × 33.
Fig. 138.—Profile of ventral and face view of dorsal limbate seta from somite X, × 98.
Fig. 139.—Limbate crochet from somite V, ¾-face view, × 250; *a*, profile view of tip of another, × 440.
Fig. 140.—End of simple hooded crochet from C, × 250.
Fig. 141.—Ventral view of mandibles of cotype (station 4,485), × 9.
Fig. 142.—Maxillæ of same, forceps jaws dorsal, other pieces ventral, × 9,

Aracoda semimaculata, figs. 143–149.

Figs. 143–145.—Parapodia X, C and CCL, from in front, × 33.
Fig. 146.—Dorsal seta from X, × 250.
Fig. 147.—Middle seta from LXXV, × 250.
Fig. 148.—Outline of mandibles of cotype (station 4,496), – 17.
Fig. 149.—Maxillæ of the same from the dorsal aspect, × 17. III, IV and V indicate maxillæ IV, V, and VI respectively, maxilla III being unlabeled.

Drilonereis falcata, figs. 150–154.

Fig. 150.—Anterior aspect of parapodium X of cotype, × 56.
Fig. 151.—Anterior aspect of parapodium C, × 83.
Fig. 152.—Seta from XXV, × 440.
Fig. 153.—Mandibles of cotype (station 4,460) from the dorsum, × 33.
Fig. 154.—Maxillæ of same from venter, × 33.

Glycera branchiopoda, figs. 155 and 156.

Fig. 155.—The three forms of proboscis papillæ from a cotype (station 4,517), *a*, *c* and *c*, respectively, × 250.
Fig. 156.—Jaw appendage of the same, × 56.

PLATE XXI.—*Glycera branchiopoda*, figs. 157–159.

Figs. 157–159.—Parapodia X, L and C, respectively, the first and last in caudal aspect, × 40, L in cephalic aspect, × 24.

Glycinde armigera, figs. 160–171.

Fig. 160.—Dorsal view of prostomium of cotype (station 4,310), × 56.
Figs. 161–163.—Anterior aspects of parapodia V, XXV and C (concealed outlines dotted), × 56.
Fig. 164.—Part of a shorter ventral neuropodial seta from XXX, × 400.
Fig. 165.—Exposed portion of a notopodial seta from XXX, × 400.
Fig. 166.—Elements of the circle of jaws; *a*, large ventral jaw, × 125; *b*, one from the dorsal arch, × 250; *c*, *c*, two forms of smaller size from the dorsal arch, × 250.
Fig. 167.—Large paragnaths from the ventral bands, in profile and top view, × 250.
Fig. 168.—Profile and top views of small papillæ (paragnaths) from ventral bands, × 250.
Fig. 169.—Two papillæ (paragnaths) from dorsal bands near jaws, × 98.
Fig. 170.—Large bifid paragnath from dorsal bands, × 250.
Fig. 171.—Two of the small scattered papillæ, × 250.
Figs. 166–171 are drawn from a cotype (station 4,548).

Aricia nuda, figs. 172–176.

Fig. 172.—Outline of parapodium and gill of X from behind, × 17.
Fig. 173.—Same of L from in front, × 24.
Fig. 174.—Large dorsal neuropodial spine with gland and cirrus from XV, × 56.
Fig. 175.—Small portion of base of neuropodial of X; *a*, from the side; *b*, from front, × 600.
Fig. 176.—Hooded spine from ventral part of neuropodium of XV, × 250.

RECORDS AND DESCRIPTIONS OF AFRICAN MANTIDÆ AND PHASMIDÆ (ORTHOPTERA).

BY JAMES A. G. REHN.

The material on which the following notes were based is chiefly from Harrar, Abyssinia, the Kikuyu Escarpment and Mombasa, British East Africa, and Mossamedes, Angola. Aside from the Mombasa series which belongs to the Hebard Collection, the material is almost entirely contained in the Academy collection. In addition to data on the material from the localities given above, supplementary notes are here given on certain Northeast African Mantidæ previously reported upon in these PROCEEDINGS.[1]

The author wishes to thank Mr. Morgan Hebard for the opportunity to examine the small but interesting Mombasa series from his collection.

MANTIDÆ.

ORTHODERINÆ.

ELÆA Stål.

Elæa marchali (Reiche and Fairmaire).

1847. *E[remiaphila] marchali* Reiche and Fairmaire, in Ferret and Galinier, Voy. en Abyssinie, III, p. 424, Zool., pl. 27, fig. 5. [Locality implied: Abyssinia.]

Harrar, Abyssinia. One female.

TARACHODES Burmeister.

Tarachodes karschii Werner.

1907. *Tarachodes Karschii* Werner, Sitzungsb. K. Akad. Wissensch., Wien, Math.-nat. Kl., CXVI, Heft II, Abt. I, p. 212. [Bondei and Dar-es-Salaam, German East Africa; coast of German East Africa; Lake Tanganyika.]

Kikuyu Escarpment, British East Africa. Two males.

These specimens apparently are not separable from the typical material of the species. It might be mentioned that the spines on the internal face of the cephalic femora and tibiæ are black to their bases, instead of black-tipped as are the external spines on the same limbs.

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[1] *Proc. Acad. Nat. Sci. Phila.*, 1901, pp. 276–288.

This record connects the original localities with nine recent records by the original author from Danakil and Abyssinia.

Tarachodes æstuans Saussure.

1895. *T[arachodes] æstuans* Saussure, Ann. Mus. Civ. Stor. Nat., Genova, XXXV, p. 91. [Laffarugh, Ogaden, Somaliland.]
1901. *Tarachodes smithi* Rehn [♀ not ♂], Proc. Acad. Nat. Sci. Phila., 1901, p. 278. [Tug Berka, Somaliland.]

After re-examination and comparison with representatives of a number of species of this genus, the immature female formerly placed under *T. smithi* has been found to be distinct from the male, and as far as possible to determine in its condition should be referred to Saussure's species.

Tarachodes smithi Rehn.

1901. *Tarachodes smithi* Rehn [♂ not ♀], Proc. Acad. Nat. Sci. Phila., 1901, p. 278. [Tug Terfa, Somaliland.]
1907. *Tarachodes taramassi* Giglio-Tos, Bollett. Mus. Zool. ed Anat. Comp., Torino, XXII, nr. 563, p. 5. [Mogadisciu, Somaliland.]

This species is found on re-examination to be quite distinct from any of the older forms, its closest relationship doubtless being with *T. media* Schulthess, while its general slender form and non-rugose integument strongly suggests species of *Galepsus*, but the shape and proportions of the head are essentially those of *Tarachodes*.

The description of *Iaramassi* agrees fully with the male type of *smithi*.

GALEPSUS Stål.

Galepsus capitatus (Saussure).

1871. *Ch[iropacha] capitata* Saussure, Mélanges Orthoptérologiques, III, p. 166, Pl. 4, fig. 2. [Africa.]

Kikuyu Escarpment, British East Africa. One male.

This species has been recorded from a number of localities extending from Delagoa Bay to Abyssinia and from Zanzibar to the Congo.

Galepsus meridionalis form **montanus** Werner.

1907. *G[alepsus] meridionalis* var. *montana* Werner, Sitzungsb. K. Akad. Wissensch., Wien, Math.-natur. Kl., CXVI, Heft II, Abt. I, p. 220. [Between Taveta and Meru; Kilimanjaro.]

Mombasa, British East Africa. Five males. [Hebard Collection.]

These specimens agree very well with the brief original description of this form, which is apparently a geographic race. The measurements of the pronotum show extremes of 5.8 x 2.5 mm. and 6.5 x 3, while the tegmina are uniformly slightly longer than the original measurement, ranging from 18 to 18.5 mm., against the original 15.4.

MANTINÆ.

ENTELLA Stål.

Entella usambarica Sjöstedt.

1909. *Entella usambarica* Sjöstedt, Wissensch. Ergebn. Schw. Zool. Exp. Kilimandj. Meru, XVII, p. 58, Pl. 4, fig. 8. [Mombo, Usambara.]

Mombasa, British East Africa. Three males. [Hebard Collection.]

These specimens agree very well with the description of this species. The amount of blackish maculations on the head, pronotum and limbs is very variable, differing in some degree in all three specimens. It is quite possible that *E. lamperti* Werner[2] from Tanga, Usambara, is the female of this species.

POLYSPILOTA Burmeister.

Polyspilota variegata (Olivier).

1792. *Mantis variegata* Olivier, Encycl. Meth., Ins., VII, p. 638. [Angola.]

South Africa. One male.

Merule to Murchison Falls, Uganda. One adult and one immature female.

Mombasa. (Hebard Collection.) One male, one female.

The South African male and the Mombasa male belong to the color-form *pustulata* as defined by Werner,[3] the Uganda and Mombasa female to color-form *striata*. Indications seem to point to the fact that east and south African individuals of *variegata* are larger than west African (forest land) specimens. Liberian specimens average very small, and specimens from the eastern edge of the great forest, west of Albert Nyanza, recorded by the author[4] are very similar. Luebo, Congo, specimens, however, are like southern individuals.

The specimens in the present series measure as follows:

	Uganda. ♀.	Mombasa. ♀.	Mombasa. ♂.	South Africa. ♂.
Length of body,	78.0 mm.	74.0 mm.	71.0 mm.	63.5 mm.
Greatest width of head,	9.0 "	9.8 "	8.2 "	7.5 "
Length of pronotum,	23.8 "	25.0 "	23.0 "	17.2 "
Greatest width of pronotum,	7.5 "	8.0 "	6.3 "	5.5 "
Length of tegmen,	61.0 "	6.2 "	57.0 "	50+ "
Length of cephalic femur,	18.2 "	20.0 "	16.2 "	13.0 "

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[2] *Jahresb. Ver. Vaterländ. Naturk. Württemberg*, LXII, p. 364.

[3] *Bericht Senckenb. Naturf. Gesell.*, 1908, p. 38.

[4] *Ergebn. Deutsch. Cent.-Afr. Exped. 1907–1908,* unter Führung Adolf Fried. Herzog zu Mecklenburg, Zool., Orthoptera.

SPHODROMANTIS Stål.

Sphodromantis rudolfæ (Rehn).

1901. *Sphodropoda rudolfæ* Rehn, Proc. Acad. Nat. Sci. Phila., 1901, p. 282. [Near southern end of Lake Rudolf, western Gallaland.]

Harrar, Abyssinia. One male.

This form, which may be merely a geographic race of *S. bioculata*, differs from the latter in the generally smaller size, broader head, breadth of pronotum, and shorter pronotum, cephalic femora and tegmina, which latter in the female fall considerably short of the apex of the abdomen.

The Harrar male measures as follows: length of body, 42.5 mm.; greatest width of head, 6.8; length of pronotum, 11.5; greatest width of pronotum, 4.2; length of tegmen, 35; length of cephalic femur, 10.

Sphodromantis lineola (Burmeister).

1838. *M[antis (Stagmatoptera)] lineola* Burmeister, Handb. d. Entom., II. Abth. II, Pt. 1, p. 537. [Sierra Leone.]

Mombasa. One male. [Hebard Collection.]

This specimen is almost uniform greenish-yellow in color.

HOPLOCORYPHA Stål.

Hoplocorypha galeata (Gerstaecker).

1870. *Mantis (Danuria ?) galeata* Gerstaecker, Archiv für Naturgeschichte, XXXV, p. 210. [Lake Jipe, German East Africa.]

German East Africa. One male, one female.

Kikuyu Escarpment, British East Africa. Two immature females.

Hoplocorypha macra (Stål).

1856. [*Mantis*] *macra* Stål, Öfv. K. Vet.-Akad. Förh., XIII, p. 169. [Port, Natal.]

Merule to Murchison Falls, Uganda. One female.

Mombasa, B. E. Africa. One female. [Hebard Collection.]

Zambesia. One female.

Transvaal. (C. W. Howard.) Two males.

Mossamedes, Angola. One female.

From the evidence of this material it appears that this species ranges north along the east coast to Mombasa and in the interior to Uganda. It is probable that it is not found in the same region as Gerstaecker's *galeata*, which may be restricted to the more elevated regions of East Africa, although the evidence is too slight to make any deductions. However, the above facts may explain the inability of some previous authors to separate East African material presumed to represent *galeata* from South African examples of *macra*.

CALIDOMANTIS Rehn.

Calidomantis affinis (Sjöstedt).

1909. *Miomantis affinis* Sjöstedt, Wissensch. Ergebn. Schw. Zool. Exp. Kilimandj. Meru, XVII, p. 63. [Kibonoto, Lower Culture-zone, Kilimanjaro.]

Kikuyu Escarpment, Brit. East Africa. Two males.

These specimens show that this form is very close to *C. quadripunctata* Saussure, differing chiefly in the greater size. The dimensions of these specimens are as follows:

Length of body,	35.0 mm.	36.5 mm.
Length of pronotum,	9.5 "	10.8 "
Greatest width of pronotum,	2.2 "	2.5 "
Length of tegmen,	30.0 "	31.0 "
Length of cephalic femur,	7.8 "	8.2 "

The original description and the above record constitute all we know of the species.

Calidomantis kilimandjarica (Sjöstedt).

1909. *Miomantis kilimandjarica* Sjöstedt, Wissensch. Ergebn. Schwed. Zoolog. Exped. Kilimandj. Meru, XVII, p. 64. [Kibonoto Culture-zone, Lower Culture-zone, Kilimanjaro.]

German East Africa. One male.

This specimen is in the brown phase, with much of the body sprinkled with dark brown. In size it is less than the type measurements, its dimensions being as follows: length of body, 28.5; width of head, 3.8; length of pronotum, 7.5; greatest width of pronotum, 1.6; length of tegmen, 22; length of cephalic femur, 6.2.

A male specimen from Mgunda, German East Africa (Langheld), taken December, 1895, belonging to the Berlin Museum, has also been examined.

Calidomantis pharaonica (Saussure).

1898. *M[iomantis] pharaonica* Saussure, Revue Suisse de Zoologie, V, p. 193. [Egypt; Senaar.]

Merule to Murchison Falls, Uganda. One male.

Werner[5] has recorded this species from the Bahr-el-Gebel (Station Bor) region.

OXYOPHTHALMUS Saussure.

Oxyophthalmus somalicus n. sp.

1901. *Oxyophthalma gracila* Rehn (not of Saussure, 1861), Proc. Acad. Nat. Sci. Phila., 1901, p. 286. [Bodele, Tug Terfa, Somaliland.]

Type: ♂; Bodele, Tug Terfa, Somaliland. August 20, 1894. (Dr. A. Donaldson Smith.) [A. N. S. P., type No. 5166.]

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[5] *Sitzungsb. K. Akad. Wissensch., Wien*, Math.-nat. Kl., CXVI, Abt. 1, p. 240.

This specimen is clearly a representative of the genus *Oxyophthalmus*, which otherwise is only known from India and Ceylon, and does not belong to *Paroxyophthalmus collaris* (Saussure) as surmised by Werner.[6] The form of the pronotum is decidedly the subequal non-attenuate type found in *Oxyophthalmus*.

This species differs from *gracilis*, the type of the genus, in having the head less arcuate emarginate dorsad, the eyes less produced with divergent points, the pronotum shorter and the face distinctively colored.

Size small; form slender. Head with the exposed dorsal length contained about three and one-half times in the length of the pronotum, occipital line moderately subarcuate emarginate, the greater (median) portion being truncate; ocelli large, arranged in a triangle; facial shield slightly higher than broad, dorsal margin very narrowly produced mesad, slightly arcuato-emarginate ventrad of each antennal base, lateral and ventral margins subtruncate; antennæ at least two-thirds as long as the body (incomplete in type); eyes elongato-ovate in basal outline, not prominent laterad, but slightly produced and bluntly mammillate dorsad, the corneal points divergent. Pronotum elongate, roughly subequal, collar about as broad as the supracoxal width, shaft slightly narrower than the width of cephalic portion of pronotum, cephalic margin of same moderately arcuate, caudal margin arcuate laterad, truncate mesad; no medio-longitudinal sulcus or carina present; greatest pronotal width contained slightly more than three times in the length. Tegmina equal to twice the length of the head and pronotum together, narrow, hyaline; costal field broad in proximal half; apex narrowly rounded. Wings extending beyond tegmina a distance equal to the exposed dorsal length of head; apex narrowly rounded. Apex of abdomen mutilated. Cephalic coxæ not quite reaching to the caudal margin of pronotum, cephalic margin unarmed; cephalic femora slightly exceeding coxæ in length, slender, dorsal margin slightly arcuate in proximal two-thirds, discoidal spines four in number and placed

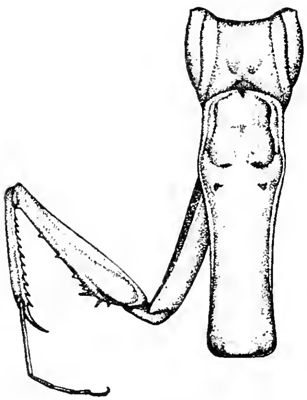

Fig. 1.—*Oxyophthalmus somalicus* n. sp. Dorsal view of head, pronotum and cephalic limb. (× 6.)

[6] *Sitzungsb. K. Akad. Wissensch., Wien,* Math.-nat. Kl., CXVI, Abt. 1, p. 256.

proximad, external spines five in number (including distal one), internal spines eleven in number, the distal one separated from the others by a considerable interval ventrad of the femoral brushes; cephalic tibiæ (exclusive of claw) equal to about three-fifths of the femoral length, armed externally with ten spines, internally with ten to eleven spines; cephalic tarsi very long and slender, the length being more than one and a half times the tibial length, metatarsi alone about three-fourths the tibial length. Median limbs very short, femora being no longer than the cephalic coxæ. Caudal limbs of medium length, femora slightly inflated in proximal half;[7] tarsi equal to three-fifths of the tibial length.

General color clay-color, the dorsum of the pronotum and the middle of the dorsum of head washed with drab and the cephalic limbs largely gamboge-yellow. Face bistre ventrad; from the antennal bases extend ventrad a pair of parallel straw-yellow lines; antennæ of the same color; eyes obscurely barred with bistre. Tegmina and wings very pale brownish hyaline. Cephalic coxæ clear gamboge-yellow; trochanter and femora lined ventro-laterad with bistre, finely dotted with same dorsad; tibiæ thickly sprinkled with bistre; all spines tipped with dark brown. Median and caudal femora thickly punctate with bistre which is arranged more or less in longitudinal series.

Measurements.

Length of body (abdomen incomplete),	23.0 mm.
Length of pronotum,	6.2 "
Greatest width of pronotum,	1.8 "
Length of tegmen,	17.0 "
Length of cephalic femur,	4.2 "
Length of median femur,	3.0 "
Length of caudal femur,	5.2 "

The type is unique.

EPISCOPUS Saussure.

Episcopus chalybæus (Burmeister).

1838. *Sch*[*izocephala*] *chalybæa* Burmeister, Handb. d. Entom., Bd. II, Abth. II, Pt. 1, p. 552. [Locality unknown.]

Kikuyu Escarpment, Brit. East Africa. One male.

Apparently this is the only exact record of the occurrence of the species in East Africa.

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[7] This may indicate considerable saltatorial ability as found in the genus *Yersinia*, which has similarly subinflated femora.

CARVILIA Stål.

Carvilia agrionina (Gerstaecker).

1869. *Mantis (Photina) agrionina* Gerstaecker, Archiv für Naturgesch., XXXV, p. 209. [Mombasa.]

1898. *Parasphendale minor* Schulthess-Schindler, Ann. Mus. Civ. Stor. Nat., Genova, XXXIX, p. 177. [Webi River, Ogaden, Biduara, Errer, Somaliland.]

1901. *Parasphendale minor* Rehn, Proc. Acad. Nat. Sci. Phila., 1901, p. 285. [Sheikh Husein and Tulu, Gallaland.]

Kikuyu Escarpment, Brit. East Africa. One immature male.

Harrar, Abyssinia. One female.

This latter specimen and the Sheikh Husein individual referred to above measure as follows:

	Harrar ♀.	Sheikh Husein ♀
Length of body,	53.0 mm.	45.0 mm.
Greatest width of head,	9.0 "	8.0 "
Length of pronotum,	18.2 "	16.2 "
Greatest width of pronotum,	5.5 "	5.0 "
Length of tegmen,	20.5 "	17.5 "
Length of cephalic femur,	15.0 "	13.5 "

The form *minor* of Schulthess does not appear separable specifically from Gerstaecker's species, the Sheikh Husein individual being nearly topotypic of *minor*, and both this and the Harrar specimen are inseparable from material from the region to the south. Werner has recorded this species from the vicinity of Harrar and from Djildessa on the border region of Somali and Galla lands.

CREOBOTRINÆ.

OXYPILUS Serville.

Oxypilus capensis (Saussure).

1871. *Ox[ypilus] capensis* Saussure, Mélanges Orthopter., III, p. 317, Pl. 6, figs. 52, 52*a*. [Cape of Good Hope.]

German East Africa. One female.

This specimen, when compared with individuals of *O. annulatus* Serville, shows that the two species are closely related, differing chiefly in the more inflated median portion of the pronotum in *capensis*, which also has the pronotal tubercles more numerous.

HARPAGOMANTIS Kirby.

Harpagomantis tricolor (Linnæus).

1758. [*Gryllus (Mantis)*] *tricolor* Linnæus, Syst. Nat., X ed., I, p. 426. ["Indiis."]

South Africa. Three females.

Johannesburg, Transvaal, 6,000 feet. January–April, 1899. (J. P. Cregoe.) Two adult females, one immature female.

JALLA Giglio-Tos.

Jalla radiosa Giglio-Tos.

1907. *J[alla] radiosa* Giglio-Tos, Bollett. Mus. Zool. ed Anat. Comp., Torino, XXII, nr. 563, p. 14. [Kazungula, Upper Zambesi.]

Zambesia. One female.

This hitherto unique genus and species is a most peculiar member of the Vatinæ, showing no close relationship to any of the other genera. The general outline of the pronotum is strikingly like that of the Orthoderine genera *Humbertiella* and *Theopompa*, but the excrescences and spines are radically different from anything found in those genera, while the other characters show no sort of analogous development.

As this is the first recognized female of the genus, a few notes made in comparison with the description of the male may be of service:

Ocelli smaller (sexual). Pronotum less distinctly medio-longitudinally sulcate caudad; margins of same non-ciliate. Tegmina short, reaching but half-way to the apex of the abdomen, ovate, coriaceous, apex broadly rounded; costal field rather narrow, this area, the region of the principal veins and the apical region with a number of scattered tuberculiform excrescences. Wings very slightly surpassing the tips of the tegmina, the exposed area of similar coriaceous structure to that of the tegmina. Internal cephalic femoral margin with fourteen spines, including the distal one; internal cephalic tibial margin with ten spines, exclusive of apical claw; abdomen strongly depressed, lateral angles rotundato-rectangulate, dorsal surface with longitudinal series of linear tubercles on the caudal portion of the segments.

Measurements.

Length of body,	38.0 mm.
Length of pronotum,	9.5 "
Greatest width of pronotum,	6.8 "
Length of tegmen,	13.5 "
Greatest width of tegmen,	7.6 "
Length of cephalic femur,	12.0 "

IDOLOMORPHA Burmeister.

Idolomorpha dentifrons Saussure and Zehntner.

1895. *Idolomorpha dentifrons* Saussure and Zehntner, in Grandidier, Hist. Phys. Nat. et Polit. Madagascar, Orth., Blatt.-Mant., pp. 242, 244. [Zanzibar.]

Mombasa. One female. [Hebard Collection.]

This species, the only East African one of the genus, is known to range from Delagoa Bay to the White Nile and the Ogaden country.

BLEPHAROPSIS Rehn.

Blepharopsis mendica (Fabricius).

1775. [*Mantis*] *mendica* Fabricius, Syst. Entom., p. 275. [Alexandria, Egypt.]

Gafsa, Tunis. One female. [Hebard Collection.]

The distribution of this species in Africa is quite extensive, apparently covering all of the northern third of the continent, as it has been recorded from the Canaries, Senegambia, Tunis, Egypt, Nubia, Schoa, Kordofan, Abyssinia and Somaliland. It also occurs in Syria and Arabia.

IDOLUM Saussure.

Idolum diabolicum Saussure.

1870. *I*[*dolum*] *diabolicum* Saussure, Mitth. Schw. Ent. Gesell., III, pp. 223. [Africa.]

German East Africa. One immature female.

PHASMIDÆ.

BACILLINÆ.

XYLICA Karsch.

Xylica kikuyuensis n. sp.

Type: ♀; Kikuyu Escarpment, British East Africa. [Acad. Nat. Sci. Phila., type No. 5,170.]

Allied to *X. abbreviata* Redtenbacher from Ukami Mountains, German East Africa, and *caligulata* Redtenbacher from Zanzibar, differing from both in the peculiar development of the dorsal surface of the fifth abdominal segment and the smaller size, also from *abbreviata* in the shorter and more robust mesothorax, metathorax and limbs and from *caligulata* in the simpler and more usual type of operculum. The cephalic metatarsi show some indications of the cristation found in *caligulata*, while the antennal length is the same as in *abbreviata*, although the coloration of the latter is as found in *kilimandjarica* Sjöstedt, from which *kikuyuensis* can be immediately separated by the form of the fifth abdominal segment and the longer antennæ.

Size medium; form fairly robust; surface granulose and rugulose. Head distinctly longer than the prothorax, slightly longer than broad, surface with numerous granular tubercles; cephalic horns two in number, prominent, sharp, divergent; occipital margin laterally with sulci separating decided trigonal elevations from the low median paired tubercles; eyes elliptical, prominent; antennæ subequal to the cephalic femora in length, composed of twenty joints, proximal one compressed, lamellate. Prothorax slightly longitudinal, rectagonal, caudal margin with a median pair of tubercles. Mesothorax slightly less than three times the length of the prothorax, subequal to the prothorax except caudad where it is somewhat expanded, medio-longitudinal carina distinct and continuous over the metathorax as well; supplementary carinæ reaching about to middle of segment, sinuate, lateral margins undulato-carinate. Metathorax about two-thirds the length of mesothorax, much similar in character, but with the supplementary carinæ reaching about to the median segment, then curving laterad; median segment comprising two-fifths of the total metathoracic length, imperfectly defined, very slightly transverse, supplied caudad with paired tubercles as on the mesonotum. Abdomen with distinct median and supplementary longitudinal carinæ, as well as more or less complete lateral ones and numerous short rugæ; each of the four proximal segments with a caudal pair of tubercles, as on the mesonotum and median segment; median carina on fifth to eighth segment cristate sublamellate; fifth dorsal abdominal segment supplied with paired horizontal dentate lobes developed on each side of the base of the median crest; anal segment obtuse-angulate distad; cerci broad, depressed, apex acute; subgenital operculum spoon-shaped, carinate ventrad, apically margin acute-angulate, the immediate apex rounded. Mesosternum distinctly medio-longitudinally carinate. Cephalic limbs short; femora decidedly compressed, proximal flexure very marked; tibiæ slightly longer than the femora, compressed; metatarsi subcristate. Median limbs very short, femora not as long as the mesothorax. Caudal limbs short, femora compressed.

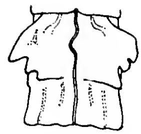

Fig. 2.—*Xylica kikuyuensis* n. sp. Dorsal outline of fifth abdominal segment (♀). (× 5.)

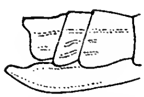

Fig. 3.—*Xylica kikuyuensis* n. sp. Lateral outline of apex of abdomen (♀). (× 3.)

General color probably pale greenish in life, some of the insect being now of this color, the remainder undoubtedly discolored and of a dull brownish. Antennæ annulate more or less regularly on alternate segments with Vandyke brown; eyes walnut-brown, crossed by one of several lateral longitudinal lines of Vandyke brown. Cephalic tibiæ tipped with dark brown. Vicinity of cephalic horns and internal portion of proximal extremity of cephalic femora pinkish.

Measurements.

Length of body,	41.0 mm.
Length of prothorax,	3.0 "
Length of mesothorax,	8.5 "
Length of metathorax,	6.0 "
Length of cephalic femur,	11.0 "
Length of median femur,	6.5 "
Length of caudal femur,	8.5 "

The type is unique.

CLITUMNINÆ.

GRATIDIA Stål.

Gratidia montana Brunner.

1907. *Gr[atidia] montana* Brunner, Die Insektenf. Phasm., II, p. 223. [Kilimanjaro; Abyssinia.]

Tanga, German East Africa. One female.

Sjöstedt has recently recorded this species[8] from the lower culture-zone of Kibonoto, Kilimanjaro and from Meru, also adding additional notes on the structure of the sexes. The specimen in hand is larger than any previously measured from German East Africa, the dimensions being as follows: length of body 84.5 mm.; length of prothorax 2.8; length of mesothorax 17; length of metathorax 15; length of cephalic femur 27; length of median femur 19; length of caudal femur 25.

Gratidia nebulosipes n. sp.

Type: ♂; Kikuyu Escarpment, British East Africa. [Acad. Nat. Sci. Phila., type No. 5,171.]

Allied to *G. fissa* Karsch from German East Africa, but differing in the non-dilated apex of the but marginally excised process of the anal segment and in the shorter thoracic segments and limbs. Some relationship exists to *G. tenuis* Sjöstedt[9] but the narrower process of the anal segment and less produced character of the same will at once separate the new form.

Size rather small; form slender; limbs but moderately elongate. Head but slightly longer than the prothorax, very slightly narrowed caudad, the interocular transverse low inflation and the fine medio-longitudinal sulcus as in numerous other species of the genus; occipital margin slightly produced into a pair of median very low subtrigonal tubercles; eyes subglobose, slightly flattened; antennæ half the length of the cephalic femora, seven-

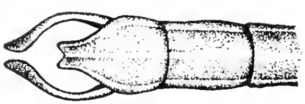

Fig. 4.—*Gratidia nebulosipes* n. sp. Dorsal view of apex of abdomen (♂). (× 6.)

[8] *Wissen. Ergebn. Schwed. Zool. Exp. Kilimandj. u. Meru*, XVII, p. 84.
[9] *Wissen. Ergebn. Schwed. Zool. Exped. Kilimandjaro u. Meru*, XVII, p. 85, fig. 5. [Kilimanjaro, Meru and Usambara.]

teen-jointed. Prothorax with the lateral pronotal margins subparallel, slightly in-bent cephalad and caudad, cephalic margin of pronotum subarcuate emarginate, caudal margin of same subtruncate, transverse sulcus distinctly impressed mesad. Mesothorax three-fourths the length of the median femora, supplied with a fine medio-longitudinal carinula. Metathorax slightly shorter than the mesothorax, with a similar extremely weak carinula; median segment subquadrate. Abdomen of moderate length, the segments longitudinal, but not excessively prolonged, toward apex of the abdomen lateral and median carinulæ are faintly indicated; anal segment fornicate, produced meso-caudad, the projection being not a half the length of the segment itself, dorsal surface with a distinct medio-longitudinal carina more distinct on the process, lateral margins regularly converging from the cercal bases caudad, the apex of the process shallowly V-emarginate; cerci inserted at the middle of the segment proper, narrowest in the premedian section, distal extremity enlarged, subclavate and trigonal in section, immediate apex bluntly acute, when viewed from the dorsum the cerci are seen to be strongly arcuate in the proximal half; sub-genital plate hardly inflated, reaching to the base of the anal segment, distal margin arcuate with a pair of small, short, rotundate median lobes, a weak medio-longitudinal carina present on distal half of plate. Cephalic femora almost equal to the head and thoracic segments in length; cephalic tibiæ exceeding the femoral length by about the length of the head. Median femora not exceeding the pro- and mesothorax in length; median tibiæ slightly exceeding the femora. Caudal femora equal to two-thirds the length of the cephalic femora; caudal tibiæ exceeding the femora by slightly less than the length of the head.

Fig. 5.—*Gratidia nebulosipes* n. sp. Lateral outline of apex of abdomen (♂). (× 6.)

General color Prout's brown, becoming bistre towards the apex of the abdomen, the latter region sparingly marked with hoary white. Head and prothorax with the base color near wood-brown, indistinct postocular bars of the general color present; antennæ drab. Limbs clouded and varied with the general color, tawny-olive and soiled buff.

Measurements.

Length of body,	46.0 mm.
Length of prothorax,	2.2 "
Length of mesothorax,	9.0 "
Length of metathorax,	8.2 "
Length of cephalic femur,	21.0 "
Length of median femur,	10.8 "
Length of caudal femur,	14.5 "

Two paratypic males show that the species probably varies little in size and structure, but considerably so in color. The general color lightens to general wood-brown tints and also toward greenish; in the former phase the legs are hardly clouded, while in the latter the dark shades remain as in the type, and the clouding is, in consequence, of even greater contrast.

LEPTYNIA Pantel.

1890. *Leptynia* Pantel, An. Soc. Españ. Hist. Nat., XIX, p. 385.

Apparently *Maransis* Karsch (*Entom. Nachrich.*, XXIV, pp. 365, 381, 1898) should be referred to this genus as a synonym.

Leptynia rufolineatus (Schulthess).

1899. *M*[*aransis*] *rufolineatus* Schulthess, Bull. Soc. Vaudoise Sci. Nat., Lausanne, XXXV, p. 200, Pl. VIII, fig. 4. [Delagoa.]
1904. *Maransis rufolineatus* Rehn, Proc. Acad. Nat. Sci. Phila., 1904, p. 83. [Zulu Mission, South Africa.]

This species should be placed in the vicinity of *L. prospera* Brunner and *aspericollis* (Bates), to both of which it is extremely close, if really separable from one or the other. Brunner in his monograph has omitted this species as well as the related *mozambicus* Westwood and *trilineatus* Stål.

Leptynia senex n. sp.

Type: ♀; Kikuyu Escarpment, British East Africa. [Acad. Nat. Sci. Phila., type No. 5,172.]

In the sublobate median femora this species shows relationship to *L. pluto* Rehn[10] from Lake Kivu, but the more robust and hoary granulate body, the longer operculum and more compressed and apically emarginate anal segment are distinctive of *senex*.

Size rather large; form moderately elongate; surface of thorax irregularly and bluntly granulate. Head slightly more than half again as long as the prothorax, gradually narrowing caudad; interocular region slightly inflated; occipital margin slightly impressed mesad; eyes subelliptical in basal outline, hardly prominent; antennæ

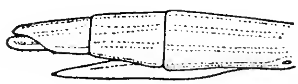

Fig. 6.—*Leptynia senex* n. sp. Lateral outline of apex of abdomen (♀). (× 6.)

[10] In *Ergebnisse der Deutschen Cent.-Afr. Exped. 1907–1908*, unter Führung Adolf Friedrichs, Herzog zu Mecklenburg, Zool., Orth. (In press.)

contained about three and one-half times in the length of the cephalic femora, non-clavate, seventeen-jointed. Prothorax with the dorsum narrowing to a premedian point of least width; cephalic margin gently arcuato-emarginate, caudal margin subtruncate. Mesothorax very slightly exceeding the median femora in length, with an extremely faint median, and intimations of lateral, carinæ. Metathorax falling short of the mesothoracic length by nearly that of the prothorax,

Fig. 7.—*Leptynia senex* n. sp. Ventral outline of apex of abdomen (♀). (× 6.)

carinæ as on the mesothorax; median segment strongly transverse, poorly delimited cephalad. Abdomen becoming progressively quinque-carinate caudad; segments, except proximal and distal ones, decidedly longitudinal; anal segment very slightly longer than the preceding abdominal segment, tectate dorsad, median carina sharp, caudal margin produced and moderately V-emarginate mesad, exposing the extreme apex of the supra-anal plate; cerci slightly more than half the greatest length of the anal segment, compressed, subequal, ventral margin straight, dorsal margin arcuate distad, the apex being ventrad, lateral face excavate and medio-carinate; operculum lanceolate, reaching to the middle of the anal segment, non-carinate mesad, but with distinct sinuate lateral carinæ in the proximal two-thirds; seventh ventral abdominal segment with prominent, paired, parallel median carinæ, distal margin rectangulate. Cephalic femora distinctly exceeding the head, pro- and mesothorax in length; tibiæ slightly longer than the femora. Median femora slightly shorter than the mesothorax, at the proximal third with a low rounded or biundulate lobe on each ventral margin, carinæ unarmed; tibiæ subequal to the femora. Caudal femora equal to the length of the pro- and mesothorax, unarmed and non-lobate; tibiæ slightly exceeding the femoral length.

General color clove-brown, the thoracic tubercles, scattered spots on the dorsum of the head and abdomen and clouding of apex of latter hoary white. Limbs finely grizzled with whitish, the vicinity of the cephalic flexure of the cephalic femora dull ochraceous.

Measurements.

Length of body,	64.0 mm.
Length of prothorax,	2.8 "
Length of mesothorax,	13.0 "
Length of metathorax (incl. med. segm.),	11.0 "
Length of cephalic femur,	20.5 "
Length of median femur,	12.0 "
Length of caudal femur,	16.0 "

The type is unique.

PHTHOA Karsch.

Phthoa occidentalis n. sp.

Type: ♀; Massamedes Province, Angola. [Acad. Nat. Sci. Phila., type No. 5,173.]

Differing from *P. prolixa* Karsch from Mpwapwa, German East Africa, the type and only other species in the genus, in the greater size and triangularly emarginate seventh ventral abdominal segment, which latter is supplied laterad with decidedly acute triangular lobes, instead of being shallowly arcuate emarginate as in *prolixa*.

Size rather large; form moderately elongate; surface smooth, an indistinct medio-longitudinal carina present. Head about twice as long as the prothorax, distinctly narrowing caudad; interocular region slightly inflated; occipital margin moderately impressed mesad; eyes subglobose, hardly prominent; antennæ less than one-third the

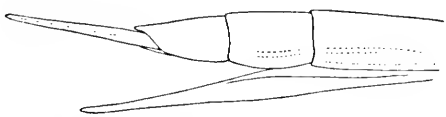

Fig. 8.—*Phthoa occidentalis* n. sp. Lateral view of apex of abdomen (♀). (× 5.)

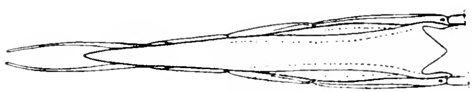

Fig. 9.—*Phthoa occidentalis* n. sp. Ventral view of apex of abdomen (♀). (× 5.)

length of the cephalic femora, seventeen- to eighteen-jointed. Prothorax with the dorso-lateral margins sinuate and converging cephalad, cephalic margin arcuato-emarginate, caudal margin emarginato-truncate. Mesothorax two-thirds the length of the cephalic femora.

Metathorax equal to three-fourths the mesothoracic length; median segment transverse, cephalic margin arcuate. Abdomen with the median segments very strongly longitudinal; anal segment but slightly longer than the preceding abdominal segment, meso-carinate, caudal margin acute-angulate; supra-anal plate small, tapering subdigitiform, horizontal; cerci about twice the length of the anal segment, subcompressed, terete; operculum elongate lanceolate, falling but little short of the tips of the cerci, carinate proximo-laterad; seventh ventral abdominal segment slightly produced distad into a pair of divergent acute triangular lobes, the interspace being V-shaped emarginate, surface of segment not carinate mesad. Cephalic femora slightly exceeding the mesothoracic and twice the prothoracic length; tibiæ exceeding the femora by about the prothoracic length. Median femora unarmed and non-lobate, nearly equal to the pro- and meso-thoracic length; tibiæ slightly exceeding the femora. Caudal femora very slightly shorter than the median pair; tibiæ exceeding the femora by more than the prothoracic length.

Natural color destroyed by immersion in spirits. Present coloration pale yellowish.

Measurements.

Length of body,	79.0 mm.
Length of prothorax,	2.5 "
Length of mesothorax,	16.0 "
Length of metathorax (incl. med. segm.),	12.5 "
Length of cephalic femur,	22.2 "
Length of median femur,	18.5 "
Length of caudal femur,	18.2 "
Length of operculum,	9.8 "

The type is the only representative of the species seen by us.

PHIBALOSOMINÆ.

ISCHNOPODA Grandidier.

Ischnopoda reyi Grandidier.

1869. *Ischnopoda reyi* Grandidier, Revue et Magasin de Zoolog., 2me ser., XXI, p. 292. [Quilimane, Portuguese East Africa.]

German East Africa. Two females.

FAUNA OF THE GATUN FORMATION, ISTHMUS OF PANAMA.

BY AMOS P. BROWN AND HENRY A. PILSBRY.

The collection of fossils studied in this paper was made by one of us (Brown) during two visits to the Isthmus in April and in August, 1910. With the exception of a tooth of a shark[1] and a few specimens of *Oliva* from Monkey Hill, all come from the excavations for the locks at Gatun. The *Oliva* taken at Monkey Hill is the same species found plentifully at the Gatun excavation. The specimens were collected from dumps and fills along the railway as well as from the dumps in the vicinity of Gatun.

A rapid reconnaissance of the stratigraphy along the line of the railway from Colon to Empire and along the canal from Colon to Gatun seemed to indicate that the formations, from the highest exposures at Monkey Hill (Mount Hope) to the lowest that contain molluscan remains at Bohio, form one stratigraphic unit, the base of which is to be found at Bohio and the top at Monkey Hill. This was the impression formed by a study of the stratigraphy on the ground. As shown below, the study of the fossils collected, and a survey of the literature on the Isthmian formations, bears out his impression formed in the field. The thickness of this Gatun formation is probably not much above 400 feet, judging from exposures and borings at Gatun. It is dredged from the canal at more than four miles north of Gatun, being here encountered at 18 feet below water level.

If this is correct that the mollusk-bearing formations from Bohio to the sea at Colon form one stratigraphic unit (and they appear to be one faunal unit), the Gatun Formation will include beds that have been variously called Bohio, Gatun, Monkey Hill, Culebra and Vamos-Vamos.

The recognition of Eocene in the Isthmian section rests upon fossils from the "Vamos á Vamos or Gatun beds" collected by Robert T. Hill and examined by Dr. Wm. H. Dall. These fossils occur as "pseudomorphs in calcite in a tough matrix, and difficult to extract in good condition." The following Eocene (Claiborne) species were "noted on a rapid examination"[2] by Dr. Dall:

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[1] *Carcharias megalodon* Ag.

[2] *Bull. Mus. Comp. Zool.*, vol. 28, p. 273. The genera noted without specific identifications are such as are found in the Oligocene beds.

Lupia perovata Conrad.
Solarium alveatum Conrad.
Natica eminula Conrad.
To which the following were subsequently added:
Corbula alabamiensis Lea.
Corbula gregorioi Cossmann.

The shell identified as *Lupia perorata* may turn out to be "*Amaura*" *guppyi* Gabb, of the Santo Domingo Oligocene, a species which resembles the Eocene form so closely that very well-preserved examples are necessary for their discrimination.

The genus *Glyptostyla*, represented by *G. panamensis* Dall, is known elsewhere only from the Upper Tejon Eocene of California, where a species very distinct from the Vamos á Vamos form occurs.

The condition of the calcite pseudomorphs at Gatun is often not favorable for exact determination, and it seems possible that some of the identifications with Claibornian species might be modified by the study of perfect examples.[3] The presence of a few Claibornian species belonging to genera not characteristically Eocene in a fauna predominantly Oligocene does not, it seems to us, justify a reference of the formation to the Eocene. Until a longer list of Eocene species including some characteristic forms is made known, we are disposed to regard all of the known tertiary beds of the Canal Zone carrying molluscan fossils as Oligocene and as constituting one formation. The exact position of the Gatun Formation among Antillean Oligocene formations cannot be fixed without a more complete list of the contained fossils than we now possess, but its approximate place is clear. As Dall has shown, the Jamaican (Bowden) marl, by the absence of *Orthaulax* and the greater proportion of modern species, is probably somewhat later than the Santo Domingo beds. The Gatun formation, as now imperfectly known, has decidedly more in common with the older and more remote Santo Domingan than with the later and geographically nearer Bowdenian.

It contains many species common to both beds, and a few show greater affinity to Bowden forms. Some of the difference between the Isthmian and Santo Domingo faunas is doubtless due to local specific differentiation; possibly this factor may account for all the differences; yet on the whole we conclude that the Gatun fauna is slightly later than the Santo Domingo and earlier than the Bowden.

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[3] We express this possibility in view of the imperfection of the material and with all respect for Dr. Dall's opinion, which is justly considered authoritative in such matters.

Gatun species identical with those of Santo Domingo	22
Gatun species identical with those of Bowden	13
(Eight of the species are common to the Santo Domingo and Bowden beds.)	
Gatun species more closely allied to those of Santo Domingo and Bowden than to any other known forms	20
Gatun species identical with those of Chipola	4
Gatun species identical with recent forms	6
Gatun species as yet known only from that formation	67

It will be noted that at least 40 per cent. of the 104 Gatun species now known are either identical with, or very closely related to, Santo Domingo forms. A considerable proportion of the remaining species are certainly allied to those of Santo Domingo, but without exhaustive studies of the groups, their nearest affinities cannot readily be determined.

Of the 6 species identical with recent forms, 4 are Antillean, one inhabits both coasts and one the Pacific coast only. It is obvious that in the Antillean and Isthmian Oligocene the ancestral stocks of a large part of the modern Antillean and Panamic faunas are present, genera now characteristically Panamic being especially well-developed, such as *Cymia*, *Solenosteira*, *Strombina*, *Malea*, *Trachycardium* of the *belcheri* group, *Clementia*, *Acila*, *Tesseracme*, *Cadulus* of the *dentalinus* group, etc. None of them are deep-water forms, and all are absent or rare in the curiously impoverished littoral Antillean fauna of the present time.[4]

In the following list we have included all species reported from the Gatun beds. Species marked with an asterisk (*) were not included in the collections we have studied. With a few exceptions noted in the text, the other species listed are in the collection of the Academy.

Acknowledgments are due to Professor Wm. B. Scott and Mr. Gilbert Van Ingen for the privilege of studying a small series of Gatun specimens in the museum of Princeton University, collected in 1908 by Mr. Ward H. Farrington. We would also acknowledge the courtesy of Dr. Wm. H. Dall, in giving access to material in the U. S. National Museum.

Genera reported by Toula and Hill without specific identifications have not been inserted in the following list.

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[4] Hill's statement (Bull. Mus. Comp. Zool., vol. 28, p. 265) that Pacific forms do not exist in the Antillean Oligocene is clearly at variance with the facts. An important element in the littoral fauna of the Panamic province is directly traceable to Antillean Oligocene faunas, as the above list demonstrates.

ACTEONIDÆ.

***Bullina chipolana** Dall.

Bullina (Abderospira) chipolana Dall, Proc. U. S. Nat. Mus., XVIII, p. 32.

Chipola beds, Chipola River, Florida; near Gatun, Rowell (Dall).

SCAPHANDRIDÆ.

***Volvulella** sp. undet.

Bulla (Volvula) cf. oxytata Bush, Toula, Jahrbuch der Kaiserlich-Königlichen Geologischen Reichsanstalt, LVIII, 1908 (April 15, 1909), p. 709, Pl. 28, fig. 4.

Gatun.

TEREBRIDÆ.

Terebra subsulcifera n. sp. Pl. XXII, fig. 7.

The shell is slender, the diameter contained about 7½ times in the length, composed of about 15 whorls in a length of 31 mm. Sculpture: A prominent band below the suture, fully one-third the width of the whorl; below it, and separated by a sulcus, another band half as wide, below which there are weak, nearly obsolete spiral striæ; the whole crossed by rather sharp vertical riblets narrower than their intervals. These are very slightly oblique on the upper band, vertical on the sunken lower part of the whorl. The riblets gradually weaken below the middle of the last whorl, leaving the base smooth. The columella is strongly biplicate, the folds subobsolete at the aperture.

Length 31, diam. 7 mm.

This species has much in common with *T. haitensis* Dall, but it differs by having two columellar folds among other minor differences. A comparison kindly made by Dr. Dall shows them to be distinct. *T. sulcifera* Sowerby, of the Santo Domingo Oligocene, is described as having a third subobsolete spiral sulcus, while the species under consideration has only two sulci.

Terebra gatunensis Toula. Pl. XXII, fig. 2 (× 2½).

Terebra (Oxymeria) gatunensis Toula, Jahrb., p. 705, Pl. 25, fig. 14.

This fine species reaches a length of 50 to 60 mm. The subsutural band is about one-fourth the width of the whorl, with sculpture of straight, vertical ribs, and is followed by a rather wide furrow, below which there are seven rounded spiral cords, the upper one larger. Fine, slightly bent, longitudinal ribs run from suture to suture over cords and intervals, forming rounded knots at the intersections. These ribs are about twice as far apart as the spiral cords on the upper whorls, but on the later ones the cords and ribs are about equally spaced. On the last whorl the siphonal fasciole is marked with rude growth-lines and lamellæ and bounded by a keel. Aperture narrow and long. The specimen figured, broken at both ends, is 51 mm. long, composed of 13 whorls. Toula's description and figure were from a young shell.

Fig. 2 is typical. Six specimens seen. We doubt whether the following form is specifically distinct, so widely it varies in sculpture. The recent *T. panamensis* Dall has some resemblance to this species. A complete specimen measures, length 52, diam. 10.5 mm.

Terebra wolfgangi Toula. Pl. XXII, figs. 1, 3–6 (× 2½).

Terebra (Oxymeria) wolfgangi Toula, Jahrb., p. 705, Pl. 28, fig. 7.

Very closely related to *T. gatunensis*, perhaps only a form of that species, from which it differs by having several weak spirals on the sutural band, running over ribs and intervals, and in the smaller number of spiral cords below the band, there being five, equally spaced, on the penultimate whorl, four on the median and upper whorls. The rate of increase of the whorls is about the same as in *T. gatunensis*. Judging from a number of incomplete shells, an adult of 50 mm. length should have about 20 whorls, of which fully 3 form a narrow, high, smooth embryonic shell.

This species is somewhat related to the Pliocene and recent *T. dislocata* Say, and especially to the preceding species. It varies widely in sculpture, as follows:

1. Sutural band differentiated on the early whorls, but on the last 3 or 4 not set off from the other spirals by a deeper furrow; 4 spiral cords as wide as their intervals below it; vertical sculpture fine and low on the later whorls, weak in the intervals of the spirals. One specimen (Pl. 22, fig. 1).
2. Typical form, described above, 2 specimens.
3. Sutural band divided by one shallow sulcus in the intercostal spaces only. Spiral cords unequal, three in a group, followed by two separated by wider spaces. Only 12 spirals on the last whorl below the band. One specimen (figs. 3, 4).
4. Sutural band with several spiral striæ indenting the ribs and intervals. Spiral cords unequally spaced. Two specimens (figs. 5, 6).

Terebra gausapata n. sp. Pl. XXII, figs. 8, 9.

A small, slowly tapering species, with very slightly convex whorls and well-impressed, undulating suture. Sutural band limited by a deep, narrow sulcus and, like the rest of the whorl, sculptured with close, unequal, spiral threads. There are three threads upon the band, eight below it. There are fourteen high, rather narrow, longitudinal ribs on each whorl, the threads obsolete on their summits. The imperfect shell figured measures, length 9, diam. 2.8 mm., of $6\frac{1}{3}$ whorls.

CONIDÆ.

Conus concavitectum n. sp. Pl. XXIII, figs. 5, 6.

A cone about twice as long as wide. Spire very concavely conic or mucronate, the inner whorls forming a very steep, acute cone, its whorls carinate below the middle of each, sloping and usually marked with a faint impressed spiral line or two above the carina, or having several striæ on the lower part of the slope, where the carina lies in the suture. The last 3 or 4 whorls revolve nearly in a plane, are markedly concave, with the outer edge raised in an erect flange or keel, the concavity marked with one or several spiral threads and distinct, arched growth-striæ. Last whorl slightly convex below the shoulder-angle, straight and slender below, marked below the middle with unequal, low spirals, most of them beaded. Length 37.5, diam. 19 mm. Incomplete adult shells are much larger, diam. 28 mm., with about 15 whorls.

This species differs from *C. domingensis* Gabb by having the outer edge of the later whorls raised in a flange and by the smooth, not tuberculate early whorls. None of the larger specimens is complete.

Conus haytensis Sowb.

Conus haytensis Sowb., Journ. Geol. Soc. Lond., VI, p. 44.

A perfect, but small specimen, length 26 mm., agrees with Santo Domingo examples.

Conus domingensis Sowerby (?).

C. domingensis Sowb., Journ. Geol. Soc. Lond., VI, p. 45.

A fragment, the spire only, agrees well with this species, so far as it goes.

Conus consobrinus Sowb.

Conus consobrinus Sowb., Journ. Geol. Soc. Lond., VI, p. 45.

A Gatun specimen is about 30 mm. long, of the highly sculptured typical form.

Conus granozonatus Guppy.

C. granozonatus Guppy, Quart. Journ. Geol. Soc. Lond., XXII, p. 287, Pl. 16, fig. 5.
C. gracilissimus Guppy, t. c., p. 288, Pl. 16, fig. 4.

Not uncommon at Gatun. While closely related to *C. consobrinus*, this seems to be a distinct species. In our series from Bowden the *C. gracilissimus* does not seem distinguishable specifically.

Couus æmulator n. sp. Pl. XXIII, fig. 9.

A cone related to *alveatus* Conr. and *imitator*, differing from both in the very concavely conic spire. Whorls slightly concave above, with about 3 spiral striæ; not tuberculate, last whorl decidedly convex below the shoulder, its lower half spirally striate, the striæ unequal, not beaded. The outer lip is much less retracted above than in *alveatus*.

Length 22.5, diam. 12.8 mm.; whorls about 9.

The single specimen is a pseudomorph in calcite. It differs from *C. domingensis* by the non-tuberculate early whorls.

Conus imitator n. sp. Pl. XXIII, fig. 4.

A cone about twice as long as wide, the spire forming about one-fourth of the length. The spire is concave and acuminate in the upper third, the first 3 whorls smooth, the next 4 or 5 whorls having a smooth carina projecting above the suture, the first $2\frac{1}{2}$ of them tuberculate, after which the carina is smooth; following whorls less steeply sloping, very slightly concave, marked with fine growth-lines and a few weak spiral striæ, slightly prominent at the sutures. Last whorl acutely carinate, the slope below the angle almost straight, but just perceptibly convex in the upper, concave in the lower half, which is sculptured with about 16 rather strong spiral cords. The outer lip arches strongly forward and is deeply retracted at the upper end.

Length 35, diam. 17 mm., whorls 12.

This small, inornate cone is probably a descendant of *C. alveatus* Conr. of the Vicksburgian, but in that species the spire is more strongly striate, more whorls are tuberculate, and the keel edging the whorls is directed upward, whilst in *C. imitator* it is rather outward.

It is rather abundant at Gatun. Also occurs in Santo Domingo.

Conus gaza Johnson and Pilsbry, n. sp. Pl. XXIII, figs. 2, 3.

"The shell is biconic, diameter over half the length, the spire is nearly one-third the total length, concavely conic, attenuate towards the apex. Post-embryonic whorls about 9, slightly concave, the lower edge of each angular, projecting a little; the angle tuberculate in the first post-embryonic whorl, smooth in the rest; sculptured with deeply arcuate, narrow, low and widely spaced riblets and striæ; no spiral striæ. Last whorl acutely angular at the shoulder, barely convex below the angle, the outline becoming concave in the lower part; sculptured with 20–22 strong, smooth, flattened spiral cords, separated by wider intervals which are sharply striated by growth-striæ. Aperture very narrow.

"Length 24, diam. 13.1 mm." (Johnson and Pilsbry).

Oligocene of Santo Domingo, Gabb. Also of Gatun, A. P. B.

This beautiful cone bears some resemblance to the longer *C. cruzianus* Dall from Santa Cruz, the horizon of which is uncertain.

The single specimen from Gatun has fully two tuberculate post-embryonic whorls. In the Santo Domingo types this stage is shorter, and generally inconspicuous or lost by erosion. We have quoted the description from Pilsbry and Johnson's MS. work on the Santo Domingo Oligocene. The figures represent the type specimens from the same place.

Conus molis n. sp. Pl. XXIII, fig. 1.

A large, ponderous cone resembling *C. promethus* in figure, the ratio of diameter to length as 1 : 1.7.

Spire but little raised except at the center, where the early whorls project in a short acute cone. Whorls about 13, the earlier 6 flat, later whorls concave, spirally striate with about 5 striæ between the seamlike sutural margins; crossed by weak growth-lines, which are not very deeply arcuate. The shoulder of the last whorl is subacute. Side strongly convex below the angle, then straight, finely striate spirally throughout, the lower third coarsely striate. Aperture as in *C. haytensis* Sowb.

Length 124, diam. 71.2 mm.

This cone resembles *C. haytensis* Sowb. of Santo Domingo, but differs by being longer in proportion to its width, in the plain, not coronated early whorls, which form a smaller mucro, the more acute shoulder, below which the side is more convex, *more distinctly striated;* the striæ at the base are more nearly equal and closer, not widely spaced with smaller striæ in the intervals, as they are in *haytensis*.

The type is No. 5,502 coll. Princeton University, collected by Ward H. Farrington, 1908.

This species is also represented by several internal casts in the Princeton and Academy Gatun collections, and there is a fine example in the U. S. National Museum from Monkey Hill, near Colon. Toula also mentions a cast, probably referable to the same species (Jahrb., p. 754).

TURRITIDÆ (PLEUROTOMIDÆ).

Pleurotoma albida Perry.

The specimens agree well with those of the Bowden beds. It is a conservative species, ranging from Eocene to recent.

Drillia gatunensis Toula.

D. gatunensis Toula, Jahrb., p. 707, Pl. 25, fig. 16.

Related to *D. indentata* J. and P., of the Santo Domingo Oligocene, but it differs by having more numerous spirals. In this feature there is rather wide variation, many specimens having but four wider spiral cords on the whorls of the spire below the sutural fasciole. It attains a length of 40 mm.

Drillia isthmica n. sp. Pl. XXIII, figs. 10, 11.

A small species, related to *D. parkeri* Gabb of the Santo Domingo Oligocene, $2\frac{1}{2}$ or 3 smooth whorls compose the embryonic shell, which is somewhat worn. Succeeding whorls have a distinct, narrow, convex, sutural fasciole, undulating in conformity with the suture, and rather weakly plicate, the plicæ perceptibly retractive, unevenly developed. Below the fasciole there are broad folds, subacute at their summits. On the slopes of the folds there are some protractive wrinkles, like ripples upon waves. There is an interrupted spiral groove midway between sutures, appearing as a series of short strokes in the troughs of the waves only. The aperture is imperfect in the type specimens. There is a small callous nodule on the left side of the posterior sinus.

Length 13 mm., 11 whorls.

The absence of spiral striation makes this species quite distinct from others of the Isthmian beds.

Drillia fusinus n. sp. Pl. XXIII, fig. 7.

The shell is fusiform, widest at the middle, like a slender *Fusinus* (*Fusus*). Spire attenuated towards the small, obtuse apex. The first half whorl is rounded, uptilted; then an acute carina appears at the lower third, at the end of the first whorl a second small cord appears above the suture. Beginning with the third whorl a small thread appears on the upper side of the main carina, and low longitudinal folds begin. On subsequent whorls these folds continue to the penultimate. They are low, very wide and on the last whorl subobsolete. The penultimate whorl has four subacute main spirals, one subsutural, two peripheral and one suprasutural; the intervals bearing smaller spiral threads and striæ. The last whorl has many spiral cords and threads. Whorls 12, concave above, the last one swollen in the middle, concave and extended in a long, straight anterior canal. Aperture narrow, small, less than half as long as the anterior canal, not deeply sinuated above.

Length 40, diam. 12 mm.

This appears to be a rather abundant shell at Gatun, but only one out of ten specimens retains the long anterior canal entire. It is extremely like *Fusinus* in contour, and is more nearly related to *D. fusiformis* than to other species known to us.

Drillia zooki n. sp. Pl. XXIII, fig. 8.

A species very closely related to *D. fusiformis* Gabb, of the Santo Domingan Oligocene, but differing as follows: The anterior canal is much shorter. There is no cord at the lower edge of the sutural fasciole, above the supraperipheral cord. There are eleven somewhat protractive longitudinal folds on the last whorl, which are narrower than in *D. fusiformis*. In other respects the two species seem to be substantially alike.

Length of last 4 whorls 20.5, diam. 8.5 mm.

Only imperfect specimens were collected. Named for Mr. E. Zook, of the Panama R. R.

Drillia consors (Sowerby).

Pleurotoma consors Sowb., Journ. Geol. Soc. Lond., VI, p. 50.

The Gatun specimens seem to have a slightly longer anterior canal than those from Santo Domingo.

***Pleurotoma gertrudis** Toula.

Pleurotoma (*Genota*) *gertrudis* Toula, Jahrb., p. 709, fig. 9.

Cythara heptagona (Gabb).

Mangelia heptagona Gabb, Geol. Santo Domingo, p. 211.

One typical specimen.

CANCELLARIIDÆ.

Cancellaria dariena Toula. Pl. XXIV, figs. 3, 4.

C. dariena Toula, Jahrb., p. 703, Pl. 25, fig. 13; Pl. 28, fig. 2.

This species resembles *C. reticulata* very closely, yet differs by having a much larger embryonic shell which is also more globose, of three whorls. There are about $5\frac{1}{2}$ post-embryonic sculptured whorls, while in *reticulata* there is at least one whorl more in shells of the same size. The first sculptured whorl in *C. dariena* has five spiral cords and 10 or 11 massive longitudinal folds. On the last whorl there are usually some smaller threads in the intervals between the principal spirals, above the periphery. The aperture is very much like that of *C. reticulata* except that a thin callus spreads far forward over the whorl to the middle of its ventral face.

Length 30, diam. 16.5 mm.

A form which may be called *Cancellaria dariena trachyostraca*,

n. subsp. (Pl. 24, figs. 1, 2), has the same comparatively large embryo, but the first sculptured whorl has about 16 more numerous, much narrower ribs. On the last whorl the spirals are equal, without spiral threads in the intervals. The callus does not extend forward from the aperture quite so extensively.

Length 30, diam. 18 mm.

Cancellaria barretti Guppy, which is very similar in appearance, has more spiral cords and more liræ within the outer lip.

Cancellaria decaptyx n. sp. Pl. XXIV, figs. 5, 6.

A small, slender species, composed of 7 whorls in a length of 11 mm. The first $2\frac{1}{2}$ whorls form a smooth naticoid embryonic shell; then three spiral cords appear, and soon after coarse, rounded longitudinal ribs. The spirals increase rapidly in number on succeeding whorls. They pass over the ribs, upon the crests of which they are slightly strengthened. The ribs are not quite as wide as their intervals. On the last whorl there are ten, on the preceding nine ribs. Whorls strongly convex. The aperture is small. Columella with two moderate, oblique folds, which are somewhat receding, being only weakly visible in a front view.

Length 11, diam. 5 mm.

We find no closely related species in the American tertiary.

MITRIDÆ.

Mitra longa Gabb. Pl. XXIV, fig. 11.

M. longa Gabb, Geol. of Santo Domingo, p. 219.

The specimens agree well with Gabb's types of this species. As it has not been illustrated, we figure one of the Gatun specimens. It measures, length 37, diam. 9.1 mm.

Mitra dariensis n. sp. Pl. XXIV, fig. 9.

A species closely related to *M. longa*, but shorter, the diameter contained about three times in the length. The apex is lost, $6\frac{1}{2}$ whorls remaining. These are rather convex, with sculpture of four strong equal spiral ridges, and a smaller thread just below the suture; and on the last three whorls another thread appears between the first and second of the spiral cords. The last whorl has twelve major spirals, and about six small, subequal spirals on the siphonal fasciole. The interstices are sculptured with rather close, sharp longitudinal threads, and in each a spiral sunken line revolves. The aperture is narrow. Columella with four strongly oblique folds, the lowest one very small, upper fold much the strongest.

Length 22, diam. 7 mm. (apex wanting).

This species differs from *M. longa* chiefly by the shorter, less contracted basal portion of the last whorl and the somewhat different sculpture of the interstices between the smooth spiral ribs.

Mitra sp. undet. Pl. XXIV, figs. 7, 8.

The internal cast of a large Mitre having three columellar plaits, the median one strongest, and with unusually short whorls, contained in the Princeton collection, No. 5,515, is figured (fig. 8). Length of the fragment, which comprises nearly 2 whorls, is 46.5 mm.

A short piece of the columella of what we take to be the same species, was taken by one of us (fig. 7). It shows three sharp plaits, the middle one largest, and on the wall above the upper plait there are several spiral threads.

This species is distinct from any known Santo Domingan *Mitra*.

MARGINELLIDÆ.

Marginella gatunensis n. sp. Pl. XXIV, fig. 10.

A rather small oblong shell, widest at the upper third of the length, the diameter contained about 1.8 times in the length. The spire is conic, short, and so enveloped in callus that the sutures are obliterated. The outer lip is rather broad, thickened outside, incurved, and delicately denticulate within. The nearly straight narrow aperture is rather abruptly but slightly dilated near the lower end. The columella bears four folds, the lower two or three a little flattened towards the outer ends. Upper half of the columellar wall is somewhat calloused, but thin at the outer edge.

Length 11.5, diam. 6.25 mm. (type).
" 8.5, " 4.8 "

This species is clearly distinct from all described from the American Oligocene. It has some resemblance to *M. limonensis* Dall, of the Costa Rican Miocene (?), but that is more than double the size of the largest *M. gatunensis* seen, and is relatively narrower.

Marginella leander n. sp. Pl. XXIV, fig. 13.

The shell is long and narrow, the diameter not quite half the length; approaching a cylindric contour, but tapering a little from the upper fourth to the base; the spire a very short, wide cone, obtuse and rounded at the summit. The aperture is straight, very narrow in the upper moiety, the lower third decidedly wider. Outer lip nearly straight, with narrow, rounded face, thickened externally, a little inflexed in the middle. Columella bearing four rather small folds, which run outward upon the ventral face of the shell. There is a low callus upon the columellar wall above. The anterior notch is rather wide and shallow.

Length 9.0, diam. 4.2 mm. (type).
" 8.6, " 4.1 "

Chiefly notable for its narrow shape and the long, emerging columellar folds. Named for the Rev. Leander T. Chamberlain.

Marginella coniformis Sowb. Pl. XXIV, fig. 12.

Marginella coniformis Sowb., Journ. Geol. Soc. Lond., VI, p. 45 (Santo Domingo).

The specimens agree very closely with the small Bowden race of this species, which has been very poorly figured by Guppy (Q. J. Geol. Soc., XXII, Pl. 17, fig. 2); but the Gatun shells are even smaller. Specimens measure:

Length 15.8, diam. 9.7 mm.
" 14.3, " 9.1 "

M. ballista Dall is broader at the shoulder, but otherwise related.

OLIVIDÆ.

Oliva reticularis gatunensis Toula.

Oliva gatunensis Toula, Jahrb., p. 702, Pl. 25, fig. 12.
Cf. Oliva liodes Dall, Trans. Wagner Inst. Sci., Pl. 58, fig. 1.

This abundant form is not really distinguishable from the living *O. reticularis*, except by its smaller size, length 35 to 38 mm.

FASCIOLARIIDÆ.

***Glyptostyla panamensis** Dall.

Glyptostyla panamensis Dall., Trans. Wagner Inst. Sci., III, p. 233, Pl. 13, fig. 5.

Not seen by us. Vamos-vamos Station, 19 kilom. from Colon. The genus *Glyptostyla* is also known from the Martinez Eocene of California, but the species of that bed, *G. crassitesta* (Gabb), is very unlike the Isthmian form in sculpture, and cannot be considered nearly related.

Fasciolaria sp. undet.

Internal casts of a species not unlike the Chipolan *F. ramondi* Maury were taken at Gatun.

BUCCINIDÆ.

Solenosteira dalli n. sp. Pl. XXIV, fig. 14.

The shell is biconic, solid and thick. Spire conic, acuminate when perfect, with about 2½ smooth embryonic whorls, the following whorls very convex, with sculpture of massive longitudinal folds not quite as wide as the intervals, and sharp spiral cords and threads passing over folds and intervals. On the last whorl there are 8 or 9 short, high folds, narrower than the intervals, and somewhat pointed at the shoulder, and sharp spiral cords, the concave intervals of which bear several unequal spiral threads. There are 16 or 17 major spirals between the suture and the basal point of the outer lip, and 5 or 6 more small ones on the convex basal fasciole. The whole surface between the spirals is marked with fine growth striæ. The last whorl is deeply concave below, expanded around the umbilicus, which is deep and funnel-shaped. Aperture as in the type of the genus, except that there is no posterior channel, merely an angle. Outer lip deeply sulcate within, with crenulate edge. Columella nearly straight. Parietal callus thin, with raised edge and one or two small liræ near the posterior angle of the aperture.

Length 41, diam. 25 mm.

This fine species bears the name of Dr. William H. Dall, whose "Tertiary Mollusks of Florida" is the greatest classic of the American Neocene.

It is evidently close to the recent *S. anomala* (Reeve), the type of *Solenosteira*, but differs by the greater number of spiral cords and the absence of an expansion or incipient channel at the posterior angle of the aperture. We know *S. anomala* only by Reeve's too brief account. It is probably a species of the Panamic region. *S. pallida* (Brod.), which Tryon considers identical with *anomala*, has more folds, 10 or 11 on the last whorl in specimens examined, and they are obtuse, not pointed as in *S. dalli*; the spiral cords are much less prominent, their intervals nearly flat instead of concave, and bear finer, less unequal threads; moreover, there is a well-marked posterior apertural sinus in all of the specimens examined, while in *S. dalli* there is none.

Solenosteira elegans Dall (Bull. Mus. Comp. Zool., XLIII, p. 300) from the Gulf of Panama, is a more compact shell than *S. dalli*, with narrower, longer ribs. *S. vaughani* Dall, from the Floridian Miocene, is also related. The last surviving *Solenosteira* in Antillean waters was *S. mengeana* Dall, from the Caloosahatchie Pliocene.

Phos gatunensis Toula. Pl. XXV, figs. 1, 2.

Phos gatunensis Toula, Jahrb., p. 701, Pl. 28, fig. 6; Pl. 25, fig. 11.

Toula's specimens of this species were poor, so that further descriptive notes and figures may be useful. It differs from *Phos metuloides* Dall, from the Oligocene of Monkey Hill, by having rather narrow and sharp spirals, not in the least straplike at any stage of growth, and there are not so many longitudinal ribs. *Phos gabbi* Dall, from the Oligocene of Santo Domingo and Jamaica, is very closely related to

P. gatunensis, but in *gabbi* the aperture is shorter and wider, in consequence of the more swollen last whorl.

The embryonic shell consists of two smooth, rounded whorls; then narrow, widely spaced protractive riblets, and a spiral carina at the lower third, appear, for a half-whorl, giving place then to rounded vertical ribs about equal to their intervals, and spiral cords passing over ribs and intervals, the spaces between them spirally striate. On the last whorl there are 13 narrow spiral cords above the siphonal fasciole, which is bounded above by an acute ridge. The cords are enlarged where they pass over the longitudinal ribs, and in each interval there are several spiral striæ except in the subperipheral region, where each interval has one spiral thread. On the convex siphonal fasciole there are 4 to 6 small cords. Adult shells have 19 to 25 longitudinal ribs on the last whorl. On the preceding whorl the number is diminished by about a fourth. There is no varix behind the outer lip, but the ribs become obsolete there in fully adult shells. The aperture is narrow and long, the outer lip strongly lirate within. The columella bears, at the origin of the anterior canal, a strong, obtuse, spirally entering plait, which ascends the internal column.

Length 32½, diam. 15 mm.
" 30, " 14 "
" 25, " 12 "

There is rather wide variation in the number of longitudinal ribs, while the number of major spirals remains very constant—thirteen on the last whorl, the upper one being more or less obviously doubled.

Phos subsemicostatus n. sp. Pl. XXV, fig. 3.

This species is closely related to *Phos semicostatus* Gabb, of the Santo Domingo beds. It differs by having slightly narrower more numerous spiral threads, and by lacking small longitudinal riblets between the rare, varix-like ribs of the later whorls. It is also larger.

Length 42, diam. 19 mm.; 10 whorls.

Further material may perhaps show this to be a subspecies of the Santo Domingan form. Our type has lost a large part of the shell from the last two whorls.

Phos metuloides Dall.

Phos metuloides Dall, Proc. U. S. Nat. Mus., XIX, p. 303, Pl. 28, fig. 15 (Ponton, Santo Domingo; Monkey Hill, Isthmus of Panama).

Several young specimens from Gatun show the embryonic and early neanic whorls. There is an embryo of at least 3 smooth whorls; then appear about five spiral threads crossed by very slender, widely spaced, protractive ribs. These gradually change, in the first sculptured whorl, to coarse, rounded, vertical ribs equal to their interstices. These continue for about two whorls, after which the adult sculpture of fine, close vertical riblets sets in, either abruptly or by a short but gradual transition.

Metula gabbi n. sp. Pl. XXV, figs. 4, 8.

This species is represented by three broken specimens, the spire, beyond the penultimate whorl, being wanting. It is closely related to *Metula cancellata* Gabb, from which it differs as follows. The sculpture of narrow longitudinal folds and spiral cords is much coarser. There are 40 to 43 spirals on the last whorl (counting the smooth ones at the anterior end). In *M. cancellata* the upper two or three spirals are separated by wider or deeper grooves than the rest, but in *M. gabbi* this is not the case. The longitudinal folds on the last whorl of *M. gabbi* are about twice the size of those of *M. cancellata*. On the spire the spirals do not pass over the longitudinal folds in *M. gabbi* as they do in *M. cancellata*. The apertures are alike in the two species. In the largest Gatun specimen the last whorl, measured in front, is 20.5 mm. long.

COLUMBELLIDÆ.

Anachis fugax n. sp. Pl. XXV, fig. 5.

A species of the *A. avara* group, slender, with long, acuminate spire. The first whorl is very minute; embryonic shell conic, composed of 3 or 3½ convex, smooth whorls, which taper more rapidly than the following whorls. The next two whorls are smooth; then longitudinal rounded ribs gradually begin, increasing in size to the last whorl. These ribs arch backward or are nearly straight, extend from suture to suture and are a little wider than their intervals. On the last whorl they weaken below the periphery. There are 3 to 3½ rather convex sculptured whorls, separated by an impressed suture, below which there is a narrow ledge or indistinct cord. The basal half of the last whorl is coarsely lirate spirally, the spirals coarsest in the concavity of the base. Above the periphery and on the spire, spirals are wanting or sometimes barely traceable in places, but just behind the outer lip they extend farther up than elsewhere. There is an indistinct broad variceal thickening behind the outer lip. The small aperture has several weak lip-teeth.

Length 11, diam. 4.25 mm., length of aperture 5 mm.; whorls about 9. Ten ribs on the last whorl.

Somewhat smaller specimens in the same lot have 13, and an immature shell as many as 15 ribs on the last whorl. This species is in or close to the ancestral stock of *A. avara*. Two Pliocene forms have features possibly derived from this Oligocene form, combined with various diverse characters: *A. avara caloosaensis* Dall, in the Floridian Stage, is more robust than *A. fugax*, the number of sculptured whorls is greater and the suture specially modified. *A. camax* Dall, from a slightly later stage, and even more like *A. fugax*, differs by having but "two smooth and eight reticulated whorls," and the spiral sculpture is far more strongly developed.

In both of the Pliocene species there has been acceleration of the sculpture since the Oligocene form, *A. fugax* having about 5½ smooth and 3 to 3½ sculptured whorls. In various other Pliocene and recent forms of the same stock, however, there has been retardation of longitudinal sculpture, which first appears on the last whorl.

Anachis styliola Dall is a form superficially similar to *A. fugax*, but unlike it in the important feature of having a large, bulbous embryonic shell.

***Strombina mira** Dall.

S. mira Dall, Proc. U. S. Nat. Mus., XIX, p. 312, Pl. 29, fig. 7.

Oligocene marl, near Gatun (Rowell, Hill).

Strombina lessepsiana n. sp. Pl. XXV, figs. 11, 12.

A species closely related to *S. cyphonotus* and *S. prisma*, but more slender than either; fusiform. Spire when perfect of fully 11 whorls, the suture distinctly, though not conspicuously *channelled*, ascending at the end less than in the other species. Last whorl subtriangular in transverse section, having a strongly oblique node on the left side, a low dorsal hump near the suture, and marked with several sharp wrinkles, and behind the outer lip a strong varix preceded and followed by a concavity. At the base there are strong spiral grooves, 11 to 15 in number. Under the lens very weak traces of spiral sculpture may be seen on the almost smooth later whorls. Aperture as in *S. prisma*, but with the canal slightly longer.

Length 27.0, diam. 10.0 mm. (apex entire).
" 22.2, " 9.2 " (apex broken).
" 26.2, " 10.0 " " "

Not uncommon at Gatun. It is even more slender than *S. prisma*,[5]

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[5] We introduce here descriptions of *S. prisma* and *S. cyphonotus* from Johnson and Pilsbry's report on Gabb's Santo Domingo fossils (not yet published), in order to demonstrate the relationships of *S. lessepsiana*.

"**Strombina prisma** P. and J., n. sp. Pl. XXV, figs. 9, 10.

"The shell resembles *S. cyphonotus*, but differs by being more fusiform, the obliquely longitudinal hump or node on the left side is stronger, dorsal hump with a lip-varix of the same type, but the dorsal hump is low and sharply plicate, as in *S. cyphonotus.* Some examples have several sharp, short folds below the suture in the space preceding the dorsal hump.

The status of these Oligocene tricornute forms is not easy to decide. Our object now is merely to indicate the differential features of the several forms.

MURICIDÆ.

Murex messorius Sow.

The Gatun form agrees well with recent specimens. The species has been found also in the Santo Domingo Oligocene, but reported by Gabb as *M. recurvirostris* (Geol. Santo Domingo, p. 201).

Murex polynematicus n. sp. Pl. XXVI, fig. 1.

This form differs from the recent *M. recurvirostris* and the Oligocene

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much more emphatic, high, less plicate. On either side of this hump the surface is more flattened, being especially flattened and sunken in the last third, between the dorsal eminence and the terminal varix. The varix is high and rather narrow, preceded by a concavity, but no ripples. Other features as in *S. cyphonotus,* except that the anterior canal is decidedly longer; lips white.

"Length 26, diam. 10.4 mm.
" 29, " 12.2 "
" 23, " 10.2 "

"This species was among the shells which Gabb had referred to *Strombina gradata.* The longer canal, the narrow lip-varix and the high dorsal hump readily distinguish it from *S. cyphonotus*" (Pilsbry and Johnson).

"**Strombina cyphonotus** P. and J., n. sp. Pl. XXV, figs. 6, 7.

"Shell fusiform, solid, with rather slender, long spire, a little attenuated above, elsewhere with straight, smooth outlines. The tip is broken in all specimens seen, 7 + whorls remaining. These are nearly flat, with the suture impressed by reason of a narrow prominence of the upper edge of each whorl. The penultimate whorl sometimes shows a few slight longitudinal wrinkles. The last whorl is obtusely triangular in transverse section, having a low, oblique hump on the left side of the ventral face, a dorsal hump near the suture sculptured with several longitudinal ripples is preceded by a noticeable concavity, and a massive varix behind the outer lip, rising from and merging gradually into the general convexity of the back. A few ripples, distinct or faint, sculpture the back of the varix. Anteriorly there are about 15 spiral grooves, the upper ones coarse and deep, the lower fine and close. Elsewhere the surface is smooth. The aperture is narrow, lips brown, the inner lip smooth, straight, elevated; the callus within the outer lip bears about 9 small teeth. Anterior canal short and slightly recurved.

"Length 23.1, diam. 11 mm.; length of last whorl, from end of canal to posterior end of the lip-varix 15 mm.

"Other specimens of the type lot measure:

"Length 21.8, diam. 10 mm.
" 23.1, " 10 "
" 21.5, " 11 "

"Oligocene of Santo Domingo, W. M. Gabb.

"This species was incorrectly identified by Gabb (Geology of Santo Domingo, p. 221) with *Columbella gradata* Guppy, a conspicuously different *Strombina* of the Bowden Oligocene. It is related to, and probably an ancestor of, the recent West Coast *Strombina dorsata* (Sowerby), which differs by lacking ripples on the humps, by its seamlike sutures, far weaker basal spirals, etc.

subspecies *domingensis* Gabb by having more numerous spiral threads in the intervals of the major spirals—three or four in each interval. There are six varices on the last one and a half whorls, none on the earlier whorls. The varices are not very large, and not excavated behind. A shoulder spine is present on the last two varices only, and is short and conic. The three intervariceal spaces on the last whorl bear three, two and one folds, respectively. These folds are shorter and higher than in *recurvirostris*. Diameter 38 mm.; length unknown, the anterior canal being broken.

Murex (Phyllonotus) gatunensis. Pl. XXVI, fig. 2.

The shell resembles *M. spinulosa* in general form. Embryonic whorls unknown; subsequent whorls about 6, strongly convex, subangular at the shoulder, the last contracted into a narrow but short anterior canal. Sculpture: on the last whorl seven strong varices, each with a short horizontal spine at the shoulder and about half as wide as the intervals; sharp, narrow, unequal spiral ridges over both varices and intervals. These ridges are unequally spaced, and the concave interstices bear numerous weak spiral striæ. On the penultimate whorl, two ridges are visible below, and two or three above the shoulder-angle. The aperture is triangular-ovate; outer lip has 11 or 12 short, acute teeth on the submarginal internal callus.

Length about 32 or 33 mm. (early whorls wanting), diam. 21 mm.

This species has much resemblance to *Murex spinulosa* Heilprin, but it differs, among other characters, by wanting a basal series of spines.

Typhis alatus Sowerby.

Typhis alatus Sowerby, Journ. Geol. Soc. Lond., VI, p. 48, Pl. 10, fig. 4.

Similar to specimens from the Oligocene of Bowden and Santo Domingo. *Typhis martyria* Dall is a recent survivor of the same group, in the Pacific.

A specimen was lost, which so far as we can remember was probably *Typhis obesus* Gabb.

Typhis gabbi n. sp. Pl. XXVI, fig. 6.

The shell is fusiform, strong, the last whorl having a peculiar sculpture, the surface shrivelled, wrinkled and pitted. The embryo, of nearly two very convex smooth whorls, forms a short style or pillar. Then the diameter enlarges, and a shoulder-angle appears on the latter part of the third whorl. In the middle of the fourth whorl varices and intervariceal tubes appear on the very prominent shoulder, these structures gradually increasing in size to the last whorl, which bears four varices. These are strong and heavy, rounded, somewhat recurved above the shoulder, where there is a deep pit behind each varix. The tubes are short, midway between the varices, and placed upon low, short folds. The aperture is very small, oval, with a raised rim. Anterior canal closed, bent to the right, having three projecting angles on the left side.

Length 14, diam. 7.3 mm.

Based upon a single quite perfect individual. The sculpture is very characteristic.

STROMBIDÆ.

Strombus gatunensis Toula. Pl. XXVI, figs. 3, 4, 5.

S. gatunensis Toula, Jahrb., p. 698, Pl. XXV, figs. 7. 8.

This species resembles *S. pugilis alatus* Gmel. in having the last whorl smooth except for rather weak spiral cords below the suture and on the base, the shoulder being unarmed. It differs from *alatus* by the neanic whorls, which in *alatus* are subangular, with folds much larger than in *gatunensis*, prominent at the shoulder, fade out above and below. In both species the spire is strongly, evenly striate spirally. In *S. gatunensis* the spire is concave-sided, attenuate and lengthened, the whorls strongly convex, finely and closely plicate longitudinally, the folds extending from suture to suture. On the penultimate and next earlier whorls the folds become obsolete above, remaining short, close nodes on the antepenultimate, larger, separated, subacute tubercles on the penultimate whorl. The last whorl has an obtusely angular shoulder. There are several coarse spiral striæ below the suture, and the lower part is spirally striate. It becomes tumid towards the aperture. The outer lip is somewhat thickened, has a very shallow notch near the lower end, and is weakly wrinkled within, but smooth in the throat.

In one specimen seen there are about two varices on each of the whorls of the attenuated part of the spire. The other shells have none.

Fig. 5. Length 45, diam. 28.5 mm.

Fig. 4. " 50 mm.

In *Strombus bifrons* Sowb., of the Oligocene of Haiti and Jamaica, the folds on the spire are coarser than in *S. gatunensis;* the tubercles persist and are somewhat spiniform on the last whorl, where also the spiral striation is much more strongly developed.

Strombus (?) sp. undet. Pl. XXVI, fig. 7.

An internal cast preserving none of the shell is referable to this genus or possibly to *Orthaulax*. It is peculiar in having an erect flange on one side of the last whorl at the suture, indicating such an ascending lobe in the sutural region as characterizes *Orthaulax gabbi* Dall.

AQUILLIDÆ.

Distorsio gatunensis Toula. Pl. XXVI, fig. 8.

Distorsio (*Distortrix, Persona*) *gatunensis* Toula, Jahrb., p. 700, Pl. 25, fig. 10.

This fine species is well-distinguished from Antillean Oligocene and recent forms by the larger size of its low, naticoid, embryonic shell of $3\frac{1}{2}$ whorls, set somewhat aslant upon the sculptured portion following. It measures 2.25 mm. in diameter. The adult shell figured is 49 mm. long, with $6\frac{1}{3}$ post-embryonic whorls.

Malea camura Guppy.

Malea ringens Conrad, Pacific R. R. Reports, VI, p. 72. Pl. 5, fig. 22 (Gatun.)
Malea camura Guppy, Journ. Geol. Soc. Lond., XXIII, p. 287, Pl. 17, fig. 9.

Several specimens, none perfect, are perhaps referable to this Jamaican and Santo Domingan species, which was described from an imperfect example of the small phase, having about 16 spiral ribs. The Gatun shells are much larger, length about 80 mm., have a longer spire than usual in *M. camura*, and about the same number of ribs. Conrad has given a figure of the Gatun form, showing the characteristic high spire.

Sconsia lævigata (Sowb.).

Cassidaria lævigata Sowb., Journ. Geol. Soc., Lond., VI, p. 47, pl. 10, fig. 2.

An internal cast and an imperfect shell broken from a hard matrix evidently belong to this species. They are somewhat more oval, less inflated above, than the largest examples from Santo Domingo.

Pyrula near **papyratia** Say.

A broken internal cast was found at Gatun, which shows no characters inconsistent with the recent species, yet is not perfect enough for positive identification.

CYPRÆIDÆ.

Cypræa henikeni Sowb., var. Pl. XXVI, figs. 9, 10

Cypræa henkeri Sowb., Journ. Geol. Soc. Lond., VI, p. 45, Pl. 9, fig. 3.

The typical *C. henikeni* from Santo Domingo has two well-developed callous tubercles on the posterior part of the back, but in some shells these are low or wanting. The sides, posteriorly, are sometimes coarsely corrugated. In the specimens from Gatun there is no trace of the dorsal nodes; the callus has several corrugations on each side of the posterior canal, and lower ones may be felt along the sides. The aperture is like that of Santo Domingo *C. henikeni*, except that the teeth are more compressed and longer. In a specimen 42.5 mm. long there are 15 teeth on the inner, 19 on the outer lip. Specimens retaining part of the color are ochraceous with orange streaks, arranged as in the recent *C. mus*.

Length of figured specimen 42.5, width 31.6, height 23.2 mm. A larger fragment has an outer lip about 55 mm. long.

CERITHIIDÆ.

Bittium nugatorium n. sp. Fig. 1.

The shell is slender, diameter about one-third the length. Embryonic shell conic, of $3\frac{1}{2}$ smooth convex whorls. Subsequent whorls about $6\frac{1}{2}$, convex, with well-impressed suture; they have three narrow spiral cords, increasing to four on the last two whorls, by the addition of a subsutural thread. These are intersected by narrow, slightly flexuous longitudinal ribs, forming a lattice work enclosing square pits. On the last whorl five spirals form this lattice; and there are five smooth spirals without longitudinal ribs on the base. There is a rounded varix on the last whorl. Aperture not perfect. There is a slight anterior channel.

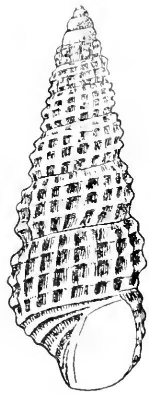

Fig. 1.

Length 3.6, diam. 1.2 mm.

This species is similar to *Cerithium collinsii* Gabb, from Limon, Costa Rica, in form, but differs by having more embryonic whorls, and three spirals on the whorls of the spire; moreover, the base has five strong spiral cords.

TURRITELLIDÆ.

Turritella mimetes n. sp. Pl. XXVII, fig. 1.

The shell resembles *T. variegata* L. in contour, except that the base is flat and the periphery much more strongly angular. Whorls 14+, flat, the lower edge of each projecting a little. In the upper third of the shell, each whorl has 16 fine, even threads, equal, and about equal to their intervals. A submedian thread then becomes larger, and on the later whorls there are many unequal spirals of three or four sizes. The flat base has similar spirals, four or five threads being larger than the other striæ.

Length 64, diam. 18 mm.

This species differs from the recent *T. variegata* by the even and finer striation of the upper whorls, the flat base and strongly angular periphery. It is probably ancestral to the modern species. Some fragments indicate that it reaches a larger size than the nearly perfect type specimen.

Turritella gatunensis Conrad. Pl. XXVII, figs. 4, 5, 9.

Turritella gatunensis Conr., Pacific R. R. Rep., VI, p. 72, Pl. 5, fig. 20. Dall, Trans. Wagner Inst., III, p. 310, Pl. 17, fig. 10.
Turritella conradi Toula, Jahrb., p. 694, Pl. 25, fig. 4.
Not *Turritella gatunensis* Conrad, Gabb, Journ. A. N. S. Phila., VIII, p. 342, Pl. 44, figs. 10, 10*a* (= *T. tristis*.[6])

This fine species stands close to *T. planigyrata* Guppy, but differs from it by having the upper part of each whorl much more excavated or contracted. Dall's figure, cited above, is not very characteristic of the typical *gatunensis*, and Gabb's figures of the form from the black shale of Oronli Creek, Talamanca, Costa Rica, represent a different species.[6] The Pliocene *T. subannulata* Dall seems to be related to *T. gatunensis*.

Turritella uvasana Conr., from the Californian Eocene, is not very closely related to *T. gatunensis*, the spiral threads being subequal, and the upper part of the whorls not nearly so much excavated as in the Panamic species. *T. uvasana* is much nearer *T. tristis* in sculpture, but on comparing specimens it is seen that *uvasana* has many more spirals, longer and less convex whorls.

T. gatunensis has been reported from Vicksburg Eocene of Florida and from the Oligocene of Ballast Point (Dall, *l.c.*). It belongs to a type widely spread in Tertiary and recent faunas.

Turritella altilira Conrad. Pl. XXVII, figs. 2, 3.

Turritella altilira Conr., Pacific R. R. Reports, VI, p. 72, Pl. 5, fig. 19 (Gatun).
Not *Turritella altilirata* Conrad, Gabb, Journ. A. N. S. Phila., VIII, p. 341 Pl. 44, figs. 9, 9*a* (Sapote, Costa Rica).
Turritella gabbi Toula, Jahrb., p. 695, Pl. 25, fig. 5 (Gatun).

This magnificent *Turritella* was rather rudely figured by Conrad. It is a common and characteristic species of the Gatun beds. It tapers slowly and, judging from the broken specimens seen, must attain a length of upwards of 100 mm., with a basal diameter of 18 mm., and probably over 25 whorls.

Each whorl bears two very high spiral ribs, crenulated at their summits, the lower rib narrow, the upper wider, usually but not always double at the ridge, or with a lower cord below the main one. The deep concavity between the ridges has sculpture of several unequal spiral cords, more or less crenulated; and the whole surface, when

[6] *Turritella tristis* n. sp. A long, slowly tapering shell with strongly convex whorls, the intermediate and lower ones with sculpture of five sharp, strong spiral cords, much narrower than their concave, spirally striate intervals. The largest fragment has 9 whorls in a length of 30 mm., the last whorl about 9 mm. in diameter. Gabb has figured this in his Pl. 44, fig. 10. Others are larger, diameter about 15 mm. The interstitial striæ are not very well-preserved, but are visible in places. Black shale bed, Oronli Creek, Talamanca.

most perfect, has a very fine spiral striation. The last whorl has a third rib, subperipheral in position, the base below it somewhat convex, marked with some radial striæ and lamellæ.

On the early whorls the spiral ribs are less prominent and the interstitial beaded cords rather better developed. The embryonic and early neanic whorls are unknown.

T. tornata Guppy, known to us by a series collected by Gabb in Santo Domingo, is very closely related to *T. altilira*, but it differs constantly, in a considerable series seen, by the far less prominent spiral ribs. Whether this difference is to be regarded as specific or as subspecific is not a matter of great importance. The Pliocene *T. terebriformis* Dall may be a descendant of the *tornata* stock.

Gabb figured an allied form from the Miocene (?) of Sapote, Costa Rica, as "*Turritella altilirata* Conrad." This name is either a mistake or an emendation of Conrad's *altilira;* but the specimens are clearly not that species. We propose to call Gabb's form *Turritella sapotensis*, n. sp. (Pl. 27, fig. 10). Each whorl has a strong, compressed spiral rib at the lower third, obliquely crenulated at its summit, as in *T. altilira*. Above this rib the surface is a little convex, and bears about five unequal spiral cords, crenulated and very low. The upper two of these cords correspond in position with the upper spiral rib in *T. altilira*. There is also a low cord above the suture. The broken shell figured (which also served for Gabb's Pl. 44, fig. 9*a*) measures 29 mm. long, 15 mm. in greatest diameter, and consists of somewhat over 3 whorls.

Gabb's figure 9 misrepresents another fragmentary shell, which, from the hard matrix which partly envelopes it, was evidently found with *T. sapotensis*. So far as visible, it very closely resembles *T. tornata* from Santo Domingo. It is clearly not *T. altilira*, nor do we think it a younger stage of *T. sapotensis*, though such may possibly prove to be the case.

The age of the Sapote bed which furnished Gabb's fossils is uncertain. *Clementia dariena* (Conr.) is the only species known to be common to this and the Gatun bed. *Turritella* is an excellent index of small divisions in the Tertiary; *T. sapotensis* is apparently a derivative from *T. altilira;* and so far as that theory is of any value, may indicate that the Sapote bed is later than the Gatun, perhaps Miocene.

VERMETIDÆ.

Petaloconchus domingensis Sowb.

P. domingensis Sowb., Journ. Geol. Soc. Lond., VI, p. 51, Pl. 10, fig. 9.

An internal cast apparently of this species.

SOLARIIDÆ.

Solarium granulatum gatunensis Toula.

S. gatunense Toula, Jahrb., p. 692, Pl. 25, fig. 3.

This form is more depressed than *S. granulatum* or its ancestor *S. quadriseriatum* Sowb., but with sculpture closely resembling both, and especially the form of *granulatum* found in the Bowden Oligocene. It differs from all of the above-named forms by lacking a small thread in the intervals immediately above and below the peripheral cord. The Gatun shell is probably, therefore, a lateral branch from the *quadriseriatum granulatum* stock.

NATICIDÆ.

Natica guppyana Toula.

Natica guppyana Toula, Jahrb., p. 696, Pl. 25, fig. 6.

Closely related to *N. rugosa* Gmel., but adult shells are larger, with the grooves obsolete in the middle of the last whorl.

Natica (?) sp. undet. Pl. XXVII, figs. 6, 7.

Internal cast of a species having about the size and contour of the small southern race of *P. duplicata* (Say). Diameter 40 mm.

Polinices subclausa (Sowb.).

Natica subclausa Sowb., Journ. Geol. Soc. Lond., VI, p. 51 (Santo Domingo).

* **Lupia perovato** Conrad.

Dall in Hill, Bull. M. C. Z., XXVIII, p. 273.
Vamos á Vamos beds (Hill). *Cf. Amaura guppyi* Gabb.

Sigaretus gatunensis Toula.

Sigaretus (Lupia Conrad) gatunensis Toula, Jahrb., p. 697, Pl. 28, fig. 3.

A form related to *S. perspectivus* Say.

CAPULIDÆ.

***Capulus** (?) **gatunensis** Toula.

Jahrb., p. 692, Pl. 25, figs. 1, 2.

Possibly identical with the *Cheilea* described below, but if so the generic characters have been overlooked by Toula. It differs by the oblong shape and more nearly central apex.

CALYPTRÆIDÆ.

Crepidula plana Say.

Several specimens occurred in the apertures of other gastropods.

Cheilea princetonia n. sp. Fig. 2.

A small species, circular, conic with apex curved in a minute hook; front slope somewhat convex, posterior slope nearly straight; surface with sculpture of fine growth-lines and a few wide, low, irregular circular waves, and excessively fine, close radial striæ. Internal process narrow and slightly asymmetrical at its insertion.

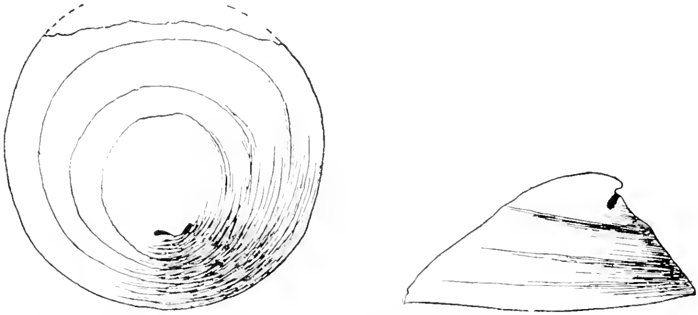

Fig. 2.—*Cheilea princetonia*, dorsal and lateral views of internal cast.

Width 8.8, alt. 3.5 mm.

The type is an internal cast and external mould of the same individual, in a hard matrix. The radial striation is finer than in the recent Antillean *C. equestris* of the same size. *C. varia* (Brod.) of the Pacific coast is apparently more nearly related to the Isthmian form.

The type is No. 5,516 of the Princeton University museum, collected by Mr. Ward H. Farrington, 1908.

NUCULIDÆ.

Nucula (Acila) isthmica n. sp. Pl. XXVII, figs. 11, 12.

The shell is trigonal with the upper margin anterior to the beaks, and the basal margin strongly convex, the posterior margin shortest and straight; posterior angle rather acute, the anterior rounded off, beaks moderately prominent, opisthocœlous, at the posterior third of the length; no lunule. Externally an angle, strong but not acute, runs from the beak to the posterior angle, and a depression or concavity of the outer face accompanies it. Elsewhere the outer face is strongly convex. The flat, truncate, posterior area has a sculpture of arcuate ribs, divaricating at the angle from those of the outer face, and terminating at right angles with the posterior end. The dorsal area anterior to the beaks has a corrugation composed of short ribs which run almost transversely to the long axis of the shell. The rest of the surface has close radial sculpture of riblets which diverge V-like from a median line. These riblets are a little irregular, in places slightly tuberculiferous; they are closer and a trifle narrower near the posterior concavity, becoming perceptibly more spaced anteriorly, where the intervals are a little wider, crossed by irregular, fine, raised striæ. At the basal margin there are several more ribs in the posterior than in the anterior series. Inside there are about 18 teeth in front of the beaks, about 7 behind them. The angle of the hinge line at the beaks is obviously greater than a right angle.

Length 18, alt. 13, diam. 9.5 mm.

Described from a right and a left valve, the latter being figured. It is clearly distinct from *N. decisa* Conrad and *N. cordata* Dall. of the Pacific slope Miocene,[8] and the recent Pacific *N. castrensis* Hinds.

LEDIDÆ.

Leda balboæ n. sp. Pl. XXVII, fig. 8.

The shell is rather thin, plump, with small submedian, closely adjacent and recurved beaks; pointed posterior and rounded anterior end, and arcuate base, which is less convex posteriorly. The upper margin is slightly concave behind and convex before the beaks. No lunule. Posterior dorsal area lanceolate, concave, defined by an acute carina running to the rostrum, sculptured with straight radial riblets. The rest of the valve has concentric ribs, which are slightly more abrupt on the upper side. In the middle of the valve in 5 mm. next the basal margin there are about 13 riblets. The hinge-line is rather narrow, armed with angular or V-shaped teeth, of which there are 18 behind and 28 in front of the beaks.

Length 22.3, alt. 12.0, diam. 10.0 mm. (type).
" 19.0, " 11.3, " 9.6 "

Known from two right valves. It has much resemblance to the recent Panamic *L. agapea* Dall in contour, but differs by the acute ridge bounding the dorsal posterior area and various other details.

Leda coelata Hinds closely resembles *L. balboæ*, but it differs by having a distinct lunule, which is not present in the Gatun species.

ARCIDÆ.

Arca dariensis n. sp. Pl. XXII, fig. 10.

The shell is long (the alt. six-tenths of the length), basal and upper margins subparallel, beaks small, at the anterior two-sevenths of the length. Valves not quite equal, the left slightly surpassing the other along the basal margin. Sculpture of about 31 radial ribs. In the median part of the valves these ribs are narrower than their intervals. In the left valve the ribs are closely nodulous in the lower part, very shortly scaly near the beaks. Towards the two ends the ribs widen and become divided by a median groove, on both sides of which it

[8] *Trans. Wagner Inst.*, III, p. 573, Pl. 40.

becomes nodulose, and the intervals are crossed by their lamellæ. In the right valve the ribs are smooth in the middle field, the intervals concave, with concentric lamellæ towards the beaks. At both ends the ribs are wider and divided by a groove, as in the other valve. In both valves the anterior ribs have a shallow sulcus, the posterior ones a distinct narrow furrow. The ligament area is narrow, lanceolate, marked with two or three grooves diverging at a wide angle The teeth are very fine and close, about 70 in a shell 36 mm. long Interior radially striate, the margin crenulate as usual.

Length 36.0, alt. 20, diam. 18.2 mm.
" 31.8, " 18, " 13.5 "

This is an abundant Ark in the Gatun bed. It is well-characterized by the rather narrow shape, grooved posterior and shallowly sulcate anterior ribs, while the ribs of the median part are simple in the right, granulous in the left valve.

Glycymeris carbasina n. sp. Pl. XXVIII, fig. 9.

Shell of the usual subcircular shape, solid, equilateral, with slightly prosogyrate beaks, scarcely separated by the very narrow ligament-area. Sculpture of many very low radial ribs equal to the intervals, with over the whole a minute sculpture of radial cut by equal concentric striæ, forming a regular granulation by their intersection. On each rib (to the middle of the interval) there are five or six radial granule-threads. The antero-dorsal and postero-dorsal areas have no major ribs, but there are fine radial riblets, the intervals of which, being crossed by the concentric striæ, appear to have a single series of punctures in each. The hinge is rather wide. Tooth-row of 10.12 teeth meeting V-like in the middle, where they are invaded by the ligamental area in the largest specimen seen. Inner margins of the valves crenulate throughout, the "teeth" of the basal portion very deeply cut, narrow, with a concavity in each.

Length 18, alt. 16, semidiam. 5 mm.; 66 crenulations in the margin, hinge teeth 10.11.

Very closely related to *G. jamaicensis* Dall, of the Bowden Oligocene, but that has much smaller, more numerous hinge-teeth in shells of the same size, the anterior contour is more irregular, and the fluting of the basal margin is far less deep. The external sculpture is practically identical in the two forms. The recent Antillean *G. lineata* (Rve.) is extremely close to *G. carbasina*, but in the latter the marginal fluting is far more emphatic. We do not know that the fossil form ever attains nearly the size of *G. lineata*, of which it is probably a direct ancestor.

Two other specimens measure as follows:

Length 14.9, alt. 14.8, semidiam. 4.9 mm.; hinge-teeth 8.9.
" 14.0, " 12.5, " 3.9 " " " 7.9.

Glycymeris canalis n. sp. Pl. XXVIII, fig. 10.

The subcircular shell is a little higher than long, solid, equilateral, with nearly straight, contiguous beaks, the ligamental area being extremely narrow and short. Sculpture of 33 strong, rounded ribs, separated by linear grooves, and obsoletely marked with rather regular concentric growth-striæ. Tooth-row strongly angulated in the middle, with 10 teeth on each side. Inner margin crenulated with about 20 strong "teeth," the upper margins not crenulated.

Length 14.5, alt. 15.1, semidiam. 4.6 mm.

Described from several valves, on which we count 30, 31, 32 and 33 ribs. This species has a close resemblance to *G. pectinata* (Gmel.) of the Antillean fauna, which differs by having wider sulci between the ribs, and by having an area of smaller ribs on the anterior end, while in *canalis* they decrease gradually in size.

Glycymeris acuticostata Sowb.

Pectunculus acuticostatus Sowb., Journ. Geol. Soc. Lond., VI, 1849, p. 53, Pl. 10, fig. 13 (Santo Domingo).

Typical, agreeing with Santo Domingo and Jamaican specimens.

PECTINIDÆ.

Pecten (Æquipecten) effossus n. sp. Pl. XXVIII, figs. 4, 6.

An orbicular, equilateral, compressed shell, resembling *P. scissuratus* Dall. The length and diameter are nearly equal, the ears subequal, the left valve nearly flat, the right one more convex. A left valve has 17 ribs, as wide as the slightly concave intervals. Each rib has the shape of an inverted V, but with rounded ridge, and a thin longitudinal lamella in the middle of each lateral slope, these lamellæ define furrows which terminate in incisions at the edge. The whole surface is finely sculptured with delicate concentric threads, subregularly and not closely spaced. These threads are arched downward in the intervals. Ears marked with several narrow radial riblets and concentric growth-threads. Length 11.2, alt. 11 mm. The right valve of a large shell, alt. about 19 mm., has similar sculpture, except that the ribs are larger. The interior is deeply furrowed in both valves.

The specimens of *P. scissuratus* in Gabb's Santo Domingo collection (Pl. 28, figs. 2, 5; alt. 27, width 27.5 mm.) differ from the above-described form by having the concentric threads crowded and crimped in the intercostal spaces and by having much better developed lamellæ across the furrows on the ribs. They have been compared with the types of the species by Dr. W. H. Dall. Fig. 2 measures, alt. 27, width 27.8 mm.

Pecten gatunensis Toula.

Pecten (Flabellipecten) gatunensis Toula, Jahrb., p. 711, Pl. 26, fig. 2.

The fragmentary specimens taken add nothing to Toula's account.

Pecten (Plagioctenium) operculariformis Toula.

Pecten (Æquipecten?) operculariformis Toula, Jahrb., p. 712, Pl. 26, fig. 3.

The ribs are narrower and have steeper slopes than in the related recent *P. nucleus*. *P. excentricus* Gabb is a closely related, yet apparently distinct form, from Santo Domingo.

***Pecten levicostatus** Toula.

Pecten levicostatus Toula, Jahrb., p. 713, Pl. 26, figs. 4 (5, 6).

Pecten thetidis Sowb. and *Janira soror* Gabb have been identified by Gabb from Gatun (*Journ. A. N. S. Phila.*, VIII, 346, 347).

***Pecten (Amusium) lyonii** Gabb.

Pleuronectia lyonii Gabb, Journ. A. N. S. Phila., VIII, p. 347 (Gatun specimens).

Pecten (Amusium) cf. mortoni Ravenel, Toula, Jahrb., p. 714, Pl. 26, figs. 8, 9.

This form is not present in our material. Gabb reported it from Gatun, and Toula has figured specimens which have the appearance of the Costa Rican species, the types of which are before us.

Pecten (Amusium) toulæ n. sp. Pl. XXVIII, fig. 7.

Pecten (Amusium) gatunensis Toula, Jahrb., p. 716, Pl. 26, fig. 10. Not *Pecten gatunensis* Toula, *t. c.*, p. 711.

The shell is smooth, thin and flat, equilateral, closely resembling *P. lyonii* Gabb. of Sapote, Costa Rica (probably Miocene), and *P. papyracea* Gabb. of the Santo Domingan Oligocene. The surface is marked with narrow, sharply defined gray rays on a white ground, the rays less than half as wide as the intervals, subequal in the median part, much narrower at the sides, where they gradually fade out, and about 17 in number. Ears broad, subequal, marked with close, fine growth-lines, more distinct than on the disk. Interior smooth, so far as seen, but the marginal region, where ribs are developed in related forms, is wanting in the specimen. Greatest breadth of the broken specimen figured 48 mm. It attains a much greater size.

In *P. lyonii* the gray rays are wider, when visible, and the spaces between them are slightly convex; the interior has coarse radial ribs, but none are visible in *P. toulæ* where the inside is exposed, at the lower margin of the broken shell. *P. papyracea* has fine internal ribs in pairs.

Toula has figured and described this species, but by oversight he used a specific name already employed on a previous page of the same paper.

OSTREIDÆ.

Ostrea gatunensis n. sp. Pl. XXIX, figs. 1, 2.

Ostrea spec. ind. and *Ostrea aff. vespertina* Conr., Toula, Jahrb., p. 710. Pl. 26, fig. 1; Pl. 28, fig. 14.

A short oval oyster, the convex valve with coarsely, radially corrugated exterior, the rugæ rarely divaricating, and with a few decumbent spines. The rather short beak is bent at an angle of about 45 degrees with the long axis of the shell. Inside there is a rather short ligament area, the wide valve-margin adjacent to it being sculptured with strong, close, transverse, irregular wrinkles. The margins are elsewhere simple. Cavity of the valve not deep, and not in the least excavating the beak.

Length 100, width 72 mm.

Toula (*l. c.*) mentions an oyster near *vespertina* Conrad which is probably the young of this species and of his undetermined *Ostrea*.

The interior reminds one somewhat of *O. iridescens* Brod., but that has a deep excavation under the beak, among other differences. It stands extremely close to the recent Indo-Pacific *O. hyotis* (L.).

Part of a valve of a very narrow, strongly convex and very peculiar oyster was also found at Gatun.

CARDIIDÆ

Cardium (Trachycardium) stiriatum n. sp. Pl. XXVIII, fig. 11.

Cardium spec., vielleicht eine neue Art, Toula, Jahrb., p. 721, Pl. 27, fig. 5; Pl. 28, fig. 15*a*, *b*.

The shell is rather thick, very plump, much higher than long, nearly equilateral, the posterior end a little straightened. Beaks median, the incurved tip concealed by the reflexed hinge-margin. Sculpture of 30 radial ribs. At the two ends these ribs bear strongly projecting, drop-shaped tubercles. In the median part of the valve the ribs lean posteriorly, and have a narrow tuberculate cord superposed on the posterior side of each, the tubercles elongated parallel to the cord in the median ribs, oblique or twisted on it, on the lateral ribs. The interstices are not very deep at the ends, but in the median moiety of the valve they are narrow and very deeply cut, overhung by the high side of the rib. The middle of each rib, anterior of the tuberculate ridge, bears one or several low cords, and the anterior slope has some fine, irregular, transverse striæ. Teeth strong, margin deeply fluted and crenulate, the crenulations narrow and deep on the posterior margin, triangular in the basal margin, very shallow at the anterior margin.

Length 29.5, width 24, semidiameter 12 mm.; 30 ribs.
" 31.0, " 25, " 13 " ; 29 "

This species is closely related to the recent West Coast *Cardium belcheri* Brod., which has ribs of the same peculiar, asymmetrical character. In the Gatun shell there are many more ribs, and the tubercles upon them are shorter and blunt, while in *C. belcheri* they are more spiniform.

Cardium lingualeonis Guppy is proportionately narrower and has more ribs, but seems to be rather close to the Gatun species.

C. stiriatum is, by its complex sculpture, a relatively specialized form; but it is less advanced than the recent *C. belcheri*, which is further evolved by the reduction in number of ribs; a large number being primitive in *Cardium*. *C. stiriatum* may be an ancestor of the recent species.

This species was known to Toula by hard internal casts, which alone are found in a layer containing mainly bivalves. The largest of several of these casts before us measures, length 26, alt. 33, diam. 26.5 mm.

***Cardium (Trachycardium) dominicanum** Dall.

C. (T.) dominicanum Dall, Trans. Wagner Inst., III, p. 1,082.

Oligocene shale near Gatun.

Cardium (Trachycardium) dominicense Gabb.

C. (T.) dominicense Gabb, Geol. Santo Domingo, p. 25; Journ. A. N. S. Phila., VIII, p. 344 (Gatun and Costa Rica).
Cardium (Trachycardium) gatunense Toula, Jahrb., K. K. Geol. Reichsanst., 1908, LVIII, p. 720, Pl. 27, fig. 4. Not *Cardium (Fragum) gatunense* Dall, 1900.

Abundant in the Gatun collection we have studied. The specimens agree perfectly with Gabb's type of *C. dominicense*.

Cardium (Lævicardium) serratum L.

Dall, Trans. Wagner Free Inst., III, p. 1110.

The shell seems indistinguishable from those of the Bowden bed and from the recent form. *C. apicinum* Cpr. from the Pacific is closely related.

***Cardium (Lævicardium) dalli** Toula.

Jahrb., p. 722, Pl. 27, fig. 6.

If really distinct from *C. serratum*, this species will require a new name, *dalli* being in use for a fine Pliocene species.

***Cardium (Fragum) gatunense** Dall.

Trans. Wagner Free Inst., III, p. 1100.

Black shales of Gatun, collected by R. T. Hill. We have not seen this species.

***Cardium (?) newberryanum** Gabb.

C. (Protocardia) newberryanum Gabb, Journ. A. N. S. Phila., VIII, p. 344, Pl. 44, fig. 17.

Gatun (Newberry).

TELLINIDÆ.

***Tellina dariena** Conrad.

T. dariena Conr., Pacific R. R. Rep., V, p. 328, Pl. 6, fig. 55.

***Tellina gatunensis** Toula.

T. gatunensis Toula, Jahrb., p. 729, text fig. 10.

***Tellina rowlandi** Toula.

T. rowlandi Toula, Jahrb., p. 728, Pl. 28, fig. 11.

***Tellina lepidota** Dall.

Tellina (Phyllodina) lepidota Dall, Trans. Wagner Free Inst., III, p. 1022, Pl. 46, fig. 18.

Oligocene sandstone at Gatun (Dall).

***Semele sayi** Toula.

S. sayi Toula, Jahrb., p. 730, Pl. 28, fig. 17.

Tellina sp. undet.

Casts of a species resembling *Tellina lævigata* in size and shape. It is distinct from any species recorded by Toula, and apparently not found in the Bowden or Santo Domingo beds.

Tellina sp. undet.

Casts of a species possibly identical with *T. laceridens* Hanley, agreeing closely with that in shape. It is somewhat larger; length 61, alt. 37 mm.

We consider fig. 168 of the *Thesaurus* monograph to be the typical form of *T. laceridens*.

VENERIDÆ.

Chione tegulum n. sp. Pl. XXVIII, fig. 8.

Shell plump, the altitude almost equal to the length, with prominent prosogyrate beaks near the anterior third. Sculpture of rounded, tilelike radial ribs (their summits 1 mm. apart near the basal margin, in the median part of a shell 19 mm. in alt.); these are interrupted by narrow, concentric, machiolated ridges, curved downwards in the intervals, upward where they cross the radial ribs. There are 26 of the concentric ridges in a shell 19 mm. in altitude. The wide, cordate lunule has radial lamellæ only, and is defined by a deep groove. The lanceolate escutcheon is concave, with sculpture of smooth raised lines continued from the concentric lamellæ. The basal and anterior valve-margins are crenulated inside, as is also the margin along the lunule.

Length 19.5, alt. 19, semidiameter 8 mm.

This species resembles *C. woodwardi* Guppy, from the Bowden Oligocene, but differs by having a smaller lunule, and in the details of sculpture, as shown in the figure.

Chione sp. undet.

A species resembling *C. woodwardi*, but reaching a length of over 40 mm., occurred as casts retaining very little of the shell.

Chione (Lirophora) ulocyma (Dall).

Trans. Wagner Inst., III, p. 1296, Pl. 42, fig. 5 (Miocene of Alum Bluff, Calhoun County, Fla., etc.).

Venus (Chione, Lirophora) ulocyma Dall, Toula, Jahrb., p. 724, Pl. 25, figs. 20–22.

There seem to be two forms: one agreeing with the type figure of *ulocyma* in having coarse concentric sculpture; the other having much finer, more numerous wrinkles. In the former the beaks appear to be smooth, but possibly as the result of wear. In the finely sculptured form the beaks have about five thin concentric widely spaced laminæ, preceding the corrugated stage, such as are described for *C. burnsi* Dall. This race may be called *C. ulocyma holocyma*. In this race, as well as in the coarse form, the radial grooves are very strongly developed.

***Chione (Liriphora) mactropsis** (Conrad)

Grateloupia mactropsis Conrad, Pacific R. R. Rep., V, p. 328, Pl. 6, fig. 54.

Chione (Liriphora) mactropsis Conr., Dall. Trans. Wagner Inst., III, p. 1294.

Eocene and Oligocene of Isthmus of Darien, Blake; Gatun and Vamos-a-Vamos, Panama Canal, Agassiz. 10.5 K. w. of Colon, Hill (Dall). Chiriqui, Dr. John Evans (Gabb).

Pitar centangulata n. sp.

Pitaria (Hyphantosoma) n. sp., Toula, Jahrb., p. 726, Pl. 28, fig. 16.

Cf. Pitaria (Hyphantosoma) opisthogrammata and *floridana* Dall, Trans. Wagner Inst., III, p. 1,267.

This species is closely related, as Toula has pointed out, to the above-named species of Dall. It differs from *P. floridana* (from the Chipola Oligocene) in the rotund-oval, not "subtrigonal" shape, and in the even rotundity of the valves, without trace of a flattening or sulcus running to the posterior base; but it agrees with *floridana* in the very fine, markedly zigzag sculpture, there being three to four lines to a millimeter. *P. opisthogrammata*, of the Floridian Pliocene, is a "rounded-quadrate" shell with "the zigzag sculpture nearly obsolete."

Pitar cora n. sp. Pl. XXVIII, fig. 3.

The shell is extremely thin, oval, with prosogyrate beaks at the anterior fourth; rather plump; dorsal margin rather concave in front of, and slightly convex behind, the beaks. Sculpture of fine, nearly even concentric riblets, without radial striation. No defined lunule or escutcheon. Interior unknown, but the valve-margins are smooth inside.

Length 35, alt. 26.5, diam. 18.5 mm.

This species occurred as casts in a hard matrix retaining the shell in places. *P. hilli* Dall is a longer, lower shell.

***Macrocallista maculata** (L.) (?).

Cytherea (?) (*Meretrix*) *dariena* Conrad, Pacific R. R. Rep., VI, p. 72, Pl. 5, fig. 21.

"Isthmus of Darien." Identified by Gabb and Dall with the above recent species, but the cast figured by Conrad seems to us uncharacteristic.

***Pitar hillii** Dall.

Pitaria (*Lamelliconcha*) *hillii* Dall, Trans. Wagner Inst., III, p. 1,268, Pl. 54, fig. 7.

Near Gatun.

***Pitar circinata** (Born).

Venus circinata Born, Mus. Test. Vindobon., p. 61, Pl. 4, fig. 8.
Pitaria (*Lamelliconcha*) *circinata* Born, Dall, Trans. Wagner Inst., III, p. 1269.
Cytherea juncea Guppy, Q. Journ. Geol. Soc. Lond., XXII, p. 582, Pl. 22, fig. 13 (Oligocene of Cumana, Venezuela).

Gatun (Dall). Also recent, on both coasts of Central America. It is a more coarsely, sharply sculptured shell than *P. cora*.

***Callocardia (Agriopoma) gatunensis** Dall.

C. (*A.*) *gatunensis* Dall, Trans. Wagner Inst., III, p. 1,260, Pl. 54, fig. 1. Toula, Jahrb., p. 723, Pl. 25, fig. 23.

Gatun; Monkey Hill.

***Callocardia gatunensis multifilosa** Dall.

Dall, *l. c.*, p. 1,261, Pl. 54, fig. 15.

Gatun, with the preceding. Also Ponton, Santo Domingo. We have not seen this species, which should resemble *Pitar cora* rather closely, except as to the lunule.

Another *Callocardia*, undetermined, is recorded by Dall from Vamos-a-Vamos (*t. c.*, p. 1,261).

Clementia dariena (Conrad). Pl. XXVIII, fig. 1.

> *Meretrix dariena* Conrad, Pacific R. R. Rep., V, p. 328, Pl. 6, fig. 55.
> *Clementia dariena* Conr., Gabb, Journ. A. N. S. Phila. (2), VIII, p. 344, Pl. 44, fig. 16. Dall, Trans. Wagner Inst., III, p. 1,235.
> Toula, Jahrb., p. 725, Pl. 27, figs. 9, 10.

A common clam in the Gatun Oligocene, also found in the presumably later bed at Sapote, Costa Rica. No nearly related species has been found in the Santo Domingo or Bowden beds.

Cyclinella gatunensis Dall.

> *C. gatunensis* Dall, Trans. Wagner Inst., III, p. 1,285, Pl. 52, fig. 18.

In the best preserved specimens the sculpture of somewhat thread-like concentric lines is about equally strong over the whole valve, except near the beaks. Except for the tenuity of the shell, it might be a *Dosinia*.

MACTRIDÆ.

***Mactra dariensis** Dall.

> *M. dariensis* Dall, Trans. Wagner Inst., III, p. 895.

Vamos-a-Vamos.

CORBULIDÆ.

Corbula gatunensis Toula.

> *C. gatunensis* Toula, Jahrb., p. 733, Pl. 27, fig. 12.

This species attains a larger size than Toula's type, an example measuring, length 26, alt. 22 mm. It is remarkable for the disparity in sculpture between the ribbed neanic and the smooth mature stage.

Corbula sphenia Dall.

> *Corbula (Cuneocorbula) sphenia* Dall, Trans. Wagner Inst., p. 847, Pl. 36, fig. 10 (Chipola River Oligocene).

A single valve agrees fairly well with the account of this species. It has more and narrower concentric ribs than the figure of that species shows, and is larger, length 22.2, alt. 13.5 mm. Probably identical with *C. dominicensis* Gabb, but there are some slight differences.

Corbula sericea Dall.

> *Corbula (Cuneocorbula) sericea* Dall, Trans. Wagner Inst., p. 848, Pl. 6, fig. 8 (Oligocene of Bowden, Jamaica).

A single valve from Gatun is evidently referable to this species.

***Corbula alabamiensis** Lea.

> *C. alabamiensis* Lea, Dall, Trans. Wagner Inst., III, p. 841.

Described from the Alabama Eocene (Claibornian); reported by Dall from the Gatun beds.

***Corbula gregorioi** Cossmann.

C. gregorioi Cossm., Dall, Trans. Wagner Inst., III, p. 843.

A Claibornian Eocene species reported by Dall from the Gatun beds.

***Corbula heterogenea** Guppy.

C. heterogenea Guppy, Dall. Trans. Wagner Inst., III, p. 850.

Vamos-a-Vamos (Dall).

***Corbula viminea** Guppy.

C. viminea Guppy, Dall, Trans. Wagner Inst., III, p. 850.

Vamos-a-Vamos (Dall).

TEREDIDÆ.

Teredo dendrolestes n. sp. Text fig. 3; Pl. I, fig. 10.

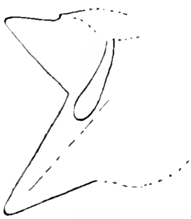

Fig. 3.

The thin-walled tubes are crowded, run with the grain of the wood, as usual, curving outward at the orifice. They have a diameter of about 5 mm., the longest (broken) reaching a length of about 60 mm. The terminus of the tube is hemispherical. It encloses a very delicate shell shaped like the annexed outline figure. There are long apophyses. The exterior of the shell is unknown, being cemented to the calcified tube.

SOLENIDÆ.

***Solecurtus gatunensis** Toula.

Solecurtus gatunensis Toula, Jahrb., p. 732, Pl. 28, fig. 12.

***Solecurtus strigillatus** (L.).

Solecurtus (*Macha*) *strigillatus* L., Toula, Jahrb., p. 731, text fig. 11, Pl. 27, fig. 12.

***Thracia gatunensis** Toula.

Thracia gatunensis Toula, Jahrb., p. 757, text fig. 15.

Reference to Plates XXII-XXIX.

Plate XXII.—Fig. 1.—*Terebra wolfgangi* Toula.
Fig. 2.—*Terebra gatunensis* Toula.
Figs. 3–6.—*Terebra wolfgangi* Toula.
Fig. 7.—*Terebra subsulcifera* n. sp., × 2.
Figs. 8, 9.—*Terebra gausapata* n. sp., two views of the type, fig. 8, × 5.
Fig. 10.—*Arca dariensis* n. sp.
Fig. 11.—*Teredo dendrolestes* n. sp.

Plate XXIII.—Fig. 1.—*Conus molis* n. sp.
Figs. 2, 3.—*Conus gaza* n. sp. (Santo Domingo).
Fig. 4.—*Conus imitator* n. sp.
Figs. 5, 6.—*Conus concavitectum* n. sp.
Fig. 7.—*Drillia fusinus* n. sp.

Fig. 8.—*Drillia zooki* n. sp.
Fig. 9.—*Conus æmulator* n. sp., × 2.
Figs. 10, 11.—*Drillia isthmica* n. sp.

PLATE XXIV.—Figs. 1, 2.—*Cancellaria dariena trachyostraca* n. subsp.
Figs. 3, 4.—*Cancellaria dariena* Toula.
Figs. 5, 6.—*Cancellaria decaptyx* n. sp., two views of the type.
Fig. 7.—*Mitra*, sp. undet., part of the columella.
Fig. 8.—*Mitra*, sp. undet., internal cast, No. 5,515, coll. Princeton University.
Fig. 9.—*Mitra dariensis*, n. sp.
Fig. 10. *Marginella gatunensis* n. sp.
Fig. 11.—*Mitra longa* Gabb, Gatun specimen.
Fig. 12.—*Marginella coniformis* Sowb., var.
Fig. 13.—*Marginella leander* n. sp.
Fig. 14.—*Solenosteira dalli* n. sp.

PLATE XXV.—Figs. 1, 2.—*Phos gatunensis* Toula.
Fig. 3.—*Phos subsemicostatus* n. sp.
Fig. 4.—*Metula gabbi* n. sp.
Fig. 5.—*Anachis fugax* n. sp.
Figs. 6, 7.—*Strombina cyphonotus* P. and J., n. sp., Santo Domingo.
Fig. 8.—*Metula gabbi* n. sp.
Figs. 9, 10.—*Strombina prisma* J. and P., n. sp., Santo Domingo.
Figs. 11, 12.—*Strombina lessepsiana* n. sp.

PLATE XXVI.—Fig. 1.—*Murex polynematicus* n. sp.
Fig. 2.—*Murex gatunensis* n. sp.
Fig. 3.—*Strombus gatunensis* Toula.
Figs. 4, 5.—*Strombus gatunensis* Toula, No. 5,512, coll. Princeton University.
Fig. 6.—*Typhis gabbi* n sp.
Fig. 7.—*Strombus* (?) sp., internal cast.
Fig. 8.—*Distorsio gatunensis* Toula.
Figs. 9, 10.—*Cypræa henikeni* Sowb., smoothish var., No. 5,511, Princeton University.

PLATE XXVII.—Fig. 1.—*Turritella mimetes* n. sp.
Figs. 2, 3.—*Turritella altilira* Conrad.
Figs. 4, 5.—*Turritella gatunensis* Conrad.
Figs. 6, 7.—*Natica*, sp. undet. Internal cast.
Fig. 8.—*Leda balboæ* n. sp.
Fig. 9.—*Turritella gatunensis* Con. Pseudomorph in calcite.
Fig. 10.—*Turritella sapotensis* n. sp., Sapote, Costa Rica.
Figs. 11, 12.—*Nucula (Acila) isthmica* n. sp.

PLATE XXVIII.—Fig. 1.—*Clementia dariensis* Conr.
Fig. 2.—*Pecten scissuratus* Dall. Typical form from Santo Domingo.
Fig. 3.—*Pitar cora* n. sp.
Fig. 4.—*Pecten effossus* n. sp.
Fig. 5.—*Pecten scissuratus* Dall. Santo Domingo.
Fig. 6.—*Pecten effossus* n. sp.
Fig. 7.—*Pecten toulæ* n. sp.
Fig. 8.—*Chione tegulum* n. sp.
Fig. 9.—*Glycymeris carbasina* n. sp.
Fig. 10.—*Glycymeris canalis* n. sp.
Fig. 11.—*Cardium stiriatum* n. sp.

PLATE XXIX.—Figs. 1, 2.—*Ostrea gatunensis* n. sp.

May 2.

Edwin G. Conklin, Ph.D., Vice-President, in the Chair.

Thirty-one persons present.

Dr. Henry Tucker having taken the Chair, Dr. Conklin made a communication on the Zoological Station at Naples and the Zoological Congress at Graz, with illustrations. (No abstract.)

May 16.

Milton J. Greenman, M.D., in the Chair.

Ninety-six persons present.

Philip P. Calvert, Ph.D., gave an account of a year's sojourn in Costa Rica, illustrated by lantern slides prepared from photographs taken by Mrs. Calvert.

A paper entitled "Some Aboriginal Sites of Mississippi River," by Clarence B. Moore, was accepted for publication in the Journal.

Henry Morris, M.D.,
H. C. Meyer,
G. Carl Huber were elected members.

The following were elected correspondents:
Edmund Beecher Wilson, of New York;
David Starr Jordan, of Leland Stanford, Jr. University, California;
Jacques Loeb, of New York;
Thomas Wayland Vaughan, of Washington;
William Bullock Cark, of Baltimore.

The following were ordered to be printed:

THE LYRIFORM ORGANS AND TACTILE HAIRS OF ARANEADS.

BY NORMAN EUGENE M'INDOO.

Introduction and Methods.

Since the discovery of the lyriform organs in 1878 only two important papers have appeared in regard to them. The object of this present paper has been to make an accurate and careful study of their morphology and physiology. The tactile hairs were later taken up in connection with the lyriform organs because their innervation was very similar to that of the latter structures.

The work has been prosecuted under the direction of Professor Montgomery, to whom I am indebted not only for the majority of my specimens, but also for suggestions and kindly criticisms which have made this work possible. He suggested this subject because these organs are so little known. The exotic species were kindly sent by Dr. Purcell, of South Africa; by Dr. Petrunkevitch, of Yale University, and by Mr. Nathan Banks, of the U. S. National Museum. The

experimental work was done at the Marine Biological Laboratory at Woods Hole from June 7 to September 20, 1910.

In regard to the methods for preparing sections, after the legs had been removed from the spiders, they were cut into short pieces and then were fixed a few hours in either strong Flemming's solution or in Carnoy's fluid, the latter being the modified form of equal parts of absolute alcohol, glacial acetic acid and chloroform with corrosive sublimate to excess. Carnoy's fluid was the better of the two fixatives and my best sections were obtained by leaving the material in the fluid over night. The material was dehydrated in the ordinary way in alcohols but was cleared by using the sinking method in cedar oil. It was embedded about an hour in hard paraffin (54° C.) On account of the hard cuticula perfect serial sections were impossible, although good sections were had in two ways: (1) After fixation the material was left in a solution of equal parts of 70 per cent. alcohol and glycerin two or three weeks; (2) The material was fixed immediately after moulting. The latter method was the better one for the cuticula was very soft and thin. The sections were cut ten microns thick and were stained with Delafield's hæmatoxylin and eosin.

In preparing the external surfaces for the study of the disposition of the lyriform organs the following method was pursued: A large slit was made on the dorsal side of the abdomen of the specimens, then they were dropped into a cold solution of caustic potash. In this solution the adults remained from six to thirty-six hours, the time depending on the size of the individual; for the spiderlings one hour was sufficient time. After being removed from the caustic potash solution all the internal disintegrated tissues were carefully removed with a camel's hair brush and water. Now the "skins" were permanently mounted between two cover slides in a one-fifth saturated solution of potassium acetate. Such a solution gave the proper refractive index so that the slits appeared more or less transparent while the surrounding cuticula was usually darker. The two cover slides were held together with a solution of asphaltum. For the dark colored specimens bright day light was used, but for the light colored ones a strong yellow artificial light was the only one which was satisfactory.

A. The Lyriform Organs.

I. MORPHOLOGY.

1. Structure of Lyriform Organs.

A lyriform organ is a cuticular structure peculiar to arachnids, composed usually of several single slits which lie side by side and more or less parallel with each other. This group of slits is generally surrounded by a border (fig. 53*b*)[1], which is nothing more than a difference in pigmentation, that gives the lyre-shape to the organ. Inside the border the pigmentation is usually much lighter than outside, but sometimes the reverse occurs. Hence with considerable magnification these organs appear as light or dark spots while the slits inside appear almost transparent. The superficial appearance of a slit reminds one of a long slightly bent spindle which has an opening or dilatation (di.) at the centre or nearer one end than the other (fig. 53).

Lyriform organs may be divided into compound and simple organs. A compound organ contains four or more single slits, which may either be enclosed by a common border or each slit may be surrounded by its own border; in the latter case if the borders are not joined with each other, then the structure may be called a diffused organ; sometimes the border is entirely absent. A compound organ never exceeds more than thirty slits and the average for *Theridium tepidariorum* is ten, but the number containing four, five or six is comparatively small. A simple organ contains either two or three single slits, around all of which there is a common definite border.

A cross-section of a lyriform organ shows that it may sometimes be located on a slight elevation or at other times in a slight depression, but in either case the cuticula at this place is considerably thicker and sometimes twice as thick as at other places. Fig. 1 shows this very well. This drawing represents about one-third of the entire cross-section of the trochanter of a mature male *Agalena nævia* just moulted. The cuticula (cu.) is only diagrammatic as taken from various species, but here its thickness represents its greatest development at any time in this species. The nerve (N.) is drawn in the location it holds when its branch (N. b.) penetrates the hypodermal basement membrane (b. m.), 220 microns in front of this locality where the nerve branch just begins to leave the nerve the latter is much nearer the centre of the leg. The sense cells (s. c.) are shown in their natural positions but they have been reconstructed from nine sections just in front of where the nerve branch enters the hypodermis. All the other parts are taken from only one section in front of the organ. In this drawing one notices that some of the slits pass entirely through the cuticula, some two-thirds through, and others show only a slight indentation. This means that the section passed exactly through

[1] The figures are numbered consecutively on Plates XXX–XXXIII.

the dilatation in the case of the first, near the dilatation of the second, and only across the ends of the slits in the last. Hence the deeper the opening the nearer the section passed to the dilatation. Thus the internal cavity of a slit may be represented by the diagram (fig. 4), which shows it to have the form of a flattened funnel with a central enlargement. At least three distinct layers are discernible in the cuticula, but they are not shown in fig. 1.

The hypodermis (hyp.), usually twice as thick as the cuticula, lies just beneath the latter. Its long cylindrical cells stand at right angles to its outer membrane (o. m.) and to the basement membrane (b. m.). The outer membrane is very thin and never shows any nuclei, while the basement membrane is much thicker and reveals several elongate nuclei (b. m. n.). Directly beneath and on either side near the organ these hypodermal cells appear to be vacuolated at their bases, while at some distance from the organ they are not vacuolated. With Delafield's hæmatoxylin and eosin the cell walls and cytoplasm stain very faintly, but the nuclei stand out very conspicuously, and nucleoli are very numerous. There are always just as many sense cells (s. c.) as there are slits in the organ; if the slits are few in number the sense cells lie at the base of the hypodermis directly beneath the organ. If the slits are many then there is not enough space just beneath the organ, so the sense cells are scattered along the basement membrane of the hypodermis toward the nerve as seen in the drawing. Each sense cell is always as large and sometimes three times as large as any hypodermal cell. It is invariably spindle-shaped with one of its poles running to the nerve of the leg and the other pole connecting with the dilatation (di.) of its respective slit. The nuclei are usually two or three times as large as those of the hypodermal cells and stain slightly darker, although sometimes both kinds of nuclei have the same dimensions and degree of staining capacity when it is difficult to distinguish the two kinds of cells unless one can readily see their walls. Moreover, most sense cells have at least at one end of their nuclei aggregations (ag. cyt.) of dense staining cytoplasm, which does not occur in the hypodermal cells. Also each sense cell has at least one very large nucleolus besides the numerous smaller ones and its cytoplasm stains slightly darker. Therefore, when we consider all these differences, we see that the sense cells are different from ordinary hypodermal cells, but since in many cases these differences are very difficult to distinguish, as with those small sense cells just beneath the organ in the drawing, we must conclude that sense cells are nothing more than modified hypodermal cells which have taken on a different function. In the specimens just moulted the sensory fibers were never connected with the dilatations (di.) of the slits, merely because they apparently had not had sufficient time for regeneration since the casting of the old skin. But in specimens six or seven hours after moulting a few of these connections were noticed, while in individuals with thick cuticula many such connections were observed. Fig. 3 shows two of these sense cells as they actually occur in a section of the trochanter of *Th. tepidariorum* six or seven hours after moulting. Here the cuticula is broken as usual, but one nerve fibre connects with its dilatation, the other one has either been broken loose or has not yet had time to join its dilatation since moulting.

In good serial sections the nerve of the leg is very distinct and branches from it can very readily be traced to the lyriform organs. Within these branches the nerve fibres can quite easily be traced to the sense cells. Usually the nerve is found near the axis of the leg, but in some cases it lies closer to the hypodermis as shown in fig. 1. Both the nerve and its branches are enclosed by a neurilemma (neu.) whose walls show numerous nuclei (n. neu.). Internal to this neurilemma the fibres are shown in cross section as the clear spaces with here and there a cross section of a tolerably deep staining nucleus, probably a neuroglia nucleus (neu. n.). These nuclei are about one-third as large as those of the hypodermal cells; their nucleoli are generally arranged around the periphery and their chromatin-network as in the other kinds of nuclei is rather difficult to see. The network (neu. w.) of the nerve is probably the walls of these neuroglia cells.

I was able to trace the innervation of a few of the single isolated slits. Fig. 5, drawn from two consecutive sections of *Th. tepidariorum* six or seven hours after moulting, shows the sense cell with its fibre connecting with the dilatation of the slit. This cell has a similar position, shape, size and structure to one of those belonging to an organ.

At certain places in the legs the muscles occupy almost all the space surrounded by the hypodermis, but generally near the lyriform organs they are not so extensive. At almost any place one may choose at least three or four such muscles (m. b.) as the one shown in the drawing may be readily seen. The single walled sarcolemma (sar.) surrounds many muscle bundles, each one of which reveals either two or three nuclei (m. nuc.) lying in the sarcoplasm.

Each leg possesses a large artery (art.) which usually lies against or near the nerve. It has a double wall which often shows nuclei. Two large venous sinuses (v. sin.) are always present, one on the ventral and the other on the dorsal side. In fact each one seems to lie directly beneath a lyriform organ. The blood plasm (b. p.) and blood corpuscles (b. c.) can readily be distinguished in both the artery and sinuses.

The connective tissue (con. t.) which stains very faintly occupies all the remaining space in the leg. Its nuclei (con. t. n.) which are very conspicuous are about one-half as large as those of the hypodermis.

Fig. 2 is a longitudinal-transverse diagram of the distal end of a femur showing the anatomy of the leg with the innervation of the lyriform organs, the fixed tactile hairs (t. h.) and the muscles which control the movable tactile hairs (mov. h.).

2. Disposition.

(*a*) *Theridium tepidariorum Koch.*

In making a comparative study of the lyriform organs of Araneads, I have used thirty-nine different species representing twenty-seven of the thirty-eight families recognized by Simon (1892). Since *Th. tepidariorum* is most conveniently studied, I shall describe its lyriform organs in detail and then state the variations found in the other species after the explanation of the table on page 394. See figs. 13 and 14.

The legs and palps may be divided for description into four surfaces. The organs, to begin with the one on the coxa of each leg and palp, may be numbered from 1 to 13 with No. 13 on the metatarsus of each leg. In *Th. tepidariorum* there is a constant number of thirteen organs on each leg; four of this thirteen are on the dorsal, three on the posterior, two on the anterior, and four on the ventral surface. Each palp has only seven organs, three of which are on the dorsal and the other four are on the ventral surface. Each chelicenon has a constant number of four organs, No. 14 and 15 of which lie on the ventral and No. 16 and 17 on the dorsal surface. There is always a constant number of two organs located on the dorsal side of the pedicle, one of these may be called No. 18. The single isolated slits are found more or less regularly distributed on all the appendages, sternum, cephalothoracic shield and on the ventral side of the abdomen (figs. 13, 14).

Every organ has a constant position except the three on the trochanter and the one on the coxa. The latter organ occurs either on the ventral or posterior side of the joint. The organs on the trochanter rotate around the segment and sometimes the same organ may be found on either the ventral or dorsal surface in two different legs as organ No. 2 on the first and third leg (figs. 13, 14). Organ No. 3 may occur on either the anterior or posterior side of the trochanter as on the second and first legs. Also No. 4 may lie on either the dorsal or ventral surface as in the first and third legs.

Organ No. 1 (figs. 13, 16) is a simple structure of three slits on the first three legs while on the fourth there are only two slits in it. These slits have about the same dimensions and the dilatations are nearer the proximal end of the organ. The distal end of the slits never come in contact with the line of articulation. No 2 varies slightly in shape, number and position of the slits. In fig. 52 the organ is from the ventral side of the first leg, while in fig. 53 the organ from the anterior side of the second leg shows the slight variation. The distal end never crosses the line of articulation. No. 3 is more or less diffused (fig. 15), but on the first and second legs the border completely surrounds the organ. Instead of the long axis of No. 4 lying parallel with the long axis of the leg, it lies transversely (fig. 30) and it always lies against the line of articulation and sometimes one-half way across it. No. 5 on the ventral surface at the extreme distal end of the femur always lies with its distal end touching the line of articulation, but very seldom crosses it. The convex part of the organ and the shorter slits invariably face the posterior surface of the leg (figs. 13, 24). No. 6 is like No. 5 except it lies on the dorsal side of the femur and usually one-half way across the line of articulation (fig. 14). Its concave side and shorter slits face the anterior surface of the leg. Organs No. 7 and 8 (figs. 13, 14, 58) are always found on the anterior surface of the patella. No. 7 (58*a*) lies almost equidistant from either end of the joint near No. 8 (58*b*) and always between the latter and the dorsal side. Its size is almost one-half that of No. 8 and its slits are very long and extremely narrow. No. 8 lies nearer the distal end of the patella, usually very near the line of articulation, but never against it. Its slits are much longer than those in No. 7 and the smaller ones face the ventral surface as in No. 7. One finds organ No. 9 at the distal end of the patella on the dorsal side about 135 degrees from organ No. 7. It never touches the line of articulation and is usually some distance from it. Its apex points toward the angle formed by the line of articulation with the edge of the anterior side. Its shorter slits always face the anterior surface of the leg. One or two or no single isolates slits usually accompany it and these occur near the concave side which faces the anterior surface of the leg (figs. 14, 18). Nos. 10 and 11 (figs. 13, 57), like Nos. 7 and 8, are paired, and they occur on the ventral surface at the extreme distal end of the tibia. No. 10 lies mostly across the first line of articulation (1. l. a.) with its apex pointing toward the articulation. Its shorter slits always face the anterior surface of the leg and it invariably lies between this surface and organ No. 11. The latter organ lies only slightly over the first line of articulation with its apex directed from the articulation. Its shorter slits face the anterior surface of the leg or exactly toward the apex of No. 10. Organ No. 12 lies at the extreme distal end of the tibia on the dorsal surface at the edge of the anterior side. It lies two-thirds across the first line of articulation with its apex touching the second line of articulation (2. l. a.). Its shorter slits and greater concave side face the anterior side of the leg (figs. 14, 45). Organ No. 13 found on the posterior surface of the metatarsus covers most of the space at the extreme distal end. The slits are transverse to the axis of the leg and they extend around about 120 degrees of the joint. The border is entirely absent. The shorter slits lie on the edge of the dorsal surface (figs. 14, 10).

The organs on the palps have a disposition similar to those of the legs. Their shape is also similar but the number of their slits is less. Organ No. 1 has only two slits instead of three (figs. 13, 27). No. 2 lying on the ventral surface of the trochanter has only seven slits as compared with 15 to 18 found in the same organ on the legs (figs. 13, 26). No. 3 is absent. No. 4 on the dorsal surface of the trochanter has seven or eight slits and its shape is very similar to that of No. 2 (fig. 14). Nos. 5 and 6 have seven slits instead of eleven as on the legs (figs. 13, 14, 38). No. 7 is missing. The shape of No. 8 is more like that of No. 7 of the legs, but its arrangement of slits and disposition correspond to that of No. 8 of the legs. It has only ten slits while on the legs there are twenty-one (figs. 13, 23). No. 9 has the same number of slits as has that organ on the legs, and it is as large as the same structure found on the second and third pairs of legs, it never has any isolated slits (figs. 14, 17). All the other organs on the palps are absent.

On the anterior and on the ventral extreme distal surfaces of the metatarsus of each leg, there is a single large slit. It may or may not touch the line of articulation and its long axis is not quite parallel with the axis of the leg (figs. 13*a*, 14*b*, 31). On each the anterior and dorsal surface of all the legs and palps there is a transverse single slit near the distal end of the tarsus (figs. 13*c*, 14*d*, 32*a*, *b*, *c*). On the ventral surface of the palps and legs single isolated slits occur only on the sixth joint of the left palp (figs. 13*e*, 34*a*); on the femur of the first and second legs (figs. 13*m*, 37*a*), and on the tibia of the third leg (fig. 14). On the dorsal surface of both the palps and legs the single slits are much more numerous and are arranged more or less in regular rows. Thus we see several on the sixth and fifth joints of the palps (figs. 14*l*, 34*b*). On the legs they occur as follows—a row on each femur (figs. 13, 14*n*, 37*b*); three or four irregularly scattered on the patella of the third and fourth legs (fig. 13); on the tibia of the first, second and fourth legs a row (figs. 13, 14*f*, 34*c*); only two on each of the metatarsi of the first, third and fourth legs (figs. 13, 14). Most all of these are parallel with the axis of the leg. On either the dorsal or anterior surface of the trochanter of the second, third and sometimes the fourth leg, there are two or more isolated single slits (fig. 14).

Organs No. 14 and 15 lie on the outer edge of the ventral side at the distal end of the chelicera. They are always paired and form a right angle with each other (fig. 13). Organ No. 14 (fig. 51*a*) is the larger and lies near the outer edge. Each organ has four slits, each of which has its own border. All of these borders are more or less connected with each other. Likewise organs No. 16 and 17 are paired, but are located on the outer edge of the dorsal surface at the distal end of the chelicera (fig. 14). No. 16, the larger (fig. 55*a*), lies the nearer the outer edge. It always has an associated single slit (fig. 55*c*). Each organ has six slits whose borders are similar to those of Nos. 14 and 15. On both the dorsal and ventral surfaces of the chelicera several small isolated slits lie along the outer edges (figs. 13*g*, 14, 50).

Organ No. 18 is one of the paired structures found on the dorsal surface of the pedicle near the distal end. Each organ lies near the outer edge and has transverse slits, but the longer axis of the organ lies almost parallel with the axis of the pedicle. The diameter of the slits is very great and each slit has its own border, but all these borders are joined at their sides while the ends are free and do not pass around the ends of the slits as usual, but connect with these ends (figs. 13, 41).

Several scattered slits lie near the outer edges of the maxillæ (figs. 13*h*, 39). Thirty-eight isolated slits of irregular sizes are found on the sternum arranged in a V-shaped figure with the apex of the V at the distal end of the sternal plate. Each row, which is composed of three or four groups more or less irregularly arranged and which contains about one-half the total sternal slits, is midway between the median line of the sternal plate and the outer edge of the sternum (fig. 13). In the group of five slits (figs. 13*i*, 42) no two are of the same size or shape. The first and third largest ones do not have any distinct dilatation, while the other three do. The second largest slit besides having its border also has a much darker colored circular disc which lies across the border at its middle.

On the ventral surface of the abdomen, we find a large isolated slit on either side of the epigynum near the lower end of the lung-book (figs. 13*j*, 44*a*). Lower down at the same distance from the edge of the abdomen midway between the epigynum and spinnerets, there is another pair of large isolated slits. Just in front of the spiracle there is another pair slightly smaller than the two preceding pairs (fig. 13). On the left spinneret of the first pair there are three small isolated slits (figs. 13*k*, 44*b*).

At the right posterior side of the cephalothoracic shield just above where the right fourth leg is attached there are two minute indistinct isolated slits (fig. 14).

The lyriform organs found in the seventeen day (just hatched) spiderling of *Th. tepidariorum* have the same disposition as the corresponding ones in the adults. But there are none on the first joint of the palps, the spinnerets, maxillæ, labium, sternum, cephalothoracic shield and near the epigynum. In other places the isolated slits are very scarce. As compared with the organs of the adult female, those of the spiderling have almost proportionately the same size, but since the number of slits in the latter is about one-half that of the former, the slits are proportionately larger. In order to compare the number of slits in each organ of the spiderling with that of the adult female, I shall indicate the number of each organ with a Roman letter and the number of slits in it with an Arabic figure. In each case the number of adult slits appears first and of the juvenile second.

Palps.—I 2–0; II 7–5; III 0–0; IV 7–5; V and VI 7–2 each; VII 0–0; VIII 10–4, but the latter does not have the same shape as former; IX 7–4; all others are absent as in the adult, but the large slits on both palps and legs marked *a*, *b*, *c*, and *d* are present as in the female.

Legs.—I 3–2; II 15–5, but the latter are all long and of equal length; III 7–0; IV 14–5, latter are all long and of equal length; V and VI 11–4 each, latter four all long and of equal length; VII 17–8; VIII 21–10; IX 6–3, in latter no isolated slits ever accompany organ as in the former; X 6–2; XI 11–6, in latter slits are about same length and are all long; XII 9–2, latter two are long ones; XIII 17–12; XIV 8–4; XV and XVI 4–2 each; XVII 6–2, young as adult with an associated slit; XVIII 6–2. By referring to the table (p. 389) we see that while the adult female has 60 compound organs, its young just hatched has only 38. By counting all the slits enumerated above the adult has a few more than twice as many as the young, then by including the isolated slits in both we see as far as number is concerned, that when the young are hatched the lyriform organs are hardly one-half developed. Thus after hatching the slits in the organs more than double themselves; organ No. 1 on the palps, the diffused organ No. 3 on the legs and the majority of the isolated slits make their appearance.

(*b*) *Other Species.*

In order to ascertain most of the variations found in the other species, reference is made to the tables on pp. 386–393. At the top of this table the families are arranged as Simon recognizes them. Just below the family names are entered the subfamilies, the generic and specific names. The following abbreviations are employed: H, hunters; S, snarers; T, tube-dwellers; the numbers 1 to 7 for the joints of the legs correspond to coxa, trochanter, femur, patella, tibia, metatarsus, and tarsus. Spinn., spinnerets; Chel., chelicera; Max., maxilla; Lab., labium; Stern., sternum; Ped., pedicle; Ceph. S., cephalothoracic shield and Near Epigy., includes all the organs on the ventral side of the abdomen, usually occuring near the epigynum; C. O. and S. O., compound and simple organs, and S. S., single slits. Where only one segment is present in the spinnerets I have considered it the first one, although it may correspond to the second or third in other cases. All the specimens were adults. The young of *Th. tepidariorum* is entered only for comparison, but has not been considered in the range or in the comparison of the adults. The total includes all the organs and slits which could be found on all the legs, palp, spinnerets, cheliceron, and maxilla on one side of each specimen. Hence the total contains slightly more than one-half the number for each individual. For the number of organs the amount of error is probably not greater than two per cent., while for the single slits not more than ten per cent. The latter possibility of error is largely due to the three following reasons: (1) the slits when placed in profile are never discernible; (2) on account of the transparency; (3) the caustic potash treatment often causes artificial slits and no doubt often destroys some of those present.

Appendage.	Joint.	Aviculariidæ.												Hypochilidæ.			Uloboridæ.		
		H. Migina.			H. Cteniziuæ.			S. Diplurinæ.			H. Atypidæ.			H. Hypochilidæ.			S. Uloboridæ.		
		Moggridgea sp. Cambr.			*Hermacha* sp. Sim.			*Evagrus* sp. Auss.			*Atypus niilberti* Walck.			*Hypochilus* sp. Marx.			*Hyptiotes cavatus* Htz.		
		♀			♀			♀			♀			♀			♀		
		c.o.	s.o.	s.s.	c.o.	s.o.	s.s.	c.o.	s.o.	s.s.	c.o.	s.o.	s.s.	c.o.	s.o.	s.s.	c.o.	s.o.	s.s.
Palp.	1	1		4			3		1		1		2	1	2				
	2	3		5	2			2			2			2			2		
	3	2		2	2		2	2		1	2		12	2		3	2		
	4	3		3	3			2	1		3			3				1	
	5	3	1	3	5			4		6	4		3	1					1
	6			14						2			4			9			
1st Leg.	1	1			1		2				1		1	1					
	2	2			2		1	1			3			3			3		
	3	2			2		2	2		1	2			2			2		1
	4	3			3			2		2	3			3			3		
	5	4		1	3			3	1		2			3			2	2	
	6	1		8	1		3	1		2	2	1		1		3	1		
	7			11			3			2			4	1		1			3
2d Leg.	1	1			1						1		2	1					
	2	2		2	2			2			3			3			3		
	3	2		1	2		1	2		1	2		1	2			2		
	4	3			3			2		1	3			3			3		
	5	4			4		1	3			4			3			1	2	
	6	1	2	6	1		3	2			2			1		1	1		
	7			7			5			3			4	1		3			1
3d Leg.	1	1			1						1		1	1					
	2	2			2			2			3			3			3		
	3	2		2	2			2			2			2			2		
	4	3			3			2			3			3			3		
	5	4			4			2			4			3			1	2	
	6	1		4	1		1	2			1		1	1			1		
	7			2			2			2			4	1		2			2
4th Leg.	1	1			1		1				1		1	1					
	2	2			2			2			3			3			3		1
	3	2		4	2			2			2		1	2			2		
	4	3			3			2			3			3			3		
	5	3		2	4			3	1		4			3			1	2	
	6	1		1	1			2	1		1			1		1	1		
	7			3			3			4			4	1		5			
Spinn.	1			10			16			21			2			9	1		
	2						6			5			3			3			
	3						3			6			4						
Chel.		3		4			15	4		2	1		4	4		6	2	2	
Max.				4			13						5			7			4
Lab.				13			6						7			1			
Stern.				34			34			8			26						8
Ped.				20												7	2		
Ceph. S				2			2			1			1			3			
Near Epigy.			2	4		1	11												
Total		66	5	176	63	1	139	55	5	70	69	1	97	69	2	64	50	11	21

Appendage.	Joint.	N. Dictynidæ.			N. Œcobiidæ.			N. Eresidæ.			N. Filistatidæ.			N. Sicariidæ.			? Oonopidæ.		
		Dictyna volupis Keys. ♀			*Thalamia parietalis* Htz. ♀			*Stegodyphus dumicola* Poc. ♀			*Filistata hibernalis* Htz. ♀			*Loxosceles rufescens* Duf. ♀			*Calculus bicolor* Purc. ♀		
		c.o.	s.o.	s.s.	c.o.	s.o.	s.s.	c.o.	s.o.	s.s.	c.o.	s.o.	s.s.	c.o.	s.o.	s.s.	c.o.	s.o.	s.s.
Palp.	1		1								1		6	1					
	2	1			2			2			2			2			2		
	3	1	1		2			2			2		2	2			2		
	4	2	1		3			3		3	3			3			3		
	5						2			8									
	6			4			12			3			6			3			1
1st Leg.	1				1			1		10	1			1					
	2	2			3			3			3			3			2		
	3	2			2			2		5	2			2			2		
	4	3			3			3			3			2			3		
	5	2	1			2		2		1	1			3			2	2	
	6	1			1		5	1		1	1			1			1		2
	7			1			10			6			2			1			3
2d Leg.	1				1			1		7	1		2	1				1	
	2	2			3			4			2			3			2		
	3	2			2			2		1	2			2			2		
	4	3			3			3			3			2			3		
	5	3	1		3			2			3		1	3			3		
	6	1			1		1	1		1	1			1			1		1
	7			2			6			1			1						3
3d Leg.	1				1			1		5	1			1				1	
	1	2			2			3			2			2		1	2		
	3	2			2			2			2			2			2		
	4	3			3			3			3			2			3		
	5	3			3			3			4	1		3			2	1	
	6	1			1		1	1		1	1		1	1			1		1
	7			1			5												3
4th Leg.	1							1		7	1			1				1	
	2	2			2			4			2			2			2		
	3	2			2			2		2	2			2			2		
	4	3			3			3			3			3			3		
	5	2	1		1	2		3		3	3			3			2	1	
	6	1			1		4	1		1	1		1	1			1		
	7			2			3			4						2			
Spinn.	1						3			7									
	2																		
	3									4									
Chel.			4	12	2	2	2	4		5	4		2	4		1	2	2	2
Max.				2			8			16			10						9
Lab.							4			4			5						
Stern.				7			21			36			30			10			22
Ped.		2						2			2								
Ceph. S.				1			1			2									
Near Epigy.				2						2			2				2		2
Total		49	10	34	53	6	88	66	0	146	62	1	71	59	0	18	52	9	49

Appendage.	Joint.	Dysderidæ.																	
		T. Dysderinæ			T. Segestriinæ			T. Caponiidæ			H. Drassidæ			S. Palpimanidæ.			S. Hersiliidæ.		
		Dysdera interrita Htz.			*Ariadna bicolor* Htz.			*Caponia* sp. Sim.			*Geotrecha pinnata* Emert.			*Palpimanus* sp. Duf.			*Tama forcipata* Cambr.		
		♀			♀			♀			♀			♀			♀		
		c.o.	s.o.	s.s.	c.o.	s.o.	s.s.	c.o.	s.o.	s.s.	c.o.	s.o.	s.s.	c.o.	s.o.	s.s.	c.o.	s.o.	s.s.
Palp.	1			3		1	10												5
	2	1		4			3	2			2			2			2		4
	3	2		4	2		11	2			2			2			2		3
	4	1			2			2			3			1			3		2
	5			2			5									2			1
	6			1									2			2			17
1st Leg.	1		1	3			10		1		1			1		10	1		
	2	2		8	4			2			2			3		2	2		6
	3	1		15	2		15	2			2			2		22	2		5
	4	3		1	2		5	3			3			3		9	3		
	5	2			2	1	6	3			3			2		3	3		8
	6	1		5	1		4	1			1			1			1		1
	7						6			1						1			2
2d Leg.	1		1	5			6		1				1	1		6	1		
	2	2			3			2			3			3			3		6
	3	2		2	1		6	2			2		1	2		16	2		9
	4	3			3		3	3			3			3		4	3		
	5	2			2	1	4	3			1	1		4		1	3		7
	6	1		1	1		3	1			1			1		2	1		1
	7						5						1			8			4
3d Leg.	1		1	9			5					1		1		9	1		
	2	1		4	3			1			2			3		1	3		
	3	2		2	1		7	2			2			2		10	2		2
	4	3			2		4	3			2			3		6	3		
	5	2	1	1	2	1	3	3			2			3		7	3		
	6	1			1		4	1			1			1		3	1		8
	7						2									4			5
4th Leg.	1		1	9		1	9		1			1		1		8		1	
	2	2		1	2			1			2			3			3		7
	3	2		1	2		12	2			2			2		10	2		1
	4	3			3		1	3			2			3		8	3		
	5	3			3			3			3	1		2		7	3		1
	6	1		1	1		3	1		1	1			1		11			2
	7						4									4			2
Spinn.	1						4						2			1	1		
	2																		11
	3																		38
Chel.		3	1	12	4		25	2		4	2	2	4	4		22	4		13
Max.				4			4			10						7			5
Lab							13			3						2			
Stern... ...				32			26			32			21			27			23
Ped.........											2			2			2		
Ceph. S ...				4			9			5						2			
Near Epigy.		2		2						4			2			4			6
Total ...		48	6	136	49	5	237	50	3	60	52	6	34	62	0	241	64	1	205

Appendage.	Joint.	S. Uroctеidæ.			? Ammoxenidæ			Pholcidæ.						Theridiidæ.					
								S.						Group Theridieæ.					
														S. Theridium.					
		Uroctea sp. Duf.			*Ammoxenus* sp. Sim.			*Pholcus phalangioides* Fuess.						*tepidariorum* Koch.					
		♀			♀			♀			♂			Young.			♀		
		c.o.	s.o.	s.s.	c.o.	s.o.	s.s.	c.o.	s.o.	s.s.	c.o.	s.o.	s.s.	c.o.	s.o.	s.s.	c.o.	s.o.	s.s.
Palp.	1	1				1			1			.	1					1	
	2	2		3	2		1	2			1	1		2			2		
	3	2		2	1		3	2			2				2		2		
	4	3		4	3			1						2			2		
	5			6			1												
	6			10			2									3			8
1st Leg.	1		1				3								1			1	
	2	2			3			3			2			2			3		
	3	2		2	1		1	2			2		6	2		2	2		13
	4	3		1	3			3			3			2	1		3		2
	5	4		2		2		3			3	1		1	2		3		8
	6	1	1	6	1		4	1		2	1		4	1		2	1		3
	7			6			2			5			2			2			3
2d Leg.	1		1			1									1			1	
	2	4			2			3			2		6	2			3		
	3	2		3	1			2		8	2			2			2		5
	4	3			3			3			3			2	1		3		
	5	4		5	2	2		3			3			1	2		3		3
	6	1		10	1		5	1		2	1			1		2	1		2
	7			7			2			4			2			2			4
3d Leg.	1		1	6		1									1			1	
	2	3			2		1	2			3			2			3		
	3	2		1	1	1		2		13	2		5	2			2		6
	4	3		3	3			3			3			2	1		3		
	5	4			2	2		3			3		1	1	2		3		
	6	1		4	1			1		1	1			1		2	1		4
	7			5			8			4			2			2			3
4th Leg.	1		1	7			1								1			1	
	2	3			2			2			2			2			3		
	3	2						2			2		4	2			2		8
	4	3			3			3			3			2	1		3		4
	5	4			1	2		2	1		3			1	2		3		7
	6	1		3	1			1		2	1		2	1		2	1		4
	7			4			2			1			2			2			3
Spinn.	1			4						1									3
	2			9															
	3																		
Chel.		3		2			4		4	2		4			4	1	4		11
Max.				22			5												10
Lab.				6															1
Stern.				55			37												36
Ped.		2			2									2			2		
Ceph. S.																			1
Near Epigy.										12									2
Total		65	5	198	41	12	82	50	5	57	48	6	37	38	22	22	60	5	154

Appendage.	Joint.	Theridiidæ.									Argiopidæ.								
		Group Theridieæ.									S. Linyphiinæ								
		S. Theridium.																	
		tepidariorum Koch.			*porteri* Banks.			*Kentuckyense* Keys.			*Grammonota inornata* Emert.			*Erigone infernalis* Keys.			*Phanetta subterranea* Emert.		
		♂			♀			♀			♀			♀			♀		
		c.o.	s.o.	s.s.	c.o.	s.o.	s.s.	c.o.	s.o.	s.s.	c.o.	s.o.	s.s.	c.o.	s.o.	s.s.	c.o.	s.o.	s.s.
Palp.	1		1									1							
	2	2	1		2						2			2			1		
	3	2			1		2	2			2			2			2		
	4	2			3			2				1	1					1	
	5						6						3						
	6			12			5			1			3			6			1
1st Leg.	1		1						1			1				1			
	2	2			3			4			2	1		3			2		
	3	2		24	2		7	2		7	2		2	2		8	2		1
	4	3			3			3			3			3			3		
	5	3		9	3		10	3		9	2			3		7	2	1	
	6	1		10	1			1		13	1		2	1		8	1		
	7			5			3						3			6			
2d Leg.	1		1						1			1			1				1
	2	3			3			4			3		2	3			2		
	3	2		13	2		8	2		16	2		2	2		11	2		2
	4	3		1	3			3			3			3			3		
	5	3		3	3			3		5	1	1	7	2	1	3	2	1	
	6	1		7	1		1	1		10	1		5	1			1		1
	7			3			3			5			4			1			
3d Leg.	1		1									1							
	2	3			3			3			3		2	2			2		
	3	2		11	2		5	2		1	2		1	2		4	2		
	4	3			3		1	3			3			3			3		
	5	3		1	2	1	1	3		7	1	1	1	2	1	1	1	1	5
	6	1		7	1			1		8	1		4	1		2	1		2
	7			4									2			1			3
4th Leg.	1		1						1			1			1				
	2	3			3		2	3			3		3	2			1		
	3	2		14	2		11	2		6	2		1	2		3	2		2
	4	3		1	3			3			3			3			3		
	5	3		3	2		2	3			2		7	3		3	2	1	4
	6	1		7	1			1		11	1		7	1		1	1		3
	7			3			3						1						2
Spinn.	1			1			2			2									
	2																		
	3																		
Chel.		4		9	4		10	3	1			4	15	2	2	16	1	3	12
Max.				8			6			4			5			2			
Lab.										2									
Stern.				43			24			24			17			24			12
Ped.		2			2			2			2			2					
Ceph. S.				1									2						
Near Epigy.				2			2			4			7						
Total		59	6	202	58	1	115	59	4	135	48	13	109	52	6	108	42	8	51

		Argiopidæ.																	
		S. Linyphiinæ.												S. Tetragnathinæ.			S. Argiopinæ.		
Appendage.	Joint.	*Troglohyphantes cavernicola* Keys.						*Linyphia weyeri* Emert.						*Tetragnatha grallator* Htz.			*Epeira marmorea* Clerk.		
		♀			♂			♀			♂			♀			♀		
		c.o.	s.o.	s.s.	c.o.	s.o.	s.s.	c.o.	s.o.	s.s.	c.o.	s.o.	s.s.	c.o.	s.o.	s.s.	c.o.	s.o.	s.s.
Palp.	1						2											1	
	2	2			1			1	1		1			2			2		
	3	2			2		6	1			1		3	2			1		
	4				1		2	1			1			3			1		
	5			7			5						2					1	
	6			11			37			3			9						4
1st Leg.	1					1			1	3			3				1		
	2	3			3			2			2			3			4		
	3	2		11	2		9	2		6	2		3	2			2		
	4	3			2			2		1	3		1	3			3		
	5	2	1	17	3		8	2		6	2		10	3			3		
	6	1		3	1		5	1		3	1		7	1		1	1		
	7			2			3			3			6			2			
2d Leg.	1					1			1	2			2					1	
	2	3			2			2			2			3			4		
	3	2		13	2		10	2		6	2		3	2			2		
	4	3			2			3		1	3		1	3			3		
	5	3		8	3	1	8	2		4	2		3	2	1		3		
	6	1		1	1		6	1		1	1		3	1			1		
	7			3			7			1			3			2			
3d Leg.	1					1							2					1	
	2	3			3			2			2			3			4		
	3	2		9	2		5	2		5	2		3	2			2		
	4	2			2			3			3			3			3		
	5	2	1	9	3	1	4	2		3	2		1	2			2		
	6	1		11	1		5	1		3	1		1	1		1	1		
	7			6			2			4			2			3			6
4th Leg.	1								1				1					1	
	2	3		1	2			3			2			3			4		
	3	2		23	2		10	2		6	2		6	2			2		
	4	3			2			3		2	3			3			3		
	5	2	1	21	2	1	8	2		2	2			2	1		3		
	6	1		6	1		2	1		3	1		2	1			1		1
	7			3			3			2			3			1			5
Spinn.	1			2		1	1									4		1	14
	2																		
	3																		
Chel.			4	26		4	15	3	1	13	3	1	11	4			4		5
Max.				6			6						4						6
Lab													2						15
Stern.				12			20			12			12			22			31
Ped.		2			2			2			2			2			2		
Ceph. S.				4			2												2
Near Epigy.				2			3						2						2
Total		50	7	217	47	11	194	48	5	95	48	1	111	58	2	36	62	6	91

Appendage.	Joint.	H. Mimetidæ.			H. Thomisidæ.			S. Agalenidæ.						H. Pisauridæ.			H. Lycosidæ.		
																	Lycosa.		
		Mimetus interfector Htz.			*Misumena* sp. Latr.			*Agalena nævia* Walck.						*Pisaurina mira* Walck.			*lepida* (Keys).		
		♀			♀			♀			♂			♀			♀		
		c.o.	s.o.	s.s.	c.o.	s.o.	s.s.	c.o.	s.o.	s.s.	c.o.	s.o.	s.s.	c.o.	s.o.	s.s.	c.o.	s.o.	s.s.
Palp.	1					1					1			1					
	2	2			2			2			3			3			3		
	3	2			2			2			2			2			2		
	4	3			2			1			2			3		5	3		
	5			1									2						
	6			10									11						
1st Leg.	1			1		1		1			1								4
	2	4			3			2			4			3			3		
	3	2		43	2			2			2			2			2		
	4	3		1	3			3			3			3			3		
	5	3		28	3			3			3			3			3		
	6	1		16	1			1		1	1			1			1		
	7			4						3									3
2d Leg.	1					1													
	2	4			3			3			3			3			3		
	3	2		34	2			2			2			2			2		
	4	3		3	3			3			3			3			3		
	5	3		19	3			3			3			2			3		
	6	1		7	1		1	1		1	1			1			1		
	7			2			1			2						1			4
3d Leg.	1		1			1		1			1								
	2	4			3			3			3			3			3		
	3	2		22	2			2			2			2			2		
	4	3		2	3			3			3			3			3		
	5	3		14	3			4			3			2			3		
	6	1		9	1			1		1	1			1			1		
	7			4			1			1									
4th Leg.	1		1						1			1							
	2	4			3			3			3			2			3		
	3	2		30	2			2			2			2			2		
	4	3		2	3			3			3			3			3		
	5	3		21	3			3			2			1	1		3		
	6	1		17	1			1			1			1			1		
	7			7						1			3						
Spinn.	1	1		3			5			9			21						2
	2																		
	3																		
Chel.		2	2	23	4		12	4		12	4		9	3	1	3	4		16
Max.				5			8			6						3			4
Lab.				3			3									6			
Stern.				31			37			14			19			18			18
Ped.		2						2			2			2			2		
Ceph. S.				3						1			2						2
Near Epigy.				10						2			2						2
Total		64	4	375	58	4	68	61	1	54	64	1	69	57	2	36	62	0	55

Appendage.	Joint.	H. Lycosidæ.						H. Oxyopidæ.			H. Salticidæ.						Range.		
		Lycosa.																	
		l. pida (Keys).			*scutulata* Htz.			*Peucetia* sp. Thorell.			*Phidippus purpuratus* Keys.								
		♂			♀			♀			♀			♂					
		c.o.	s.o.	s.s.	c.o.	s.o.	s.s.	c.o.	s.o.	s.s.	c.o.	s.o.	s.s.	c.o.	s.o.	s.s.	c.o.	s.o.	s.s.
Palp.	1																0-1	0-2	0-10
	2	3			3			2			2			2			0-3	0-1	0-5
	3	2		4	2			2			2			2			1-2	0-1	0-12
	4	3			3			3		1	3			3			0-3	0-1	0-5
	5															8	0-5	0-1	0-8
	6			5												6	0-0	0-0	0-37
1st Leg.	1			1					1				2				0-1	0-1	0-10
	2	3			3			3			2			3			1-4	0-0	0-8
	3	2			2			2			2			2			1-2	0-0	0-43
	4	2			3			3			3			3			2-3	0-0	0-9
	5	3			2	1		3				2			2		0-4	0-2	0-28
	6	1			1			1			1			1			1-2	0-1	0-16
	7			5						3							0-1	0-0	0-11
2d Leg.	1	1											1			2	0-1	0-1	0-7
	2	3			3			3			3			2			2-4	0-0	0-6
	3	2			2			2			2			2			1-2	0-0	0-34
	4	3			3			3			3			3			2-3	0-0	0-4
	5	3			3			3			1	1		1	2		1-4	0-2	0-19
	6	1			1			1			1		1	1		2	1-2	0-2	0-10
	7						1			5						1	0-1	0-0	0-8
3d Leg.	1	1							1				4		1	4	0-1	0-1	0-9
	2	3			3			3			3			2			1-4	0-0	0-4
	3	2			2			2			2			2			1-2	0-1	0-22
	4	3			3			3			3			3			2-3	0-0	0-6
	5	2	1		2			3			1	2		1	2		1-4	0-2	0-14
	6	1			1			1			1			1		1	1-2	0-0	0-11
	7			1												1	0-1	0-0	0-8
4th Leg.	1	1							1				9			2	0-1	0-1	0-9
	2	3			2			3			3			3			1-4	0-0	0-2
	3	2			2			2			2		2	2			0-2	0-0	0-30
	4	3			3			3			3			3			2-3	0-0	0-8
	5	3		1	1	1		3			1	2		1	2		1-4	0-2	0-21
	6	1			1			1			1			1		1	1-2	0-1	0-17
	7									3			1			3	0-1	0-0	0-7
Spinn.	1			3			1			3			6				0-1	0-1	0-21
	2																0-0	0-0	0-11
	3																0-1	0-0	0-38
Chel.........		4		15	4		7	4		2	4		6	4		3	0-4	0-4	0-26
Max.........				1			3			4			4			4	0-0	0-0	0-22
Lab				2									3			5	0-0	0-0	0-15
Stern.......				20			28			19			20			18	0-0	-0	0-55
Ped.........		2			2			2			2			2			0-2	0-0	0-20
Ceph. S....				4			1			2			5			3	0-0	0-0	0-9
Near Epigy.				2			2						2				0-2	0-2	0-12
Total....		63	1	64	57	2	43	61	3	42	51	7	66	50	9	64			

The following are those variations which could not be placed in the table. (1) Organ No. 1 on the coxa of the legs in *Moggridgea* and a few others have six or seven slits (fig. 35). (2) On the trochanter of the palps in one-half the cases where two or three organs are present at least one is always and sometimes two are diffused. (3) Concerning the same joint of the first leg, there are 18 species with one diffused organ, 10 species with two diffused organs; for the second leg 23 species each with one diffused organ, 7 species each with two such organs; for the third leg one diffused structure in each of 17 species and 5 species each with two such organs; for the fourth leg in each of 14 species one such organ, while each of 9 species has two diffused organs. On the legs a diffused organ never occurs unless at least two organs are present, and two diffused organs are never seen unless at least three in all are observed. (4) In all species with a low total number of organs, No. 5 and 6 on the femur never have many more than three slits. (5) The paired organs No. 7 and 8 are always present, while in six species No. 9 is absent on the first and third legs; it is missing, however, in only three species on the second and fourth legs. In *Hermacha* this organ on each leg is slightly diffused. No. 7 and 8 in *Caponia* and *Palpimanus* are out of their ordinary position. (6) On the fifth joint of the palp of the first five named species, there is a transverse organ (fig. 40) in the same position as No. 13 on the metatarsus of the legs. In the first four species three or four longitudinal organs occur besides this transverse organ. All of these organs are proportionately large as represented by those of *Moggridgea* (figs. 25, 40, 48, 56). The largest of these (fig. 56) has thirty slits, the greatest number found in any organ of any species. Fig. 12 shows the large organ on the dorsal side of the tibia of *Uroctea*. The other three on this joint are very small. (7) On the sixth joint of the palps the large transverse slits called *c* and *d* were observed in only a few of the species. (8) On the legs the majority of the species have at least one of the two large slits called *a* and *b*. In several cases one of these slits becomes a simple organ and in a few cases as in *Eragrus* or *Atypus* one has changed into a compound organ, while the other one remains a simple organ. Hence, on the sixth joint in the first leg of *Atypus* and on the fourth leg of *Eragrus* there are two compound and one simple organ. As usual one of the former is transverse and the other two are longitudinal. (9) Among the 39 species only *Hypochilus* has organs on the tarsi. These are small transverse organs located at the extreme distal end always on the anterior side (fig. 49). In almost every species there is at least one, but in most cases two transverse single slits like *c* and *d*. Besides these in many species there are several other smaller transverse slits. These usually lie near the larger ones but not so near the distal end. (10) Fig. 29 shows three slits and three hairs found on the first joint of the spinnerets of *Eragrus*. Organs on the spinnerets occur in only five species. In *Hytiotes* there is a small transverse compound organ at the base of the spinnerets; at the same place in the male of *Troglohyphantes* and *Epeira* this organ is transverse and simple (fig. 19). On the ventral extreme distal end of the first joint of *Mimetus* there is a transverse organ of nine slits; at the same location on the foremost spinneret of *Tama* there is a large transverse organ with eleven slits (fig. 33). (11) For the chelicera, fig. 28 shows two of the four simple organs found in *Dictyna*. Here the border is entirely absent. In *Hyptiotes* (fig. 20) the border surrounds all the slits of each organ. Fig. 11 shows the very large organ in *Moggridgea*. (12) Fig. 21 represents two of the thirteen slits on the labium of *Ariadna*. (13) Whenever the number of slits on the sternum is approximately 24, they are arranged in groups of threes. In such cases the proximal end of each coxa faces one of these eight groups. Whenever the number is much smaller than 24, they are not arranged in groups, but are scattered irregularly. Whenever the number is much more than 24, then they are grouped as in *Th. tepidariorum*. (14) Fig. 36 shows two of the twenty very small slits on the pedicle of *Moggridgea*. (15) When the minute slits can be detected on the cephalothoracic shield they occur usually at either side or directly in front of the pedicle. Fig. 46 shows three taken from *Ariadna*. (16) Near the epigynum we have the following: Fig. 22 shows two of the twelve scattered slits in the female of *Pholcus*. These twelve are found on both sides of the epigynum a little above the ones marked *j* in *Th. tepidariorum*. Fig. 54 shows a group of these in *Moggridgea*. They are drawn much too close together. Fig. 43 represents the two diffused organs in front of the epigynum of *Calculus*, while fig. 47 shows one of the two organs in front of the epigynum of *Dysdera*. In only a few cases have the two pairs of large slits been found which lie between the epigynum and spinnerets as shown in *Th. tepidariorum*.

(*c*) *Individual and Sexual Variations.*

For a study of the individual variation, I have used the fourth pair of legs of ten males and ten females of *Th. tepidariorum*, thus making forty legs in all. Organ No. 1 in the females occurs nine times to only six in the males on the right side; on the left side ten times in the females to nine times in the males. Organ No. 3 of the females on both sides is much oftener diffused than is that of the males. The only other striking difference is the greater number of isolated slits on both legs of the females. In two cases in the males a simple organ takes the place of a compound one, and in the legs on either side in both sexes an organ is occasionally absent. In all other cases in which I have carefully examined more than one specimen of the same species, I have not found any individual variations of more importance than the above. Hence we see that the organs are pretty constant on both sides of the body in both sexes, while the number of single slits varies considerably both individually and sexually.

By carefully comparing the males and females of the same species we see that there are no variations except what can be considered as individual variations. The only difference worth mentioning is the great number of single slits on the last joint of the palps in the males (fig. 9), while none or only a few are found at the same place in the females. By referring to the totals in the table one sees that the males of *Th. tepidariorum* and *Phidippus* have one compound organ less than the females; the male of *Pholcus* two less; the male of *Troglohyphantes* three less; an equal number in both sexes of *Linyphia;* the male of *Lycosa lepida* one more, and the male of *Agalena* three more organs than the female.

(d) Conclusions.

Now, to interpret the meaning of the totals in the table, it is evident that relationships play no part at all, for there is a great range of variation within a genus or family. Therefore these organs are not useful for taxonomy. As already stated individual and sexual variations are very slight. Specific variations are also very slight as seen in the two Lycosas, and in the three species of *Theridium*. Generic differences are not very great when the various genera have a similar habitat, as in *Moggridgea*, *Hermacha*, and *Evagrus;* a less variation between *Tetragnatha* and *Epiera*, but the same number of organs in *Dysdera* and *Ariadna;* however when the habitat is dark and damp the number of compound organs is usually much less as shown in the linyphiid cave forms and in a linyphiid littoral form, *Grammonota*. The most important variation in the morphology of the lyriform organs can certainly be correlated with the method of capturing food. In the manner of securing food, spiders are divided into three classes as follows: (1) The hunters are those which wander about in search of food and when sufficiently close they jump and seize the prey. They use no snares whatever in capturing food. (2) The snarers catch their food with snares and never hunt for it. (3) The tube-dwellers run to the entrance of their tubes in order to catch the prey. These three classes in the table (pages 386–393) are referred to as H, S, and T. The hunters without exception have more compound organs than either the snarers or tube-dwellers. The average number of compound and simple organs and single slits for the hunters is 61–3–100; for the epigæan snarers 58–4–99, and for the littoral and cavernicolus snarers 51–6–119; but for snarers of all kinds 56–4–105; for the tube-dwellers 49–5–144. Hence the number of single slits in both hunters and snarers is the same while the number of organs varies considerably. The cave forms have a few more single slits than either the hunters or epigæan snarers, but their number of organs is much reduced. The tube-dwellers have the greatest number of single slits, but the fewest organs of all. The range for the hunters is 69–51 c. o., 7–0 s. o., 375–34 s. s.; for the epigæan snarers 66–49 c. o., 11–0 s. o., 241–18 s. s.; for the other snarers 59–42 c. o., 13–1 s. o., 217–51 s. s., but for both kinds of snarers 66–42 c. o., 13–0 s. o., 241–18 s. s. and for the tube-dwellers 50–48 c. o., 6–3 s. o., 237–60 s. s. The difference between the maximum and minimum is practically the same between the hunters, epigæan and cavernicolus snarers but when all the snarers are compared with the hunters, the former vary much among themselves. The reason why there is such a slight range among the tube-dwellers is perhaps because *Caponia*, *Ariadna* and *Dysdera* are the only forms included here.[2]

All true cave spiders are snarers and it is manifest that the more they have become adapted to a subterranean life, the more their lyriform organs have degenerated. Thus to arrange them according to the degree of such an adaptability, we have the following series with regard to the number of compound organs: *Th. kentuckyense* with 59, *Th. porteri* 58, *Erigone* 52, *Troglohyphantes* 50, *Linyphia* 48, and *Phanetta* 42, of which series there is a gradation from the epigæan *Th. tepidariorum* with 60 compound organs which nests in walls and outhouses to Phanetta which is able to adapt itself to any place in a

[2] *Calculus* and *Ammoxenus* have not been included in the above comparison because I have been unable to find any literature concerning their habitats. *Calculus bicolor*, from South Africa, is a new species described by Purcell, and its habits have not been described. Simon (1892) described for the first time and created a new family for *Ammoxenus* from South Africa, but all he says about the habitat is—"Ils se trouvent à terre, dans les endroits découverts, et ils courent au soleil avec une telle rapidité qu'il est difficile de s'en saisir."

cave where the three following necessary requirements are present: (1) Total darkness, (2) an even temperature and (3) a saturated atmosphere. In Banta's (1907) cave work and my recent paper (1911) on some cave arachnids, their habitat is briefly discussed. The first three species may be found from twilight localities where food is very abundant and where there is a considerable range in the annual temperature and a daily range in the humidity to places in total darkness where insects are rather scarce, and where there is only a slight range in the temperature and humidity. These first three are much larger in size, all the eyes are present and they are much darker in color than are the last three. The fourth and fifth species are never found in the twilight, but always where the three above necessary requirements occur, although most abundantly where food is comparatively plentiful. The average color is rather light and the eyes are partially or totally absent. *Phanetta* may be found in the same localities as the above two species, but furthermore it is able to live in any part of a cave if the three necessary requisites are present regardless of the distance from the entrance or the paucity of the insect food. Of the six species it is the smallest, lightest in color and perhaps has the greatest percentage of totally blind individuals, although in twenty-seven specimens Banta did not find any totally devoid of eyes. Since *Grammonota* lives under wet eel grass in the dark, its small number of organs probably can be explained in a similar way.

Now, since hunting spiders have the greatest number of lyriform organs, and as these usually contain more slits than those of the snarers or tube-dwellers, we must conclude that the method of capturing food has brought about these changes in the number of organs.

3. *Discussion.*

(*a*) *Disposition.*

Bertkau (1878) was the first to notice some isolated slits grouped together and located at the distal end of the segments in Araneæ. Dahl (1883) first discovered and described the transverse organ No. 13 on the metatarsus. Schimkewitsch (1884) was the first to observe the isolated slits on the sternum but did not recognize them as lyriform organs. The next year (1885) the same author found eleven organs on the legs and four on the palps of *Epeira diademata*, while I have observed fourteen on the legs and six on the palps of *Epeira marmorea*. Wagner (1888) first saw the two organs on the pedicle and the single slits near the spinnerets, but he did not recognize them as lyriform organs. Gaubert (1890) described the disposition of the lyriform organs and said that these structures were as characteristic for arachnids as are the pectines for scorpions. He gave them the appellation of "lyriform organs." In (1892) Gaubert worked on several species and found the organs as follows: one on the coxa of the legs and palps; three on the trochanter; two on the femur; three on the patella; three on the tibia; one on the metatarsus; no organs but occasionally isolated slits on the tarsus. He said that the four pairs of legs have similar organs and the first four segments of the palps have organs located like those of the legs. Therefore he was the first to see organ No. 1 on the coxa, and he has seen all the organs present on these appendages, but he failed to observe them elsewhere. Hansen (1893) selected *Epeira diademata* Clerk ♂, the same species that Gaubert used, and searched for organs and slits which were overlooked by the latter observer. Besides finding the thirteen organs on each leg, some isolated slits, the organs on the palps, chelicera and the slits on the sternum as pointed out by Gaubert, Hansen found many isolated slits of various sizes irregularly distributed on the palps, legs, chelicera, maxillæ, labium, near the epigynum, on the spinnerets, and on the cephalothoracic shield in much the same manner that I have described. Thus he was the first to recognize the two organs on the pedicle as lyriform organs and pointed out for the first time the isolated slits near the epigynum, on the spinnerets, labium and cephalothoracic shield.

My more comprehensive study of these structures has enabled me to find all those organs pointed out by my predecessors, besides those compound organs occasionally on the fifth joint of the palp, on the tarsus of the legs and compound and simple organs on the spinnerets and in front of the epigynum.

(*b*) *Structure.*

Bertkau (1878, 1885) described an enlargement at the middle of the slit covered by a fine membrane and connected with a nerve fibre. Dahl described a vessel under the transverse slits of organ No. 13. Schimkewitsch says a lyriform organ has a chitinous coat which may be incomplete and has edges which separate the parallel slits. He describes the nerve fibres passing to the organ and their connection with the ganglia (sense cells), but he failed to see the union of the latter with the nerve "pédieux." Wagner states that these organs present at the exterior a very thin membrane which afterwards covers the dilatations which are located at the middle of the slit. Gaubert has described the structure of an organ very nearly as I have, but since his drawing is much too small and fails to give most of the details one cannot gain from it the proper conception of such a structure. He shows only six sense cells, all of which are at the base of the hypodermis just beneath the organ. Also he connects the nerve fibres with the dilatations, but he fails to show how the other end of the sense cells connects with the nerve of the leg.

(*c*) *Disposition in other Orders of Arachnids.*

In regard to the lyriform organs of other orders of arachnids which have been studied by Gaubert and Hansen, a brief summary is necessary in order to understand the development of these structures throughout the class of Arachnida. Gaubert failed to find any organs in the Scorpions and Solifugids, and he saw only a small portion of the organs present in the Pedipalps, Pseudoscorpions and Phalangids. Hansen who examined more specimens and with greater care, found the following in two species of different genera of the scorpions: several isolated slits on the trochanter and femur of the legs and palps; numerous slits on the patella, tibia, and metatarsus of the legs. All of these vary much in size and are irregularly scattered. Almost all of these slits are parallel with the axis of the leg and the dilatation is always at the proximal end.

In short, Hansen has found the lyriform organs in one family, Thelyphonidæ, of the Pedipalps as follows: the legs and palps are abundantly supplied with scattered slits and the only organ which occurs is on the metatarsus and it is highly developed. The chelicera have numerous slits; the cephalothoracic shield and sternum only a few, while the dorsal and ventral sides of the abdomen have many. In another family, Phrynidæ, the legs besides having many slits also have two organs on each trochanter. There are many slits on the chelicera, dorsal and ventral sides of the abdomen and only a few on the cephalothoracic shield.

According to Hansen and Sörensen (1904) lyriform organs are completely wanting in the order Palpigradi.

Among the Solifugids Hansen has found only five scattered slits on the last and fifteen on the first joint of the chelicera. These are very different in size and are irregularly scattered. He says: "Undoubtedly we have here lyriform organs in a somewhat modified shape."

For the Pseudoscorpions Hansen states that only a few isolated slits are found on most of the joints in the legs and palps, while an organ composed of five slits is found on the second joint of each species. Chelicera and maxillæ with only a few, both ventral and dorsal sides of the abdomen and dorsal side of the cephalothorax with many small scattered slits.

Hansen and Sörensen stated that it was impossible to find lyriform organs in the order Ricinulei.

Concerning the Phalangids Hansen says that numerous isolated slits of unequal lengths occur on the first three joints of the legs, third joint of the palps, chelicera, ventral side of the abdomen, but only a few on the cephalothorax and dorsal side of abdomen.

Gaubert was unable to find any lyriform organs in the order of Acarina. Hansen thought that he found some scattered, very tiny slits on the shield and a most remarkable transverse slit on the legs of one species. Thus he thinks that they appear as single slits in this family.

To briefly summarize the discussions about the disposition of the lyriform organs in all the orders of arachnids, we see that scorpions possess many irregularly scattered slits of various sizes on the legs and palps, but no compound organs. For the family, Thelyphonidæ, of the pedipalps there are many scattered slits on all the appendages, a few on both sides of the cephalothorax, while many are scattered all over the abdomen. In this family there is only one compound organ on each leg, while in the family, Phrynidæ, there are two compound organs on each leg besides the many slits. For the solifugids the only signs of lyriform organs are a few scattered slits on the chelicera. The pseudoscorpions have only one organ of five slits on each leg and scattered slits occur everywhere. The phalangids have only numerous slits scattered everywhere; the acarinids have nothing more than a few scattered slits, and no slits have ever been found in the Palpigradi and Ricinulei.

(*d*) *Phylogeny.*

Thus it is clear that the development of the lyriform organs in all the orders except Araneæ is in a very primitive state. In the degree of development perhaps the pedipalps stand next to the araneads for some of them have two compound organs on each leg, while Palpigradi and Ricinulei have these structures totally absent. It seems probable that at one time all kinds of lyriform organs were nothing more than minute slits irregularly scattered over all parts of the entire body as seen in some of the lower orders. Then when organs made their appearance the tiny slits on the dorsal side of the body disappeared as illustrated in the pedipalps. This is further exemplified with the araneads in which one never finds isolated slits on the dorsal side of the abdomen and none on the dorsal side of the cephalothorax except a few that still persist on the cephalothoracic shield. In some species among the araneads the single slits seem to be as numerous as ever, but in all cases they have become more or less regularly distributed. Where the single slits are as numerous as ever, then the compound and simple organs must be entirely new formations.

Among the lower orders the range is from a total absence of either isolated slits or organs for the entire animal to many single slits plus two compound organs for each leg. Among the araneæ the range is from 41 c. o., 12 s. o., 82 s. s. to 69 c. o., 2 s. o., 64 s. s. The total number of slits in all these organs plus the scattered ones of the latter aranead is probably twice that of the former. According to this the development of the lyriform organs in the latter is twice that of the former, while in the lower orders this ratio is doubled many times.

II. PHYSIOLOGY.

4. *Experiments.*

(*a*) *Olfactory Sense.*

Triangular experimental cases were constructed by using three pieces of glass, two of which were 10 cm. wide by 13 cm. long and the other 6 cm. wide by 10 cm. long. Cheese cloth served as a bottom. The glass and cheese cloth were held together with adhesive tape. A top of cardboard was laid over each case to prevent the escape of the specimen. Cases of the same dimensions except height were used for the attiids. These were only one centimetre high with a glass top. The extreme ends of the experimental cases rested on two supports which were placed on sawdust, the latter being used to break the jar caused by heavy walking. A screen was placed in front of the cases to prevent the spiders from seeing the observer.

On account of their size, abundance, and because their webs did not interfere with the experiments *Lycosa lepida*, *L. scutulata*, and *Phidippus purpuratus* were employed. However in one test *Pardosa lapidicina* Emert. was used. In all cases the spiders were brought immediately fresh from the fields, then and each day afterwards they were fed and watered. They were experimented with in series of fourteen in which each specimen was tested each day with five or six different odors for four or five days. The first experiments were made with the following five oils; clove, thyme, wintergreen, peppermint and bergamot, each of which was kept securely in a small vial. The spiders were left undisturbed in the cases over night. The next morning if they were perfectly quiet a vial of oil was placed directly beneath and within one centimetre of each individual. Time was counted in seconds. An intermission of forty-five minutes elapsed between any two tests of various odors. The following are the average results of the tests for four or five days with the above five oils.

Clove.—Most specimens moved away slowly; a few moved away quickly; some moved only slightly; several worked palps, chelicera and legs; one rubbed palps and two threw up front legs quickly. Time ranged from 3 to 90 sec. with an average of 27 sec. for *L. lepida*; for *Phidippus* from 3 to 32 sec. with an average of 13 sec. Forty-one specimens were used.

Thyme.—Almost one-half moved away slowly; the same number away quickly; the remainder either raised up quickly, threw up front legs, worked palps and chelicera or rubbed their legs together. Time for *L. lepida* 2 to 95 sec. with an average of 10 sec.; for *Phidippus* 2 to 15 sec. with an average of 4 sec. Forty-two specimens were used.

Wintergreen.—The majority moved away slowly; several away quickly; several arose quickly; a few worked palps, chelicera and legs; one lay down over the odor, and one rubbed legs together. Time for *L. lepida* 2 to 80 sec. with an average of 11 sec.; for *Phidippus* 3 to 15 sec. with an average of 7 sec. Forty-eight specimens were employed.

Peppermint.—All either moved away quickly or arose quickly and then moved away slowly; some of these after moving away worked palps, chelicera and legs; three threw up front legs; one lifted feet high; one rubbed legs and chelicera together. Time for *L. lepida* 2 to 13 sec. with an average of 6 sec.; for *Phidippus* 2 to 7 sec. with an average of 3 sec. Forty-eight individuals were used.

Bergamot.—The majority moved away slowly; the remainder either raised up quickly or moved away quickly; only a few worked palps, chelicera and legs. Time for *L. lepida* 3 to 45 sec. with an average of 14 sec.; for *Phidippus* 3 to 35 sec. with an average of 6 sec. Forty-one specimens were employed.

The total average of the results for the five oils is 13 seconds for *L. lepida* and for *Phidippus* it is 7 seconds.

Now, since it may be contended that the results obtained by using the above oils are due to an irritation of the skin rather than due to an olfactory sense, I also used the following which cannot be classed as irritants:

Buttercup (*Ranunculus sp.*).—Both the fresh and decayed flowers were employed, and there was practically no difference either in time or reactions. The general result was to move away slowly; sometimes a few worked palps and chelicera and one lay down over the odor. In this test only six specimens of *Pardosa* were used with the fresh flowers. Time 23 to 56 sec. with an average of 32 sec. The same number of specimens of *L. lepida* were employed with the decayed flowers. Time 3 to 120 sec. with an average of 36 sec. In this as in other cases 120 seconds was the limit of time without result.

Decayed Snail (*Littorina littorea*).—Most moved away slowly; only a few away quickly and only a few worked palps, chelicera and legs; one threw up front legs and one rubbed legs together. Time for *L. lepida* 7 to 120 sec. with an average of 61 sec.; for *Phidippus* 5 to 120 sec. with an average of 68 sec. Thirty-four specimens were used.

Squash Bug (*Anasa tristis*).—One-half moved away slowly, the other half either arose quickly and moved away slowly, or moved away quickly when the squash bug was held in the fingers beneath the spider; a few after moving away worked legs and palps; one lay down over the odor and one followed the odor when the bug was moved beneath the case. Squash bugs which were caused to exhaust all their secretion and had become odorless were placed in the cases with the spiders. In almost every case the spider within a few minutes seized and ate the bugs. When squash bugs with a strong odor were placed in the cases the spiders never came within reaching distance of them and usually remained away from the bugs and when the latter moved toward the spiders, the araneads gave them the right of way. Time for *L. lepida* 3 to 11 sec. with an average of 7 sec.; for *L. scutulata* 3 to 25 sec. with an average of 13 sec.; for *Phidippus* 3 to 6 sec. with an average of 4 sec. Twenty-one specimens were employed.

Phalangids. Most moved away slowly; the others moved away quickly, or moved only slightly; one threw up front legs and two turned around. The phalangids were held in the fingers beneath the cases. Only occasionally when phalangids were put into the cases did the araneads eat them. Time for *L. lepida* 3 to 25 sec. with an average of 8 sec.; for *L. scutulata* 5 to 55 sec. with an average of 19 sec. Thirteen individuals were used.

Thus the general average in time for the five oils was ten seconds, while for the four odors found in nature the time was thirty seconds. Hence, it is evident that spiders respond to other odors besides those from irritating oils, and that they have a true olfactory sense.

To experiment with araneads collected miscellaneously without regard to sex, age, time of moulting, whether parasitised or not, and conditions of the weather, one obtains all kinds of variations and complexities. Not enough males were used to ascertain positively their degree of sensitiveness to odors, but they seemed to respond slightly quicker than do the females. Perhaps this is due not to the higher development of their olfactory organs, but to their greater activity. Probably the same reason is sufficient to explain the quicker response to odors of *Phidippus* than of the *Lycosas*. Only a few experiments were conducted with spiderlings. In these few cases their actions were not essentially different from those of the adults. Females about ready to oviposite were generally very slow to respond and in a few cases were almost negative to odors. A few hours before and after moulting specimens were entirely negative to odors. On the first day a female of *Trochosa frondicola* (Emert.) responded rather slowly; on the fifth day she was almost negative; on the sixth day a large insect parasite was removed from her abdomen. After this she lived two months but never again responded readily to odors. Other individuals of her kind also responded very slowly. Ten individuals of *Ariadna bicolor* likewise responded very slowly; when not in their tubes their average time was 63 seconds for the five oils, and when in their tubes they rarely responded to any kind of odors. A female of *Dysdera interrita* which did not spin any kind of a nest responded still more slowly; the average time for the five oils was 70 seconds. Generally on damp or rainy days all specimens responded very slowly and since no definite conclusions could be derived by including such data, all results on these days have been eliminated. If the individuals were normal in every way they may be educated to respond to odors more quickly each successive day. In twenty-three specimens of *L. lepida* the time for the first day was 14 seconds, for the second day 12 seconds, thus making an increase of fourteen per cent.

(*b*) *Hearing.*

In order to determine whether spiders show any response to sounds which a person may hear any day in the same environs in which arachnids live, I placed five male crickets, two small and one large katydid beneath the experimental cases. The pitch of all the cricket chirps were very similar, but the notes of the small katydids were rather high, while those of the large katydid were pretty low. For over a week's time I watched the spiders every day very carefully, but not once did I ever notice a single spider show the least response. I observed very closely the first time the insects were brought into the laboratory, and in order to test them repeatedly the music makers were removed from the room, then were brought back after a short time, but in every case the result was a negative one. Also it was noticed that there was no response whatever whether the araneads were quiet, or moving when the chirping or singing began. If they were moving when the music began they did not cease, but continued to move as if nothing were happening. Eighteen individuals of *Lycosa* and *Phidippus* were employed.

Therefore if spiders have any auditory sense why do they not respond to the very sounds which a human being can hear at all times immediately in their neighborhood? If quiescence can be considered as a sign of hearing why did not these spiders stop moving when the crickets began to chirp or when the katydids began to sing? Furthermore large spiders can easily catch crickets and small katydids, but as yet there are no observations which show that the sense of hearing aids araneads in capturing their prey. One day I saw a *L. scutulata* and a small katydid on the same weed. The insect sang continuously, I watched the spider carefully for several minutes, however it did not show the least sign of hearing the katydid as far as I could observe.

(*c*) *Function of the Lyriform Organs.*

In order to ascertain whether the olfactory organs are localized in the palps or in the maxillæ, the former were first removed from eleven specimens of *Phidippus*. The operation was performed by seizing the coxa of the palps with a small pair of forceps, then by giving a quick jerk the appendage was detached, thus leaving only a very small opening through which a minute drop of blood emerged. To cut the appendages off caused the specimens to lose too much blood which in many cases was fatal. The maxillæ of the same eleven were removed in the same way the second day after the removal of the palps. These spiders were the only ones found which were able to endure a double operation of this kind, but after such an operation they did not hesitate to catch and eat flies as usual. The following table gives the results of the average time in seconds for the five oils before removal of palps, after removal of palps and after removal of palps and maxillæ both.

No. of specimen.	Before removal of palps (in seconds).	After removal of palps (in seconds).	After removal of palps and maxillæ (in seconds).
77	3	4	4
75	7	8	7
97	5	5	4
98	3	5	14
99	4	5	6
106	4	4	4
108	7	7	7
123	7	7	7
129	3	3	4
130	6	4	4
131	4	5	5
Average	5.0	5.2	6.0

Thus it is seen that before any operation the average time is five seconds, after removal of palps 5.2 seconds, with palps and maxillæ both removed it is 6 seconds. Therefore after considering the 14 per cent. increase of response on the second day, it is evident that the palps have but little to do with the olfactory sense. Moreover the maxillæ seem to play a slightly more important rôle but this may probably be due to the effect of the operation, because the spiders were slightly less active after the removal of the maxillæ.

Judging from the structure of the lyriform organs, we must conclude that they have some kind of a sensory function. Sight, touch, taste and hearing may be eliminated at once for the following reasons. The eyes serve for the sense of sight. Spiders are no more tactile near or directly on these organs than elsewhere. The taste organs would have to be associated with the mouth. Since it is evident that spiders cannot hear, then these organs could not have an auditory function. Now, there are left for consideration the humidity, olfactory and temperature senses. No experiments were performed to determine the humidity sense, but in my opinion spiders do not have such a sense.

In order to ascertain whether the lyriform organs have an olfactory sense fifteen large adult *Lycosa lepida*, fresh from the fields and all normal in every way, were selected for the varnishing operations. Here as in other cases each spider was fed and watered each day. These fifteen Lycosas were tested carefully with the five oils to see if they had the correct olfactory perception. Late in the afternoon all the lyriform organs (single slits not included) on the legs, palps, chelicera, mouth parts and sternum were carefully varnished with yellow commercial vaseline by placing a tiny daub of this substance on each organ. Great precaution was taken not to use too much vaseline and not to get any of it on the lung-books. Immediately after being varnished the spiders began to clean themselves and removed practically all the vaseline from the chelicera, mouth parts and tarsi of the legs and palps. After one day's time the remaining vaseline did not spread very much, but after four or five days it formed a thin coating over all the legs, cephalothorax and sometimes over the abdomen. When the vaseline covered the lung-books and tracheæ the spiders died in a short time. Most of these araneads, however, lived at least four or five days after such an operation, while some lived fifteen to twenty days, and a few survived almost the entire summer. In these latter the vaseline had all evaporated and the arachnids again responded normally to odors. After the operation the spiders took water and food in the normal way and then they were left undisturbed during the night. The next morning they were tested again with the five oils. The following table gives the average in seconds for the five oils before and after being varnished.

No. of specimen.	Before varnishing (in seconds).	Next morning after varnishing (in seconds).
♀ 37	4	57
♂ 46	3	54
♀ 51	9	77
♀ 52	6	51
♀ 61	5	78
♂ 75	3	82
♀ 81	11	64
♀ 90	4	32
♀ 93	4	39
♀ 94	8	97
♀ 96	6	33
♀ 116	8	50
♀ 117	15	74
♀ 118	8	82
♀ 119	6	41
Average	7.0	61.0

Hence, the above table shows that the average for all the spiders before varnishing was 7 seconds and after the operation 61 seconds, thus increasing the time nine times. The thin coating of vaseline on the lyriform organs affected No. 117 the least. It responded only five times slower. No. 75 was affected the most. Its time was increased twenty-seven times. Some of these specimens were tested the second, third and ninth day after being varnished. The result was a gradual decrease in time. At the fourteenth day the varnished spiders had almost returned to their normal state for detecting odors.

Now, since this yellow vaseline itself has a slight odor, three sets of controls were used to determine whether the vaseline odor interfered with the response to other odors. First, vaseline in little paper boxes was suspended in the cases and left over night. The cases were made as near air-tight as possible, so that the next morning the air inside the cases was thoroughly permeated with the vaseline odor. Tests with the oils were now prosecuted with the vaseline still suspended. Second, a lump of vaseline was placed on the floor of the cases. The spiders paid no attention to and ran over it as if it were a pebble. Third, a daub of vaseline was placed on the dorsal surface of the cephalothorax and abdomen where it could not interfere with any of the lyriform organs, and where the araneads could not rub it off. Thus it was ascertained that the vaseline odor did not interfere with the response to other odors, because the time in seconds for each test was exactly the same after as before using the control.

In view of the above facts we are safe in assuming that the lyriform organs function in some measure as olfactory sense organs.

(1) *The Temperature Sense.*—As Gaubert (1892) came to the conclusion that the lyriform organs are an apparatus to determine temperature and perhaps other general senses, a set of experiments was performed in order to test his statement.

A temperature case was constructed by making a glass case 40 cm. long, 5 cm. wide and 10 cm. high with a cheese cloth bottom. At one end placed at right angles was suspended a tin box 20 cm. long, 10 cm. wide by 3 cm. high, so that only 5 centimeters of one end of this box were under the glass case. At the other extreme end of the tin box was placed a small alcohol lamp to heat the water in this box. A piece of glass served as a cover for the box, the top of which was just one centimeter beneath the bottom of the temperature case. One thermometer was laid horizontally on the floor of the temperature case with the bulb over the water. A second thermometer was placed vertically in the other end of the temperature case as a control. Its reading always coincided with that of the normal temperature of the room. Both thermometers had previously been tested.

Ten specimens of *Lycosa lepida*, one at a time, were left in the temperature case for several hours until they came to perfect rest over the water in the tin box and near the bulb of the thermometer. Now the water was gradually and gently heated. Before varnishing the lyriform organs the spiders moved away from the heated region when the temperature on an average was raised 11.2° C. After varnishing the same specimens moved away when the temperature on an average was raised 12.75° C. Since more specimens of *Lycosa lepida* could not be found, ten *L. scutulata*, a very similar form, were used in the same way. Before being varnished they moved away from the heated end when the temperature on an average was raised 15.5° C.; after being varnished on an average of 14.2° C. In each test the time was approximately 15 minutes and each specimen was tested with odors after being varnished to see if the varnishing had been well done. Thus before being varnished twenty specimens of *Lycosa* left the heated end of the temperature case when the temperature was raised 13.3° C. and after being varnished they left that end when the temperature was raised 13.4° C. It hardly seems probable, therefore, that the lyriform organs are an apparatus to determine temperature as Gaubert thought.

In all the experiments of various kinds 173 individuals have been used. In conclusion the evidence favors the view that the lyriform organs function only as olfactory organs.

5. *Discussion.*

(*a*) *Function of the Lyriform Organs.*

Bertkau (1878) supposed that they have an auditory sense. Dahl (1883) thought that organ No. 13 on the metatarsus was an apparatus to help in the spinning; since the same organ is found in other members of the arachnid group which do not spin, this hypothesis is no longer admissible. Vogt and Yung (1894) suggest that these organs have a respiratory function. They made this statement based upon a supposed vessel placed below the organ as described by Dahl. Since this vessel never existed their suggestion can have no force. Schimkewitsch (1885) attributes an auditory rôle to them, and thinks that they play the same part as do the "chordotonales" of Graber which are found in adult insects and their larvæ. This function is not yet sufficiently demonstrated in insects. Wagner has the same opinion as Bertkau and Schimkewitsch, but since none of these preceding observers have performed any experiments to prove their views we need not further consider their hypotheses.

Gaubert concludes that the lyriform organs are an apparatus for perceiving heat and probably the sense of humidity and senses in general. He varnished (but does not say with what kind of varnish) the lyriform organs of several Lycosas carefully so that no more of the surface was covered than necessary and so that the varnish did not interfere with the articulations. These specimens and several which had not been varnished were placed in a large glass vessel. In one end of this vessel he placed a shelter or protection and, when the spiders had come to rest, the other end of the vessel was lowered into hot water. He says: "Quand la température commence à s'élever les Araignées n'ayant subi aucune préparation abandonnent leur retraite et se dirigent vers l'autre partie du bocal, celles qui ont les organes lyriformes vernis ne cherchent à fuir qu' *on moment* après, lorsque la température est plus élevée."

(*b*) *Olfactory Experiments.*

Robineau-Desvoidy (1842), according to Packard (1887), said that the olfactory sense of spiders is very well developed and localized in the mandibles.

Dahl (1884) found a very peculiar sense organ in the maxillæ of spiders. He called it an olfactory organ because he failed to find any olfactory structure near the breathing apparatus and because its location is not suitable for any other function. He performed no experiments to determine its office. According to my experiments it has probably not the slightest olfactory sense. He experimented on various species with turpentine and clove oils, but was not able to ascertain whether they have the power to distinguish differences in various oils. Each oil repelled the specimens in a like manner.

Dahl (1885) states that Bertkau does not agree with him in regard to the histology of his so-called olfactory organ.

The Peckhams (1887) experimented on various species with strong smelling oils and perfumes. Three species, *Epeira hortoum*, *Dolomedes tenebrosus* and *Herpyllus ecclesiasticus* did not respond to the test. Sometimes the legs were rubbed between the palps and falces. Various other movements also were exhibited similar to those I have described. Among spiders of the same species there was a great degree of difference in the sensitiveness to various odors.

McCook (1890) concludes from experiments and observations that spiders have little sense of smell, although they are in some way affected by certain odors. At first he entertained the opinion that the sense of smell in spiders, like that of hearing, abides entirely in the delicate hairs covering the creature. Later, judging from the experiments of the Peckhams, he states that their experiments would indicate that the olfactory organs are distributed more or less over the entire surface of the body, especially at the tips of the feet and at the apex of the abdomen. After the extirpation of the palps of two females, there was no apparent loss of sensitiveness.

Pritchett (1904) states that both kinds of odors, non-irritant and irritant, repel both males and females in the same degree. Individuals with either palps, or first pair of legs, or tarsi of all legs removed, responded normally when all the other appendages were intact. Also they responded in the same way when the sense hairs were removed from all the legs.

(*c*) *Sense of Hearing.*

Boys (1889) asserted that the garden spider responded readily to the vibrations of tuning forks, but since this is an orb-weaver the web certainly must have been irritated in some way to cause the so-called auditory reactions.

The Peckhams found that only web-makers responded to tuning forks, while those that make no webs gave not the slightest heed to sounds. They attempted to explain this phenomenon by the difference in the method of capturing food, but now it is pretty generally agreed that in all such experiments the vibrations from the tuning forks agitate the webs.

McCook cites several recorded cases where spiders are supposed to hear and in a few cases to really enjoy music, but he thought that such responses of the araneads could be explained in other ways than by imagining that they have an auditory perception. McCook concluded after many experiments with musical instruments, various sounds of the human voice and sonorous objects that if spiders have any sense of hearing, that sense is distributed, like the sense of smell, over the entire body and that it can scarcely be distinguished from the sense of touch.

Dahl (1883) called certain peculiar hairs on the three end joints of the legs auditory hairs. They are even so constant in arrangement that he attaches an important taxonomic significance to them. In order to prove the possibility that they have an auditory function he placed the foot of a dead dried spider under the microscope. Then he struck a deep tone on a violin and noticed a vibration of these hairs. From this evidence he claimed that spiders have an auditory sense, although with live araneads he could not always notice any reaction to tones. He stated that a nerve fibre runs out from the base of each of these hairs but presents no drawing of such. The next year Dahl described and presented a drawing of the nerve of a spider's leg which can be easily recognized by its long irregularly arranged nuclei. He said that from this nerve fibres run out to the individual auditory hairs, but even here he produces no drawing of such a connection. Judging from the similarity in structure of various kinds of hairs Wagner (1888) asserted that Dahl's so-called auditory hair could not have such a function.

Westring (1843) was the first to mention a stridulating organ in a theridiid, *Asagena phalerata*. Wood-Mason (1875) exhibited specimens of a gigantic theraphosid which he called *Mygale stridulans*. These produced loud stridulating sounds. Campbell (1881) observed these organs in three or four different species of theridiids. Peal (1895) noticed the stridulating phenomena of an Australian spider. Pocock (1895) discovered and gave drawings of a stridulating organ in the male of *Cambridgea antipodiana*, an agalenid. Since the organs were present only in the males he concluded that the sound emitted must be a sexual call. Spencer (1895) observed a theraphosid which was able to produce a stridulating sound. Montgomery (1909) stated also that the genus *Geotrecha*, a drassid, exhibits a good case of stridulation. In the theridiids and *Geotrecha* as yet the stridulation has never been heard by the human ear. It cannot be a sexual call for the sexes in *Geotrecha* show no responses whatever to the stridulation of each other and do not even stridulate during the mating. Even if the sound in the theraphosids and others is audible to the human ear, this need not imply that these araneads have auditory organs for it is much more probable that such sounds serve only as a warning to animals other than spiders. Therefore, when all the evidence concerning the sense of hearing is summarized, I am convinced that spiders have no such sense according to our present definition of that perception.

B. The Tactile Hairs.

Morphologically there are probably five or six different kinds of hairs on the various parts of the bodies in different species of araneads. Physiologically, as far as we know, they may be divided into the spinning hairs located on the spinnerets and the tactile hairs which include all others found elsewhere. The latter group includes the large movable spines, the so-called auditory hairs and the various types of tactile hairs.

While searching for the sense cells of the lyriform organs, I was successful also in finding the innervation of two kinds of tactile hairs and the muscles which move one of these. The ones without muscles I shall call fixed tactile hairs and those with muscles movable tactile hairs. In diameter the movable hairs are the second largest of all kinds of hairs and in length they are either as long but usually longer than any other type of hair; in *Theridium tepidariorum* they are abundantly distributed on the four distal joints of each leg, but rather sparingly on the other three joints of the legs and elsewhere, while on the femur most of them are located at the distal end arranged in two circular rows on the two lines of articulation. While these hairs are long, slender, more or less bent and can be moved only slightly, the movable spines are generally short, thick, straight and can be moved considerably. The former are certainly only a modification of the latter.

Fig. 7, from the trochanter of *Pholcus*, exhibits the complete innervation of the fixed tactile hairs. The socket (sk.) here, as in other cases where no muscles were observed, is like those of the movable hairs. The nerve (N.) is considerably torn, but still the parts are very distinct. A process of the neurilemma (neu.) encloses the nerve fiber (n. f.) which runs to the sense cell (s. c.) lying at the base of the hypodermis. After the neurilemma passes around this sense cell it can no longer be seen, but the delicate sensory fiber (s. f.) continues to the socket. The sense cell at the right is much smaller and the neurilemma seems to stop before it surrounds the cell. Fig. 6, from the distal end of the femur of *Th. tepidariorum* six or seven hours after moulting, shows the actual union of the sense cell (s. c.) with the base of the movable hair. Here the sensory fiber (s. f.) ends in the cavity of the hair very near the bottom. This sense cell is similar to those of the lyriform organs, but is more difficult to find. In this section only fragments of the two muscles (m.) were discernible, and the hypodermis (hyp.) is pulled away from the newly formed cuticula (cu.). Fig. 8, from the same section as fig. 6, is a better representation of the socket and muscles, but the sense cell was not present. Here the apparently smooth muscles are attached at one end to the bottom of the flask (fl.) of the socket and at the other end to the basement membrane (b. m.) of the hypodermis. The sensory fiber is very indistinct here. The cytoplasmic substance (cyt. s.) exhibited in the cavity of this hair was observed in another hair of the same individual. It has the same color as has the sensory fiber, but instead of its walls being smooth, they are corrugated. Thus this substance must be dead cytoplasm and not a continuation of the fiber into the cavity. In the cross sections of the smaller fixed tactile hairs the sockets were always similar to those drawn, but in only one case did I see the sense cell, and in no instance did I ever see any signs of the muscles.

One can easily illustrate that the largest hairs and particularly the spines on the legs of any spider are movable by gently touching them with a small object. Before being touched they form an angle of about twenty degrees with the leg; at the instant of being irritated they lie down almost flat on the leg, the spider either lifts its leg or moves away and in only a few seconds the hairs are raised again to their normal position. Perhaps the movable spines serve primarily as a protective purpose in guarding off enemies and various kinds of obstacles, while probably the movable tactile hairs are used primarily as tactile instruments which receive the impulses of gusts of wind and the heavy vibrations of the webs, and the various kinds of smaller tactile hairs with their nervous connections receive and transmit the more delicate tactile stimuli.

Dahl (1883) called the slenderest and probably the most delicate of the tactile hairs on the legs and palps auditory hairs, because they responded to the vibrations of a violin. Wagner (1888) described and gave drawings of four different kinds of hairs. His type called the "poil tactil fin" seems to correspond very closely to Dahl's auditory hair. Wagner showed that each type has a nerve fiber running out from its base. He said that the function of these different types cannot be recognized as identical and that no one of them can be regarded as an auditory organ. But if their function is not identical, the similarity of their fundamental parts as compared with each other and with Dahl's auditory hair causes one to conclude that they have an analogous function. Neither one of the above observers has seen the sense cells or muscles of any one type of these tactile hairs.

McCook (1890), in discussing the so-called auditory and tactile hairs, thought that all the various types should be regarded as tactile only and that perhaps each type has a particular tactile function to perform, but not an auditory one as Dahl thought.

Gaubert (1890) stated that the tactile hairs are moved by turgescence and that they possess no muscular fibers. In (1892) he asserted that the short curved spines of spiders are innately movable and serve as a strong defense by projecting outward when the aranead is seized. In discussing the blood pressure he stated that the joints are stretched by turgor, which also moves the tactile hairs.

Both Gaubert (1892) and Hansen (1893) have found tactile hairs in certain species of scorpions. The latter author described two kinds of sensitive hairs in various species of the pedipalps, and tactile hairs are found in all genera known to him in the pseudoscorpions. Hansen and Sörensen (1904), pp. 39 and 130) state that sensitive hairs are present in the phalangids and ricinulei.

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Explanation of Plates XXX–XXXIII.

All figures are from camera lucida drawings made at the base of the microscope.

Abbreviations.

ag. cyt.......aggregations of dense staining cytoplasm.
art............artery.
b..............border.
b. c...........blood corpuscles.
b. m..........basement membrane of hypodermis.
b. m. n....nuclei of basement membrane.
b. p..........blood plasm.
ca.............cavity of hair.
con. t........connective tissue.
con. t. n..connective tissue nuclei.
cu.............cuticula.
cyt. s........cytoplasmic substance.
di.............dilatation.
ex. m........extensor muscle.
fl..............flask of socket.
hyp...........hypodermis.
int. b........internal border.
l. o............lyriform organ.
m. b..........muscle bundle.
m. nuc.....muscle nuclei.
mov. h.....movable tactile hair.
N..............nerve of leg.
N. b..........nerve branch.
n. f............nerve fiber.
neu ....neurilemma.
n. neu......nuclei of neurilemma.

neu. n......neuroglia nuclei.
neu. w......neuroglia walls.
nuc. c.......nuclei of hypodermal cells.
o. m.........outer membrane of hypodermis.
r. m.........reflexor muscle.
sar............sarcolemma.
s. c............sense cell.
s. c. n.......sense cell nucleus.
s. f............sensory fiber.
sk..............socket.
sl...............slit.
s. s...........single slit.
t. h............fixed tactile hair.
v. sin........venous sinus.
1. l. a........first line of articulation.
2. l. a........second line of articulation.

Plate XXX.—Fig. 1.—Cross section of distal end of trochanter of *Agalena nævia* just moulted, showing the anatomy of the leg and the innervation of a large lyriform organ. The cuticula is only diagrammatic as taken from various species. The nerve is drawn at the location it holds when its branch penetrates the basement membrane of the hypodermis, although this branch begins to leave the nerve 220 microns in front of this place. The sense cells have their natural position, but they have been reconstructed from nine sections just in front of where the nerve branch enters the hypodermis. All other parts are taken from just one section in front of the organ. Leitz oc. 2 and obj. 7. × 290.

Fig. 2.—Diagram of a longitudinal-transverse section of the distal end of the femur of *Th. tepidariorum*, showing the anatomy of the leg and the innervation of the following: a lyriform organ, a fixed tactile hair, a movable tactile hair, and the two muscles of the latter hair. All the larger hairs are more or less movable, while the smaller ones are nonmovable.

Plate XXXI.—Fig. 3.—Two sense cells as they actually appear in a cross section of a trochanter of *Th. tepidariorum* six or seven hours after moulting. Zeiss comps. oc. 6 and oil imm. 12. × 960.

Fig. 4.—Diagram showing a single slit of a lyriform organ with its sense cell attached at the bottom of the dilatation.

Fig. 5.—Reconstruction from two consecutive sections of the trochanter of *Th. tepidariorum* six or seven hours after moulting, showing the innervation of a single slit. Zeiss comps. oc. 6 and oil imm. 12. × 960.

Fig. 6.—The innervation with fragments of two muscles of a movable tactile hair from the distal end of the femur of *Th. tepidariorum* six or seven hours after moulting. The hypodermis is pulled away from the cuticula. Leitz oc. 4 and obj. 7. × 720.

Fig. 7.—The innervation of two fixed tactile hairs on the trochanter of *Pholcus*. The nerve is considerably torn. Leitz oc. 2 and obj. 7. × 455.

Fig. 8.—Same as fig. 6, except a much smaller hair. Here the muscles are distinctly shown, but the sense cell is absent. Zeiss comps. oc. 6 and oil imm. 12. × 960.

Plate XXXII.—Fig. 9.—*a* ventral and *b* dorsal surface of the palp of a male *Troglohyphantes*, showing the single slits on the sixth joint. The bulb with its accessaries are omitted. Leitz oc. 2 and obj. 3. × 50.

Fig. 10.—Organ No. 13 on metatarsus of second leg of *Th. tepidariorum*.

Figs. 10–12 and 15–58. × 385. Zeiss comps. oc. 6 and Leitz obj. 7.

Fig. 11.—The extremely large organ on cheliceron of *Moggridgea*.

Fig. 12.—Organ on tibia of third leg of *Uroctea*.

Fig. 13.—Ventral view of *Th. tepidariorum*, showing disposition of lyriform organs. The legs are slightly too short and the last two pairs are turned over so that their dorsal surface is shown. The spider is enlarged about five, while the lyriform organs are enlarged about seven times.

Fig. 14.—Same as fig. 13, except here the dorsal view is shown and the last two pairs of legs are turned over so that they show their ventral surface.

Plate XXXIII.—Fig. 15.—Organ No. 3 from trochanter of fourth leg of *Th. tepidariorum*.

Fig. 16.—Simple organ No. 1 from coxa of first leg of *Th. tepidariorum*.
Fig. 17.—Organ No. 9 on patella of palp of *Th. tepidariorum*.
Fig. 18.—*b* organ No. 9 and *a* its associated slit on patella of second leg of *Th. tepidariorum*.
Fig. 19.—Simple organ on spinneret of *Epeira*.
Fig. 20.—Organs Nos. 14 and 15 on cheliceron of *Hyptiotes*.
Fig. 21.—Slits from labium of *Ariadna*.
Fig. 22.—Slits from female *Pholcus* near epigynum.
Fig. 23.—Organ No. 8 on patella of palp of *Th. tepidariorum*.
Fig. 24.—Organ No. 5 on femur of second leg of *Th. tepidariorum*.
Fig. 25.—Organ on fifth joint of palp of *Moggridgea*.
Fig. 26.—Organ No. 2 on trochanter of palp of *Th. tepidariorum*.
Fig. 27.—Organ No. 1 on coxa of palp of *Th. tepidariorum*.
Fig. 28.—Organs No. 16 and 17 on cheliceron of *Dictyna*.
Fig. 29.—Single slits with hairs on first joint of spinneret of *Evagrus*.
Fig. 30.—Organ No. 4 from trochanter of third leg of *Th. tepidariorum*.
Fig. 31.—Single slit marked *a* in figs. 13 and 14.
Fig. 32.—*a* is single slit marked *c* on legs; *b* is the slit marked *c* on ventral side of palp; *c* is slit called *d* on dorsal side of palp. See figs. 13 and 14.
Fig. 33.—Compound organ on spinneret of *Tama*.
Fig. 34.—*a* is slit called *e* on palp; *b* is slit marked *l* on palp; *c* is slit marked *f* on first leg. See figs. 13 and 14.
Fig. 35.—Organ No. 1 on coxa of third leg of *Moggridgea*.
Fig. 36.—Slits from pedicle of *Moggridgea*.
Fig. 37.—*a* is slit marked *m* on first leg; *b* is slits on same leg in figs. 13 and 14.
Fig. 38.—Organ No. 5 on femur of palp of *Th. tepidariorum*.
Fig. 39.—Slits marked *h* on maxilla in fig. 13.
Fig. 40.—Transverse organ on fifth joint of palp of *Moggridgea*.
Fig. 41.—Organ No. 18 on pedicle of *Th. tepidariorum*.
Fig. 42.—Slits marked *i* on sternum in fig. 13.
Fig. 43.—Two organs in front of epigynum of *Calculus*.
Fig. 44.—*a* is slit marked *j* near epigynum; *b* is slits *k* on spinneret in fig. 13.
Fig. 45.—Organ No. 12 on tibia of second leg of *Th. tepidariorum*.
Fig. 46.—Slits from cephalothoracic shield of *Ariadna*.
Fig. 47.—Organ with two isolated slits in front of epigynum of *Dysdera*.
Fig. 48.—Organ on fifth joint of palp of *Moggridgea*.
Fig. 49.—Organ on tarsus of second leg of *Hypochilus*.
Fig. 50.—Slits marked *g* on cheliceron of fig. 13.
Fig. 51.—*a* and *b* organs 14 and 15, respectively, on cheliceron of *Th. tepidariorum*.
Fig. 52.—Organ No. 2 from trochanter of first leg of *Th. tepidariorum*.
Fig. 53.—Organ No. 2 from trochanter of second leg of *Th. tepidariorum*.
Fig. 54.—Slits near epigynum of *Moggridgea*.
Fig. 55.—*a* and *c* organ No. 16 and its associated slit; *b* No. 17 on cheliceron of *Th. tepidariorum*.
Fig. 56.—Organ on fifth joint of palp of *Moggridgea*.
Fig. 57.—*a* and *b* organs Nos. 10 and 11, respectively, from tibia of second leg of *Th. tepidariorum*.
Fig. 58.—*a* organ No. 7 and *b* No. 8 on patella of third leg of *Th. tepidariorum*.

SOME FISHES FROM VENEZUELA.

BY HENRY W. FOWLER.

Mr. Frank E. Bond having, during the past winter, organized an expedition to collect objects of natural history in the region of the Orinoco delta, secured the fishes here reported. The collection, though small, is important, as it contains several interesting forms apparently new. The Academy is indebted to Mr. Bond for the gift of the specimens to the museum.

CHARACIDÆ.

TETRAGONOPTERINÆ.

Phenacogaster bondi sp. nov. Fig. 1.

Head $3\frac{3}{5}$; depth 2; D. iii, 9, I; A. iii, 33, I; P. i, 12; V. i, 6; scales in l. l. 31 + 2; 8 scales above l. l.; 8 scales below l. l.; 14 predorsal scales; head width $2\frac{1}{10}$ its length; snout 4; eye $2\frac{4}{5}$; maxillary $2\frac{4}{5}$;

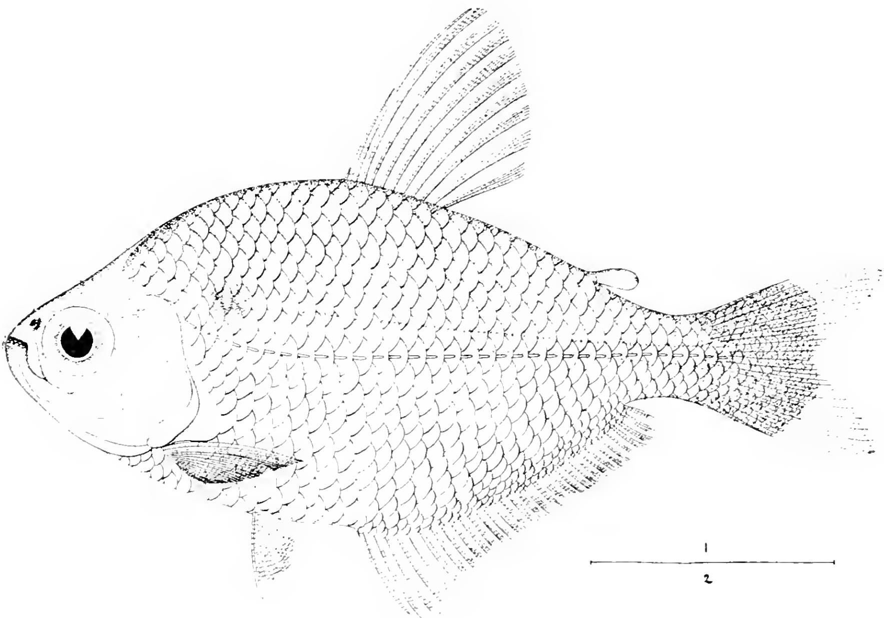

Fig. 1.—*Phenacogaster bondi* Fowler. Type.

mandible $2\frac{2}{5}$; interorbital $2\frac{1}{4}$; first branched anal ray $1\frac{3}{4}$; least depth of caudal peduncle $2\frac{1}{3}$; pectoral $1\frac{2}{5}$; ventral (tip damaged) $2\frac{1}{8}$.

Body deep, strongly compressed, contour slightly ovoid with greatest depth at dorsal origin, profiles generally similar, predorsal and postventral slightly trenchant and all other edges rounded convexly. Caudal peduncle well compressed, length about $\frac{4}{5}$ its least depth.

Head rather small, well compressed, upper profile at first slightly convex and then equally concave, lower profile a little convex, and flattened sides slightly constricted below. Snout convex over surface, obtuse, length about half its base. Eye rounded, but little elevated and near first $\frac{3}{8}$ in head. Maxillary exposed, except under edge which slips below narrow preorbital, nearly vertical, toothless, extends back a little beyond front eye margin, but not quite opposite pupil. Mouth broadly transverse, rather small, commissure as seen laterally slight and a little inclined. Lips rather thin. Teeth only in jaws, upper biserial and lower entirely uniserial, and most all or at least anterior ones with a strong median cusp and 2 smaller ones each side. Upper teeth of about uniform size, all at least tricuspid and smaller than mandibular teeth. Mandible about even with snout tip when closed, scarcely projects, surface convex and rami but little elevated. Tongue depressed, upper surface flattened, free in front, tip rounded. Nostrils close together, close before eye above, similar, and anterior with slight posterior cutaneous flap exposing posterior in slight crescent. Interorbital evenly convex. Postero-infraorbital width 2 in eye, and postorbital a little narrower. Suborbitals not entirely covering cheek or extending to preopercle ridge, leaving a rather wide strip of skin. Preopercle ridge inclined a little forward, and at lower corner 3 diverging flutings. Opercle narrow, width about $2\frac{3}{4}$ its depth. Occipital fontanel broad. Head bones all smooth.

Gill-opening forward about opposite or trifle before front pupil edge, though not to front eye edge. Rakers about 9 + 9, slender, weak, pointed, compressed, about 2 in filaments. Latter about 2 in eye. No pseudobranchiæ. Isthmus compressed, constricted in front, surface convex. Branchiostegals 4, compressed, rather large.

Scales large, each well exposed, in longitudinal series parallel with l. l., each with 2 or 3 radiating striæ, size uniform except smaller ones apparently distributed entirely over caudal, though at present most of them removed. Anal base covered with small scales like those on caudal. Other fins naked. Apparently no scaly axillary pectoral or ventral flaps. L. l. complete, a trifle decurved at first from shoulder, then straight to median caudal base. Tubes in l. l. simple, each well exposed and not extending back to exposed scale edge.

Dorsal origin a little nearer snout tip than caudal base, first branched ray longest, though tip of third depressed branched ray reaches well behind tip of last, and fin $1\frac{2}{3}$ to caudal base, or a little longer than head. Adipose fin inserted a little nearer caudal base than last dorsal ray base, fin base slender and end a little expanded, reaches 2 to caudal base. Anal base long, origin of fin about opposite second branched dorsal ray base, first branched ray longest with others graduated down about first half in fin length, after which rays uniformly lower. Caudal emarginate (damaged), apparently about long as head? Pectoral inserted low, extends well beyond ventral origin. Latter midway between pectoral and anal origins, fin about $\frac{7}{8}$ to anal. Vent close before anal.

Color when fresh in rum ecru-brownish generally, paler to whitish with bright silvery on sides below. Head pale brownish above, sides and below burnished brilliant silvery-white. Iris deep umber, with rather reddish tinge. Lips brownish. A grayish humeral spot about size of pupil. No caudal spot. From humeral spot to median caudal base an underlaid leaden streak, very narrow and well defined behind, overlaid silvery. Upper edge of body dusted with dull or pale brownish. Dorsals, caudal and anal dull olivaceous-brown, and other fins paler.

Length $1\frac{1}{2}$ inches (caudal tips damaged).

Type No. 37,863, A. N. S. P. Corisal, Venezuela. February 27th, 1911. F. E. Bond and Stewardson Brown.

Nos. 37,864 to 37,866, paratypes, same data. Head $3\frac{1}{4}$ to $3\frac{1}{2}$; depth 2; D. iii, 9, I; A, iii, 29, I to iii, 32, I; scales in l. l. 30 to 32 + 2 or 3; scales above l. l. 8 or 9; scales below l. l. 9 or 10; predorsal scales 14 or 15; snout 4 to $4\frac{1}{4}$ in head; eye $2\frac{1}{10}$ to $2\frac{1}{2}$; maxillary $2\frac{2}{5}$ to $2\frac{3}{4}$; interorbital $2\frac{3}{5}$ to $2\frac{4}{5}$; length $1\frac{3}{8}$ to $1\frac{1}{2}$ inches (caudal tips damaged).

Though the scales are not entirely distributed over the caudal fin at present, they were evidently so when the examples were fresh, and for this reason I have restored them on the accompaning figure. *P. bondi* differs from all the known species in its deeper body, which suggests *Tetragonopterus*. *P. pectinatus* (Cope) has the anal beginning before the dorsal origin, which may be seen on comparing my figure, wrongly called *Astyanax longior*.[1] The species I have figured as *A. pectinatus*[2] is *A. longior* (Cope). *P. megalostictus* Eigenmann and

[1] *Proc. Acad. Nat. Sci. Phila.*, 1906, p. 342, fig. 30.
[2] *L. c.*, p. 341, fig. 29.

P. microstictus Eigenmann both differ in the slender body, coloration, etc., when compared with *P. bondi*. *P. bairdii* (Steindachner) has the anal radii 40 to 42.

(Named for Mr. Frank E. Bond.)

APODASTYANAX gen. nov.

Type *Apodastyanax stewardsoni* sp. nov.

Body elongated moderately, well compressed. Head moderate. Mouth small. Teeth only in jaws, upper biserial and lower uniserial. Maxillary small, reaches front eye edge, toothless. Rakers thin, slender. Scales moderately small, cycloid, and only on base of caudal, remainder of fin and other fins naked. L. l. complete, median along side. Dorsal inserted about midway in body. Anal with long base, inserted about opposite dorsal origin. Adipose fin present. Caudal emarginate. Pectoral low, moderate. No ventral fins. Coloration brownish, silvered. A grayish shoulder spot and a dusky basal caudal spot. Size small.

This genus seems to be well separated from almost all the others in the absence of ventral fins, of which there is no trace whatever.

(*A*, without; πούς, foot; ἀστυάναξ, *Astyanax*; with reference to the absence of the ventral fins.)

Apodastyanax stewardsoni sp. nov. Fig. 2.

Head $3\frac{3}{4}$; depth $2\frac{1}{4}$; D. iii, 9; A. iii, 39, i; P. i, 12; scales in l. l. about 42 + 3 ? (squamation injured); 12 scales above l. l.; 13 scales below l. l.; 21 predorsal scales; head width $2\frac{1}{3}$ its length; mandible about $2\frac{4}{5}$; dorsal base $1\frac{4}{5}$; first branched anal ray about 2; least depth of caudal peduncle $2\frac{1}{4}$; pectoral $1\frac{1}{6}$; snout 5 in head measured from upper jaw tip; eye $2\frac{1}{2}$; maxillary $3\frac{1}{8}$; interorbital $2\frac{3}{4}$.

Body strongly compressed, deepest before middle or about first $\frac{2}{5}$ in total length at dorsal and anal origins, predorsal region with slightly constricted or trenchant edge due to median keel, other edges rounded convexly, and general contour ovoid. Caudal peduncle well compressed, length about $\frac{4}{5}$ its least depth.

Head moderate, compressed, lower profile slightly more inclined, flattened sides a little constricted below. Snout short, surface convex, obtuse as viewed from above, length about half its basal width. Eye large, circular, a little elevated, about first $\frac{3}{7}$ in head. Mouth small, transverse, with strong jaws. Maxillary small, vertical, along front edge of eye below, and not extending below lower edge of latter, its greatest expansion about 4 in pupil. Lips thin. Teeth only in front of each jaw, none on maxillary. Upper jaw teeth 9 in outer series, tricuspid, smaller than in inner series, and with median cusp enlarged. Inner upper teeth quadricuspid, each tooth having 2 small inner cusps and an enlarged cusp next to small external cusp. Mandibular teeth similar to last, large, uniserial, and 10 in number. No other teeth in mouth. Tongue depressed or flattened, rounded

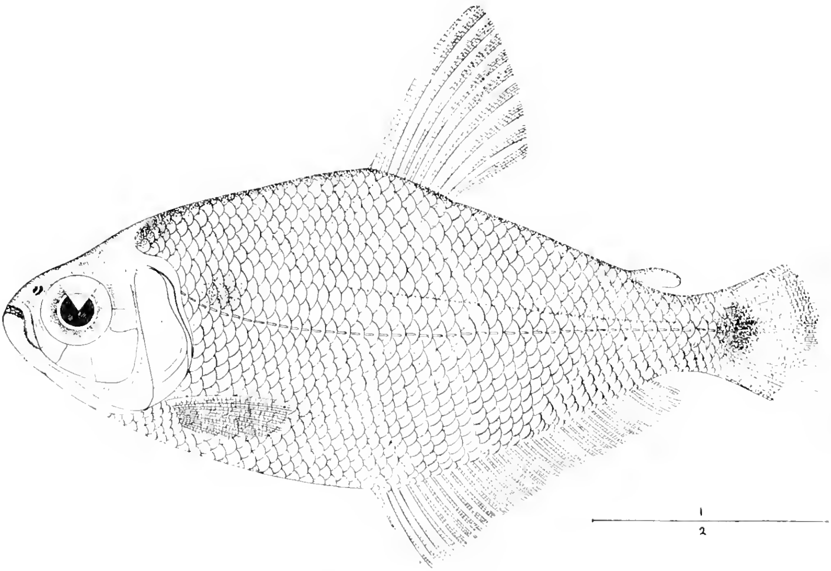

Fig. 2.—*Apodastyanax stewardsoni* Fowler. Type.

or free in front. Mandible small, strong, well protruded before snout tip, rather short. Nostrils together, close before eye above. Interorbital slightly convex. Postero-infraorbital broad, width about $\frac{3}{4}$ of eye. Other suborbitals all narrower. Preopercle ridge slightly inclined forward, its hind edge vertical. Opercle width $1\frac{1}{2}$ in eye.

Gill-opening forward about opposite front eye edge. Rakers $9 + 14$, small, thin, slender, $2\frac{1}{2}$ in eye. Filaments 2 in eye. Pseudobranchiæ not evident. Isthmus narrowly constricted in front. Branchiostegals about 6, well compressed and rather broad.

Scales cycloid, all well exposed in longitudinal series parallel with l. l., not extending on fins except few on caudal base. No axillary pectoral scaly flap. L. l. complete, a little decurved at first, then straight and midway along side of body to caudal base medianly. Tubes in l. l. simple, each extending well over exposure of scale, though not quite reaching its hind exposed edge.

Dorsal origin inserted about midway between snout tip and caudal base, first branched ray largest (now a little damaged terminally), and apparently a little longer than head, depressed back slightly more than half way to caudal base. Adipose fin inserted trifle after last third in space between last dorsal ray base and caudal base, fin slender, about $1\frac{3}{5}$ to caudal base. Caudal (damaged) evidently emarginate. Anal inserted nearly opposite dorsal origin, anterior or first branched ray longest, base of fin long and all other rays low. Pectoral inserted low, rather long, upper rays longest, pointed, and falling little short of anal origin. Vent close before anal.

Color when fresh in rum pale brownish, nearly ecru, sides and below silvered whitish. Scales along edge of back and above dusted rather inconspicuously with dull dusky. A leaden streak from shoulder to caudal base, where it resolves in an ill-defined dusky spot a little larger than pupil, but not so large as eye. Another spot at shoulder, where leaden streak begins, a little smaller than caudal spot, and paler or leaden in color. Dorsal and caudal pale olivaceous-ecru, and anal similar though still paler. Pectoral very pale or whitish. Iris deep brown, tinged reddish. Head pale brown above, sides and below burnished bright silvery-white. Lips pale brownish. Peritoneum showing through abdominal walls as whitish.

Length $1\frac{3}{4}$ inches (caudal tips damaged).

Type No. 37,867, A. N. S. P. Corisal, Venezuela. February 27th, 1911. F. E. Bond and Stewardson Brown.

Only the above, a small example, taken in a pail from a small stream, along with the types of *Phenacogaster bondi*. It is now in rather poor preservation.

(Named for Mr. Stewardson Brown.)

SERRASALMINÆ.

Pygocentrus stigmaterythræus sp. nov. Fig. 3.

Head $2\frac{3}{4}$; depth $1\frac{5}{6}$; D. ii, 15, I; A. iii, 27, I; P. i, 15; V. i, 6; scales in l. l. according to tubes 80 + 9; scales above l. l. along its course 102 + 12; 40 scales above l. l. to dorsal origin; 48 scales below l. l. to ventral origin; 38 scales below l. l. to anal origin; predorsal scales about 57; head width about $1\frac{4}{5}$ its length; head depth at occiput about $1\frac{1}{10}$; mandible $2\frac{1}{3}$; first branched dorsal ray (tip damaged now) about $1\frac{3}{5}$?; third simple anal ray $2\frac{1}{4}$; least depth of caudal peduncle $3\frac{1}{2}$; upper caudal lobe (tip damaged) about $1\frac{2}{5}$?; lower caudal lobe (tip slightly damaged) about $1\frac{1}{4}$; pectoral $1\frac{1}{2}$; ventral $2\frac{1}{2}$; snout $3\frac{3}{4}$ in head measured from upper jaw tip; eye $4\frac{1}{5}$; maxillary $2\frac{1}{2}$; interorbital $2\frac{1}{4}$.

Body deep, well compressed, robust, contour slightly ovoid with greatest depth at dorsal origin, predorsal edge slightly trenchant, also postdorsal, abdominal edge trenchant with 19 + 9 serræ, of which postventral larger, and other body edges all convexly rounded. Caudal peduncle well compressed, its least depth about equal to its length.

Head heavy, robust, compressed moderately, upper profile more

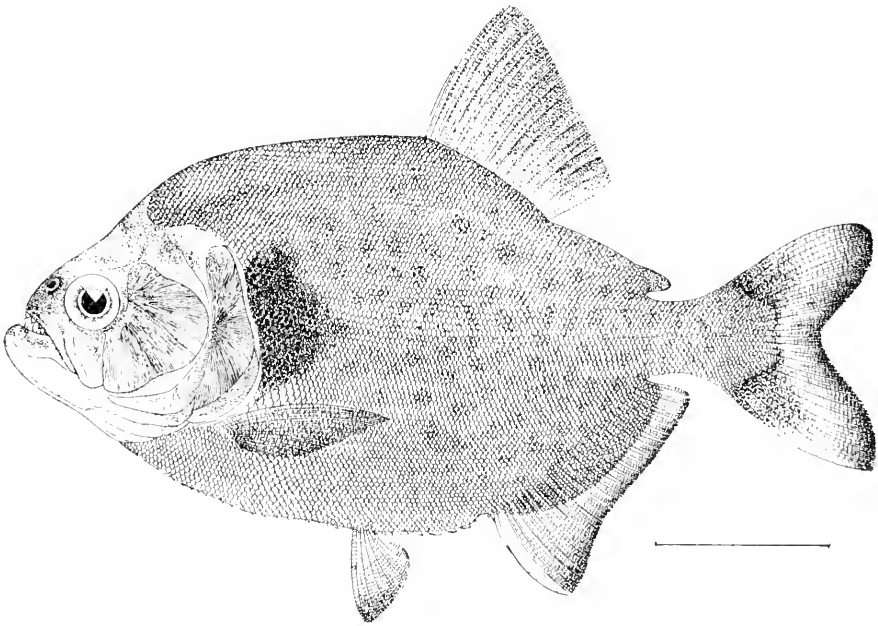

Fig. 3.—*Pygocentrus stigmaterythraeus* Fowler. Type.

inclined, first convex and then slightly concave. Lower head profile a little convex and flattened sides scarcely constricted below. Snout surface convex, abruptly declivous in front and length about $\frac{2}{5}$ basal width. Eye circular, lower edge falling about level with middle in greatest head depth at occiput, and about first $\frac{2}{7}$ in head measured from snout to hind edge of opercle. Mouth broadly transverse, a little oblique and with strong, powerful jaws. Maxillary small, well inclined, rather small, its upper hind end entirely concealed by broad infraorbital, though it would reach about opposite middle of eye. Lips well developed, mandibular a little thicker. Teeth only in jaws, well compressed, uniserial, all with tips slightly recurved, triangular, and most or at least median ones with a small and often obsolete basal cusp each side. Mandibular teeth much larger than those in upper jaw, all sharply pointed and with entire edges. Buccal fold inside each row of teeth large and fleshy. Tongue broad, depressed, fleshy, rounded and free in front. Mandible large, strong and protruding well beyond snout, surface broadly convex below, and rami but little elevated in mouth, though much deeper at articulation behind than at symphysis. Nostrils large, together, anterior large pore with broad cutaneous flap behind exposing posterior in crescent. Interorbital broadly and evenly convex. Infraorbital width about equals eye, with narrow anterior preorbital moiety. Postero-infraorbital width about equals $1\frac{1}{2}$ eye-diameters, though not extending below to preopercle ridge, leaving an elongated unevenly triangular naked region on cheek below, greatest width of which area about $2\frac{3}{4}$ in eye. Postorbital large, nearly equal to greatest width oı postero-infraorbital. Opercle vertical, narrow, greatest width about $3\frac{1}{2}$ its depth or but trifle less than eye. All suborbitals and opercle with conspicuous or well-marked radiating striæ, also some coarser and uneven striæ in lower hind flange of preopercle. Lower and exposed surfaces of subopercle, interopercle and branchiostegals also show a few feeble striæ. Cutaneous margin of gill-opening narrow. Upper surface of head covered with smooth skin and a long, narrow median occipital fontanel. Shoulder-girdle little exposed, smooth.

Gill-opening forward about opposite hind eye edge. Rakers 8 + 12, conic, with rather slender tips, fleshy, pliable, uppermost and lowermost somewhat rudimentary, longest 2 in eye. Filaments $1\frac{1}{3}$ in eye. No pseudobranchiæ. Gill-membranes form broad fold over isthmus, latter broad and surface slightly convex. Branchiostegals 4, broad, all well exposed.

Scales small, cycloid, mostly disposed in longitudinal series parallel with l. l. and becoming a little enlarged just after gill-opening, along abdominal serræ and behind pectoral base. Caudal base broadly covered with scales but little smaller than those on caudal peduncle. Anal base also broadly scaly, only outer scales much smaller. A concealed depressed sagittate spine before dorsal origin with apex directed towards head. Small broad-based double spine before anal origin. No axillary scaly flaps to paired fins. L. l. complete, begins a little high at first, slopes down soon till opposite median axis and then runs straight to caudal base, and also extends over squamation of latter. Tubes rather small, simple, well exposed, but not extending entirely over exposures of scales. Scales not completely passing over predorsal ridge, but leave a narrow naked strip.

Dorsal origin falls about midway in vertical between eye center and caudal base, first branched ray (tip slightly damaged) evidently longest, and not quite depressed posteriorly far as tip of last ray, fin $1\frac{3}{4}$ to caudal base. Adipose fin inserted about midway between last dorsal ray base and caudal base, fin about 2 to latter. Caudal broad, emarginated behind, lower lobe much larger and stronger, all rays rather osseous. Anal inserted opposite seventh dorsal ray base, rudimentary rays and also first branched, all rather enlarged, osseous and conspicuous, third simple longest with others graduated down about first half of fin, after which all of about uniform height. Pectoral inserted low, pointed, about $1\frac{4}{5}$ to anal, or tip at least a little beyond ventral origin in vertical. Ventral inserted a little before dorsal or about midway in vertical between pectoral and anal origins, reaches about $1\frac{1}{3}$ to anal. Vent close before anal, but without abdominal serræ extending along sides. Last abdominal serrature (counted one above) a series of 3 small transverse spines in front of vent.

Color when fresh in rum with back brilliant steel-blue, more or less dusky and brownish in some lights. Upper surface of head dusky-brown, becoming paler on sides and ruddy-vermilion on lower surface. Lips dusky like top of head. Iris deep brown, tinged with deep reddish. Teeth shining white. Abdomen brilliant vermilion, fading rosy and paler above and behind. Flanks grayish-brown with iridescent bluish of more or less paler tints than back, and all this region down to base of anal with inconspicuous deeper ill-defined spots, all of which much more clearly where scales have fallen. These obscure spots all small, mostly rounded, and apparently larger than pupil. A broad jet-black blotch of large size, about equal in extent to entire postero-suborbital area, at beginning of l. l. just after gill-opening. Dorsal deep dusky, also caudal largely similar, with rather broad submarginal diffuse brownish or paler area concurrent with much narrower blackish edge along hind emargination. Adipose fin dusky or blackish. Anal largely vermilion, scaly base reddish-brown, and lower edge narrowly dusky. Pectoral and ventral brilliant vermilion, latter with slight dusky tinge distally. Peritoneum whitish.

Length 5 inches.

Type No. 37,868, A. N. S. P. La Pedrita, on the Cano Uracoa, Venezuela. February 16th, 1911. F. E. Bond and Stewardson Brown.

Also No. 37,869, A. N. S. P., paratype, with same data. Head $2\frac{3}{4}$; depth $1\frac{9}{10}$; D. ii, 16, I; A. iii, 27, I; scales in l. l. according to tubes 77 + 7; scales in lateral series counted along course of l. l. above 103 + 12; 40 scales above l. l. to dorsal origin; 40 scales below l. l. to anal origin; about 40 scales below l. l. to ventral origin; about 59 predorsal scales; snout $3\frac{5}{6}$ in head measured from upper jaw tip; eye $4\frac{1}{5}$; maxillary $2\frac{1}{3}$; interorbital $2\frac{2}{5}$. Abdominal serræ 14 + 8. This example otherwise agrees in most all respects. Length about 4 inches.

Although this species agrees very well with the diagnosis of *Serrasalmo* (*Pygocentrus*) *notatus* Lütken,[3] the latter is too insufficiently described for positive identification. Lütken's examples were 9 inches long, and thus the smaller eye he gives as 3 in the interorbital and 6 in the head, may be due to age? Lütken also says the head is 3 in the body, without caudal. The only feature of coloration he mentions is the black shoulder spot. My examples show the eye half the interorbital width.

(*Στίγμα*, brand, with reference to the large black post-scapular blotch; *ἐρυθραῖος*, reddish, referring to the abdomen.)

Serrasalmus coccogenis sp. nov. Fig. 4.

Head $3\frac{1}{4}$; depth $1\frac{2}{3}$; D. ii, 14, I; A. iii, 29, I; P. i, 14; V. i, 6; scales in l. l. according to tubes 64 + 6; scales counted above l. l. along its course 87 + 8; 33 scales above l. l. to dorsal origin; 34 scales below l. l. to anal origin; 30 scales below l. l. to ventral origin; 49 predorsal scales; head width about $1\frac{7}{8}$ its length; head depth at occiput about 1; mandible $2\frac{2}{3}$; first branched dorsal ray $1\frac{3}{4}$; third simple anal ray $2\frac{1}{5}$; least depth caudal peduncle 3; upper caudal lobe (tip slightly damaged) about $1\frac{1}{5}$; lower caudal lobe $1\frac{1}{10}$; pectoral $1\frac{3}{5}$; ventral $2\frac{3}{5}$; snout 4 in head measured from upper jaw tip; eye $3\frac{1}{5}$; maxillary 3; interorbital $2\frac{2}{5}$.

Body deep, strongly compressed, contour slightly ovoid with greatest depth at dorsal origin, predorsal edge a little trenchant, postdorsal with only very slight median keel, abdominal edge trenchant with 23 + 10 serræ, and other body edges rounded convexly. Caudal peduncle well compressed, length $\frac{1}{5}$ its least depth.

Head heavy, compressed, profiles similarly inclined, upper slightly convex and then equally concave, lower slightly convex. Flattened head sides scarcely constricted below. Snout surface convex, obtuse in front, and its length about half its basal width. Eye circular, but slightly elevated above middle in head depth and about first $\frac{4}{11}$ in head length between snout tip and hind edge of gill-opening. Mouth broadly transverse, a little inclined, and with strong jaws. Maxillary well inclined, rather small, its upper posterior end entirely concealed by broad infraorbital, though it reaches about opposite front pupil

[3] *Vidensk. Meddel. For. Kjöbenh.*, 1874, p. 238 (240).

edge. Lips rather thin, mandibular little better developed. Teeth only in jaws, well compressed, uniserial, all with tips slightly inclined inward, each tooth triangular with broad base and slight cusp each side, these becoming obsolete only on posterior teeth. Cutting-edges of teeth mostly with at least obsolete or feeble minute serræ, usually better developed towards basal cusps when present. Mandibular teeth considerably larger than upper ones. Buccal fold inside mouth along each row of teeth, large and fleshy. Tongue depressed, surface

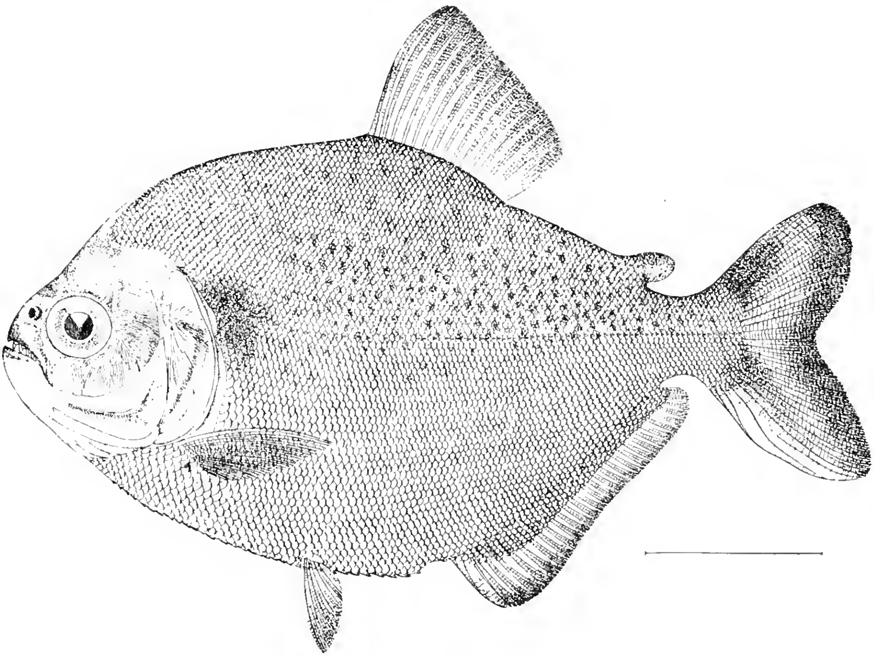

Fig. 4.—*Serrasalmus coccogenis* Fowler. Type.

level, rather pointed, and free in front with rounded tip. Mandible well protruding, moderate, strong, surface rather well convex below, and rami little elevated in mouth, though much deeper at posterior articulation than at symphysis. Nostrils large, together, both as simple large pores with broad cutaneous flap of anterior exposing posterior in crescent. Interorbital broadly and evenly convex. Infraorbital width $1\frac{3}{4}$ in eye, with narrow preorbital anterior projection. Postero-infraorbital width about $1\frac{2}{5}$ in eye, though not extending below to preopercle ridge, leaving an elongated and somewhat crescentic naked region on cheek below, greatest width of latter about

$2\frac{4}{5}$ in eye. Postorbital large, about as wide as postero-infraorbital. Opercle narrow, inclined slightly forward, its width about $3\frac{3}{4}$ its depth. Suborbitals, opercle, small marginal area of supraorbital, lower limb of preopercle, exposed portions of shoulder-girdle, subopercle, interopercle and lower or exposed portions of branchiostegals with radiating striæ. On suborbitals and opercle striæ quite numerous and fine, on lower limb of preopercle coarse and irregular, and quite feeble on subopercle, interopercle and branchiostegals. Upper head surface covered with smooth skin, and median occipital fontanel moderate.

Gill-opening forward about opposite front pupil edge. Rakers vi $2 + 7$, compressed, rather weak, flexible, pointed, about 3 in filaments. Latter $1\frac{1}{3}$ in eye. No pseudobranchiæ. Gill-membranes form rather broad free fold over isthmus, latter well constricted in front and broad behind, its surface slightly convex. Branchiostegals 4, well compressed, upper rather long, and all rather broad.

Scales small, cycloid, mostly disposed in series parallel with l. l.; and becoming a little enlarged just after gill-opening and pectoral base. Caudal base broadly covered with scales like those on caudal peduncle. Anal base broadly scaly, and scales but little smaller than those on trunk above. A concealed sagittate-shaped spine before dorsal origin, apex directed towards occiput. Small broad-based double spine before anal origin. No axillary scaly flaps to paired fins. L. l. complete, begins a little high at first, then slopes from shoulder down to about opposite median axis, when straight to caudal, also extending out on squamous area of latter. Tubes simple, rather small, well exposed and not quite reaching across scale exposures. Narrow median naked strip along predorsal edge, over which scales do not pass and extending from occiput to dorsal.

Dorsal origin trifle nearer caudal base than mandible tip, first branched ray longest, falling well short of tip of last when depressed, fin $1\frac{4}{5}$ to caudal base. Adipose fin inserted about midway between eleventh dorsal ray base and caudal base, fin about 2 to latter. Caudal broad, emarginated behind, lower lobe much larger and stronger, all rays rather osseous. Anal inserted about opposite ninth dorsal ray base, rudimentary rays well compressed, osseous and enlarged, third longest, first branched ray strong and longest in fin, others graduated down about first third in fin, after which all of about uniform length. Pectoral inserted low, moderate, upper rays longest, reaches opposite ventral origin in vertical. Ventral inserted a little before dorsal or about midway between pectoral and anal origins in vertical, fin $1\frac{4}{7}$ to anal origin. Vent close before anal, but abdominal serræ not along sides. Last abdominal serrature (counted as one above) a series of 3 small transverse spines before vent.

Color when fresh in rum with back bright or shining metallic-bluish in some lights, ground-color grayish-brown, and many obscure underlaid and rather crowded small pale dusky spots, these all much less than pupil, mostly only prominent above l. l. and scarcely evident below. Midway between dorsal origin and l. l. spots a little larger and more sparsely distributed than others. At shoulder above, just behind upper portion of exposed shoulder-girdle bones at beginning of l. l., a blackish blotch nearly equal to eye in extent, and of rather irregular triangular shape. Side of body below l. l. with general pale or whitish shade, but along its upper regions quite soiled with dull brownish, made up of minute dots. Head dull brownish above, sides tinged dull rosy, upper sides with olivaceous reflections, and under surface brilliant vermilion about branchiostegals and lower preopercle limb. From latter point all lower surface of head tinged or blushed rosy. Opercle ruddy, with smutty tints. Lips dusky. Iris deep and warm brownish. Chest, breast, axillary region of pectoral, and all region about abdominal serræ brilliant or blushed vermilion. Serræ on abdomen pale or whitish, like teeth. Dorsals and caudal dusky largely. Rayed dorsal somewhat tinged with olivaceous, and adipose fin rather brownish. Caudal margin behind blackish, also base, and intervening region brownish. Inside mouth and gill-opening pale. Anal ruddy vermilion basally, margin dusky-black. Pectoral and ventral brownish, ruddy basally.

Length $4\frac{7}{8}$ inches.

Type No. 37,870, A. N. S. P. La Pedrita, on the Cano Uracoa, Venezuela. February 16th, 1911. F. E. Bond and Stewardson Brown.

Head 3 to $3\frac{2}{7}$; depth $1\frac{3}{5}$ to $1\frac{3}{4}$; D. usually ii, 14, I, often ii, 15, I, rarely ii, 13, I; A. usually iii, 30, I, often iii, 29, I, rarely iii, 28, I; scales in l. l. according to tubes 58 to 69 + 5 to 7; scales counted in lateral series above l. l. 78 to 80 + 7 or 8; predorsal scales 47 to 53; scales above l. l. to dorsal origin 30 to 35; scales below l. l. to ventral origin 25 to 30; scales below l. l. to anal origin 30 to 35; abdominal serræ usually 21, sometimes 22, rarely 14 + 9; snout $3\frac{3}{4}$ to $4\frac{1}{2}$ in head measured from upper jaw tip; eye $2\frac{7}{8}$ to $3\frac{1}{2}$; maxillary $2\frac{7}{8}$ to 3; interorbital $2\frac{1}{3}$ to $2\frac{3}{4}$; length $2\frac{5}{8}$ to $4\frac{1}{4}$ inches. These examples all agree largely with the type, except that the two smallest show posteriorly on each palatine a small tooth. In color they also differ somewhat in having the dark spots of the back quite large, rather sparse and conspicuous, even below the l. l. and to the caudal base. They also have less ruddy on the under surface of the body. Nos. 37,871 to 37,875, A. N. S. P., paratypes, with same data as type.

The true generic position of this species would appear somewhat doubtful, if the diagnosis of *Pygopristis* Müller and Troschel is allowed on its most important character, and that the absence of palatine teeth. None of my large examples have any palatine teeth, and in the 2 small ones there is only a single simple small conic cusp on each palatine bone, except in one instance where 2. Thus *P. serrulatus* Valenciennes[4] may be found identical, though that writer does not mention any dark blotches on the side of the body, and yet he does say there are some traces of the dark shoulder-spot.

Serrasalmus caribe Valenciennes[5] differs in the D. 20, A. 27, and no scapular spot is mentioned or represented on the figure. It may also be noted that *Serrasalmo albus* Humboldt and Valenciennes[6] is evidently an older name for *S. caribe*, and should therefore replace it. *Serrasalmus rhombeus* (Linnæus) differs according to Müller and Troschel's figure[7] in having more palatine teeth.

S. marginatus (Valenciennes) differs in the lower anal edge being black only, but not the hind caudal edge. Both *S. spilopleura* (Kner) and *S. gymnogenys* (Günther) are said to have 95 scales. *S. elongatus* (Kner) differs in its elongated contour, the depth $2\frac{2}{3}$. *S. gibbus* Castelnau apparently has no spots whatever on the trunk. *S. brandtii* (Lütken) has the scales 90, and the coloration is largely uniform or with minute blackish dots.

Among the species I have examined, *S. humeralis* Valenciennes, *S. maculatus* Kner, *S. æsopus* Cope, *S. iridopsis* Cope and *S. unimaculatus* Cope, all were found to have more palatine teeth in each series, besides various other characters.

S. paraënsis (Steindachner) I have not seen, and also have not been able to consult its original description.

(*Κόκκος*, berry-red; *γένειον*, cheek; with reference to the ruddy cheek.)

GASTEROPELECINÆ.

Chalcinus elongatus Günther.

Head 4 to $4\frac{2}{5}$; depth $3\frac{1}{3}$ to $3\frac{4}{7}$; D. ii, 9, i; A. iii, 25, i to iii, 28, i; scales in l. l. 38 to 40 + 4 or 5; 7 scales above l. l.; 3 scales below l. l.

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[4] *Hist. Nat. Poiss.*, XXII, 1849, p. 224.
[5] *L. c.*, p. 208.
[6] *Obs. z. Comp.*, II, 1835, p. 173, Pl. 47, fig. 1. Orinoco R.
[7] *Hor. Ich.*, I, 1845, Pl. 2, fig. 4.

to anal origin; 1 scale below l. l. to ventral origin; 21 to 23 predorsal scales; snout $3\frac{3}{5}$ to 4 in head measured from upper jaw tip; eye $3\frac{1}{8}$ to $3\frac{2}{5}$; maxillary $2\frac{3}{4}$ to 3; interorbital 3 to $3\frac{1}{8}$; gill-rakers 12 to 14 + 24 to 28. Snout obtuse, surface convex, length about $\frac{3}{4}$ its basal width. Adipose eyelid moderate, pupil vertical, ellipsoid. Maxillary vertical, to front eye edge. Lips rather thin. Usually, though sometimes absent, a pair of inner symphyseal mandibular small conic teeth. Each maxillary with 2 small teeth. Mandible slightly protruding. Interorbital well convex. Suborbital length about equals postocular. Gill-opening extends forward about opposite eye front. On thorax median series of scales largest. Pointed free axillary pectoral and ventral scaly flaps well developed. Color when fresh in rum largely bright silvery-white, back and upper surface with brilliant blue-green shade and largely brownish to dusky ground-color. Head brownish above, silvery-white on sides. Iris deep reddish-dusky. Lips brownish. Fins mostly olivaceous-dusky, lower pectoral rays, ventral and anal paler. Length $6\frac{1}{2}$ inches. La Pedrita, on the Cano Uracoa. February 16th, 1911. Five examples.

This species is undoubtedly related to the specimen I have identified with *Chalcinus brachipomus* Valenciennes, from Guiana.[8] It agrees in the enlarged median lateral series of thoracic scales, and moderate adipose eyelid. From Castelnau's figure of *Chalcinus auritus* Valenciennes, it appears that species is also related, but it would differ in the hind caudal edge being convex. Possibly the enlarged median series of thoracic scales may be a character of subgeneric value, and for this group of species, the subgenus *Chalcinus* Valenciennes, type *C. brachipomus* Valenciennes, may be restricted. For the others the subgenus *Triportheus* Cope, type *T. flavus* Cope, may be used. It is, however, not possible to locate the other species satisfactorily, as they have been little studied and mostly imperfectly described. *C. albus* (Cope) and *C. magdalenæ* Steindachner, however, seem allied with Triportheus (*C. angulatus* group).

ERYTHRININÆ.

Hoplias malabaricus (Bloch).

Three from Pedernales on January 27th.

SILURIDÆ.

AUCHENIPTERINÆ.

Pseudauchenipterus guppyi Regan.

Two specimens from Pedernales taken January 26th, and both

[8] *Proc. Acad. Nat. Sci. Phila.*, 1906, p. 449, fig. 43.

agree with Regan's description.[9] Surely, his figure on Plate 23 is also identical, though the legend reads *Pseudauchenipterus pasca*, while on Plate 24 it reads as the present species, and thus the latter is truly *P. pasca*.

Pseudauchenipterus nigrolineatus sp. nov. Fig. 5.

Head $3\frac{3}{4}$; depth $3\frac{3}{4}$; D. i, 6; A. iii, 18; P. i, 6; V. i, 7; head width $1\frac{1}{10}$ its length; head depth at occiput $1\frac{1}{5}$; snout $3\frac{2}{5}$; eye $5\frac{3}{4}$; maxillary $3\frac{2}{5}$; mouth width $2\frac{2}{5}$; interorbital $1\frac{1}{6}$; antero-internasal $3\frac{2}{5}$; pectoral $1\frac{1}{10}$; ventral $1\frac{7}{8}$; third simple anal ray $1\frac{7}{8}$; least depth caudal peduncle $2\frac{2}{5}$.

Body compressed, anteriorly robust, deepest at dorsal origin, and edges all convex. Caudal peduncle well compressed, least depth about $1\frac{2}{5}$ its length.

Head robust, upper profile nearly straight from snout tip to dorsal origin and little more inclined than lower profile, slightly convex sides a little converging above and very broad below, with under surface convex. Snout broadly depressed, its length about $1\frac{3}{4}$ its greatest width. Eye ellipsoid, inclined a little posteriorly, about midway in depth of head near first third head length, as seen in profile. Adipose eyelid well developed, completely covering eye. Mouth small, broadly transverse, commissure short. Band of villiform teeth in each jaw, moderately broad, and these dental areas simple. No other teeth in mouth. Tongue broad, fleshy, thick, not free, depressed. Maxillary barbel slender, reaches about $\frac{3}{5}$ in depressed pectoral spine. Four equally spaced mental barbels, outer reaches about middle in depressed pectoral spine and inner about first tenth. Internasal spaces about equally spaced, and space between front and hind nostril about 2 in internasal. Interorbital broad, depressed, and with very slight concave transverse area anteriorly. Frontal region with bones greatly perforate or honeycombed, and median fontanel opening broadly in front. Occipital and lateral contiguous bones, also predorsal plate, all finely rugose-striate. Opercle broadly triangular, and like all skin on side of head and snout, smooth. Antero-supraorbital process swollen.

Gill-opening extends froward last $\frac{2}{8}$ in head. Rakers 8 + 14, short, firm, mostly well bifurcated, about $2\frac{1}{2}$ in filaments. Latter about equal eye. No pseudobranchiae. Branchiostegals 4, slender, rather long.

Body covered with smooth skin. Head rugose on portions men-

[9] *Proc. Zool. Soc. London*, Jan.–April, 1906, p. 387.

tioned, also large part of dorsal spine basally, hind projection of shoulder-girdle and pectoral spine slightly basally. Shoulder-girdle anteriorly, and above articulation of pectoral spine, swollen, its surface smooth. L. l. median, rather tortuous in its course, and with numerous small bifurcations, complete.

Dorsal origin trifle behind last third in space between snout tip and caudal base, spine long, nearly straight, much longer than head or equals space between snout tip and hind edge of posterior projection

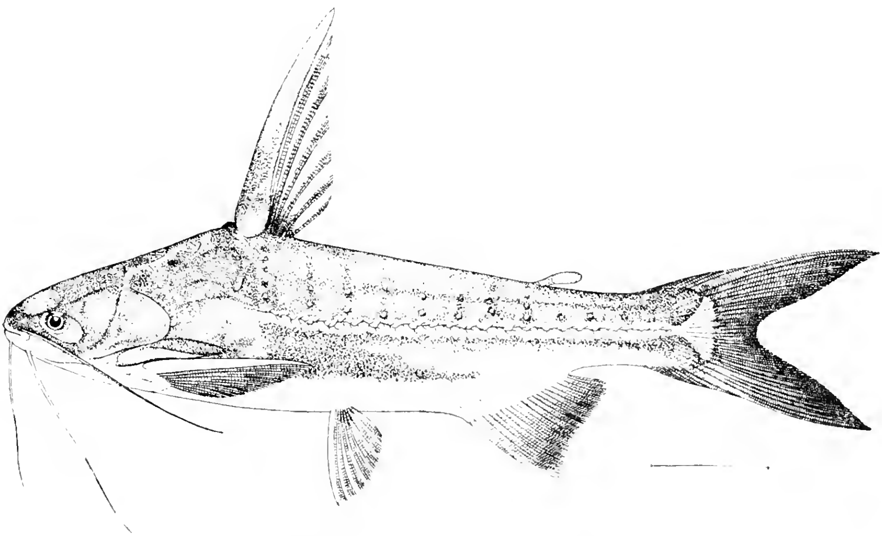

Fig. 5.—*Pseudauchenipterus nigrolineatus* Fowler. Type.

of shoulder-girdle, greatly swollen at each side basally, and its hind surface with numerous antrorse serræ. Dorsal radii slender, first but little shorter than spine and others rapidly graduated down. Adipose fin inserted about last third in space between dorsal origin and caudal base, fin 3 to latter. Anal inserted about midway between base of first dorsal ray and caudal base, third simple ray longest, rays evenly graduated down with edge of fin entire. Caudal well forked, a little longer than head, lobes slender, pointed, equal. Pectoral depressed about $\frac{7}{8}$ to ventral, with spine longest, then first ray but little shorter and others rapidly graduated down. Pectoral spine with inner margin evenly and finely serrated antrorsely. Ventral inserted about midway between hind end of posterior projection of shoulder-girdle and anal origin, fin about $\frac{4}{5}$ to latter. Vent close before anal.

Color when fresh in rum largely deep slaty-dusky or blackish, below whitish. A pale or whitish streak along l. l. to middle of caudal base bifurcating on caudal base to form a semi-ocellus at base of each caudal lobe. Posteriorly on caudal base this whitish bifurcation still margined dusky or blackish. Head and casque above mostly tinted olivaceous-dusky. Along each side of back, from below base of rayed dorsal about a dozen transverse series of very small white round spots, and in each series many as 4 or 5 sometimes, but only lower 2 of each at all distinct or conspicuous. Iris brownish. Lips whitish. Barbels whitish basally, otherwise grayish, though maxillary a little more brownish. Dorsal whitish, basally blackish, spine pale, and rays distally dusky. Adipose fin whitish. Caudal largely dusky to blackish, rays a little paler than membranes. Anal whitish, anterior longer rays medianly slightly dusky. Pectoral largely whitish, grayish above. Ventral whitish.

Length $7\frac{1}{2}$ inches.

Type No. 37,876, A. N. S. P. Pedernales, Venezuela. January 26th, 1911. F. E. Bond and Stewardson Brown.

Head $3\frac{2}{3}$ to 4; depth 4 to 5; D. i, 5; A. iii, 16 to iii, 18; snout $3\frac{2}{5}$ to $3\frac{1}{2}$ in head; eye $3\frac{2}{3}$ to $4\frac{1}{4}$; mouth width $2\frac{1}{3}$; interorbital $1\frac{3}{4}$ to 2; length $7\frac{7}{8}$ to $8\frac{3}{4}$ inches. The dorsal and pectoral spines are quite variable and all much shorter than in the type. Nos. 37,877 and 37,878, A. N. S. P., paratypes, same date as type.

This species is related to *P. guppyi* Regan, but differs in the complete dark lateral band longitudinally below the l. l.

(*Niger*, black; *linea*, line; with reference to the complete black infero-lateral band.)

LORICARIIDÆ.

Plecostomus verres (Valenciennes).

Two from Pedernales on January 27th.

CALLICHTHYIDÆ.

Hoplosternum littorale (Hancock).

One adult from La Pedrita, on the Cano Uracoa, on February 16th.

Hoplosternum thoracatum (Valenciennes).

One small example with the last.

PŒCILIIDÆ.

Anableps microlepis Müller and Troschel.

Three from Pedernales on January 25th.

CICHLIDÆ.

Astronotus ocellatus (Agassiz).

One from La Pedrita, on the Cano Uracoa, on February 12th. Color when fresh nearly uniform blackish, with bright orange circle a little less than orbit in size, a little above middle of caudal base.

TETRODONTIDÆ.

Colomesus psittacus (Schneider).

Three from Tucapeta, on the Rio Manimo, on February 22d.

One adult from Pedernales on January 27th.

BATRACHOIDIDÆ.

Batrachoides surinamensis (Schneider).

One from Pedernales on January 27th.

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A NEW ECPHORA OF THE CHESAPEAKE MIOCENE.

BY HENRY A. PILSBRY.

Ecphora parvicostata n. sp. Fig. 1.

The shell is shaped like the more globose forms of *Ecphora quadricostata* (Say); the umbilicus moderate, rapidly contracting inward, not so ample as in *E. q. umbilicata* (Wagner). The last whorl has four very low, narrow spiral ribs; the surface above the upper rib slopes upward to the suture, immediately below which it is a little swollen. The spiral ribs are stronger on the spire, where two are

Fig. 1.—*Ecphora parvicostata*, natural size.

exposed, the suture revolving on the third. Between the ribs there are irregular growth-wrinkles, but no spiral striæ.

Length 82, diam. 70 mm. (apical whorls wanting).

Three specimens of this form were found in a tray together with *Ecphora quadricostata umbilicata* (Wagner) and *E. tricostata* Martin, in the Museum of the Academy, labelled "*Ecphora quadricostata*, Maryland." The former of these occurs in various beds of the Choptank formation, the latter in the underlying Calvert formation, so that no more definite locality and horizon can be given than Chesapeake Miocene.

While all of the Ecphoras are variable shells, yet in the large series in the collection of the Academy this species seems detached from those hitherto defined[1] by the extreme weakness of the ribs in the adult stage and the sloping shoulder. The types of *E. parvicostata* are No. 1,514, A. N. S. P., collector unknown.

[1] See *Maryland Geological Survey, Miocene*, pp. 207–211. 1904.

SOME ARACHNIDA FROM NORTH CAROLINA.

BY NATHAN BANKS.

The material upon which this article is based was collected by Prof. J. H. Emerton, Mr. William Beutenmüller, and the writer, mostly in the mountainous, western part of the State. Prof. Emerton, during a collecting trip in the South in 1903, stopped at a number of localities in North Carolina. His itinerary was about as follows:

Durham, 8 and 9 July; Chapel Hill, 10 July; Salisbury, 12 July; Morganton, 12 July; Pineola, 14 July; Road to Roan Mt., 15 July; Roan Mt. Summit, 15 to 18 July; Linville, 19 July; Blowing Rock, 19 July; Paint Rock, 20 July; Asheville, 23 July; Balsam, 24 July; and Black Mt., Aug. 1 to 3.

Mr. Beutenmüller collected for several seasons in the valley of the Black Mountains for the American Museum of Natural History. The spiders were sent to me for identification. The writer spent the last two weeks of May, 1910, in the same valley visited by Mr. Beutenmüller. This valley is on the north fork of the Swannanoa River, about five miles from Black Mountain Station. The altitude is about 2,500 or 2,600 feet; and most of the collecting was done below 3,000 feet. Some specimens were taken on the summit of Mt. Graybeard, a neighboring peak, 5,548 feet high.

The spider fauna of these western mountains is similar in many respects to that found in New York and New England. Some few species, such as *Hypochilus* and *Nemastoma*, indicate the remnants of a fauna once connected with that of the Northwestern United States and China, or Mongolia. Why these few forms, so long resident in these mountain valleys, have failed to spread, will, doubtless, long be a puzzling question. There is apparently nothing in their habits to justify such a restricted habitat.

HYPOCHILIDÆ.

Hypochilus thorelli Marx.

Paint Rock; Balsam; Swannanoa Valley, up Sugar Fork, hanging under rocks near stream.

SCYTODIDÆ.

Scytodes thoracica Latr.

Durham.

PHOLCIDÆ.

Pholcus phalangoides Fuessl.

Chapel Hill, Salisbury.

DYSDERIDÆ.

Ariadne bicolor Htz.

Paint Rock.

DRASSIDÆ.

Sergiolus variegatus Htz.

Black Mts. (Beutenmüller).

Sergiolus cyaneoventris Simon.

From Southern Pines (Manee).

Zelotes atra Htz.

Roan Mt. Summit, Swannanoa Valley.

Zelotes depressa Emer. Pl. XXXIV, fig. 1.

Swannanoa Valley.

Zelotes frigida Banks.

Swannanoa Valley.

Callilepis femoralis n. sp. Pl. XXXV, fig. 11.

Cephalothorax pale red-brown, margin darker; mandibles red-brown; sternum and coxæ pale yellowish-brown; abdomen deep black; legs pale, but femora and tibiæ I and II black, and densely black-haired. Eyes about as in *C. imbecilla*, the rows very short, and the S. E. perhaps a little larger than in *C. imbecilla;* sternum a little longer than broad; abdomen truncate at base, depressed; legs long and slender, the metatarsi and tarsi longer than usual in the genus; tibia I and II with three pairs of spines below, the last apical, two pairs below these metatarsi, tarsus I only a little shorter than metatarsus I.

Length 10 mm.

From Mt. Graybeard, N. Car., 23 May, 1910. Differs from *C. imbecilla* in longer legs, and darker femora and tibiæ I and II.

Callilepis imbecilla Keys.

Balsam, Swannanoa Valley, among dead leaves.

Drassus robustus Emer.

Swannanoa Valley, among leaves.

CLUBIONIDÆ.

Clubiona abbotti Koch.

Balsam, Mt. Graybeard, Swannanoa Valley, in dead leaves of Rhododendron.

Clubiona crassipalpis Keys.

Swannanoa Valley, in curled Rhododendron leaves.

Clubiona pallens Htz.

Swannanoa Valley, one female.

Clubiona canadensis Emer.

Linville.

Chiraoanthium inclusum Htz.

Chapel Hill.

Trachelas tranquilla Htz.

Swannanoa Valley, one female.

Castianeira pinnata Emer.

Blowing Rock, one female.

Phrurolithus alarius Htz.

Swannanoa Valley, common under stones; this is *P. palustris* Bks.

Phrurolithus sp.

One female from Balsam; this is the form that Emerton figured as female of *P. alarius;* he will describe it as new.

Phrurolithus formica Banks.

Swannanoa Valley, under stones; I have seen this species from Missouri.

Gayenna pectorosa Koch.

Mt. Graybeard, Swannanoa Valley, in dead leaves.

Gayenna saltabunda Htz.

Durham.

Micaria agilis Bks.

Chapel Hill, road to Roan Mt., Pineola.

Scotinella n. gen.

Clubionid, maxillæ rather short, inclined over the lip, lip broader than long, eyes similar to *Liocranum*, posterior eye-row straight, the P. M. E. slightly elliptical, dorsal groove present; spinnerets short; legs slender, without spines, except two on anterior femora, and a double series of long ones beneath tibiæ and metatarsi I and II, no spines on hind legs; claws long, not much curved, with small teeth near base. Differs from *Scotina*, *Liocrannum*, *Agræca*, and *Apostenus* in absence of spines on the hind legs.

Scotinella pallida n. sp. Pl. XXXIV, fig. 7.

Cephalothorax uniform yellowish, sternum and legs paler; abdomen whitish; all clothed with short hairs, dense on abdomen, sparse on cephalothorax. Cephalothorax a little longer than broad, broad in front, groove distinct; eyes as figured, mandibles moderately stout, each with a prominent erect bristle on middle of front; abdomen truncate at base, rather slender, sternum nearly as long as broad, broadest behind coxæ II, somewhat 7-sided, rounded at tip. Legs slender, with short hairs, spines only as follows: two long, erect ones on middle of femur I, a double row of six each under tibia I, a double row under metatarsus I, 4 on inner side, 3 on outer side; beneath tibia II, 5 pairs, and under metatarsus II, 3 pairs, none of these are apical, and all very long.

Last joint of palpus densely clothed with short spine-like bristles.

Length 2.3 mm.

From Black Mt., north fork of the Swannanoa River, May, under dead leaves in forest.

AGELENIDÆ.

Agelena nævia Htz.

Morganton, Linville, Murphy, Blowing Rock, Pineola, Durham, Black Mt., Swannanoa Valley, not common.

Tegenaria derhami Scop.

Roan Mt. Summit, Salisbury, Paint Rock, Swannanoa Valley.

Cybæus giganteus Bks.

Balsam, Black Mts. (Beutenmüller).

Coras medicinalis Htz.

Balsam.

Cœlotes oalcarata Keys.

Mt. Graybeard, one female, male and female from Swannanoa Valley, Black Mts., Sept. (Beutenmüller).

Cicurina arcuata Keys.

Balsam, Swannanoa Valley.

Cicurina brevis Emer.

Roan Mt. Summit, Black Mts., Sept. (Beutenmüller).

Hahnia agilis Keys.

Roan Mt., Chapel Hill, Swannanoa Valley.

DICTYNIDÆ.

Dictyna foliacea Htz.

Pineola, Mt. Graybeard, Swannanoa Valley, common.

Dictyna sublata Htz.

Morganton, Durham.

Dictyna armata n. sp. Pl. XXXIV, fig. 9.

Male; cephalothorax reddish-brown, rather paler on the head, with white hairs; abdomen reddish-brown through the middle of dorsum, blackish on base and sides, the posterior dorsum often broken up by blackish bands, sometimes dorsum mostly all dark, with a pair of pale spots in front, one on each side before middle, and a row of pale spots behind in middle; legs very pale; venter and sternum pale. Female, cephalothorax pale yellowish through the middle, sides brownish, almost black on lower sides of head; abdomen pale yellowish, a faint dark spear-mark on base, two rows of brown spots behind, and the sides with dark marks; venter and sternum wholly pale, unmarked; legs very pale, and very slender, the abdomen rather short, broad, and flat. The male palpus has a very long tibial spur, which is faintly bifid at tip, and bears two bristles.

Length ♂ 1.5 mm.; ♀ 1.4 mm.

From north fork Swannanoa River, Black Mountain, N. Car.; the webs were found in dead, curled Rhododendron leaves lying on the ground.

Amaurobius bennetti Blackw.

Roan Mt. Summit, Blowing Rock.

THERIDIIDÆ.

Theridium tepidariorum Koch.

Paint Rock, Linville, Pineola, Chapel Hill, Swannanoa Valley.

Theridium rupicola Emer.

Paint Rock, Swannanoa Valley, quite common under stones.

Theridium punctosparsum Emer.

Balsam, Swannanoa Valley, beating Rhododendron leaves.

Theridium spirale Emer.

Swannanoa Valley, only one taken, sweeping.

Theridium differens Emer.

Durham, Road to Roan Mt., Balsam, Swannanoa Valley.

Theridium atramontanum n. sp. Pl. XXXV, fig. 12.

Cephalothorax yellowish, with a brown median stripe from eyes to tip, sometimes broken up near eyes. Legs yellowish (♂), in ♀ whitish with the femora I yellowish near tip. Abdomen grayish-white, reticulate above, with a basal, median brown mark, one on each lower anterior side, and two rows of three or four dark spots on the posterior middle of the dorsum, sometimes these dark marks outline a pale median stripe; venter and sternum pale unmarked.

Of the general structure and shape of *T. differens*, the male abdomen rather low, the female Epeira-shaped. Legs long and slender.

Length ♀, 2 to 2.5 mm.; ♂, 2 to 2.3 mm., femora I (♂), 2 mm.; tibia plus patella, 2.1 mm.; metatarsus, 1.9 mm.

From north fork Swannanoa River, Black Mountain, N. Car.; usually found under the leaves of the lowland Rhododendrons.

Theridium murarium Emer.

Linville, Durham.

Theridium blandum Htz.

Blowing Rock, Swannanoa Valley; sweeping.

Theridium frondeum Htz.

Road to Roan Mt., Pineola, Blowing Rock, Swannanoa Valley.

Theridium globosum Htz.

Swannanoa Valley, one.

Theridula sphærula Htz.

Morganton, Durham, Murphy, Blowing Rock, Pineola, Swannanoa Valley.

Euryopis funebris Htz.

Black Mts. (Beutenmüller).

Dipœna nigra Emer.

Swannanoa Valley, sweeping.

Pedanostethus riparius Keys.

Road to Roan Mt.

Steatoda borealis Htz.

Linville, Murphy, Pineola.

Enoplognatha marmorata Htz.

Pineola, Roan Mt. Summit, Swannanoa Valley, under stones.

Teutana triangulosa Walck.

Chapel Hill.

Crustulina guttata Reuss.

Swannanoa Valley, among dead fallen leaves.

Asagena americana Emer.

Linville, one.

Lathrodectes mactans Fabr.

Morganton, Swannanoa Valley, Black Mts. (Beutenmüller).

Epesinus amœnus n. sp. Pl. XXXV, figs. 13, 15.

Cephalothorax pale, with a broad dark stripe over head and back to near the tip, a more or less distinct dark streak near or on the sides, eyes surrounded by black. Dorsum of abdomen grayish or blackish as far back as the humps, the sides and hind margin of this dark is edged with white; behind paler, but darker again toward tip; venter blackish on the sides, pale in the middle; sternum dark, with a pale median streak. Legs pale, broadly marked with brown, or reddish-brown; femur I mostly brown, others near tip; patellæ mostly dark; tibiæ brown at each end, broader at tip, and hardly distinct on legs II and III; metatarsi narrowly marked with brown at base and tip; and the tips of the tarsi usually darker. The cephalothorax is broad and rounded, the head distinctly elevated, the eyes as usual, but the hind row is scarcely recurved; the abdomen is flat, truncate at base, widened to the humps at the posterior third, and then tapers to tip.

Length 3 mm.

From north fork Swannanoa River, Black Mountain, N. Car., May; obtained by beating Rhododendron bushes.

Spintharus flavidus Htz.

Paint Rock.

Argyrodes trigonum Htz.

Linville, Swannanoa Valley.

Argyrodes cancellatus Htz.

Chapel Hill, Durham.

Ariamnes fictilium Htz.

Durham, one specimen.

Ceratinella fissiceps Cambr.

Roan Mt. Summit.

Ceratinella minuta Emer.

Swannanoa Valley, among dead leaves.

Ceratinella brunnea Emer.

Black Mts., Sept. (Beutenmüller).

Ceratinella lætabilis Cambr.

Black Mt. (Beutenmüller).

Notionella interpres Cambr.

Morganton, Chapel Hill, Linville, Pineola, Swannanoa Valley, Black Mts. (Beutenmüller), very common.

Ceratinopis nigripalpis Emer.

Swannanoa Valley, among dead leaves.

Ceratinopis alternatus Emer.

From Balsam.

Maso frontata Banks. Pl. XXXV, fig. 17.

Swannanoa Valley, under fallen leaves.

Lophocarenum mœstum Banks. Pl. XXXV, fig. 10.

Swannanoa Valley, sifting fallen leaves.

Diplocephalus rostratus Emer.

Black Mts., Sept. (Beutenmüller), one male.

Diplocephalus carolinus n. sp. Pl. XXXIV, fig. 2.

Cephalothorax chestnut-brown; legs yellow-brown; abdomen black, sternum yellowish-brown, black on margins. Head elevated, into a median lobe, which is truncate in front and bears the P. M. E., which are over two diameters apart; A. M. E. small, scarcely diameter apart, farther from the larger A. S. E., the P. S. E. close to A. S. E. Inner edge of front of the mandibles with two small teeth; sternum fully as broad in front as long, rather rounded between hind coxæ, which are separated by more than their width.

Length 1.5 mm.

From Black Mt., N. Car., Swannanoa Valley, sifting fallen leaves.

Gonglydium atramontensis n. sp. Pl. XXXIV, figs. 5, 8.

Cephalothorax pale yellowish, legs still paler; abdomen blackish above and below; sternum blackish. Cephalothorax broad, mandibles with three teeth on outer side and a large median one on the inner edge; palpi long and slender, the basal hook large, a sharp, straight, simple stylet at tip; the sternum as broad at base as long, triangular, sharp-pointed behind; legs long and slender.

Length 1.1 mm.

From north fork of the Swannanoa River, Black Mountain, N. Car., May, under fallen leaves.

Hypselistes florens Cambr.

Black Mts. (Beutenmüller).

Grammonata ornata Cambr.

Black Mts. (Beutenmüller).

Cornicularia indirecta Cambr.

Black Mts., Sept. (Beutenmüller).

Erigone autumnalis Emer.

Swannanoa Valley, among leaves.

LINYPHIIDÆ.

Linyphia phrygiana Koch.

Roan Mt. Summit, in balsam trees, Swannanoa Valley, Black Mts. (Beutenmüller), common.

Linyphia maculata Emer.
One from Swannanoa Valley.

Linyphia grandæva Keys.
Roan Mt. Summit, one female.

Linyphia communis Htz.
Linville, Chapel Hill, Road to Roan Mt., Balsam, Durham, Swannanoa Valley, very common.

Linyphia marginata Koch.
Paint Rock, Linville, Murphy, Chapel Hill, Balsam, Pineola, Swannanoa Valley, common.

Neriene clathrata Sundv.
Swannanoa Valley, on ground in the cherry orchard.

Linyphiella coccinea Htz.
Morganton, Chapel Hill, Durham.

Tapinopa bilineata Banks.
Black Mts., Sept. (Beutenmüller).

Lepthyphantes minuta Blackw.
Black Mt.

Bathyphantes zebra Emer.
Mt. Graybeard, Swannanoa Valley, among dead leaves.

Bathyphantes micaria Emer.
Swannanoa Valley, in grass.

Bathyphantes galbea Keys.
Swannanoa Valley, one specimen.

Bathyphantes unimaculata Banks.
Swannanoa Valley, in old meadow.

Bathyphantes nigrina Westr.
Roan Mt. Summit.

Microneta cornupalpis Emer.
Black Mts., Sept. (Beutenmüller), one male.

MIMETIDÆ.

Mimetus interfector Htz.
Chapel Hill, Swannanoa Valley, on low branches of trees.

TETRAGNATHIDÆ.

Pachygnatha tristriata Koch.
Blowing Rock.

Tetragnatha laboriosa Htz.

Morganton, Pineola, Black Mt., Linville, Durham, Murphy, Blowing Rock, Swannanoa Valley, common.

Tetragnatha grallator Htz.

Durham, Murphy, Linville, Paint Rock, Swannanoa Valley, common.

Eugnatha straminea Emer.

Linville, Swannanoa Valley.

EPEIRIDÆ.

Epeira displicata Htz.

Swannanoa Valley, common.

Epeira globosa Keys.

Linville.

Epeira foliata Koch (*strix* Htz.).

Road to Roan Mt., Blowing Rock, Linville, Swannanoa Valley, on porch.

Epeira vulgaris Htz.

Salisbury, in stables.

Epeira infumata Htz.

Swannanoa Valley, young.

Epeira domiciliorum Htz.

Asheville.

Epeira ocellata Clerck.

Roan Mt. Summit, on balsam trees.

Epeira sanguinalis Htz.

Durham, one female.

Epeira juniperi Emer.

Black Mt., Paint Rock.

Epeira sericata Clerck.

Black Mt., also (Beutenmüller).

Epeira gigas Leach.

Black Mts. (Beutenmüller).

Epeira nordmanni Thor.

Linville, Swannanoa Valley, young.

Epeira trifolium Htz.

Linville.

Epeira trivittata Keys.

Morganton, Linville, Black Mt., Blowing Rock, Durham.

Epeira prompta Htz.

Paint Rock, Linville, Murphy, Black Mt., Durham, Swannanoa Valley, sweeping meadow.

Epeira catawba n. sp. Pl. XXXIV, fig. 4.

Cephalothorax dark brown, paler in eye-region, two pale median spots behind eyes, two more elongate near middle, and the posterior part under the abdomen is pale. Abdomen whitish-gray above, mottled and streaked behind and on the sides by greenish-white; underside pale, mottled with brownish, and with dark streaks radiating from the spinnerets; sternum pale, with faint dark spots on the sides; legs pale, marked with dark brown, two or three spots on femora, the patella mostly dark, and two spots on tibiæ, less distinctly on the metatarsi. Abdomen short, and broad, and high, about as broad behind as long, the base at middle with a pair of small approximate humps, at each outer corner a double hump, not elevated; the tip, seen from below, shows two other humps not far from the spinnerets; sternum with four humps each side and one behind; finger of epigynum quite long, transversely wrinkled on basal part.

Length 3 mm.

From Asheville (July).

Plectana stellata Htz.

Morganton, Durham.

Metepeira labyrinthea Htz.

Morganton, Durham, Pineola, Linville.

Acacesia foliata Htz.

Morganton, Paint Rock, Black Mt., Durham, Chapel Hill.

Zilla montana Koch.

Roan Mt. Summit, on houses and dead trees.

Singa truncata Banks.

Swannanoa Valley, in web near ground.

Mangora gibberosa Htz.

Black Mt., Blowing Rock, Durham, Chapel Hill.

Mangora maculata Keys.

Black Mt., Chapel Hill.

Mangora placida Htz.

Paint Rock, Linville, Durham, Chapel Hill, Mt. Graybeard, Swannanoa Valley, very common.

Cyclosa conica Pallas.

Linville, Durham, Black Mt., Blowing Rock, Balsam, Chapel Hill, Pineola, Black Mts. (Beutenmüller).

Theridiosoma radiosa McCook.

Swannanoa Valley, not uncommon sweeping low plants; Pineola.

Gea heptagon Htz.

Chapel Hill, one male.

Argiope trifasciata Forsk.

Durham, Road to Roan Mt., Linville.

Argiope aurantia Lucas.

Raleigh.

Leucauge hortorum Htz.

Linville, Black Mt., Road to Roan Mt., Durham, Chapel Hill, Swannanoa Valley, Black Mts. (Beutenmüller).

Acrosoma gracilis Walck.

Asheville, Swannanoa Valley, Black Mts. (Beutenmüller).

Acrosoma spinea Htz.

Chapel Hill.

ULOBORIDÆ.

Uloborus plumipes Lucas.

Morganton, Swannanoa Valley, Black Mts. (Beutenmüller), web on dead branches.

Hyptiotes cavatus Htz.

Paint Rock, Durham.

THOMISIDÆ.

Misumena vatia Clerck.

Black Mts. (Beutenmüller).

Misumena oblonga Keys.

Morganton, Balsam, Pineola, Durham, Roan Mt. Summit, Blowing Rock, Black Mts. (Beutenmüller).

Misumessus asperatus Htz.

Morganton, Durham, Swannanoa Valley, mostly young.

Runcinia aleatoria Htz.

Morganton, Pineola, Durham, Chapel Hill.

Xysticus ferox Htz.

Pineola.

Xysticus triguttatus Keys.

Pineola, Blowing Rock.

Xysticus formosus Banks.

Black Mts. (Beutenmüller).

Xysticus gulosus Keys.

Morganton, Chapel Hill, Swannanoa Valley.

Coriarachne versicolor Keys.

Black Mts. (Beutenmüller).

Tmarus caudatus Htz.

Durham, Chapel Hill, Swannanoa Valley, on dead branches.

Philodromus rufus Walck.

Swannanoa Valley, Black Mts. (Beutenmüller), common.

Philodromus ornatus Banks.

Black Mts. (Beutenmüller).

Philodromus oarolinus n. sp. Pl. XXXV, figs. 14, 16.

Cephalothorax whitish, with several short brown streaks in eye-region, one each side on clypeus, and three brown spots on each side of the cephalothorax. Legs yellowish or brownish-yellow, the femora whitish, femora I and II with a broad brown stripe on anterior side beneath, behind mostly brown; femora III and IV with a dark brown stripe on the anterior side beneath, one behind and a less distinct one above, rest of legs not plainly striped, although tibiæ III and IV are darker in front below than elsewhere. Abdomen white, with a pattern of rich brown marks as in the figure; venter and sternum whitish. Cephalothorax moderately broad; eyes all small and wide apart; legs II a little longer than I, femora II longer than the cephalothorax, tibiæ and metatarsi I and II each with two pairs of long spines beneath, the second pair at the middle of joint; femur I with three bristles on front, and two above.

Length 3.5 mm.

From Durham, N. Car., 8 July (Emerton).

PISAURIDÆ.

Pisaurina undata Htz.

Morganton, Murphy, Chapel Hill, Swannanoa Valley, Black Mts. (Beutenmüller).

Dolomedes urinator Htz.

Swannanoa Valley, near stream.

Dolomedes fontanus Emer.

Lower part of Roan Mt., Black Mts. (Beutenmüller).

Dolomedes vernalis Emer.

Swannanoa Valley, in a bush.

Dolomedes sexpunctatus Htz.

Swannanoa Valley, by side of stream.

LYCOSIDÆ.

Pardosa retrorsa n. sp. Pl. XXXIV, figs. 3, 6.

Cephalothorax nearly black on the sides, black on eye-region, and there traversed by a narrow median line of white hair, extending down to the front eye-row: behind with a broad median reddish stripe, much constricted before the dorsal groove; some pale spots on the sides; and some white on the sides of clypeus. Mandibles reddish-brown, maxillæ pale, lip black, sternum blackish; abdomen pale above, blackish on anterior sides, and with some scattered black marks above, most noticeable behind; venter pale. Legs pale, the front femora black, and other femora and hind tibiæ more or less distinctly banded with dark; basal joint of palpus black, rest pale. Of general shape of *P. lapidicina*, but legs perhaps a little longer, all with long stout spines.

Length 6 mm.; hind legs 15 mm.

From Linville, N. Car., July (Emerton). Related to *P. lapidicina*, but the palpus quite different, and the white line on eye-region is peculiar. A female, apparently of this species, sent by Prof. Emerton, was taken at Coles Creek Notch, 20 miles north of Bloomsburg, Pa., 19 Sept., by Mr. Lutz.

Pardosa minima Keys.

Swannanoa Valley, in meadow.

Pardosa canadensis Blackw.

Morganton, Balsam, Roan Mt., Murphy, Linville, Pineola, Asheville, Durham.

Pardosa mœsta Bks.

Linville, one female.

Pardosa lapidicina Emer.

Roan Mt., Swannanoa Valley, in field.

Lycosa carolinensis Walck.

Asheville.

Lycosa helluo Walck.

Asheville, Swannanoa Valley.

Lycosa frondicola Emer.

Swannanoa Valley, among dead leaves.

Lycosa aspersa Htz.

Linville, Durham, Black Mts., Sept. (Beutenmüller).

Lycosa lenta Htz.

Morganton.

Lycosa pulchra Keys.

Swannanoa Valley, one female.

Lycosa avida Walck.

Roan Mt., Blowing Rock, Linville, Pineola, Swannanoa Valley, under stones.

Lycosa ocreata Htz.

Pineola, Balsam, Linville, Swannanoa Valley, very common, Black Mts. (Beutenmüller).

Lycosa gracilis Bks.

Paint Rock, Swannanoa Valley, common.

Lycosa punctulata Htz.

Chapel Hill.

Lycosa rabida Walck.

Morganton, Asheville, Swannanoa Valley, young.

Pirata minuta Emer.

Blowing Rock, Pineola.

Pirata montana Emer.

Linville, Balsam, Asheville, Swannanoa Valley, very common in a woods near stream.

Geolycosa missouriensis Bks.

Chapel Hill.

Trochesa cinerea Fabr.

Morganton.

Allocosa funerea Htz.

Swannanoa Valley, common.

Allocosa sublata Montg.

Swannanoa Valley, a few specimens.

OXYOPIDÆ.

Oxyopes salticus Htz.

Morganton, Paint Rock, Linville, Blowing Rock, Pineola, Durham, Roan Mt., Chapel Hill, Swannanoa Valley.

Peucetia viridans Htz.

Durham.

ATTIDÆ.

Phidippus audax Htz.

Swannanoa Valley, young, Black Mts. (Beutenmüller).

Phidippus podagrosus Htz.

Asheville, Mt. Graybeard.

Phidippus insigniarius Koch.

Swannanoa Valley, one specimen sweeping.

Phidippus rufus Htz.

Durham.

Dendryphantes octavus Htz.

Durham, Swannanoa Valley, very common.

Dendryphantes castaneus Htz.

Balsam, Swannanoa Valley, among dead leaves.

Philæus militaris Htz.

Swannanoa Valley, not common, on trees.

Pellenes borealis Bks.

Mt. Graybeard, one male, in grass.

Pellenes peregrinus Peckh.

Swannanoa Valley, one female, under leaves.

Habrocestum pulex Htz.

Durham, Swannanoa Valley, common on fallen trees, stones, etc.

Habrocestum parvulus Banks.

Black Mts. (Beutenmüller).

Thiodina sylvanus Htz.

Durham.

Phlegra leopardus Htz.

Swannanoa Valley, one specimen, among dead leaves.

Mævia niger Htz.

Blowing Rock, Durham, Mt. Graybeard, Swannanoa Valley, very common on bushes and herbage.

Wala palmarum Htz.

Blowing Rock, Swannanoa Valley, on trees.

Wala mitrata Htz.

Swannanoa Valley, also on trees.

Marpissa undata DeGeer.

Black Mts. (Beutenmüller).

Hyctia pikei Peckh.

Durham.

Icius canadensis Blackw.

Blowing Rock.

Fuentes lineata Hentz.

Paint Rock.

Tutelina elegans Htz.

Asheville, Durham, Swannanoa Valley, Black Mts. (Beutenmüller).

Zygoballus sexpunctatus Htz.

Swannanoa Valley, in old field.

Zygoballus parvus Htz.

Swannanoa Valley, Durham, Black Mts. (Beutenmüller).

Neon nelli Peckh.

Swannanoa Valley, among fallen leaves.

Sassacus papenhœi Peckh.

Blowing Rock.

Synemosyna formica Htz.

Swannanoa Valley, on plants.

PHALANGIDÆ.

Liobunum grande Say.

Swannanoa Valley.

Liobunum ventricosum Wood.

Swannanoa Valley, common.

Liobunum flavum Banks.

Black Mts. (Beutenmüller).

Liobunum crassipalpis Bks.

Roan Mt.

Oligolophus pictus Wood.

Roan Mt.

Scotolemon brunnea Banks.

Collected by Mr. Beutenmüller at Black Mt.

Caddo agilis Banks.

Swannanoa Valley, under leaves.

Nemastoma dasycnemum Crosby.

Swannanoa Valley, under leaves.

Explanation of Plates XXXIV, XXXV.

Fig. 1.—*Zelotes depressa.*
" 2.—*Diplocephalus carolinus.*
" 3.—*Pardosa retrorsa.*
" 4.—*Epeira catawba.*
" 5.—*Gonglydium atramontensis.*
" 6.—*Pardosa retrorsa.*
" 7.—*Scotinella pallida.*
" 8.—*Gonglydium atramontensis.*
" 9.—*Dictyna armata.*
" 10.—*Lophocarenum mœstum.*
" 11.—*Callilepis femoralis.*
" 12.—*Theridium atramontanum.*
" 13.—*Epesinus amœnus.*
" 14.—*Philodromus carolinus.*
" 15.—*Epesinus amœnus.*
" 16.—*Philodromus carolinus.*
" 17.—*Maso frontata.*

OBSERVATIONS ON SARCOCYSTIS RILEYI (STILES).

BY HOWARD CRAWLEY.

On March 22, 1911, there was received at the laboratory of the Zoological Division of the Bureau of Animal Industry, Washington, D. C., a piece of the breast of a Mallard duck, in which were Sarcosporidian cysts. A preparation of the spores of this parasite, made for purposes of identification, showed it to be *Sarcocystis rileyi* (Stiles). This form is by no means rare in Mallards, Shoveller ducks and domestic ducks. The preparation, however, showed certain morphological details in the so-called spores which do not appear to have been described. In consequence, a number of preparations were made, the study of which brought to light the facts set forth below, which are believed to be of considerable interest and of some theoretical importance.

The duck from which the material was obtained had been shot near the mouth of the Illinois River, probably very shortly before March 20. The specimen was handed to one of the veterinary inspectors of the Bureau of Animal Industry, at Chicago, and by him forwarded to Washington. The meat had merely been sprinkled with borax, and reached Washington in good condition. It was quite liberally parasitized. The cysts were confined mainly to the more superficial portions of the breast of the duck, a good many lying immediately beneath the connective tissue covering the muscle.

It is believed that the parasites were still alive, or, if not, had been dead for so short a time that they had not suffered any degeneration. Examined fresh, they presented a picture characteristic of living organisms. They fixed well, and gave good stained preparations. On the other hand, attempts to stimulate them to display movement failed. Mounts were kept for several hours in the incubator, and brought at once under the microscope. Others were kept for a considerable period over the dark field illumination, since this procedure heats the preparation. But in no case were any of the spores[1] seen to move.

[1] The propagative bodies found in the cysts of Sarcosporidia are conventionally designated spores, and hence that term is used here. It is much more likely, however, that they are the homologues of the sporozoites of Gregarines, Coccidia and Hæmosporidia.

This does not prove that the spores were no longer living, as it is by no means easy to get Sarcosporidia spores to display movements. Some years ago, at the Pathological Laboratory of the Medical School of the University of Pennsylvania, some experiments were made with the spores of *Sarcocystis muris*. It was found that if these were kept in the incubator, in some appropriate medium, and then examined at a temperature of 32° C., very lively movements were displayed. These movements, however, were not maintained for any length of time, even at this temperature, and at ordinary room temperature quickly ceased. It is evident that the organisms are sensitive to any fall of temperature below the so-called blood heat.

Methods.

Both fresh and prepared material were studied. The latter was either smears or paraffin sections. The smears were prepared as follows: A cyst was removed from the muscle, placed on a slide with a small drop of salt solution, and broken into several pieces with needles. These pieces were then smeared over the slide, thus scattering the spores, and the preparation fixed before it had dried. Three methods were used, the best results being obtained with fixation in vapor of osmic acid. For this a wide-mouthed, glass-stoppered bottle was used, in which was placed a small quantity of a 4 per cent. solution of osmic acid. The wet smear was left in this bottle ten to thirty seconds, sometimes more, and then transferred at once to absolute alcohol. The air in such a bottle is saturated not only with osmic acid vapor, but with water vapor as well and the smears do not dry. It may be noted that any osmic acid solution which adheres to the slide after removal from the fixing bottle must be wiped off before immersion in alcohol.

Other smears were fixed by dropping on them, while still wet, a quantity of fixative. Two of these were used: Hermann's fluid and an alcoholic corrosive acetic mixture made up as follows:

95% alcohol	50 parts.
Sat. sol. of $HgCl_2$ in water	50 parts.
Glacial acetic acid	5 parts.

Both of these fluids caused the parasite to swell and to become relatively very much broader than it was in the fresh state. Nor were the structural details preserved anything like so well as with fixation in osmic acid vapor.

Three stains were used:

1. Iron hæmatoxylin and acid fuchsin.

2. Thionin and acid fuchsin.

3. Wright's stain.

The two former were used in the usual way. With Wright's stain, the conventional procedure was slightly varied. The smear, kept in absolute ethyl alcohol, was first washed in absolute methyl alcohol. It was then stained in the usual way, but after being washed in water, it was dehydrated with alcohol and transferred to oil. It could therefore be brought into balsam without ever becoming dry.

The material for paraffin sections was fixed in Hermann's fluid.

Observations.

Fresh Material.

The Cysts.—As already stated, the cysts were mostly aggregated in that portion of the muscle lying beneath the skin. As is usual with Sarcosporidia, their long axes lay in the same direction as the long axes of the muscle fibres. Stretching of the muscle caused the cysts to lengthen and become narrower, they being in all cases very soft and flexible. They were very easily teased out from the surrounding host tissue, and could be obtained free of all such tissue and wholly intact without the least difficulty.

Both *in situ* and when free on the slide, the form was that of a cylinder with rounded ends. That is, the diameter was sensibly uniform throughout, although, when the muscle surrounding a cyst was stretched, the cyst became somewhat narrower at the ends.

The length varied from 2.75–6.5 mm.; the diameter from .6–1.0 mm. There was, however, no constant relation between length and thickness, and indeed the shorter cysts were frequently the thicker. Four, selected at random, and measured while in position, gave the following:

6.0 by .60 mm.
5.5 by .75 mm.
4.0 by 1.00 mm.
6.5 by .60 mm.

It is probable that the ratio of length and breadth depends a good deal on the pressure exerted on the cyst by the surrounding tissue. Obviously, also, in the living bird, the parasites are subjected to very violent stresses and strains.

The Spores.—Preparations made by teasing the cysts in salt solution were examined under the microscope. The spores varied a good deal in size and shape. Some were short, broad ovals, others had somewhat the outline of a fish. The long, narrow spores (Plate XXXVI, figs. 1–3, 10–12), which were in the great majority, sometimes tapered regularly from the broad to the narrow end. In others, however, the contours were not smooth, there being little irregularities and swellings along the periphery of the body. The short, broad individuals, as will be shown later, were probably degenerate.

A vacuole near the centre could generally be seen. At times, also, a second vacuole could be made out very close to the broad end.

In a number there could be seen a dark, refractive body, rounded or rod shaped. It was sometimes near the centre; in other cases nearer the broad end.

A few of the long forms were slightly curved, but as a rule the longitudinal axis was sensibly a straight line. In a few the cytoplasm contained granules.

Measurements of several individuals, taken at random, gave:

Long.	*Short.*
13.8 x 2.6 microns.	8.3 x 4.1 microns.
13.8 x 3.1	8.3 x 4.1
14.5 x 2.1	8.3 x 3.1
14.5 x 2.6	9.4 x 2.6
15.0 x 2.6	9.4 x 2.6
14.5 x 3.1	

Hence the length varies from 8.3–15μ; the breadth from 2.6–4.1. Excluding, however, the short forms, believed to be degenerate, it is found that the spores are about 14–15μ long by 2–3 broad.

Fixed Material.

Cysts.—In cross section the cysts show a differentiation into what Stiles has termed central core and peripheral layer or zone. This differentiation, while quite evident when the cross section is viewed with low powers, has no morphological significance. The peripheral zone is that portion of the cyst in which the spores are still alive; the central core that portion wherein they have died and degenerated. This was pointed out by Stiles.

In the case of one of the mounted specimens, the cross section was oval, measuring 1.05 by .84 millimeters. The central core was roughly .71 x .57, while the peripheral shell varied in thickness from .105 to .194 mm. Presumably, in the living cyst, the central core will occupy the geometrical centre of the cyst.

Hence, in this particular case, there had been distortion, which was also indicated by the fact that where the shell was thin, it was quite dense, and where thick, very loose and open. The distortion was probably due to exigencies of fixation, but, as already indicated, the cysts must be subjected to great distortion during the flight of the bird.

There was the mesh-work characteristic of sarcosporidian cysts, the meshes being coarser at the periphery and finer in the centre.

In the former position they measured from 10–20μ across; in the latter they were as small as 1–2μ.

In the material on which this study is based the cysts, being mature, lie between the muscle fibres and not within them.

Stiles, studying the parasites of five ducks, found intermuscular cysts alone in four, but in the fifth specimen both intermuscular and intramuscular stages were seen. He states that in the latter, the cysts were thinner and showed no non-staining central core. Although Stiles suggested that they were only developmental phases of the same form, he followed Blanchard's classification, calling one *Balbiania rileyi* and placing the other in the genus *Sarcocystis*. It is now known that the distinction between inter- and intramuscular positions is only a question of development. The young stages lie within the muscle fibre, but as they grow they become too large to be contained within it. According to Minchin, the originally parasitized fibre is ruptured and the cyst escapes. It seems more probable, however, that the fibre is merely almost wholly destroyed, its remnants remaining around the parasite as an adventitious cyst. However this may be, in the present case, the parasites were inclosed within a tightly stretched membrane, showing a considerable number of long, narrow nuclei. This was derived from the host. The actual cyst membrane is very thin, homogeneous, and part and parcel of the net work.

The compartments, as we have seen, grow progressively smaller from without inwards. Within them are the spores.

These, in the peripheral compartments, are seen to be elongated elements radially arranged. That is, as seen in the cross section of the cyst, the spores are in more or less definite files directed along the radii of this cross section.

In the central portion of the central core, the meshes of the net are filled with debris, which stains only with the plasma stain. Further out, however, it is frequently possible to see that this debris is more or less well divided up into little aggregates, doubtless each such aggregate standing for a spore which has died and disintegrated. In such situations chromatin masses are also frequent, following the well-known rule that chromatin does not break down so quickly as cytoplasm.

In general, the line of demarcation between the normal and degenerate spores was abrupt. The same compartment might be filled partly with normal spores and partly with debris.

The degenerating spores differ from the normal spores in being shorter and broader, even at times round. As the spore changes in shape, the cytoplasm becomes very loose and to a large extent loses its ability to stain, the spores frequently taking on the form of a chromatin mass lying in an empty shell. It is on account of these observations on the sectioned cyst that the short, broad spores found in the fresh preparations are believed to be degenerate.

The relative extent of central core and peripheral layer in the make up of the cyst is merely a question of its age. Thus, Stiles found the small, intramuscular cysts to be without a central core. Further, in his description of the intermuscular form, Stiles gives .48 mm. for the thickness, and in his figures the central core is relatively very much smaller than it is in my material, where the diameter is as much as 1 millimeter. It is merely a matter of evolution. The cysts herein described are older than those studied by Stiles and spore degeneration has proceeded much further.

Smears.—The description which follows is based wholly on material fixed in osmic acid vapor and absolute alcohol, the other fixations giving obviously bad results. The three different stains mentioned above were all used, and all were good. They gave, however, quite different appearances, which will be noted as the description proceeds. Yet although the appearances were quite different, it was perfectly easy to correlate them. No one of the three stains showed any structural details not shown by the other two. The distinction between them had to do primarily with the chemical composition of the different parts of the spore.

As was to be expected, the sharpest pictures were obtained with iron hæmatoxylin and acid fuchsin. This method was best for the detection of the presence and form of the figured elements. But iron hæmatoxylin does not distinguish between different grades of chromatin, staining that containing much nucleic acid the same as that which contains little. Differences of this sort were, however, brought out by thionin and Wright's stain.

The observations were made with a 2 mm. apochromatic oil immersion lens, with a No. 12 or No. 18 eye-piece. These give, respectively, 1,500 and 2,250 diameters. The light was obtained from an incandescent gas lamp, and no trouble was experienced in getting excellent definition.

The spore, in the fixed smears, shows distinctly a differentiation into a broad and a narrow end. As in the fresh material, the broad end is rounded; the narrow end tapering and sometimes almost pointed.

The cytoplasm is either homogeneous, staining solidly, or there can be made out a poorly defined spongioplasm. This latter is mostly confined to the broad end of the spore, where there can often be seen minute vacuoles. In this part, also, rather coarse granules are frequent, which take the chromatin stain. It was not possible, however, to say whether these belong to the cytoplasm or to the nuclear apparatus of the spore. They were usually in association with the nucleus-like body in the centre of the parasite, and may belong to the class of the so-called metachromatic granules which have been described as present in sarcosporidian spores.

In the narrow end of the spore, the cytoplasm nearly always stained homogeneously, and in many cases was so solid near the extremity as to suggest a differentiation such as occurs in the anterior end of Telosporidian sporozoites. In these, the cytoplasm is greatly stiffened and forms a sort of beak, which enables the parasites to bore into the cells of the host. This is the only indication obtainable as to which is the anterior end of these spores of *Sarcocystis rileyi*.

The cytoplasm takes the usual stain, being red in acid fuchsin and blue in Wright's stain.

A distinct periplast is present, which stains the same as the rest of the cytoplasm. It could easily be seen in all of the smears, and was well demonstrated with those fixed in Hermann's fluid, where, as a consequence of the violent invasion of the cell by the fluid, it was frequently torn loose from the entoplasm.

Measurements show that there is quite a little shrinkage during fixation. The fresh spores measured 14–15 microns long by 2–3 broad. Those free in the smears range from 9–13.4 long by 1.7–2.3 broad. In a number of cases, however, there were present in the smears portions of the cysts, showing the spores still lying within the compartments. Measurements of such spores showed them to be 11.4–13.0 long by 1.6–2.3 microns wide, and gave a mean of 12.2 by 2 microns. In these fixation is probably a trifle slower, and hence there is not so much shrinkage.

Internally, counting from the broad to the narrow end, the spores show:

(1) A vacuole.

(2) A chromatin body.
(3) A vacuole.
(4) A chromatin body.

These four elements are normal constituents of all of the spores, although it is often difficult to see them all in any given spore.

The chromatin bodies are probably nuclei, but this point will be considered later. The vacuoles are not to be confounded with the small vacuoles frequently present here, as in all other protozoa, but are clearly morphological entities.

For convenience, the vacuoles will be referred to as vacuole No. 1 and vacuole No. 2; the chromatin bodies as chromatin body No. 1 and chromatin body No. 2, the count being made from the broad to the narrow end of the spore.

Vacuole No. 1.—This, when distinct, appeared as a very narrow ring, inclosing a clear space. In other cases it was not nearly so sharply differentiated, appearing only as a vague, poorly defined region, while very often it could not be seen at all. The space within the ring was sometimes colorless, but more often faintly stained, and at times took much the same stain as the surrounding cytoplasm. Occasionally, it contained a faintly staining granule or irregularly shaped mass, staining a trifle more deeply than the ground substance. In spores still *in situ* within the compartments of the cyst the vacuole was often very conspicuous, presenting the aspect of a hole in the cytoplasm.

The vacuole was usually nearly or quite round. It was sometimes at the extreme end of the spore; in other cases some distance from the end. It varied a good deal in size, at times being large enough to fill the entire width of the cell, again quite small. The appearance is shown in figs. 1–3, 10, 12.

The different stains used made little or no difference in the appearance of this element.

It is possible that this is the so-called striated body said to be present in sarcosporidian spores, and interpreted as the homologue of the polar capsule of the spores of Myxosporidia.

Chromatin Body No. 1.—The appearance of this element is shown in figs. 1–3, 5, 6, 8 and 10–12.

Viewed under a magnification of some 700–800, it appeared as a solid, deeply stained, spherical, oval or roughly demi-lunar body, frequently broken into two equal or unequal parts. (Plate XXXVI, figs. 1–3, 5*c*, 8*d*, *e*, 10, 11). Under higher powers, however, and with an intense light, it was frequently possible to make out that it was more or less lobulated, and apparently composed of several masses, closely compacted together (fig. 5*a*, *b*, *h*). Much more rarely it consisted of an aggregate of large granules rather than lobes (figs. 5*d*, *f*, 6*b*).

Sometimes the appearances suggested division into two (figs. 13, 8*d*, *e*).

Generally speaking, this body took a dense chromatin stain, but frequently it did not stain homogeneously, one part taking the chromatin, the other the plasma stain. Thus, the case shown by fig. 13 shows two heavily stained demilunes, with between them some plasma-like substance. Figs. 6*c* and 8*a*, *b*, *c*, show elements which are solid, but which stain partly like chromatin and partly like plasma. It is by no means unlikely that in cases where the element appears double (fig. 8*d*, *e*) the conditions really are as in fig. 8*b*, the plasmic portion having failed to stain. Further, in the case of such a body as is shown in figs. 6*c*, 8*a*, *b*, *c*, an alteration in the chemical composition of the central portion, or overstaining, would give elements such as are shown in figs. 1 and 2.

The data just given suggest that this element is a nucleus of the massive or compact type, such as the macronuclei of the ciliate Infusoria. It has ordinarily the aspect of a solid mass, but is composed rather of several closely compacted masses. Under certain conditions a larger or smaller portion of it changes in chemical composition and stains like albumin.

In smears fixed with Hermann's fluid this body frequently lay in a vacuole, but it is believed that such an appearance is the result of a too violent fixation.

In smears stained with iron-hæmatoxylin the color is sensibly black. In thionin it is deep blue, while in Wright's stain it is a nearly black garnet, precisely like the kinetonuclei of trypanosomes.

Vacuole No. 2.—In general this is more distinct than vacuole No. 1. Usually, it showed as a distinct ring, which was frequently irregularly thickened. At times, this vacuole has the appearance of a hole in the cytoplasm, and this was always the case when the spores were *in situ;* either in sections or in cyst compartments in the smears.

But in many cases, it is inconspicuous (see figs. 1, 3). Here it is seen to be irregularly shaped and quite small. More probably, this is an accident of fixation. This vacuole, in the spore, lies between two chromatin bodies, and hence can easily be pressed upon during fixation. In the spores in the cysts it is always very conspicuous, and it was also quite evident in the fresh spores.

Chromatin Body No. 2.—This apparently consists of a nuclear membrane, nuclear sap and chromatin which is typically in the form of a rounded karyosome. The appearances, however, vary to a very great extent. The chromatin is very often in the form of a rod (figs. 4*b*, *d*, 7*c*, *f*, *g*). It may also consist of two or more separate bodies (figs. 4*c*, 7*b*, *c*, *g*, *h*). At times the chromatin mass is irregular in shape, and appears to send out strands which unite with the membrane (fig. 4*c*). In a large number of cases the membrane cannot be demonstrated at all, the chromatic mass apparently lying free in the cytoplasm (figs. 4*c*, 7*b*, *d*, *e*, *f*, *g*).

In iron hæmatoxylin the karyosome or karyosomes take a deep chromatin stain and, as a rule, stand out sharply. With thionin or Wright's stain the chromatin reaction is given, but the stain is pale. This element obviously comes within the category of vesicular nuclei.

Summarizing the above observations, it is seen that the spores of *Sarcocystis rileyi* show two chromatic elements and two vacuoles. The latter, although rather curious possessions, offer no difficulties of interpretation. The young stages of certain hæmogregarines (for examples, *Lankesterella* and *Karyolysus*) typically show two vacuoles, although it is not known what their function may be.

It is not so easy, however, to explain the significance of these two chromatic elements. The one, the chromatin body No. 1, is typically a rounded solid element, belonging to the massive type of nucleus. It takes an intense chromatin stain, and is clearly an element high in nucleic acid. The other, chromatin body No. 2, consists of a nuclear membrane, inclosing a clear space within which is one or more karyosomes. These stain like chromatin. This vesicular type of nucleus is widespread in protozoa.

With iron hæmatoxylin there is no choice between the staining reactions of these two elements. Sometimes the one is more deeply stained, sometimes the other, but in general both are black, and the spores are seen at a glance to be binucleate. On the other hand, with Wright's stain, chromatin body No. 1 is larger and more conspicuous than it is with iron hæmatoxylin, while chromatin body No. 2 may at first glance be overlooked. The appearance here is of a uninucleated element. There is here very nicely illustrated the advantage of the use of more than one staining method, and the contention of the English School of protozoologists that iron-hæmatoxylin should be used in the study of trypanosomes receives emphatic support.

It is impossible to establish a correlation between the spores of *Sarcocystis rileyi* and those of other Sarcosporidia. Concerning the latter, the most noteworthy feature of published figures is a lack of clear-cut details. In one of the most elaborate studies, that of Erdmann, the figured spores show vague differentiations, but, to the present writer, no exact correlation can be established. The granules figured by Erdmann may be the same as those sometimes seen in *Sarcocystis rileyi*, or they may stand for the ordinary sarcosporidian nucleus.

There is a general consensus of opinion that sarcosporidian spores show a vesicular nucleus, and this probably corresponds with the vesicular nucleus of *S. rileyi*. As already suggested, vacuole No. 1 may correspond to the supposed homologue of the polar capsule of myxosporidian spores.

But neither chromatin body No. 1 nor vacuole No. 2 appears to be represented in any sarcosporidian spores other than *S. rileyi* which have hitherto been described.

Conclusions.

(1) The spores of *Sarcocystis rileyi* are 14–15μ long and 2–3μ wide.

(2) One end is broad and rounded, the other narrow and tapering.

(3) The cytoplasm is spongy in the central portion, nearly or quite homogeneous in the narrow end.

(4) Within, counting from the broad end, the spore shows a vacuole, a chromatin body, a vacuole, a chromatin body.

(5) Vacuole No. 1 lies in or near the broad end. It is not usually very conspicuous.

(6) Chromatin body No. 1 is next in order to vacuole No. 1. It is apparently a nucleus of the massive or compact type and stains like the kinetonuclei of trypanosomes.

(7) Vacuole No. 2 lies roughly in the middle of the spore. It is usually more conspicuous than vacuole No. 1.

(8) Chromatin body No. 2 is usually nearer the narrow end than the broad end. It is apparently a nucleus of the vesicular type, the chromatin of which is typically aggregated into a single large karyosome.

(9) The spores of *Sarcocystis rileyi*, being apparently binucleate, are very different from any other sarcosporidian spores hitherto described.

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EXPLANATION OF PLATE XXXVI.

Figs. 1–3, 10–12 are made from camera outlines, drawn on the table with a 2 mm. objective and No. 18 eye-piece. The balance are free-hand sketches of the two chromatin bodies. The published figures are copies made by Mr. Haines, artist of the Bureau of Animal Industry, from pencil drawings made by the author.

Figs. 1–3, 6–12 are from smears stained with hæmatoxylin and acid fuchsin.

Figs. 4 and 13, from smears stained with Wright's stain.

Fig. 1.—Spore. All the elements large except vacuole No. 2. All further from the broad end of the spore than is usual.

Fig. 2.—Spore. Vacuole No. 1 small; other elements large. This spore is typical for the positions occupied by the vacuoles and chromatin bodies.

Fig. 3.—Spore. Vacuole No. 1 small; vacuole No. 2 almost obliterated. Karyosome of chromatin body No. 2 sending out strands toward the nuclear membrane.

Fig. 4.—Chromatin body No. 2. *a* is taken to be the typical appearance, but *b* and *d* are very frequent; *e* is not so often seen.

Fig. 5.—Chromatin body No. 2. *a*, *b*, *c*, *g* and *h* are frequent appearances; *d*, *e* and *f* are not so often seen.

Fig. 6.—Chromatin body No. 2. Compare *a* with *h* of fig. 5. In *c* the element stains partly like chromatin and partly like plasma.

Fig. 7.—Chromatin body No. 2. *a*, *c* and *h* show the entire nucleus; in *b*, *d*, *e*, *f* and *g* only the karyosomes can be seen. This condition occurs frequently.

Fig. 8.—Chromatin body No. 2. In *a*, *b* and *c* the bodies stain partly like chromatin and partly like plasma. In *d* and *e* it is apparently double.

Fig. 9.—Chromatin body No. 2. Appearances frequently presented by the karyosome.

Fig. 10.—Spore. Vacuole No. 1 contains a granule. Chromatin body No. 2 has here the typical appearance of a vesicular nucleus with one karyosome.

Fig. 11.—Spore. The vacuoles are obliterated.

Fig. 12.—Spore. Chromatin body No. 2 shows three karyosomes.

Fig. 13.—Chromatin body No. 1. The element is here cleft into equal parts.

NOTES ON THE ANATOMY AND CLASSIFICATION OF THE GENERA OMPHALINA AND MESOMPHIX.

BY HENRY A. PILSBRY.

In the course of studies on the shells of large *Zonitidæ* of the Southern States Mr. George H. Clapp reached the conclusion that the species referred to *Omphalina* are divisible into two generic groups, one having the embryonic whorls of the shell smooth, the other having these whorls radially costulate or sharply striate. His results being communicated to me, an anatomical study of all the species was undertaken. I found that two genera are clearly indicated by the soft anatomy and that these coincide with the groups based upon the sculpture of the embryonic shells, except that the species *inornata* Say and *andrewsæ* Pils. have smooth embryos, yet their soft anatomy is like the group with striate embryos.

Hoping to find time for a revision of the species with full illustration of the shells, I laid aside the notes made in 1905–6; but as opportunity for the preparation of adequate illustrations of the shells has not appeared, the anatomical and taxonomic data are now published.

W. G. Binney, in the *Terrestrial Mollusks*, vol. V, has figured the genitalia of *inornata* (Pl. XI, fig. C), *friabilis* (fig. D.) and *lævigata* (fig. E). In the latter figure the penis is lettered *d.s.*, and its flagelliform gland and retractor, or both, marked *r*. *Omphalina friabilis* is figured with a vaginal gland marked *p.p.* The fact is that Binney took the distal end of the penis for an appendage or dart-sack, and did not recognize the true nature of the epiphallus. The resulting inaccuracy of the figures and descriptions deprives them of value. He has, however, done much useful work on the dentition, the shell-characters, and in the elucidation of the older species, the synonymy of which had become intricate.

Genus OMPHALINA Rafinesque.

It is proposed to restrict this genus to species having the embryonic whorls of the shell smooth, and the penial retractor muscle terminal on the penis, which does not extend beyond it in a flagelliform blind sac. The type is *O. cuprea* Rafinesque (*fuliginosa* "Griffith" Binney).

The Mexican species *lucubrata* Say (Pl. XXXVII, fig. 8, genitalia), *caduca* Pfr., *zonites* Pfr., belong to this genus. *Zonyalina* (*jalapensis*) and *Patulopsis* (*carinata*), according to Strebel's figures, are very closely related and might be retained as subgenera of *Omphalina*, as von Martens has done.

Both *Omphalina* and *Mesomphix* have a collar-like gland, usually chocolate-colored, around the base of the vagina. A similar gland has been noticed in *Zonites algirus*, *Zonitoides nitida* and *excavata*, *Rhysota brookei*, etc. Its apparent absence in some dissections may be due to imperfect preparation or to imperfect development or pigmentation. The external features of the soft parts are similar in the two genera. In both the orifice of the genitalia is posterior, under the pneumostome, as shown in fig. 2 C.

The dentition is not greatly varied in the Omphalinas of the United States and probably the radulæ of *O. pilsbryi*, *O. cuprea* and *O. friabilis* could not always be distinguished. *O. kopnodes* has more lateral teeth than the other species. The number of teeth in radulæ counted is as follows:

	Central.	Lateral.	Marginal.	
O. kopnodes	1	7	66	Huntsville, Ala.
"	1	9	57	(Binney).
O. pilsbryi	1	5 or 6	49 or 50	Wetumpka, Ala.
O. cuprea	1	5	54	Emporium, Pa.
"	1	5	45	Pennsylvania.
"	1	4	60	(Binney).
O. c. ozarkensis	1	6	54	Magazine Mt., Ark.
O. friabilis	1	7	54	Wyandotte, I. T. (*immature*).
"	1	5	65	San Marcos, Tex.
"	1	5	55	Mablevale, Ark.
"	1	6	51	(Binney).

The position of the epiphallus on the penis is a character of importance in distinguishing species, but it fails with immature individuals, in which the epiphallus is probably always inserted very near the end of the penis. The "swollen" or "slender" shape of penis and epiphallus is variable individually, and probably related to functional activity. The measurements of the organs in specimens figured follow:

Length of	*kopnodes.*	*cuprea.*	*pilsbryi.*	*friabilis.* (Mablevale.)	*friabilis.* (San Marcos.)
Penis	10.5	12	9	5	6
Epiphallus	21	15.5	16	5.5	15
Vagina	7.5	6		4	8.5
Spermatheca and its duct	19	15	11	8	13.5

A Miocene species, *O. laminarum*, has been described by Professor

Cockerell from the Florissant shale, but the fragment obtained leaves the generic reference in doubt.

Omphalina cuprea Rafinesque.

Helix fuliginosa Griffith, of Binney and other authors.

The tail is flattened, the caudal pore a small slit not reaching the end, as figured for *O. friabilis* from San Marcos. The mantle over the lung has some irregular scattered spots and some of the branches of the vena cava are diffusely pigmented in places. *The pulmonary vein and its branches are not pigmented.* The collar usually has a black patch or several spots. Specimens from many localities examined.

In two examples of *O. c. polita* from Cades Cove I found a few spots near the branches of vena cava and on the collar in one, the other being without pigment spots.

The genitalia of an individual from York Furnace, Pa., have been figured in these PROCEEDINGS for 1894, p. 14, Pl. I, fig. 5.

In other specimens opened the penis and epiphallus are less swollen, but otherwise similar. The base of the vagina is swollen and white, not chocolate-colored, as in the Arkansan form. The retractor muscle of the penis is rather short. The epiphallus arises near the end of the penis, but not quite so near as in *O. kopnodes.*

I have examined several radulæ. One from Emporium, Cameron County, Pa., has 54, 5, 1, 5, 54 teeth (Pl. XXXVIII, fig. 1), the central and laterals with side cutting points. The decrease of the marginals to the outer edge is very gradual, as usual.

Another radula from Pennsylvania has 45, 5, 1, 5, 45 teeth. Binney found 60, 4, 1, 4, 60 teeth in one, 57, 1, 57 in another radula.

The number of teeth and of laterals is variable in different colonies, but apparently neither reaches the number found in *O. kopnodes.* The ectocones are a little better developed than in *O. friabilis*, but it is doubtful whether some radulæ could be distinguished.

Rafinesque's description is as follows: "Omphalina, differs from Helix by no lips, but an umbilic. *O. cuprea*, suboval, four spires, smooth, brittle, diaphanous, coppery, shining, opening very large. In Kentucky." While this definition leaves much to be desired, it is excellent as far as it goes. It will apply to no other Kentucky shell, to my knowledge. The adjective "coppery" is especially good. Binney years ago recognized *cuprea* as identical with *fuliginosa*, but he continued to use the later name, either being opposed to change or perhaps considering Rafinesque an outlaw, undeserving of recognition. This view seems to have been prevalent with the early American conchologists.

Binney states that he never received this species from west of the Mississippi River south of Iowa. I never saw it in Iowa, nor do I know of any record from Iowa, Minnesota or any northern State west of the Mississippi.

Omphalina cuprea ozarkensis P. and F.

Omphalina fuliginosa ozarkensis Pilsbry and Ferriss, Proc. A. N. S. Phila., 1906, p. 562.

Shell similar to that of *O. cuprea*. Soft parts differing by having the branches of the vena cava in the lung intensely black-pigmented, showing through the shell in life. Epiphallus inserted midway on the penis, not distally as it is in *O. cuprea*.

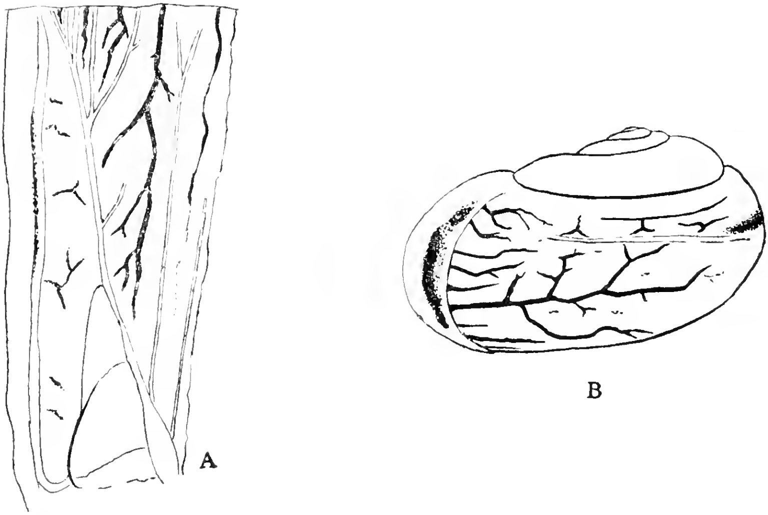

Fig. 1.—*O. cuprea ozarkensis*. A, pallial region of individual from Magazine Mountain. B, the same as seen in an unopened specimen removed from the shell, the pigmented blood vessels showing through the mantle. Petit Jean, Ark.

Petit Jean Mountains, south of Magazine Mountain, Arkansas. Cotypes No. 91,348 A. N. S. P., collected by Ferriss and Pilsbry, April 1 and 2, 1903. Also on the north side of the summit of Magazine Mountain, Logan County, Arkansas, March 28 to April 2, 1903, and Sugarloaf Mountain, on the Oklahoma boundary.

I can find no differential characters in the shells of this race, though the microscopic striation and obscure granulation may be a trifle more distinct than in *cuprea;* but the anatomical characters seem so diverse that a special race is indicated. In the field it was at once recognized by Mr. Ferriss and myself as unlike any *Omphalina* we had seen, on account of the black lines of the lung showing through the shell.

As usual in this genus, it lives on moist, well-shaded hillsides, buried in the leaf-covered humus up to the apex, which alone is exposed.

The external characters of foot and body are substantially as in *O. friabilis* from San Marcos, Texas, except that the last half of the last whorl, as seen through the shell in life, shows a few *irregular, sharply defined black lines* on a pale, or in life cream-white ground.

The pallial tract when opened (fig. 1 A) shows a short subtriangular brown kidney, the ureter projecting well forward from its apex. The secondary ureter is closed throughout. The pulmonary vein branches somewhat freely near its anterior end, and there are two slender, weak branches of the pericardial vein. *All of these veins are colorless,* like the pale wall of the lung. *Most of the branches of the vena cava are intensely black* and show on the outside as black lines. This marking renders the subspecies easy to recognize in the field or when handling alcoholic specimens.

The genital system (Pl. XXXVII, fig. 3) is practically identical with that of *O. friabilis* from San Marcos, Tex., but differs in the following points: the base of the vagina is not swollen, the penis is more slender and the muscle controlling the epiphallus is inserted at the distal third of the latter instead of near its end.

The epiphallus is inserted about midway on the penis, whereas in *O. cuprea* it inserts near the distal end. The organs of the individual drawn measure:

Length of penis	7.5 mm.
" " epiphallus	14 "
" " vagina	6.3 "
" " spermatheca and duct	13 "

Two radulæ examined agree essentially with *O. cuprea.* Formula of teeth about 54, 6, 1, 6, 54.

Two shells measure:

Alt. 15.0, diam. 25 mm.
" 13.3, " 22 "

The jaw is yellow, with truncate ends, the median projection either low or strong.

Omphalina cuprea polita Pils.

Omphalina fuliginosa polita Pils., Nautilus, XII, p. 86, Dec., 1898. Ferriss, Nautilus, XIV, p. 56; Pilsbry, Proc. A. N. S. Phila., 1900, p. 134.

Has not been dissected. It is characteristic of the mountains along the Tennessee—North Carolina boundary.

Omphalina pilsbryi Clapp.

Omphalina pilsbryi Clapp, Nautilus, XVIII, p. 30, July, 1904.

The foot has a wide double margin, the upper groove obsolete near the end of the tail, as usual (fig. 2 C). The tail is elevated, not flat as in *cuprea*. The caudal pore is a short median slit, surrounded by concentric grooves (fig. 2 A).

The mantle-edge bears a very large, right lobe and smaller left, both being *conspicuously larger than in other known Omphalinas*. The lung is irregularly and rather copiously maculate (fig. 2 B, anterior end from the inside).

The penis and epiphallus are very long and there is a thick chocolate-colored vaginal gland around the base of the vagina. Other organs as usual in the genus (Pl. XXXVII, fig. 6).

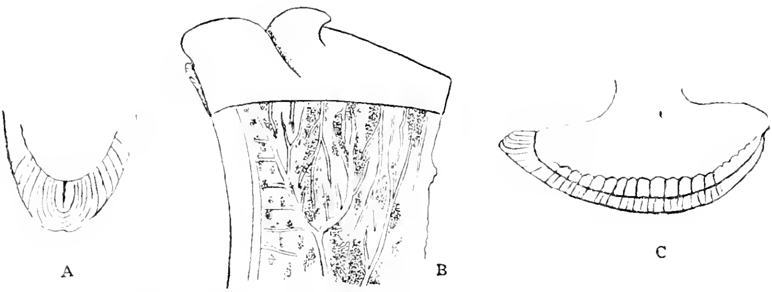

Fig. 2.—*Omphalina pilsbryi* Clapp. A, end of foot and tail pore. B, anterior end of lung and mantle-edge. C, side view of foot, contracted in alcohol, showing position of genital orifice and double foot-groove.

The jaw is pale yellow and has a very strong median projection.

The radula (Pl. XXXVIII, fig. 7) has 55, 1, 55 teeth with 5 or 6 laterals. The basal plates of central and lateral teeth are somewhat shorter than in *O. cuprea*, and the transition teeth have a more distinct and more acute ectocone. Otherwise the teeth do not differ materially from those of *O. cuprea*.

Omphalina kopnodes (W. G. Binn.).

Zonites capnodes W. G. B., Terrestr. Moll., V, p. 98, pl. 2, f. K, teeth. Ann. N. Y. Acad. Sci. I, 357, pl. 14, f. C, genitalia of specimen from near Knoxville, Tenn. Also first supplement to Terr. Moll., V, p. 137.

The foot has the usual double margin. The tail pore is in form of a median slit, with some short converging furrows on each side (fig. 3). The mantle has the same profuse maculation figured for *O. pilsbryi*. The mantle-lobes are not quite so large as in *O. pilsbryi*, but larger than in any other *Omphalina*.

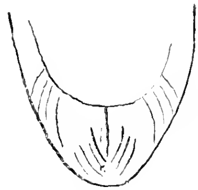

Fig. 3.

In genitalia (Pl. XXXVII, fig. 1), it resembles *O. pilsbryi*, but the proportions of penis and epiphallus differ, and the latter is inserted much nearer to the distal end of the penis than in *O. pilsbryi*, only 1.5 mm. from the end, being more nearly terminal than in any other *Omphalina*. The epiphallus passes without abrupt contraction into the vas deferens. The vagina is enveloped in a large chocolate vaginal gland.

The jaw is pale yellow, with a strong median projection. The radula (Pl. XXXVIII, figs. 3, 5) has 66, 7, 1, 7, 66 teeth. There are distinct outer cutting-points on the central and lateral teeth, the change to the marginal type is very abrupt. A group of marginals from the middle of the marginal field is figured. The teeth decrease in size very gradually towards the outer margin of the radula.

The specimens examined and figured were collected at Monte Sano, near Huntsville. Ala., by Mr. H. H. Smith. The type locality is "Alabama."

Binney found 66, 1, 66 (57, 9, 1, 9, 57) teeth in one, 46, 1, 46 teeth in another radula. I doubt whether the latter radula was from an adult individual. He describes it as with no side cusps, but having cutting-points on the lateral and central teeth, thus agreeing with the radula I examined in the shape of the teeth; but the number of laterals was 9 in his preparation, 7 in mine. The genitalia as figured by Binney agree well with my dissection except in one important particular: he figures the epiphallus as arising near the base of the penis, whereas I found it to spring from near the distal end. The lower part of the epiphallus is bound to the penis, as shown in my figure, and it is probable that Binney did not determine its real point of insertion.

The number of lateral teeth in *O. kopnodes* exceeds that of any others of our species examined except immature *O. friabilis* from Wyandotte, Okla., which has teeth of a quite different shape.

Omphalina friabilis (Binney).

The type locality of this species is banks of the Wabash River and in Illinois. It ranges southwest to San Marcos, Tex., and is a common snail in suitable stations in Arkansas and northeastern Oklahoma, where Ferriss and I collected in 1903.[1] Specimens have been dissected from Mablevale, Ark., Wyandotte, Okla., and San Marcos, Tex. As they show some variation, notes on all are given.

At Mt. Carmel, Ill., the shells are typical. They lack spiral striæ. The Arkansas shells are more depressed and have spiral striation. Moreover, the apices are sometimes slightly worn. In Texas the shells are very globose with spiral striæ and perfect apices.

Mablevale, Ark. (Pl. XXXVIII, fig. 4).—The foot has the usual double margination. Caudal pore as in *friabilis* from San Marcos, Tex. The mantle over the lung shows a few irregular scattered small black spots and flecks, and an oblong black spot marking the position of the reflexed ureter, but the veins are not pigmented.

The epiphallus is swollen and not much longer than the penis. The vagina is longer than usual, white to the base, which is not swollen. As the specimen was very hard, from preservation in strong alcohol, it is possible that a vaginal gland was present and much contracted or possibly torn off in dissection. (Pl. XXXVII, fig. 4.) The jaw is yellow, with truncate ends and a rather low median projection.

Wyandotte, Okla.—Two specimens dissected. In one the radula is normal for *O. friabilis*. In the other, an immature example with a shell 16 mm. in diameter, the radula (Pl. XXXVIII, fig. 2) has about 61, 1, 61 teeth with 7 laterals. Both cusps and basal plates are decidedly shorter than in any other *Omphalina*. The marginal teeth also have remarkably short cusps. All of the teeth are separated more than usual in this genus. The number of lateral teeth is greater than in any other of our species except *O. kopnodes*, which has much longer teeth. The jaw is pale yellow, with a strong median projection.

The epiphallus is almost terminal on the penis, a position which I think must be due to immaturity (Pl. XXXVII, fig. 5).

The pedal grooves are double as usual, caudal pore a simple slit. There is some sparse blackish streaking on the lung (fig. 4).

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[1] Specimens reported in these Proceedings for 1906, p. 562, as *O. fuliginosa* from Wyandotte, in the "Wyandotte Nation," Oklahoma, are young *O. friabilis*.

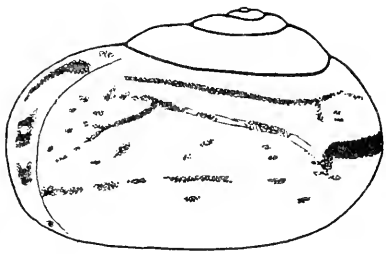


Fig. 4.—*O. friabilis* from Wyandotte, removed from the shell, showing pigmentation of mantle.

San Marcos, Tex.—The pedal lines are double as usual, the deeper ones meeting in a curve over the tail. No distinct caudal mucus pore is discernible in some alcoholic specimens, but the margin is less deeply grooved near the end of the tail than elsewhere. Other individuals have a simple slit. There are no specialized dorsal or facial grooves. The mantle margin has a short right body-lobe, but no shell-lobes. The sole is tripartite. All the veins and arteries of the lung are outlined with black pigment, causing it to appear much darker than the lung of Arkansas examples dissected.

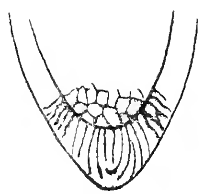


Fig. 5. — *O. friabilis* Binn. from San Marcos, end of foot with tail-pore

The atrium is excessively short, only reaching through the integument. The penis is stout and short with terminal retractor muscle, inserted distally in the lung floor. About in the middle of the penis a long stout epiphallus enters. It tapers distally into the vas deferens, and near the end receives a very slender muscle which is inserted in the connective tissue around the base of the penis. The vagina is chocolate colored and much swollen below. The spermatheca is very large, oblong, on a slender duct about as long as the vagina (Pl. XXXVII, fig. 2). The organs measure as follows:

Length of penis	about 6.0 mm.
" " epiphallus	about 15.0 "
" " vagina	8.5 "
" " spermatheca and duct	13.5 "

The jaw is pale yellowish-gray, with a median ridge and strong projection, sides distinctly striate.

The radula of a San Marcos specimen (Pl. XXXVIII, fig. 6) has 65, 5, 1, 5, 65 teeth, the cusps, especially of the centrals, being longer and narrower than in any other of our species of *Omphalina*. Two radulæ examined.

In an individual from Mablevale, Ark. (Pl. XXXVIII, fig. 4), there are about 55, 5, 1, 5, 55 teeth, the centrals somewhat less lengthened. Counted in another place, I found 53, 5, 1, 5, 53 teeth on the same radula.

Binney records 57, 1, 57 teeth with 6 perfect laterals. The locality of the snail he examined was not stated. Except in having somewhat longer cusps, the radulæ I prepared differ very little from *O. cuprea*.

Genus **MESOMPHIX** ('Raf.') Beck.

Beck, Index Molluscorum, p. 7 (1837), for *M. virginalis* B. (undescribed), *M. fuliginosa* Griff., *M. walkeri* Gray, *M. lævigata* Raf., *M. elliptica* Mich. and *M. olivetorum* Gm.

Herrmannsen, Indicis Generum Malacozoorum Primordia, II, p. 40, "typus *Helix lævigata* Raf." (July 17, 1847).

The shell is like *Omphalina*, except that it is more depressed, with a much smaller umbilicus and the embryonic whorls are ribbed or striate radially in most species.

External anatomy as in *Omphalina*. Genitalia differing from *Omphalina* by the development of *a flagelliform gland terminal on the penis*. The epiphallus is distinctly differentiated from the vas deferens. Vaginal gland wanting. Jaw reddish-brown or black, very opaque, with a small median projection.

Radula with the basal-plate of the central tooth contracted in the middle; lateral teeth few, 0 to 4. Marginal teeth as in *Omphalina*.

Type *M. lævigata*.

This genus is well differentiated from *Omphalina* by the presence of a flagelliform penial gland, a very unusual structure in American *Zonitidæ*. This gland is long and slender in *M. subplana* (Pl. XXXVII, fig. 7, *p.g.*), shorter and stout in *M. lævigata* (fig. 10). The shell often bears a diagnostic feature in its scuptured apex. The jaw in all the species examined (*M. lævigata, subplana, rugeli, andrewsæ* and *inornata*) is remarkable for its dark or black color. In *Omphalina* the jaw is pale yellow, so far as observed.

These features are an advance beyond the morphology of *Omphalina*, being, as it were, superposed upon the Omphalinoid organization. The radula also is more specialized by the partial or complete elimination of lateral teeth.

In describing the genus *Mesomphix*, Rafinesque mentioned no species. Its foundation therefore dates from the memorable *Index* of Beck, who included some species of other groups. Herrmannsen, in 1847, expressly selected *lævigata* as the type, probably because this was known to be a Rafinesquian species. Gray, in the same year, names *lævigata* and *olivetorum* as examples. Von Martens and American authors have used the name *Mesomphix* for heterogeneous assemblages of species, but this later usage cannot be upheld against Herrmannsen's selection of *lævigata* as type of the group.

The dentition in *Mesomphix* is varied in the several species. *M. lævigata* is quite peculiar in having no lateral teeth, the inner ones being transitional to the marginal type, and the central tooth is peculiar in the form of the basal plate and the great reduction of its single cusp. The radula in this species is evidently evolving towards the type of *Circinaria.*

In the other species the central tooth is well developed and tricuspid, with a somewhat hour-glass-shaped basal plate. This is least marked in *M. rugeli*, which has teeth much like *Omphalina.* The number of teeth is also characteristic, as seen in the formulas below, in which the transition teeth are counted as marginals.

	Central.	Lateral.	Marginal.
M. inornata	1	2	21–25
M. andrewsæ	1	3	37
M. subplana	1	2	34
M. rugeli	1	4	34–37
M. lævigata	1	0	17–19

Mesomphix may be divided into three subgenera, as follows:

I. Embryonic whorls of the shell radially striate.

Subgenus MESOMPHIX.

No lateral teeth; central tooth with a single small cusp. Flagelliform gland of the penis very short. Type and only species *M. lævigata* "Raf." Beck.

Subgenus MICROMPHIX (new).

Several (two to four) lateral teeth; central tooth well developed, tricuspid. Flagelliform gland of the penis long, about half the length of the penis. Type *M. subplana* Binn. Includes also *M. rugeli.*

II. Embryonic whorls smooth or faintly striate spirally.

Subgenus OMPHIX (new).

Radula and genitalia as in *Micromphix*, but embryonic whorls of the shell smooth. Type *M. inornata*. Includes also *M. andrewsæ* Pils.

Mesomphix lævigata Beck.

Beck. Index Moll., p. 7, based upon Férussac, Histoire, etc., pl. 82, f. 6.
Helix lævigata Pfr., not of Pennant, 1777. Bland, Ann. Lyc. N. H. of N. Y., VII, p. 120 (identity of *lævigata* with *inornata* Say affirmed).
Omphalina lævigata "Raf." Beck, Pilsbry, Proc. A. N. S. Phila., 1900, p. 134.

Beck gives the locality as North America in South Carolina, but he gave no description, basing the name solely upon Férussac's figures of specimens sent by Rafinesque from Kentucky; hence the type locality is in the latter State.

The common form of *lævigata* from Kentucky south to northern Florida, Alabama, and southwest to Lake Charles, Louisiana, is rather a capacious shell, rarely entirely green, usually russet above, green beneath. The striæ are very fine, close and deeply cut, covered with a beautiful sculpture of minute papillæ in close spiral lines. A large specimen from Alabama measures, alt. 16, diam. 26.5 mm., umbilicus about 1.8 mm. wide.

While there are local differences in size, color, and minute sculpture, it seems doubtful whether any definable races exist except in the southern Alleghanies, where several forms have been differentiated. A very small race occurs in Florida.

Mesomphix lævigata monticola n. subsp.

Omphalina lævigata (specimens from Great Smoky Mountains) Pils., Proc. A. N. S. Phila., 1900, p. 135.

The shell is more glossy on the upper surface than *M. lævigata*, the striæ less deeply cut and less regular, covered with a much more minute, less distinct, microscopic granulation. Smaller than typical *lævigata* and more depressed, green throughout.

Alt. 11.5, diam. 20.5 mm.; $4\frac{3}{4}$ whorls.

Sugar Cove (type locality) and Cades Cove at the western foot of Thunderhead Mountain, and also on Thunderhead nearly to the summit, Blount County, Tennessee, collected by Messrs. Ferriss, Walker, Clapp, Sargent and Pilsbry, 1889. Types No. 71,367 A. N. S. P.

The same form has also been collected by the late Mrs. George W. Andrews, in the same neighborhood, and it was also taken on the Little Tennessee River near Tallassee Ford by Mr. Ferriss.

The so-called *lævigata* from southwestern Pennsylvania is much closer to this race than to typical *lævigata*, and for the present they may be placed here. The shells differ from those of the southern mountains chiefly by being rather strongly chestnut or reddish-brown tinted. Those seen are from Somerset and Fayette Counties, Pennsylvania.

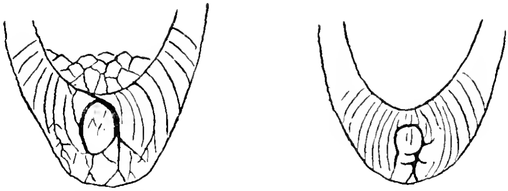


Fig. 6.—*Mesomphix lævigata monticola.* End of foot and tail-pore of two individuals from Cades Cove, Tenn.

The penis is fusiform, slender at its distal end, terminating in a stout finger-shaped gland, and with a very short and strong retractor muscle. Epiphallus somewhat longer than the penis. The lower portion of the oviduct is much convoluted. Vagina short, whitish, not swollen basally, and no vaginal gland was seen (Pl. XXXVII, fig. 10).

Length of penis	8.5 mm.
" " epiphallus	10.0 "
" " vagina	3.0 "
" " spermatheca and duct	10.0 "

The caudal gland is an irregular curved fissure, partly surrounding a median areole (fig. 6).

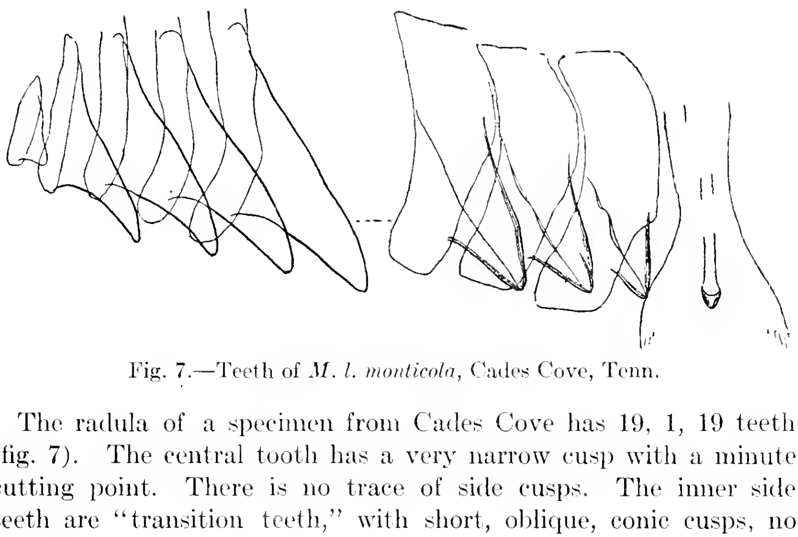


Fig. 7.—Teeth of *M. l. monticola*, Cades Cove, Tenn.

The radula of a specimen from Cades Cove has 19, 1, 19 teeth (fig. 7). The central tooth has a very narrow cusp with a minute cutting point. There is no trace of side cusps. The inner side teeth are "transition teeth," with short, oblique, conic cusps, no ectocones. They are of the aculeate rather than the quadrate form. Further out the cusps are strictly aculeate, but short and stout.

Binney records 19, 1, 19 and 17, 1, 17 teeth in specimens of *lævigata* he examined. His figure shows rudimentary side cusps, but no cutting points on the central, and a well-developed ectocone on the first lateral tooth. The locality of his specimen is not stated.

Mesomphix lævigata perlævis (Pils.).

Omphalina lævigata perlævis Pilsbry, Proc. A. N. S. Phila., 1900, p. 135. Ferriss, Nautilus, XIV, p. 56.

(*a*) The radial striæ on the embryonic $1\frac{1}{2}$ whorls are coarser than in *lævigatus*, weak or wanting on the first half whorl. The typical form from Tallassee Ford, Monroe County, Tenn., has irregular wrinkles on the last whorl, with a spiral sculpture of very faint, close, smooth lines, often nearly or quite obsolete. The largest shell of the type lot measures: alt. 10, diam. 17.5, aperture alt. 9, width 10 mm.; whorls $4\frac{1}{2}$.

A few shells, not quite adult, from Lawrenceburg, Dearborn County, Ind. (A. C. Billups), do not appear to differ from *perlævis*.

(*b*) Three lots from Macon County, Ga., and Black Mountains, N. C., collected by Hemphill, and from Burnside, Ky., collected by Ferriss, differ by having the last whorl closely striate above, but under the microscope only very fine, smooth, spiral lines are seen. A specimen from Macon County measures: alt. 12, diam. 19.5, aperture 9 x 11 mm., with 5 whorls.

(*c*) Another form related to *perlævis* is densely striate above, but the aperture is wider, less rounded. The upper surface is often russet-tinted, as in *M. lævigata*, but the microscopic spirals are faint, fine and smooth, not granulose. The aperture is more oblique than in the preceding race. Alt. 12, diam. 21, aperture 9.3 x 12.7 mm., whorls 5.

This form is from Cheoah River at the junction of Yellow Creek, Graham County, N. C.

Some shells not quite mature, but apparently the same, were taken by Rhoads at Sawyer Spring, Walden's Ridge, Hamilton County, Tenn., at an elevation of about 2,300 feet.

Forms (*b*) and (*c*) may eventually be separated as distinct subspecies.

Mesomphix lævigata latior Pils.

Omphalina lævigata latior Pils., Proc. A. N. S. Phila. 1900, p. 135. Ferriss, Nautilus, XIV, p. 56.

The sculpture of the embryonic $1\frac{1}{2}$ whorls is coarser than in *lævigata;* then $1\frac{1}{2}$ finely striate whorls follow, after which the striæ weaken to low irregular wrinkles. The last $1\frac{1}{2}$ whorls have fine granules in spiral lines, as in the Great Smoky Mountain *monticola*. The soft anatomy has not been examined. It has been found at Tallassee Ford of the Little Tennessee River, Monroe County, Tenn., and at Chambers Creek Church, Swain County, N. C.

Mesomphix (?) perfragilis (Wetherby).

Zonites perfragilis A. G. Wetherby, Notes on American Land Shells, Journ. Cincinnati Soc. Nat. Hist., IV, p. 326, 1881 (undescribed). Same journal for 1891, p. 215.

On principle I oppose the introduction of MS. or "provisional" names into print, because any name not fully defined entails labor and waste of time upon others. Since this name has been printed, it may be well to give what information I can. I quote from a letter received from Wetherby years ago, date not preserved. "I tell you about *Zonites perfragilis* W., MS., so that in case you should go into the limestone region of middle Tennessee you may be on the lookout for it. It is a species built much on the plan of *Z. lævigatus* and varies in size as that does. All the specimens yet found have a shell thinner than that of *Vitrina limpida*. I first found it in a sink-hole in a cedar glade on the Murphreesboro Pike about two miles out of Nashville, in August, 1875. Not doubting my ability to clean them, with care, I plunged them into hot water, but the experiment was fatal. I lost them all. I next put some in alcohol, but before we got back to Cincinnati they were reduced to nothing as to the shells. It is not uncommon, I think, in the limestone sink-holes, especially in the damper parts."

In 1894 Wetherby gave the following description: "As thin and pellucid as *Vitrina limpida*, the shells being extremely fragile and delicate. They were much flattened, and the umbilical opening was much larger than typical *lævigatus*." Rutherford County, Tenn. This description was from memory, the specimens having been lost as noted above.

In another letter Wetherby reiterates the opinion that *perfragilis* is a very distinct species. It should be easy to find the original locality and to recognize the species from the details given above. They could probably be cleaned successfully if drowned before boiling. Otherwise the forcible retraction of the animal, in shells so fragile, breaks them up.

Mesomphix subplana (Binn.).

The caudal pore resembles that of *Omphalina pilsbryi*.

The penis has a long, slender, flagelliform terminal gland, 5 mm.

in length. Its retractor muscle is long and slender (Pl. XXXVII, fig. 7). Epiphallus 12 mm. long.

The radula examined (Pl. XXXIX, fig. 1) has 36, 1, 36 teeth. The basal-plates are very long, the cusps arising far backward, about the middle of the plates, about as in *M. andrewsæ* and *M. inornatus*. Two or three teeth on each side may be reckoned laterals, having well-developed side cusps and cutting points; the next is transitional, the rest marginals. The marginal teeth are closely crowded, with long slender cusps, longer than in other species of *Mesomphix*, and more like those of some Omphalinas. Binney found 37, 1, 37 teeth in a Roan Mountain specimen, agreeing in form with my figure except that the basal-plates are a little shorter.

The large number, closely crowded and long cusps of the marginal teeth are characteristic of this species.

Mesomphix rugeli (W. G. Binn.).

Zonites rugeli W. G. B., Ann. N. Y. Acad. Sci., I, p. 357, pl. 15, f. H (shell), I (teeth), pl. 14, f. D (genitalia).

Type locality, Roan Mountain, Mitchell County, N. C. The individual I dissected was collected there.

The mantle is unpigmented or of a diffuse smoky color, darker near the collar. The male organs (Pl. XXXVII, fig. 9) do not differ materially from *M. subplana*. Binney's figure shows the epiphallus arising too near the base of the penis, but its real insertion is not far from the middle. Length of penis 8, epiphallus 9.5 mm.

The radula examined (Pl. XXXIX, figs. 2, 3) has 41, 1, 41 teeth, of which about 4 or possibly 5 on each side are laterals, with well-developed cusps and cutting points. The central tooth has a wider, shorter basal-plate than in allied species, more like that of *Omphalina*. The intermediate marginal teeth are rather stout and ungraceful (fig. 3, left side). The outer ones decrease rapidly to the outer edge of the radula (fig. 2). The radula figured has an abnormal row of teeth on one side, the second lateral having a double ectocone. The teeth are all shorter than in *M. subplana*. Binney records 38, 1, 38 teeth, with 4 or 5 laterals, the form of the individual teeth being as figured by me.

This species is quite distinct by the short form of the central teeth and the comparatively large number of lateral and marginal teeth.

Mesomphix rugeli oxycoccus (Vanatta).

Omphalina rugeli oxycoccus Vanatta, Nautilus, XVI, p. 106, January, 1903.

Cranberry and Banners Elk, N. C.

Mesomphix inornata (Say).

Cf. Bland, Ann. Lyc. N. H. of N. Y., VII, 127.

Genitalia as in *M. rugeli.* Caudal pore as in *O. cuprea.*

The radula (Pl. XXXIX, fig. 5) has 24, 1, 24 teeth. The tricuspid centrals have an hour-glass-shaped basal-plate and well-developed cusps. There are two lateral teeth, the next two teeth being transitional. Three side teeth have cutting points on the ectocones. The marginal teeth are less crowded than in *M. subplana* or *M. andrewsæ*, with shorter cusps than the former.

The number of teeth in a row is much smaller in *M. inornata* than in any species except *M. lævigata.* The cusps of the lateral teeth have a bulging outline on the inner side as in *M. andrewsæ*, but they are much longer than in that species.

Mesomphix andrewsæ (Pils.).

The tail pore is like that of *M. lævigata.* The mantle is not pigmented over the lung. The genital system (Pl. XXXVII, fig. 11) differs from related forms by the greater length of the spermatheca duct and epiphallus. The penis is strongly swollen near the base and has a rather long terminal gland (*p.g.*). Its retractor muscle is long. The very short vagina is somewhat swollen near the base, but I can see no vaginal gland there. Length of penis 3.5; of epiphallus 14 mm.; of spermatheca and duct 9.5 mm.

The radula (Pl. XXXIX, fig. 4) has 40, 1, 40 teeth, more crowded than in *M. inornata*, the central and lateral teeth have much shorter, stouter cusps. There are three lateral teeth, the next two being transitional. The marginal teeth are less slender and graceful than in *M. inornata.*

The radula of *M. andrewsæ* most resembles that of *M. inornata*, but differs by the much shorter cusps and the far greater number of teeth.

The soft anatomy of *M. a. montivaga* Pils. has not been examined.

Explanation of Plates XXXVII, XXXVIII and XXXIX.

Plate XXXVII.—Genitalia of *Omphalina* and *Mesomphix.*

Fig. 1.—*Omphalina kopnodes* (W. G. B.). Monte Sano, near Huntsville, Ala. (H. H. Smith).

Fig. 2.—*Omphalina friabilis* (W. G. B.). San Marcos, Tex. (Pilsbry and Ferriss, 1903).

Fig. 3.—*Omphalina cuprea ozarkensis* P. and F. Magazine Mountain, Ark.

Fig. 4.—*Omphalina friabilis* W. G. B. Mablevale, Ark. No. 81,115 A. N. S. P.

Fig. 5.—*Omphalina friabilis* W. G. B. Immature. Wyandotte, Okla.

Fig. 6.—*Omphalina pilsbryi* Clapp. Near Wetumpka, Ala. No. 87,349 A. N. S. P.

Fig. 7.—*Mesomphix subplana* (Binn.). Thunderhead Mountain. No. 58,004 A. N. S. P.
Fig. 8.—*Omphalina lucubrata* (Say). Texolo, V. C., Mex.
Fig. 9.—*Mesomphix rugeli* (W. G. B.). Roan Mountain, N. C. No. 70,566.
Fig. 10.—*Mesomphix lævigata monticola* Pils. Cades Cove, Blount County, Tenn.
Fig. 11.—*Mesomphix andrewsæ* Pils. Cades Cove, Tenn. No. 76,821 A. N. S. P.

Plate XXXVIII.—Fig. 1.—*Omphalina cuprea* Raf. Emporium, Cameron County, Pa. No. 68,481 A. N. S. P.
Fig. 2.—*O. friabilis* W. G. B. Wyandotte, I. T. No. 91,353 A. N. S. P.
Figs. 3, 5.—*O. kopnodes* (Binn.). Monte Sano, near Huntsville, Ala.
Fig. 4.—*O. friabilis* (W. G. B.). Mablevale, Ark.
Fig. 6.—*O. friabilis* (W. G. B.). San Marcos, Tex.
Fig. 7.—*O. pilsbryi* Clapp. Near Wetumpka, Ala.

Plate XXXIX.—Fig. 1.—*Mesomphix subplana* Binn. Thunderhead Mountain.
Figs. 2, 3.—*Mesomphix rugeli* W. G. Binney. Roan Mountain, North Carolina.
Fig. 4.—*Mesomphix andrewsæ* Pils. Central, lateral and transitional, and two marginal teeth. Cades Cove, Tenn.
Fig. 5.—*Mesomphix inornata* Say. Pittsburgh, Pa.

A NEW CALIFORNIAN CHITON.

BY S. S. BERRY.

Through the kindness of Dr. Harold Heath, of Stanford University, I have had placed at my disposal a series of small chitons dredged by him in Monterey Bay, Cal. Among them are several specimens of the curious *Mopalia heathii* and an equally aberrant allied species which seems undescribed. To contain these anomalous forms, I propose the following new group.

DENDROCHITON nov. subgenus.

Species small; valves divided into more or less distinct areas in the usual manner; insertion plates as in *Ischnochiton*, the posterior valve without a posterior-median sinus. Valve I with 7–8 slits; valves II–VII with 1,1 slits; valve VIII with 6–8 slits. Sculpture variable, as in *Mopalia*. Girdle covered above with minute ovoid spinelets or spicules, larger on the lower surface. Sutural and intersutural tufts present, the former well developed with a very long and branching central bristle.

This subgenus in large measure breaks up the distinction between the *Mopaliidæ* and the *Ischnochitonidæ*, presenting many of the features proper to both groups. In this connection it should be remarked that the girdle of even the true Mopalias is not strictly nude, but in the young, at least, is furnished (though not densely) with minute spinelets very similar to those of *Dendrochiton*.

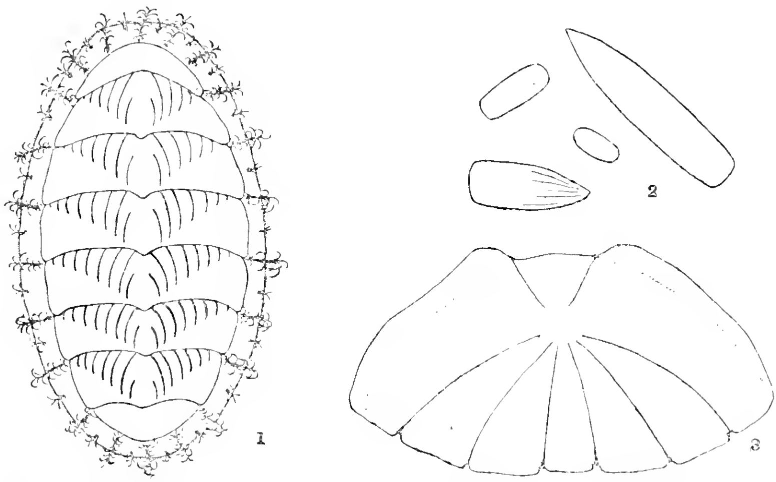
Type: the following species.

Mopalia (Dendrochiton) thamnopora n. sp. Plate XL, figs. 4, 5, 6, 8.

Shell small, oblong, rather narrow for *Mopalia*, much elevated and strongly carinated, the side slopes nearly straight.

Valves sharply beaked in front; the lateral areas fairly well defined, not raised, having a few very faint radial grooves, but without well-marked sutural or diagonal ribs. Central areas ornamented with a series of about nine or ten very strong, low, broad, longitudinal riblets, curved and converging toward the median ridge; their intervals of nearly equal breadth, not latticed or otherwise sculptured. On the jugal tract these ribs are obsolete or wanting. Entire surface minutely granular-porous, but not so distinctly as in *M.* (*D.*) *heathii*, and due largely to the numerous sense organs which under high power appear with great clearness.

Anterior valve everywhere very finely granulose, otherwise without distinct sculpture. Central area of posterior valve reduced, but similar in ornamentation to those of the median valves; mucro anterior to the middle of the tegmentum; posterior slope steep, slightly concave; posterior margin of the tegmentum in general semicircular, but rather abruptly (though not extensively) squarish truncate or emarginate at the middle.



Mopalia thamnopora.—1. Outline of entire animal. 2. Girdle spines. 3. Outline of interior of tail valve.

Anterior valve with 7 slits; intermediate valves with 1,1 slits; tail valve "ischnoid," with a regular crescentic insertion plate cut by 6 slits. Sinus broad, rather shallow; in last valve narrower and minutely crenulate. No median sinus behind, and no indications of an approach to this condition other than the above-noted squaring of the tegmentum.

Girdle narrow, apparently nude even under a hand lens, but shown by high power to be well clothed above with numerous exceedingly minute, not very crowded, ovoid spicules developed into stout elongate spines at the margin. The spinelets of the lower surface are longer, flatter and more pointed than those of the upper, being somewhat intermediate in character between these and the marginal ones.

Opposite each suture is a pore from which springs a group of about six recurved bristle-like hairs surrounding a single much larger and longer bristle, which branches freely, and in living or alcoholic material is a prominent feature even to the unaided eye. Being very brittle, these structures are frequently broken off, but their stumps or pores are always evident and show a very regular arrangement. Apparently homologous with the sutural tufts are two similar ones on each side of the head valve, one on either side of the tail valve, and one in the median line in front and behind. In addition there is a second series of much smaller but equally distinct tufts lying just outside of the first and in more or less regular alternation with them, as shown in fig. 1. The long central bristles have a thickened sheath-like base from which are given off slender, more or less recurved, hair-like processes. Altogether there are 22 of these major tufts besides an equal or slightly larger number of the minor (alternating) ones.

Color (in alcohol) a deep rose-pink, which may be either (1) without mottlings, or (2) with a stripe of reddish-brown along each side, or (3) with a broad irregular clouding of pale green, accompanied by some lateral spots of brown or Indian red, or (4) with median spots of bright orange-yellow on some of the valves, and lateral markings of Indian red.[1] The typical form seems to be pink with sutural spots of brown and more or less green suffusion. The girdle shows alternating bands of burnt sienna and pale buff. The latter are sutural in position and there are also small intersutural spots of the same color. The interior is rose, paler toward the edges, but not so vivid as in *M.* (*D.*) *heathii*.

Length of largest specimen, 9 mm.; width 5 mm.

Type locality: Off Monterey, Cal., in about 15 fathoms (H. Heath, 1908). Fifteen specimens examined, as follows:

No.	Locality.	Depth.	Collector.	Date.	Author's Register
11	Off Monterey, Cal.	15 fms.	H. Heath.	1908.	(8)
3	Off Monterey, Cal.	12 fms.	S. S. Berry.	June, 1906.	(9)
1	Pacific Grove, Cal.	Low tide.	S. S. Berry.	June, 1906.	(10)

M. (*D.*) *thamnopora* seems nearer to the *Mopalia heathii* of Pilsbry than to any other form known to me, but is so widely diver-

[1] This specimen has the usual ground color of pink with numerous small white spots and a few larger lateral ones of Indian red, but is remarkable in that the central area of the first and second valves only is a clear bright cadmium-yellow.

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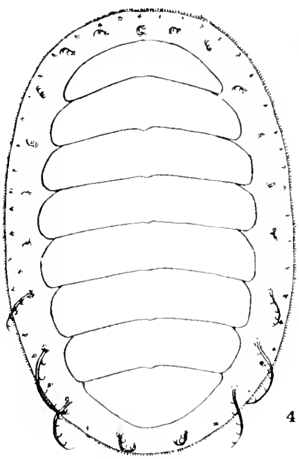
gent in sculpture as well as in other particulars that a glance is sufficient to separate the two. They agree in the characters upon which I have founded the present subgenus, but otherwise do not seem to be remarkably close. For the sake of comparison, a few notes upon the latter species are appended.

Mopalia (Dendrochiton) heathii Pilsbry. Pl. XL, figs. 1, 2, 3, 7.

Mopalia heathii Pilsbry ('98), p. 288.
Mopalia heathii Keep ('04), p. 350 (merely listed).
Mopalia heathii Thiele ('10), pp. 108, 109.

Shell small, oblong, elliptical, wide in relation to its length, carinated, rather elevated, the side-slopes nearly straight.

Valves wide and short, little beaked; the lateral areas not raised, ill defined; central areas without sculpture[2] save the very fine, even, rather distant granulation which covers the whole surface. Posterior valve with semicircular posterior outline, the mucro anterior in position; posterior slope concave, but not so steep as in *M. thamnopora*.



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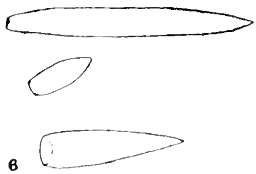

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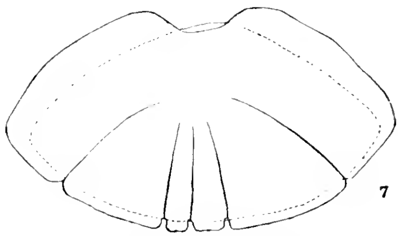

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Mopalia heathii.—4. Outline of entire animal. 5. Large lateral tooth of the radula. 6. Girdle spines. 7. Outline of interior of tail valve.

Anterior valve with 8 slits; intermediate valves with 1,1; last valve "ischnoid," with a regular crescentic insertion plate cut by 5–8 slits. In the intermediate valves the insertion plates are continuous across the sinus.

[2] Pilsbry writes: "The intermediate valves very faintly radially trisulcate at the sides," but my specimens exhibit this feature with difficulty.

Except for the sutural bristles, the girdle is stated to be nude, but examination of specimens mounted in xylol or balsam and especially dissolving fragments in Javelle water shows that the condition is approximately the same as in *D. thamnopora,* although the spicules are even smaller than in that species. In none of the specimens seen were the bristles still adherent at all of the sutures. Usually they are lost except around the posterior valve, and even here they are rarely unbroken. When complete they are longer than in the preceding species, more slender, lack any appearance of surrounding hairs at the base and give off shorter and less numerous recurved processes. Originally there seem to have been one bristle opposite each suture, from two to five in front of the head valve, and two behind the tail valve. There is no mention made by Pilsbry of intersutural tufts, but I find that very small inconspicuous bristles are sometimes evident in the centre of the round whitish spots which are to be seen about the periphery. Although so greatly reduced they seem clearly homologous with the structures holding a similar relation in the preceding species.

The color ornamentation is described by Pilsbry as follows: "(1) olive-green with some lighter spots, or purplish maculation, or slight roseate suffusion, or (2) vivid red, with scattered blue spots." With one exception my specimens are all of the latter type, agreeing with one another further in that valve VI, and to a less extent valves V and VII, are irregularly clouded with a pale greenish hue.

The nine specimens I have seen are doubtless all immature. Length of largest 11 mm.; width 7 mm.

Type: No. 71,902, A. N. S. P.

Type locality: Monterey Bay, Cal. (H. Heath, 1897).

Specimens examined:

No.	Locality.	Depth.	Collector.	Date.	Author's Register.
9	Off Monterey, Cal.	15 fms.	H. Heath.	1908.	(3)

Thiele has suggested that *Mopalia heathii* may be a *Ceratozona,* but although it is certainly suggestive of that genus in several ways, I fail to see that it does not show equally significant approximation to the group in which it was originally placed. The truth is that the diagnosis of either genus, as previously recognized, would have to be so greatly amplified to admit of the reception of the forms now before us that the erection of a new group would seem to be at present the safest course.

Literature.

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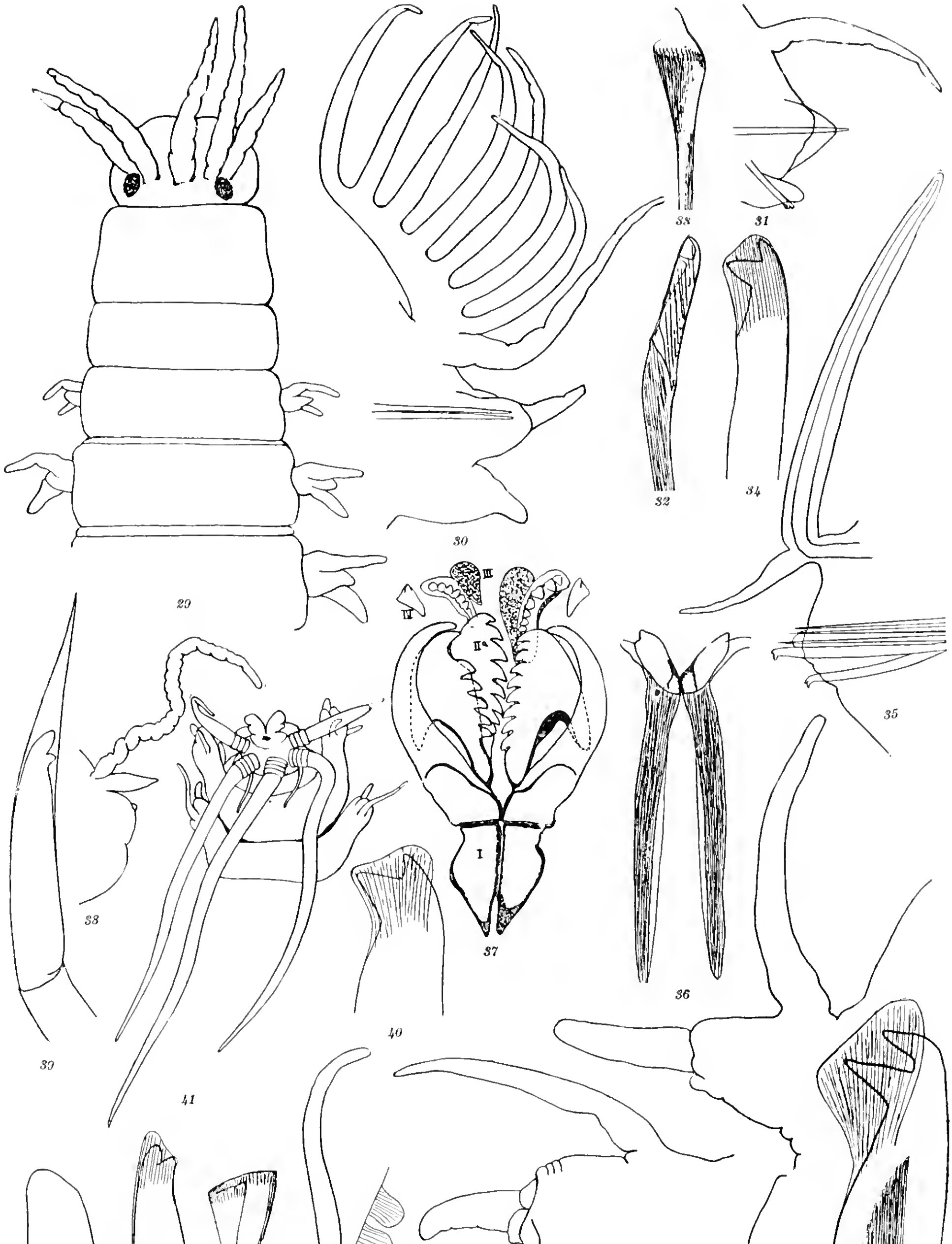
PILSBRY, HENRY A. ('92.) Monograph of the Polyplacophora. *Man. Conch.* (1), XIV, 1892.
—— ('98.) Chitons collected by Dr. Harold Heath at Pacific Grove, near Monterey, Cal. *Proc. Acad. Nat. Sci. Phila.*, 1898, pp. 287–290.
THIELE, JOHANN. ('10.) Revision des Systems der Chitonen. II. Teil. *Zoologica*, Heft 56, Bd. 22, pp. 71–126, Pls. VII–X, 1910.

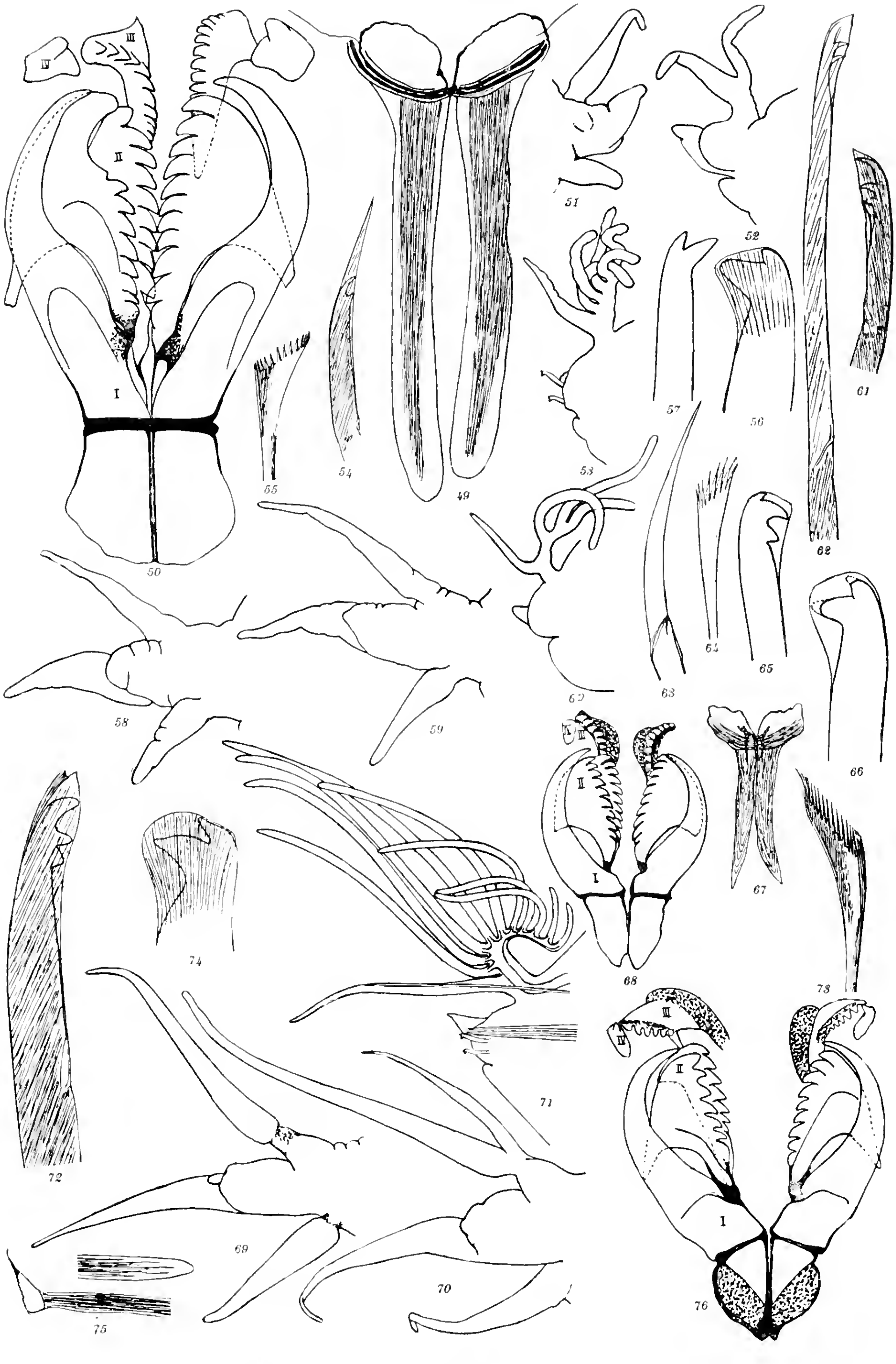
Explanation of Plate XL.

Fig. 1.—*Mopalia heathii* Pilsbry. Head valve, exterior.
Fig. 2.— " " " Third valve, exterior.
Fig. 3.— " " " Tail valve, exterior.
Fig. 4.—*Mopalia thamnopora* Berry. Head valve, exterior.
Fig. 5.— " " " Tail valve, exterior.
Fig. 6.— " " " Fifth valve, exterior.
Fig. 7.—*Mopalia heathii* Pils. Sutural bristle.
Fig. 8.—*Mopalia thamnopora* Berry. Sutural bristle.

J. P. MOORE: POLYCHÆTOUS ANNELIDS.



J. P. MOORE: POLYCHÆTOUS ANNELIDS.



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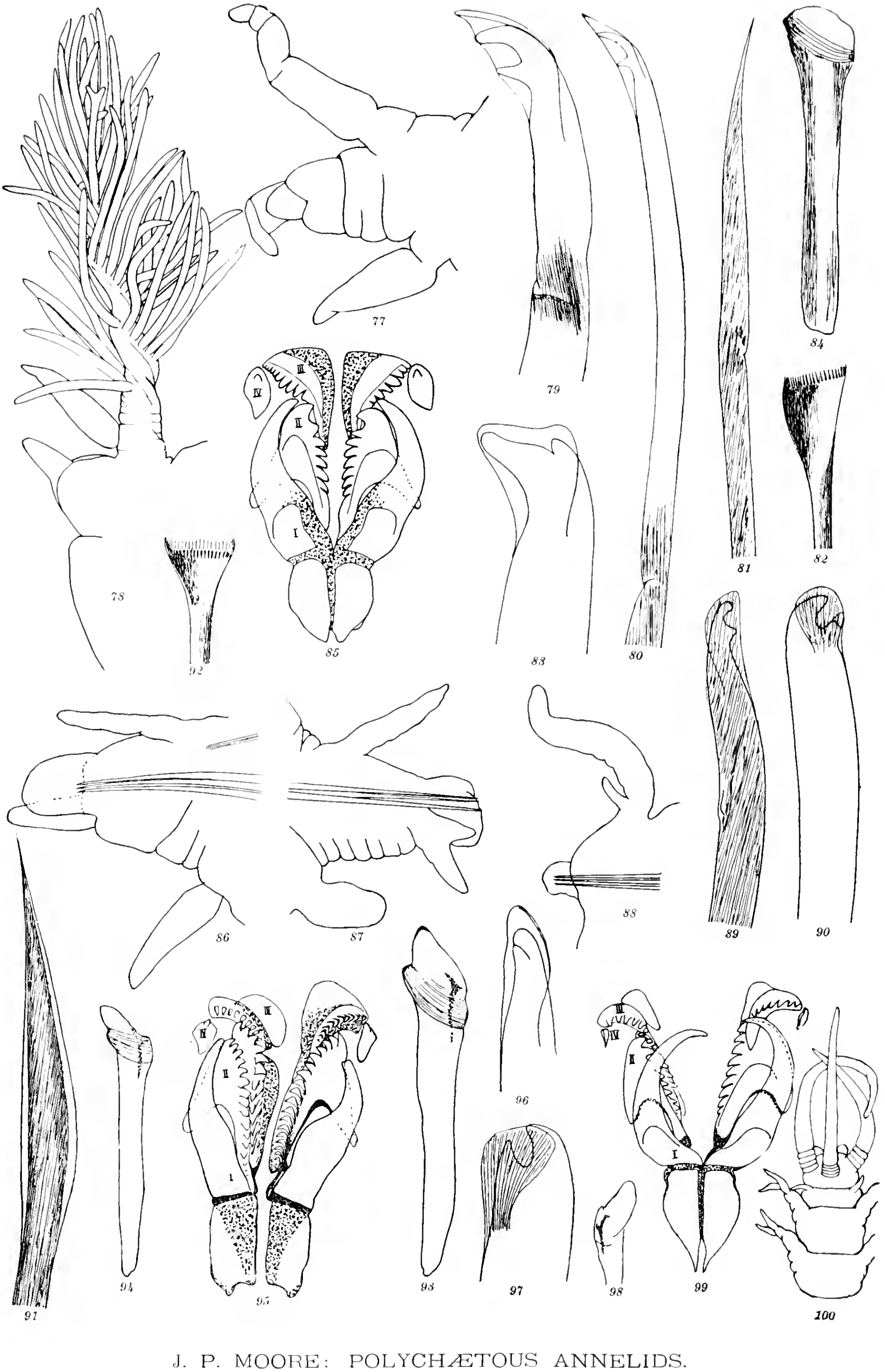

J. P. MOORE: POLYCHÆTOUS ANNELIDS.

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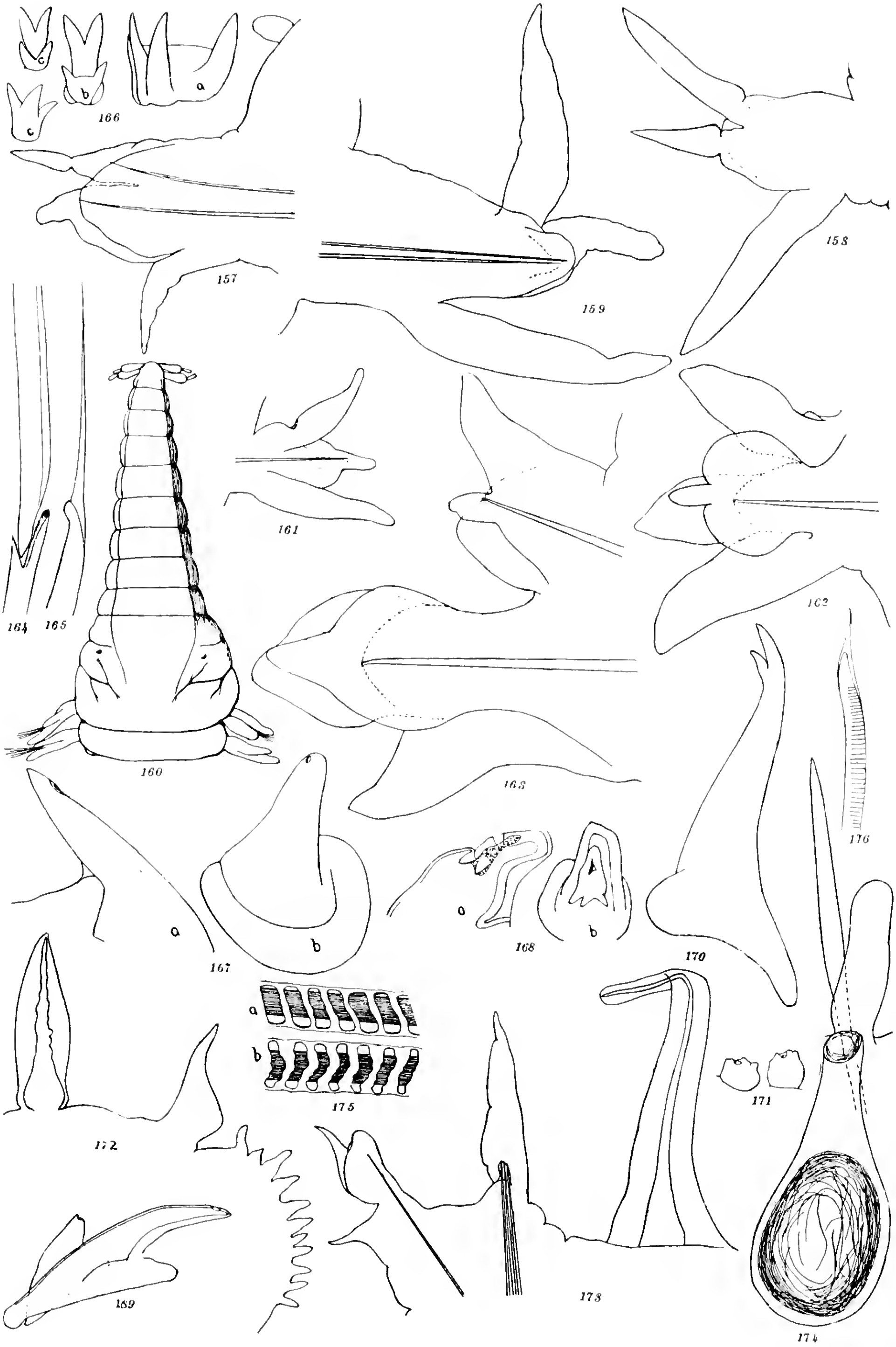
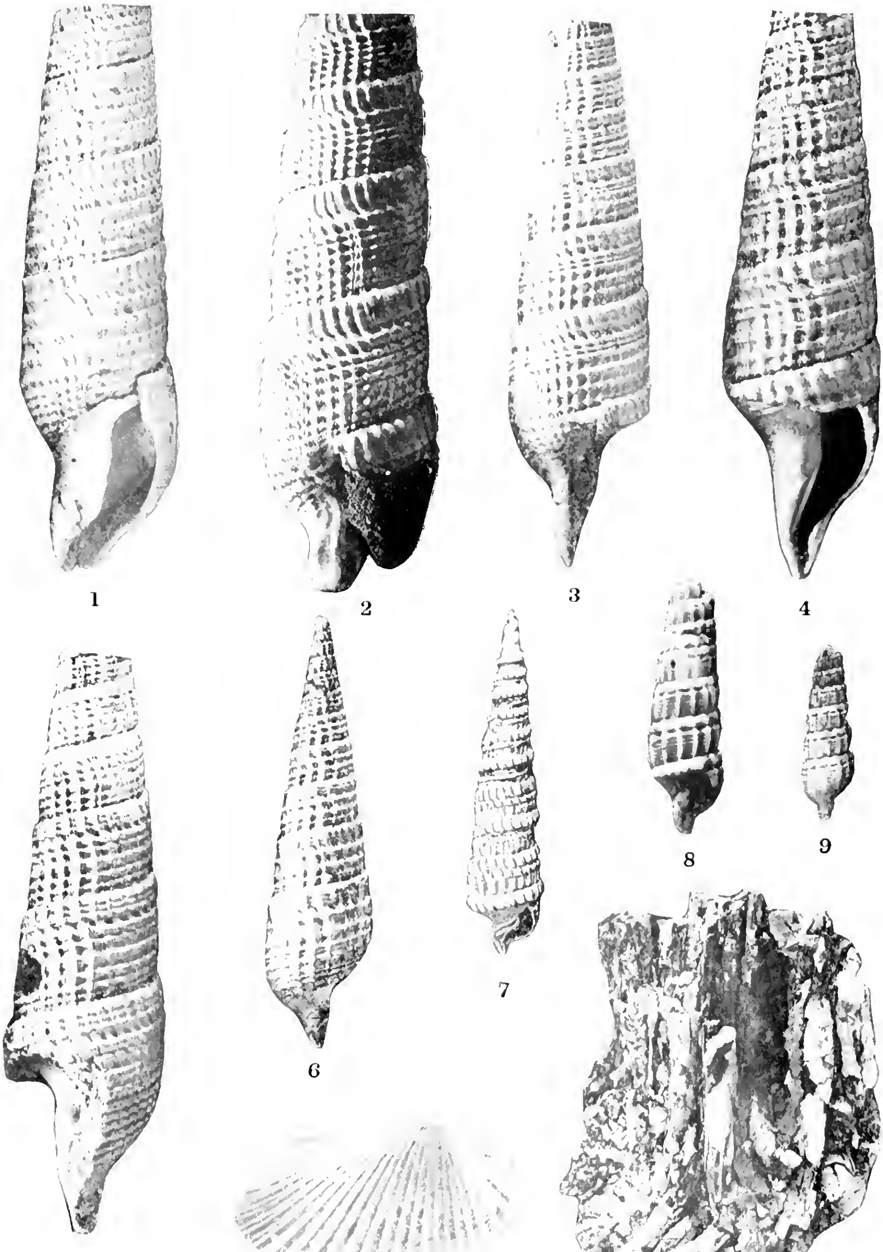
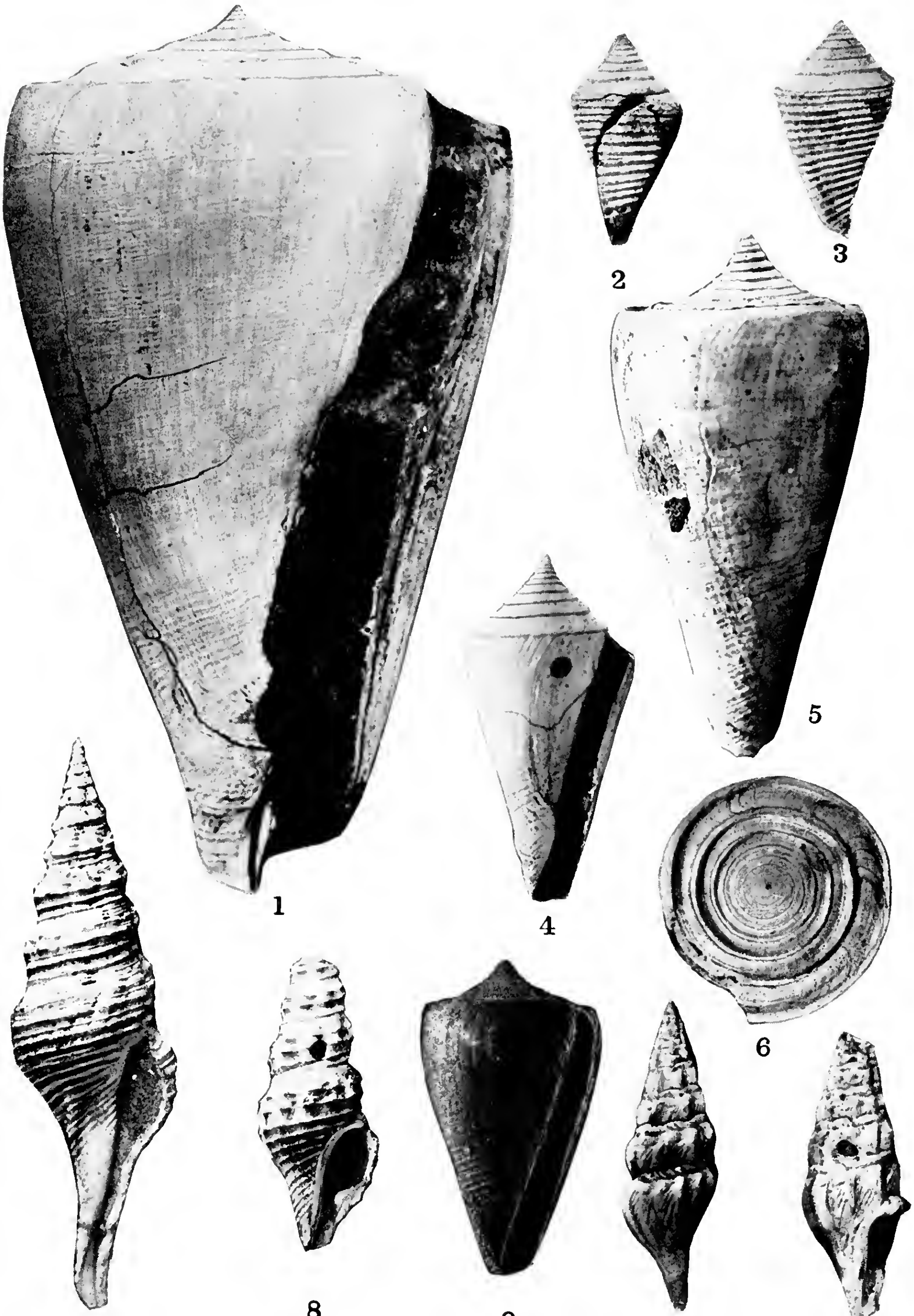


J. P. MOORE: POLYCHÆTOUS ANNELIDS.



BROWN AND PILSBRY: GATUN FOSSILS.



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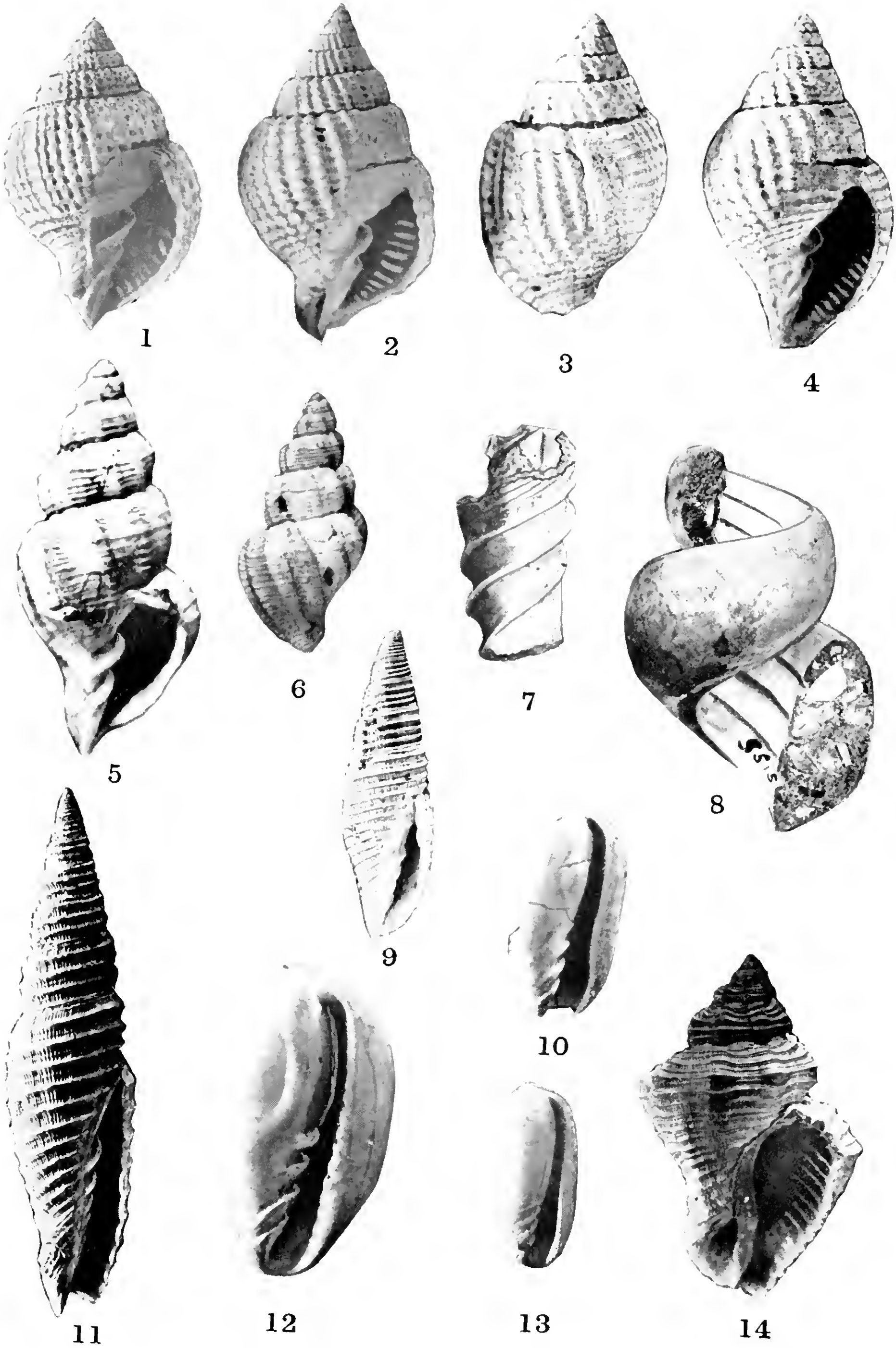

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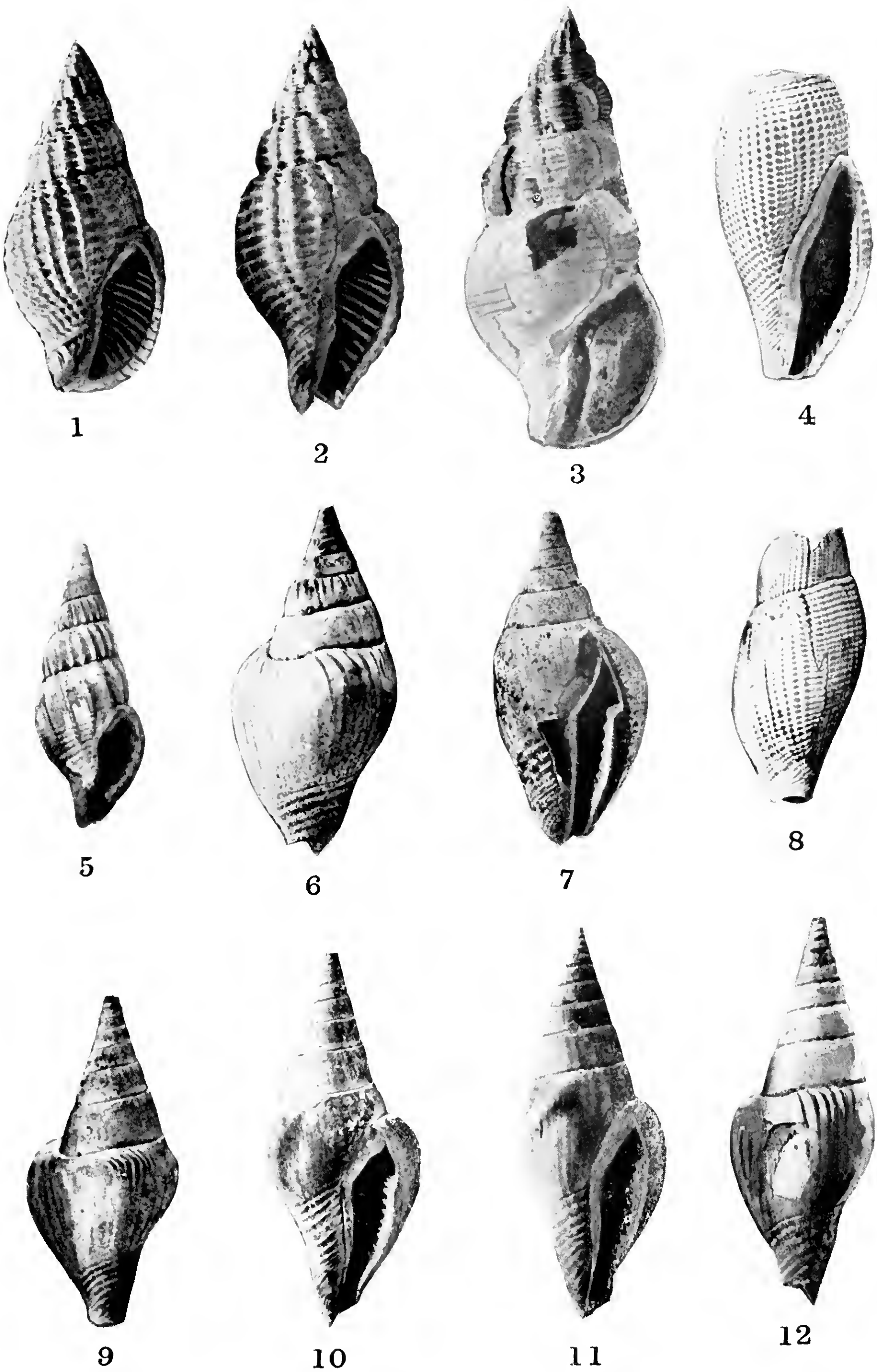

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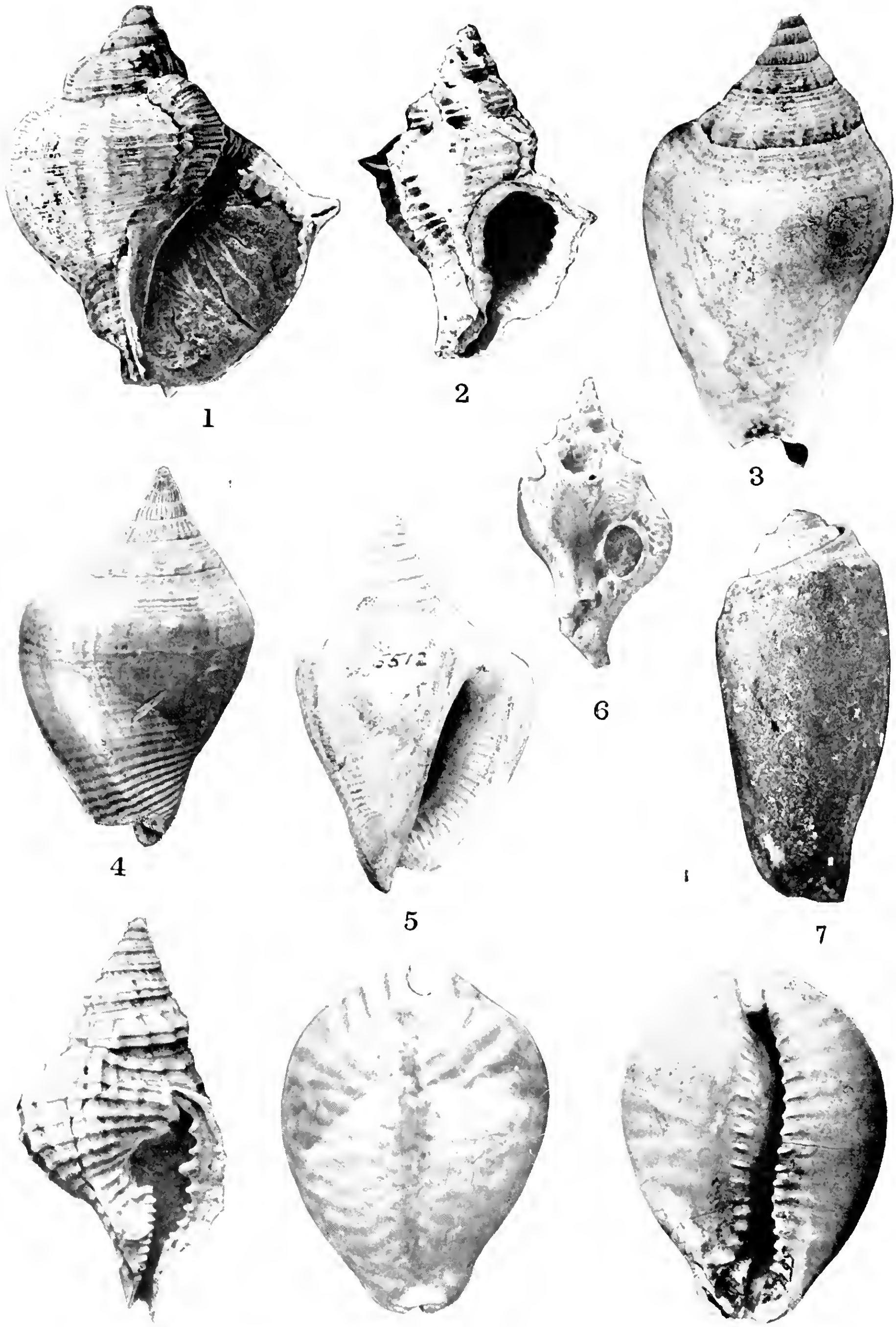

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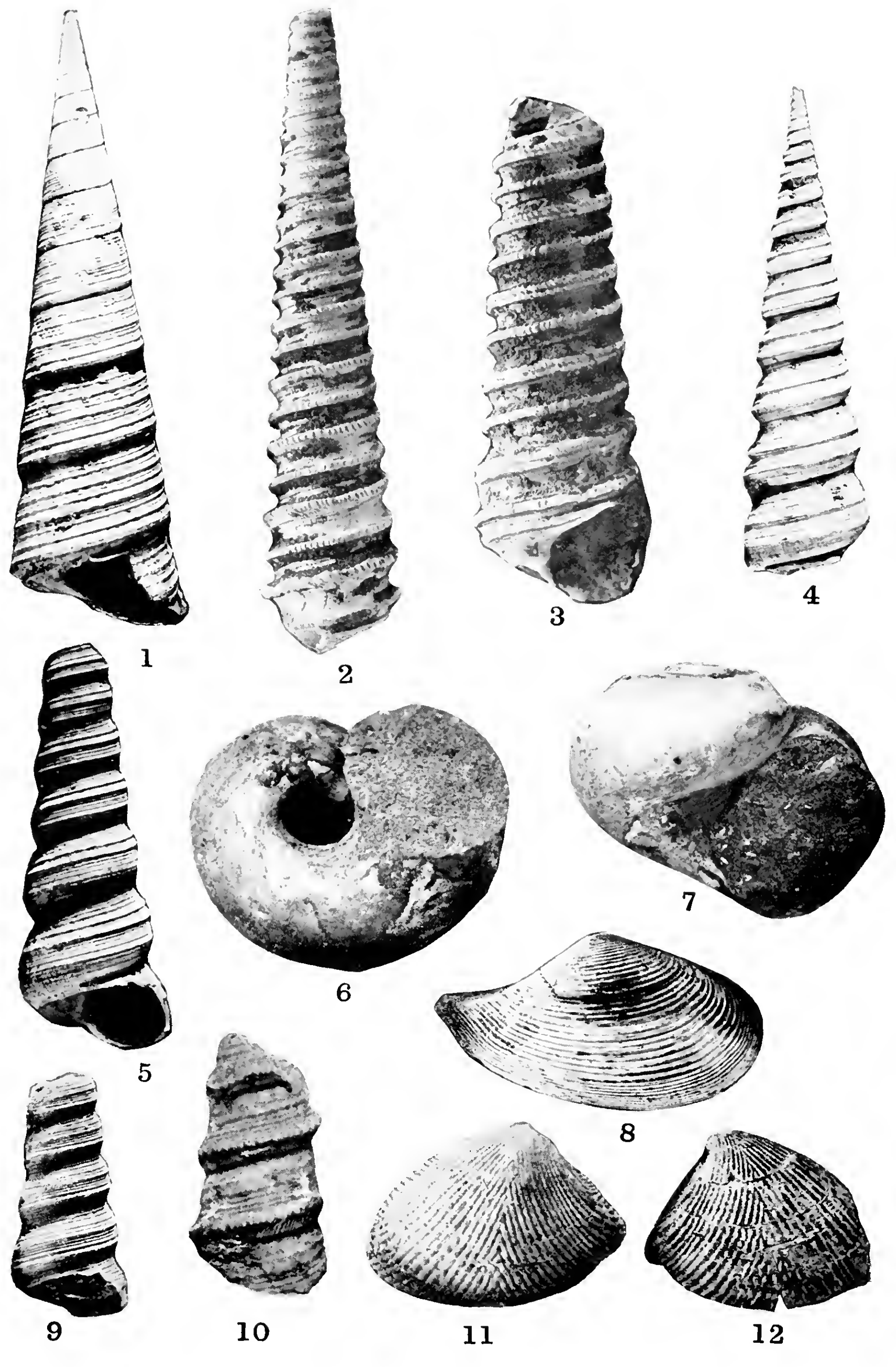

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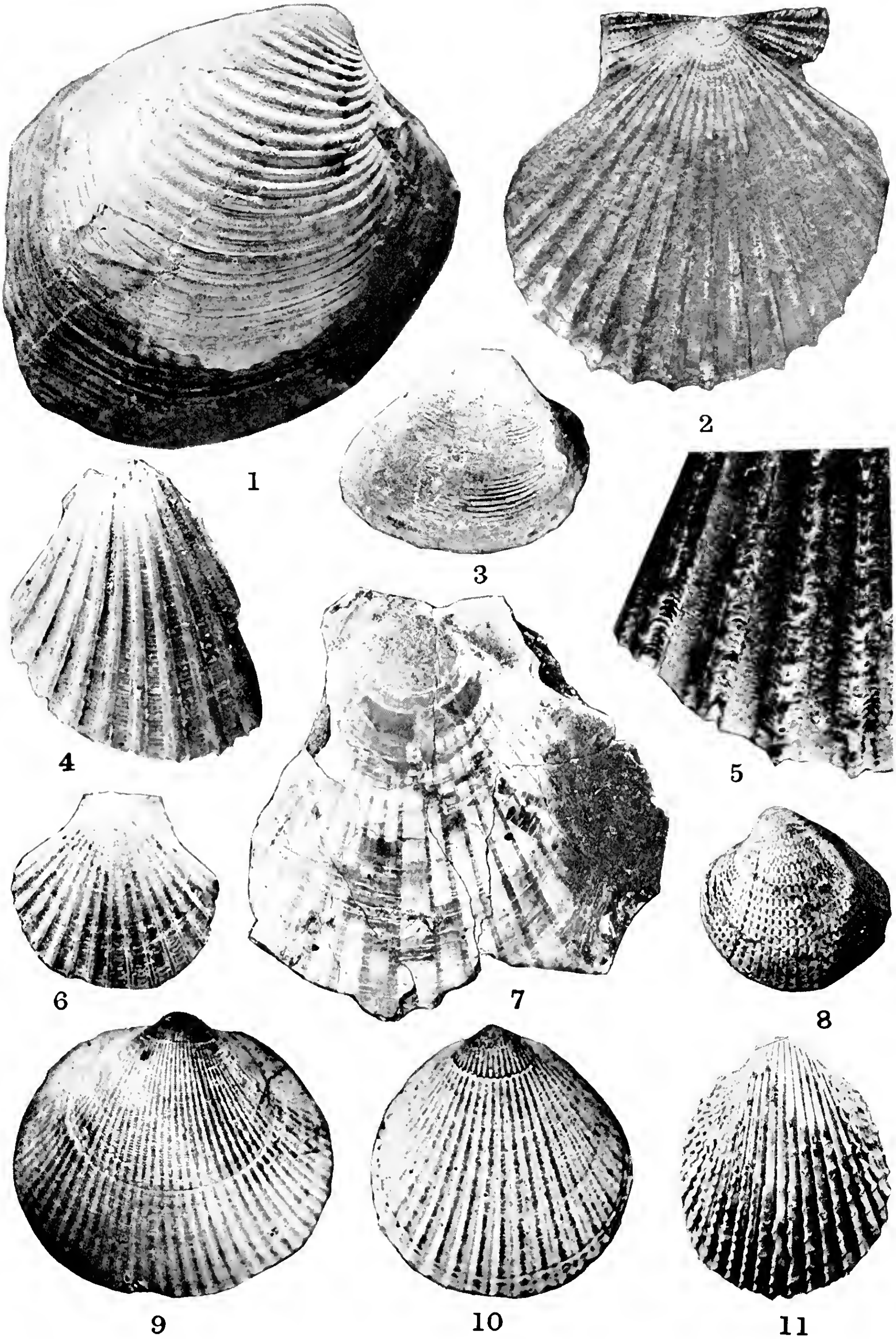

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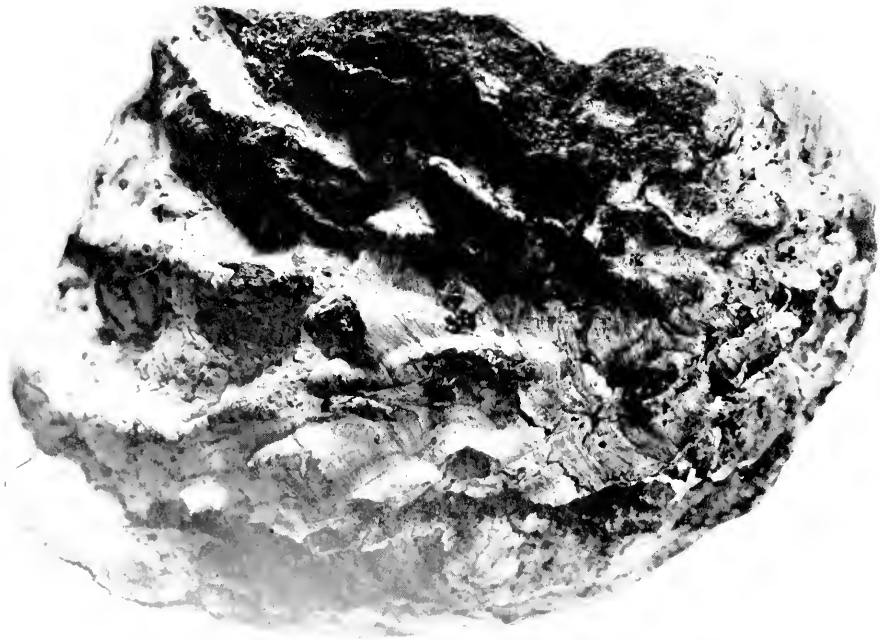

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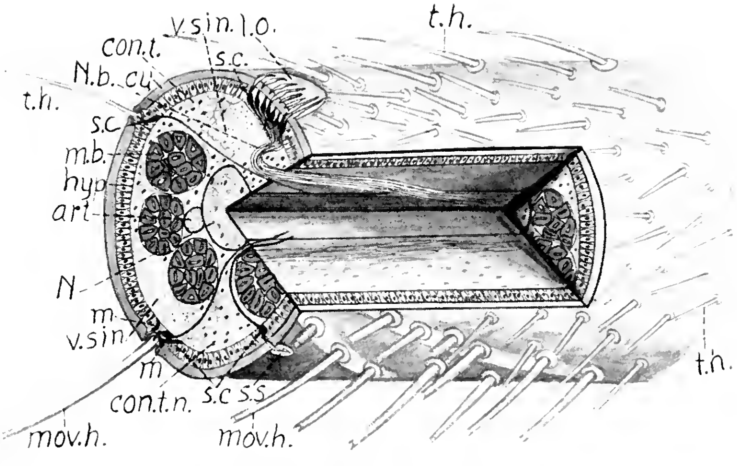
BROWN AND PILSBRY: GATUN FOSSILS.



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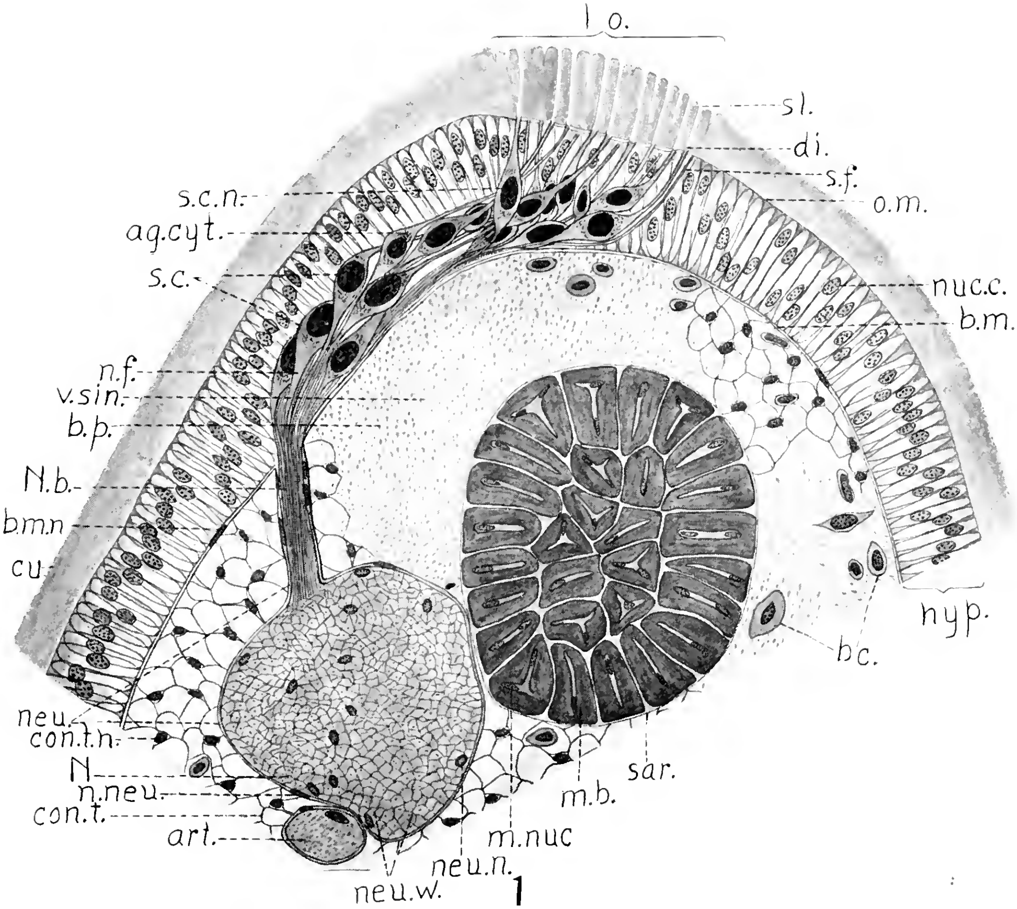

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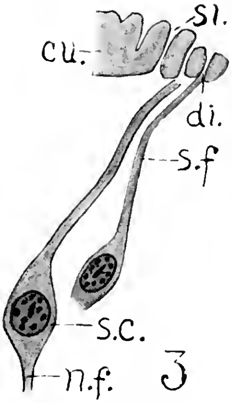
N. E. McIndoo del.

McINDOO. LYRIFORM ORGANS AND TACTILE HAIRS OF ARANEADS.



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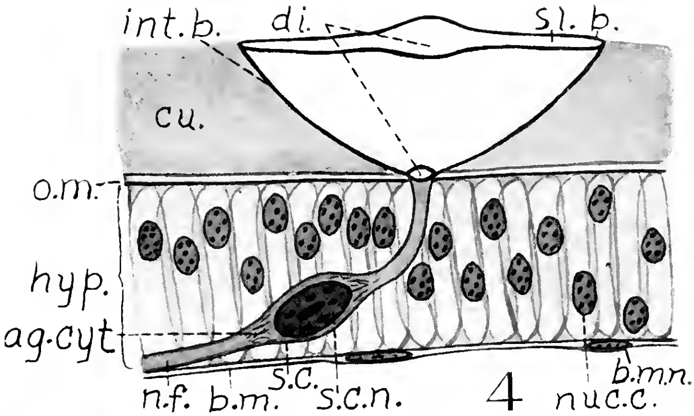

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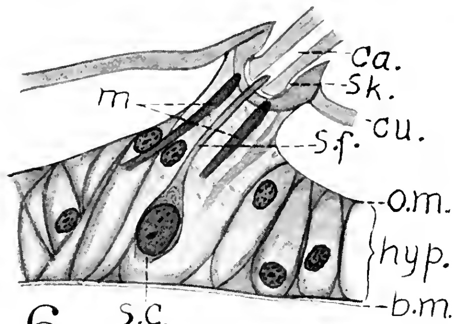

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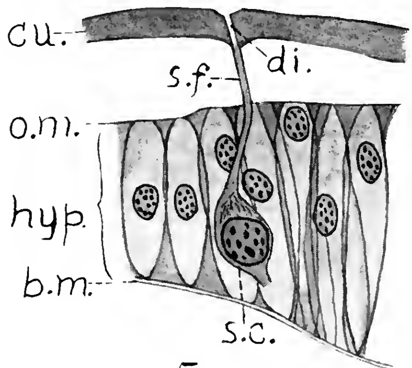

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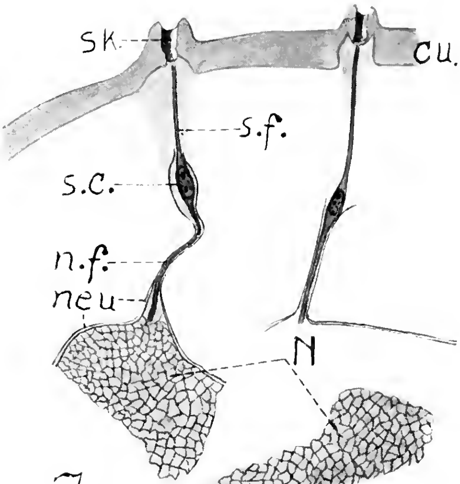

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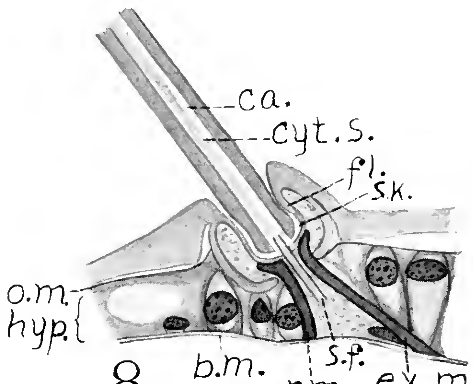

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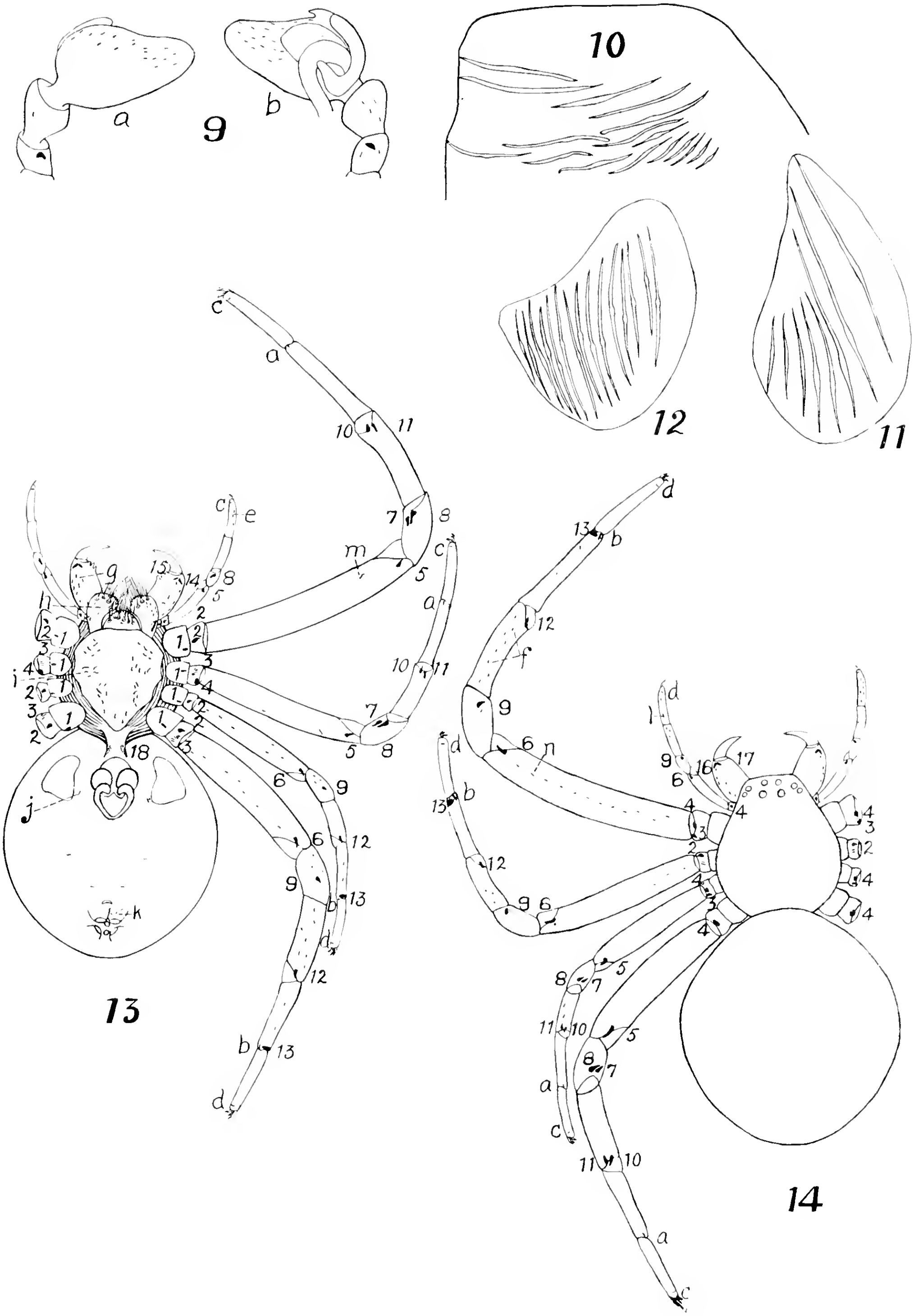
N. E. McIndoo del.

McINDOO: LYRIFORM ORGANS AND TACTILE HAIRS OF ARANEADS.



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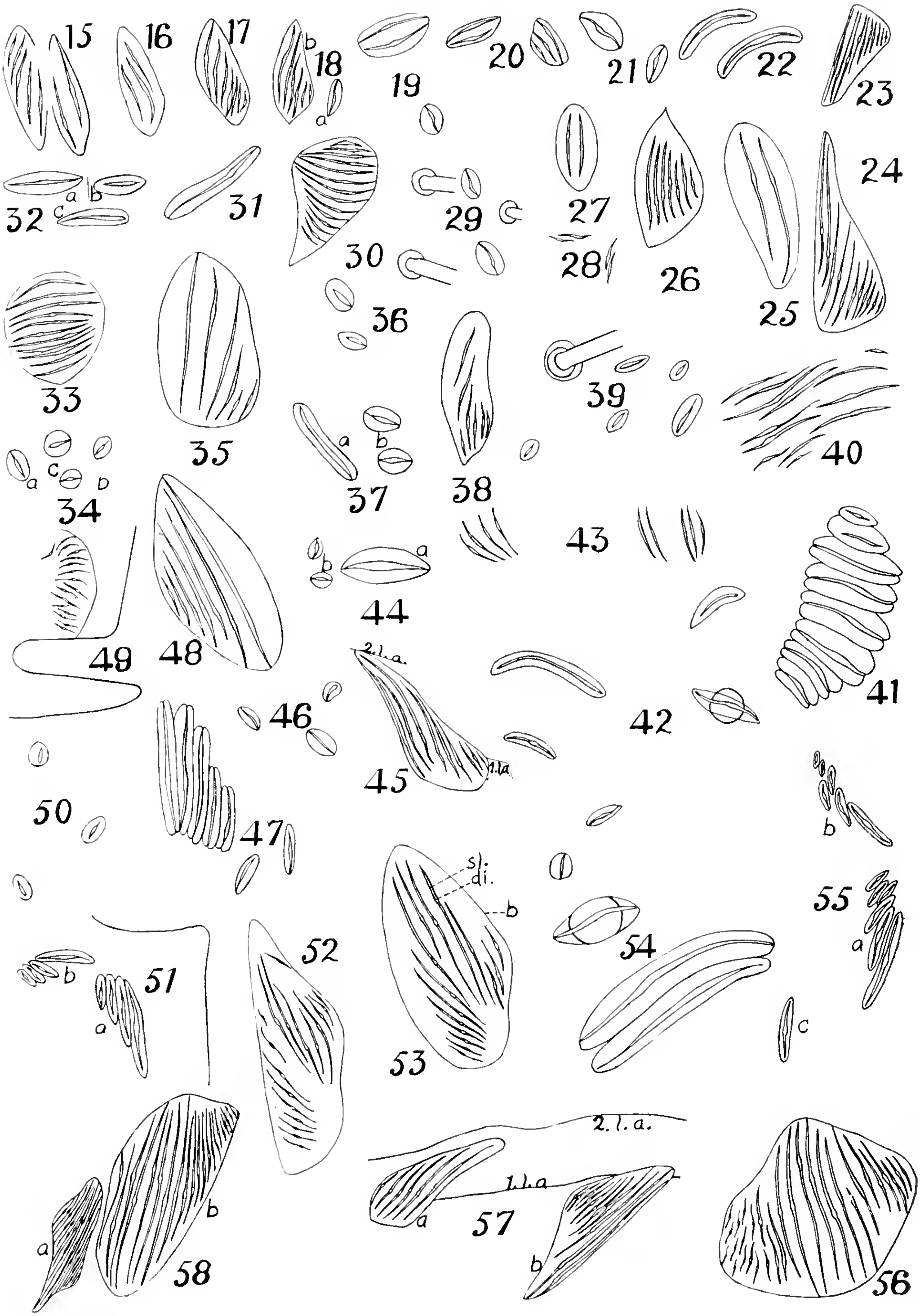
McINDOO: LYRIFORM ORGANS AND TACTILE HAIRS OF ARANEADS.



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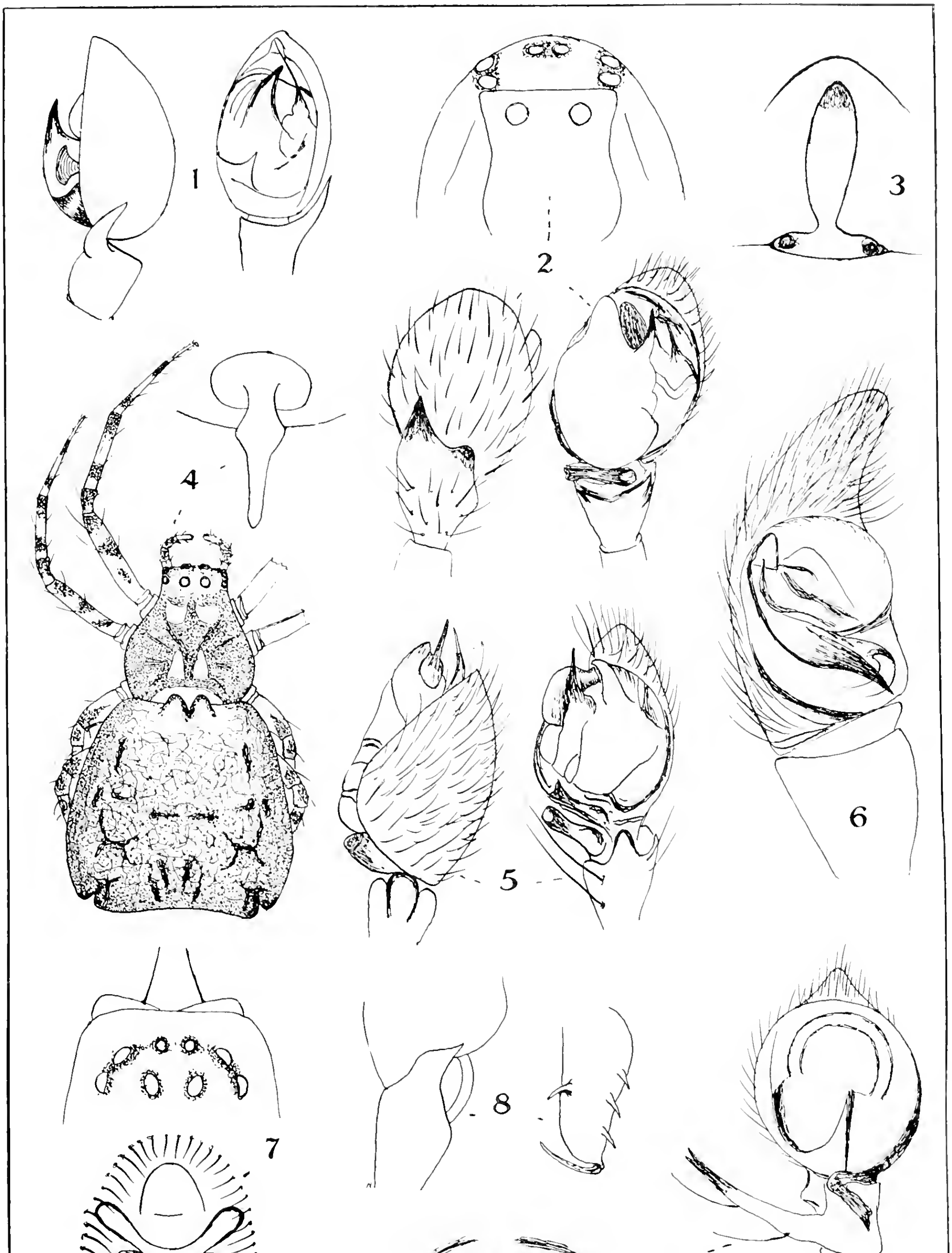
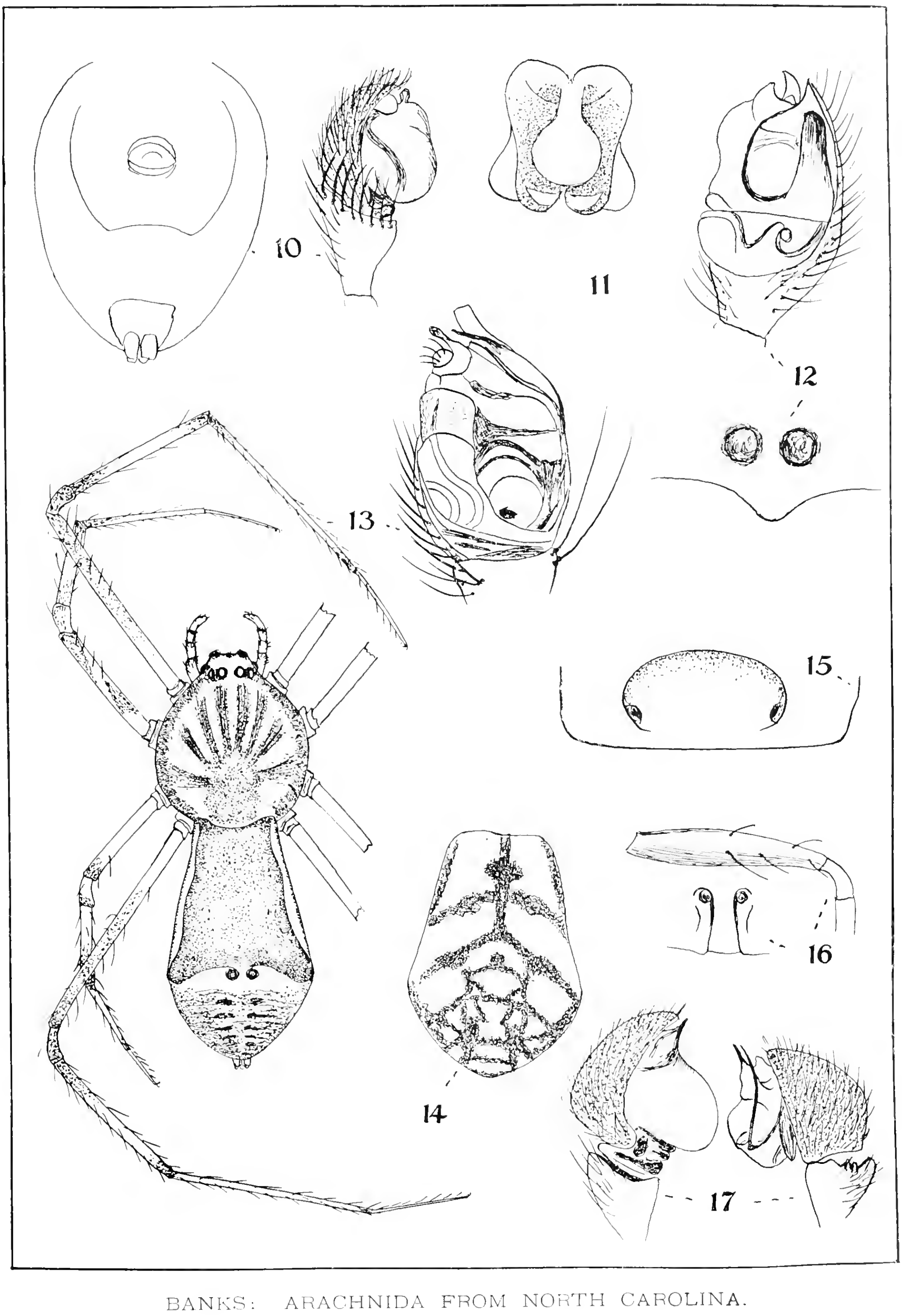
McINDOO · LYRIFORM ORGANS AND TACTILE HAIRS OF ARANEADS.



BANKS: ARACHNIDA FROM NORTH CAROLINA.



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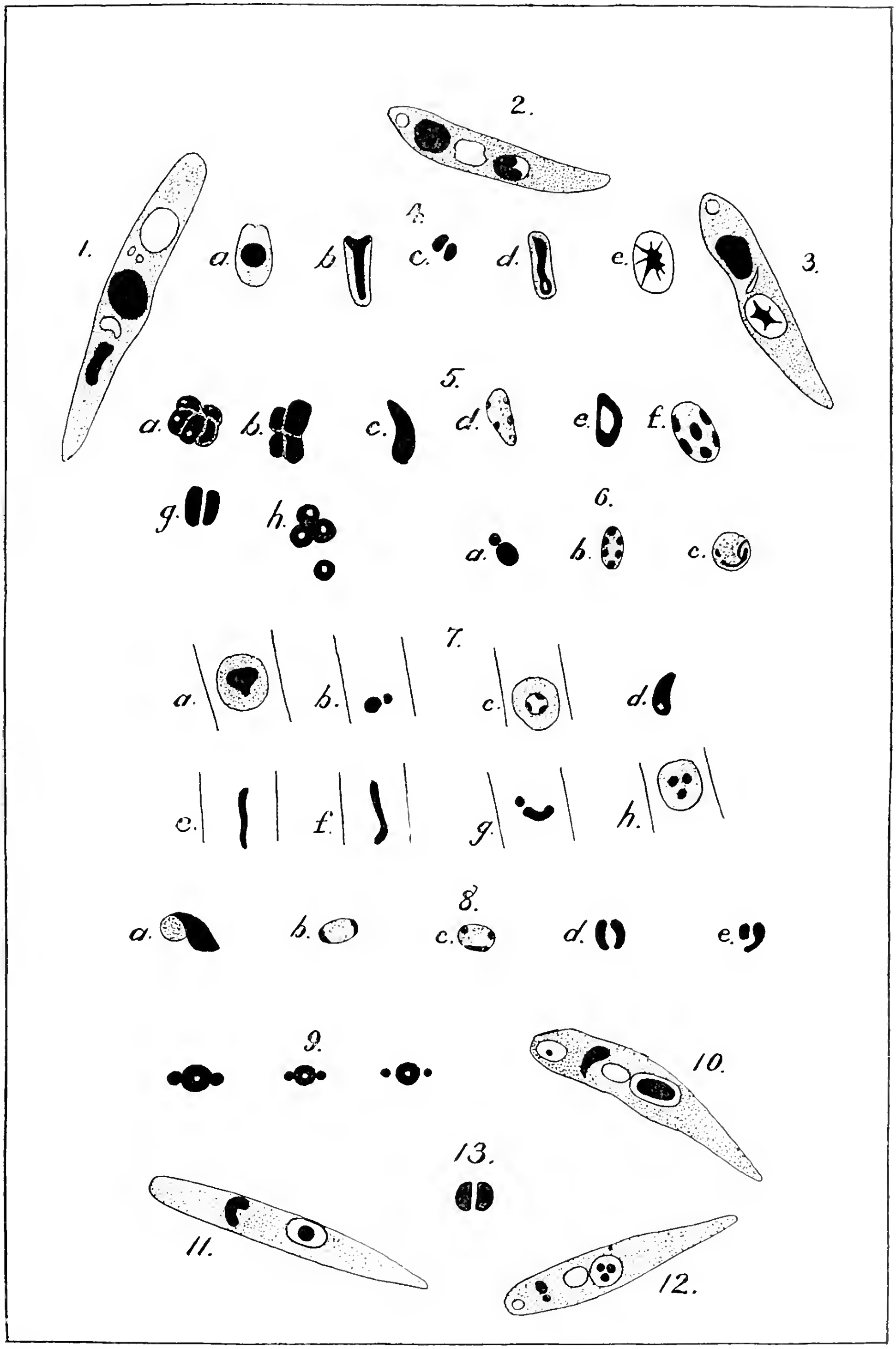
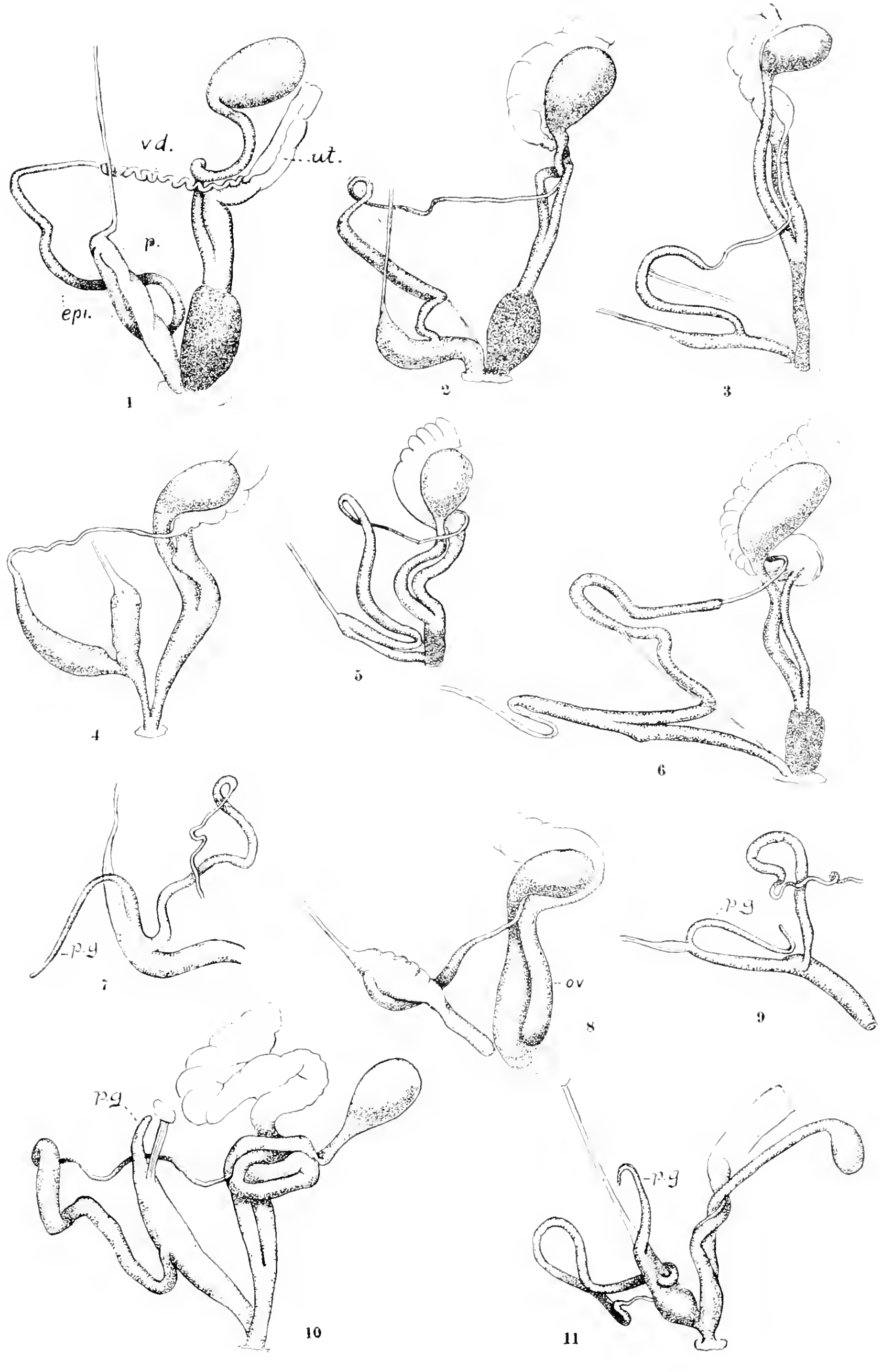
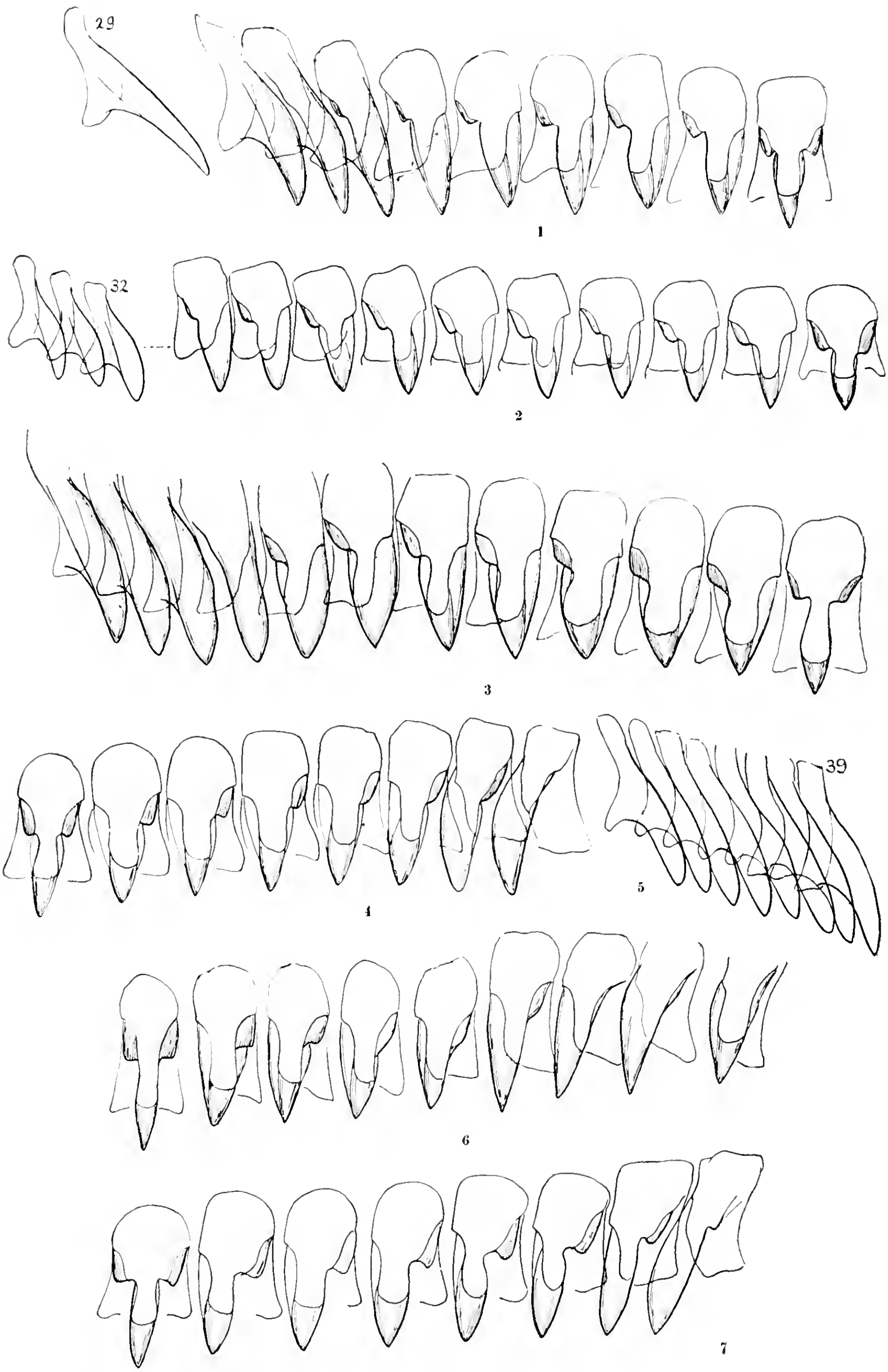


H. Crawley del.

CRAWLEY: SARCOCYSTIS RILEYI (STILES).



PILSBRY: OMPHALINA AND MESOMPHIX.



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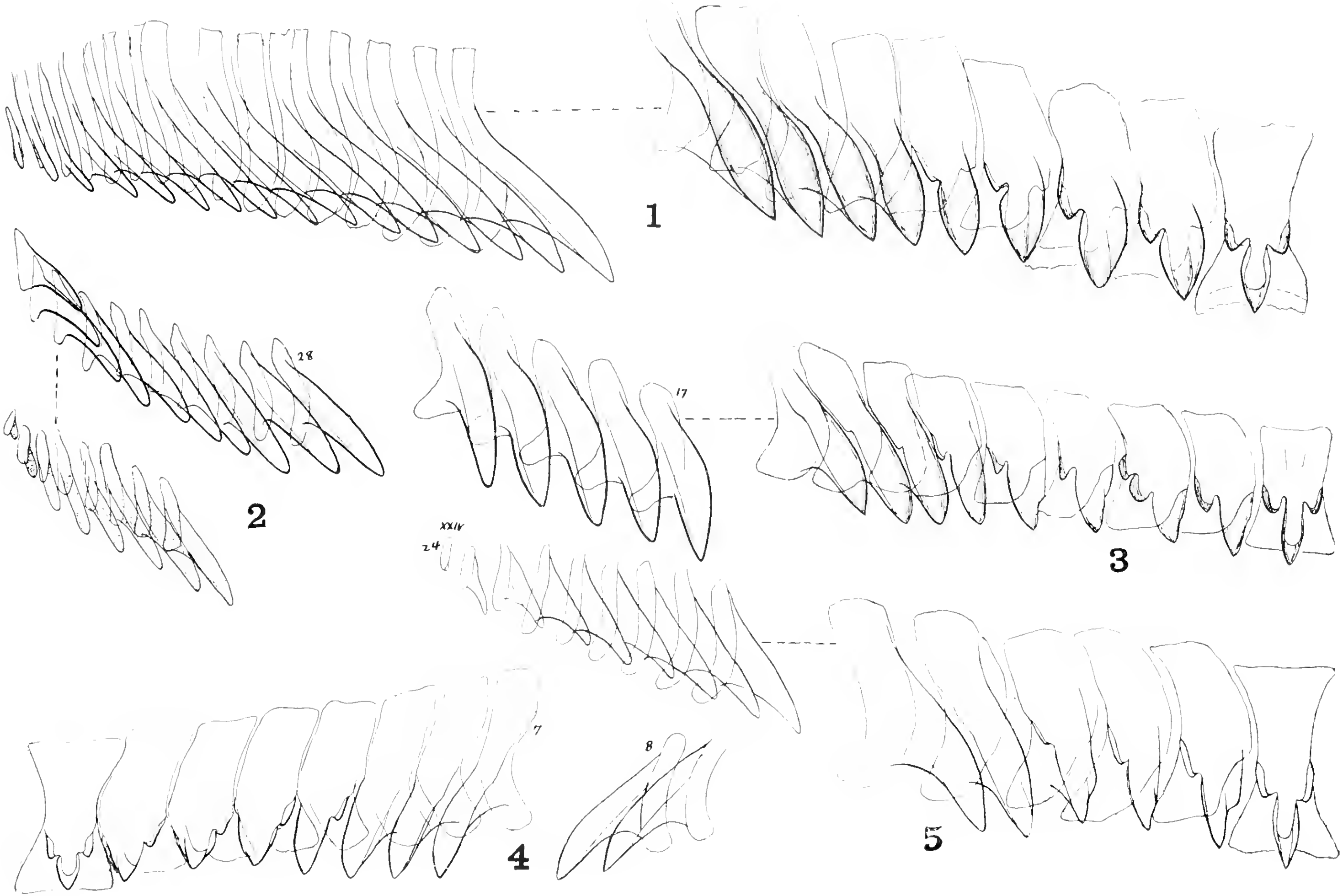

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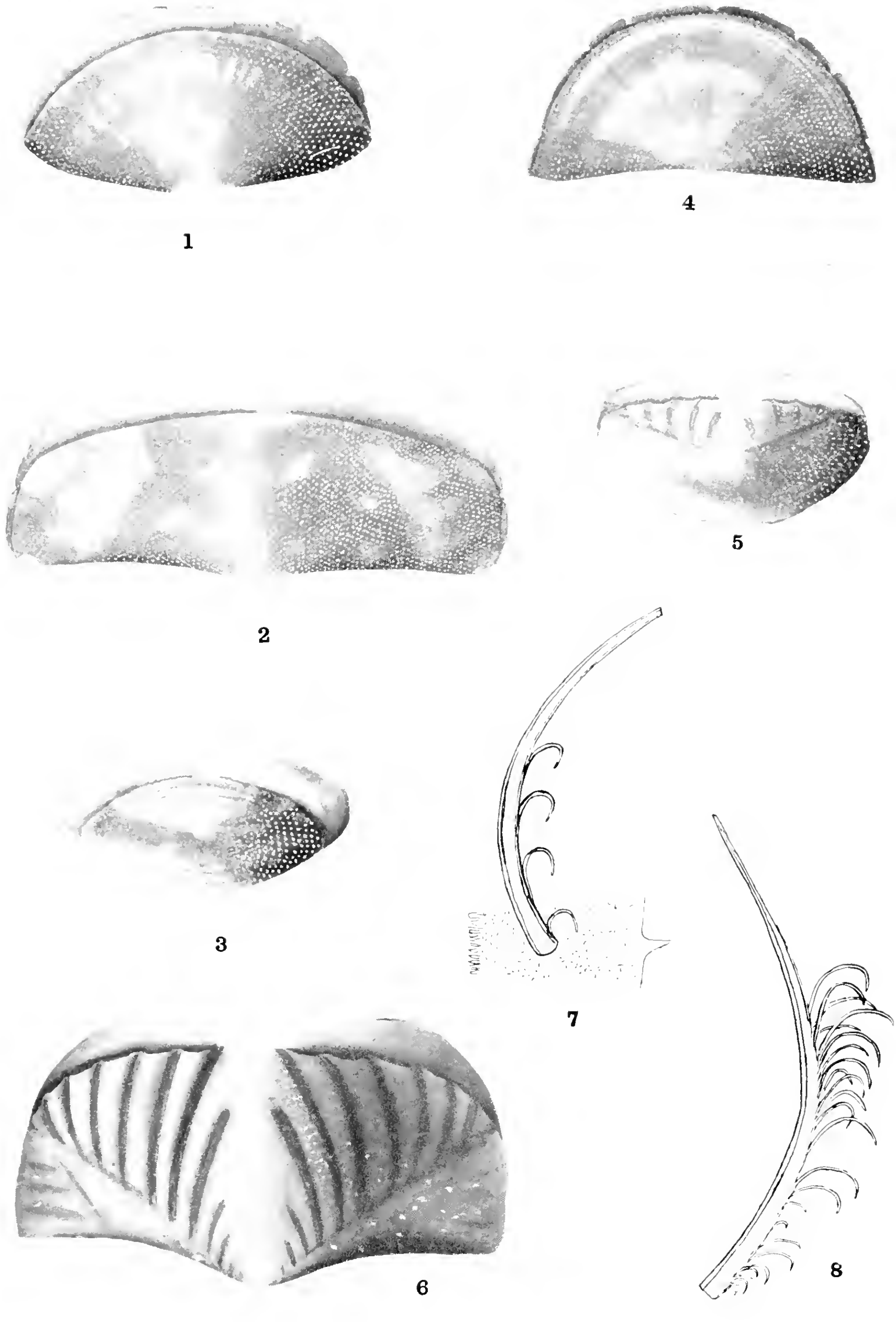

BERRY: NEW SPECIES OF MOPALIA.

NEW FRESH-WATER FISHES FROM WESTERN ECUADOR.

BY HENRY W. FOWLER.

A small collection of fishes, secured in the affluents of the Chimbo River near Bucay, in the Province of Guayas, Ecuador, in July of 1911, was recently submitted to me for study by Mr. S. N. Rhoads. At present this collection is placed on deposit in the Academy. As the region in question presents some interesting hydrographic features, Mr. Rhoads kindly contributes the following notes, gathered from his recent explorations in the country where he obtained the collection.

"The Rio Chimbo, joining the Rio Chanchan several miles below Bucay, flows almost directly southward from its source in the western foothills of Mount Chimborazo for a distance of about 50 miles. It is more practically isolated in a faunal sense from the sources of all the other river systems of Ecuador flowing into the Pacific than any other watercourse of its size in that country. This is due to its being hemmed in both east and west by the lofty parallel ranges of the Main or Central Cordilleras and that of the Pacific system of mountains which goes by the name of the Western Cordilleras. Until it joins the Chanchan, its waters have no alternative but to continue their precipitous and turbulent course due south as in a mighty trough, but there, having reached more level and less elevated country, its course naturally deflects almost at right angles and makes a short cut for the ocean via the mighty Guayas. The Chimbo is characteristic of all those rivers of western Ecuador which owe their origin, as well as their perpetuity during the dry season, to the snow- and glacier-fed springs of the great peaks of the Andean system which rise to an elevation of 15,000 to 20,000 feet above sea level. The greater part of the lofty country drained by these rivers is extremely precipitous, almost denuded of forest growth and trampled by cattle. The soil is filled with boulders and pebbles, and the rock- and mud-encumbered river channels are continually changing base with every sudden rise of the water. Couple this with a continuous gradient of the river bed of 5 to 15 and even 20 per cent. and one begins to understand why only one species of fish can exist in these waters at elevations of over 3.000 feet. Even below this there are very few species to be found in the main channel until the upper edge of the lowland terraces appears, at about 1,000 feet above the sea, and even here the majority of the fish fauna confines itself to the smaller creeks and rivulets of clear water which are fed by the perennial springs of the densely wooded foothills and jungles of the 'Tierra Caliente.' Such conditions necessarily develop these tributary streams of the foothills into isolated fish faunas of the most restricted local character, as it is practically impossible for the majority of those fish which thrive here in such great profusion to live in the turbid and rushing waters of the main river, which, under more pacific conditions, would be a means of intercourse rather than a barrier. For this reason we may expect to find the most varied and puzzling faunal conditions in the ichthyology of the west Andean foothills when systematic collections have been made. As yet there is a vast area of this character in Colombia and Ecuador which has been almost untouched by the scientific collector of fishes. All the fish described in this paper, with one or two exceptions, were dynamited by railroad men in the larger pools of clear-water streams flowing into the Chimbo River, about 2 miles from Bucay. These streams are for the most part deeply shaded by forests and enclosed by high and rocky banks, their sandy or gravelly beds much strewn by boulders and in many places their quiet reaches are broken by shallow rapids, as in our larger trout streams of the Alleghany Mountains. Some of a larger species of Characid than any here described, weighing about 2 to $2\frac{1}{2}$ pounds, were secured with the others, but considered by their captors too valuable as food to be pickled in the interests of science! The flesh of these was good, but the bones too omnipresent for comfort."

CHARACIDÆ.

PROCHILODINÆ.

Prochilodus stigmaturus sp. nov. Fig. 1.

Head $3\frac{3}{5}$; depth $3\frac{1}{4}$; D. III, 9; A. III, 7; P. I, 13; V. I, 8; scales in l. l. 38 to caudal base, and 3 more on latter; 9 scales above l. l. to dorsal origin; 6 scales below l. l. to ventral origin; 6 scales below l. l. to anal origin; 17 predorsal scales; head width $1\frac{9}{10}$ its length; head depth at occiput $1\frac{2}{5}$; snout 3; eye $4\frac{1}{3}$; maxillary $4\frac{2}{5}$; mouth width $4\frac{1}{6}$; interorbital $2\frac{1}{2}$; second branched dorsal ray $1\frac{2}{7}$; first branched anal ray $1\frac{9}{10}$; least depth of caudal peduncle $2\frac{1}{10}$; lower caudal lobe $1\frac{1}{8}$; pectoral $1\frac{1}{2}$; ventral $1\frac{3}{5}$.

Body elongate, compressed, contour fusiform, and deepest at dorsal origin. Upper profile convex, bulging slightly more anteriorly, though back not elevated conspicuously. Lower profile rather more evenly convex. Edges of body all evenly convex, without keels. Caudal peduncle compressed, moderate, length about $\frac{7}{8}$ of least depth.

Head small, compressed, sides flattened and not constricted above or below, though both of latter surfaces evenly convex. Profiles similar, nearly straight. Snout broad, obtuse, convex both over surface and in profile, produced well beyond mandible tip, and length about $\frac{7}{8}$ of basal width. Eye nearly circular, but little elevated, and centre well before middle in head length. Eyelid narrow. Mouth broad, and commissure short in profile, horizontal largely. When opened, mouth quite broad, directed downwards, and jaws rather firm and but moderately strong, apparently not disk-like. Lips thin and scarcely developed, edge of upper rather trenchant and lower rather broad. Edge of each lip with a row of numerous minute papillæ its whole extent, and apparently all sessile. No inner series in either jaw. Mouth aperture small, as seen in front with a medium notch in upper jaw into which symphysis

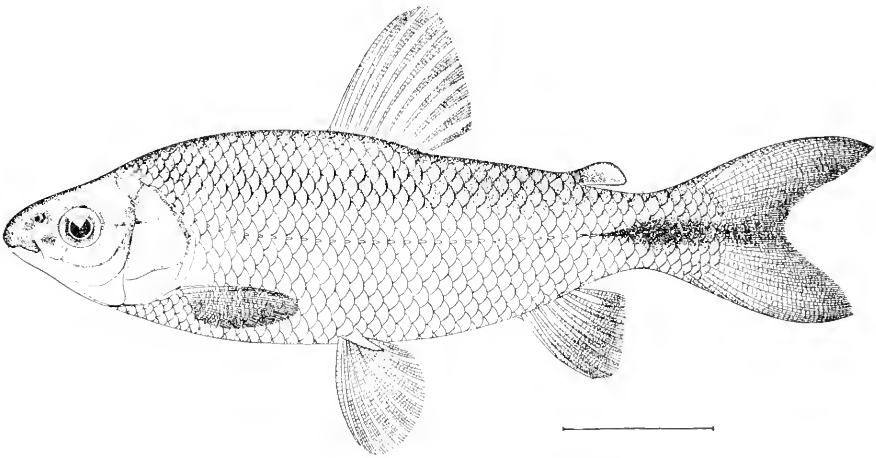

Fig. 1.—*Prochilodus stigmaturus* Fowler. Type.

of mandible fits. Also each ramus of mandible swollen a little on its upper edge, this fitting in a corresponding concavity also in side of upper jaw. Upper and lower buccal folds moderately broad in mouth. Tongue small, fleshy, not free. Mandible short, and rami well elevated inside mouth, articulated below hind nostril. Nostrils moderate, close together, anterior circular and about midway in snout, and posterior exposed in crescent close behind. Interorbital space broadly convex. Preorbital about $1\frac{1}{2}$ in eye. Infraorbital narrow, about equals eye. Postorbital width $1\frac{4}{5}$ in eye. Preorbital also a little swollen, with cavity below, into which maxillary fits when closed, its hind edge then about opposite nasal frenum. Opercle width about $1\frac{3}{4}$ its depth and smooth like other bones of head. Cutaneous opercular flap moderately broad behind.

Gill-opening extends forward about opposite hind edge of eye. Rakers none. Filaments of inner series a little longer than those in outer, or about equal to $\frac{7}{8}$ of eye-diameter. Isthmus broad. Inner upper portion of gill-opening with many small papillæ. Branchiostegals 4, strong, graduated slightly from innermost to outermost, all straight and rather long.

Scales large, of more or less even size, disposed in even longitudinal series parallel with l. l., well exposed, and each one with as many as a dozen rather irregular radiating striæ in some cases, usually less. Margin of each scale entire, evenly convex, not rough. Scales a little small on breast. Caudal base with most of scales scarcely smaller than elsewhere on body, other fins naked. Head naked. Pointed scaly flap in ventral axil $2\frac{1}{2}$ in fin. Apparently no median predorsal keel, though just traces of a faint one behind dorsal fin. Though belly and chest rounded convexly, a very faint ridge or keel extends from below lower pectoral base nearly to ventral axil. Postventral and postanal regions entirely evenly convex. L. l. complete, begins at shoulder and nearly follows median axis to median caudal base. Tubes simple, at first little exposed, and after ninth extending at least half-way over scale exposures.

Dorsal origin a little nearer snout tip than caudal base, fin moderate, second branched ray longest, and when depressed reaches $1\frac{3}{7}$ to adipose fin origin. Anal smaller than dorsal, margin of fin straight its origin a little nearer caudal base than ventral origin, and depressed fin $1\frac{1}{2}$ to caudal base. Adipose fin rather large, length about equals snout, its base over bases of last anal rays. Caudal rather large, rays broadly expanded, fin deeply emarginated, and lower lobe a little shorter. Pectoral moderate, upper rays longest and fin $1\frac{2}{7}$ to ventral origin. Latter about opposite first branched dorsal ray base, second and third branched rays longest, and fin $1\frac{2}{5}$ to anal origin. Vent close in front of anal.

Color in alcohol, when fresh, largely pale slaty above, sides and below silvery-white. In some lights back with an olivaceous tint, in others largely grayish. Median line of back largely with dusky tinge. Head dusky to olivaceous or grayish above, sides with some brassy tinges, and lower surface whitish. Snout largely brownish, even to edge of upper lip. Mandible pale or whitish. Iris silvery-white. Dorsal slaty-dusky, deeper towards edge of fin, immaculate. Caudal paler than dorsal, but large blackish blotch on caudal peduncle side at terminal portion of lateral line continued back over median rays to their tips, though paler. Inner submarginal portions of caudal lobes very indistinctly mottled with pale gray spots, or leaving incomplete short wavy lines of darker color somewhat transversely over these portions of fin-rays. Adipose fin pale or dull olive-brown. Pectoral and ventral pale brownish to whitish, former with median upper portion a little grayish or darker. Anal pale basally, though greater outer or distal portion quite dusky.

Length $5\frac{1}{2}$ inches.

Type, No. 1. Collection, S. N. Rhoads. Affluent of the Chimbo River near Bucay, Province of Guayas, Ecuador. July, 1911.

Only a single example of this species, described above, was obtained. It differs from *Prochilodus humeralis* Günther[1] chiefly in coloration, that species being marked with a black shoulder spot on the fourth to sixth scales of the lateral line and the dorsal with blackish dots posteriorly, though the other fins and base of the caudal are immaculate.

Other species from the eastern drainage of South America which I have examined are, of course, entirely different in coloration, viz.: *P. steindachneri* Fowler, *P. ortonianus* Cope, *P. cephalotes* Cope, *P. teraponura* Fowler and *P. amazonensis* Fowler.

(*Στὶγμα*, blotch; *οὐρα*, tail; with reference to the dark caudal blotch.)

RHOADSINÆ.

Preventral region rounded, without keel. Dentition perfected. Jaws peculiar, well back, and long mandible articulated below hind edge of eye. Dorsal and anal rays elongated. Adipose fin present.

I have framed this subfamily for the single aberrent genus described below. It is remarkable for the constriction of the jaws, somewhat suggestive of the salmonoid *Plecoglossus*. Its affinities are likely near the *Tetragonopterinæ*.

RHOADSIA gen. nov.

Type *Rhoadsia altipinna* sp. nov.

Body deep, compressed. Belly rounded. Mouth cleft large, deep. Front jaw teeth in adult largely uniserial, strong, compressed, each with large pointed median denticle and two graduated smaller denticles each side, of which outer or lower smaller. Sometimes three or four external short conic teeth on upper lip in adult, absent in young. In young anterior jaw teeth all broader, with more uniform cutting-edge, as denticles all more on a line and median denticle but slightly enlarged. Adult with a single series of conic

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[1] *Proc. Z. S. London*, 1859, p. 419. *Western Andes of Ecuador.*

maxillary and lateral mandibular teeth, absent in young. Maxillary long and slender in adult, much shorter in young. Mandible articulated well posteriorly, or below hind eye edge in adult, and in young articulated a little anterior. Nostrils close together, separated by valve only. Gill-opening wide, membranes free from isthmus and largely separated. Rakers lanceolate. Scales all cycloid, well exposed, parallel with l. l. above and below, though latter also oblique. Anal with narrow scaly area basally, and scales on caudal base not extending far out on fin. L. l. incomplete, not extending beyond dorsal base. Dorsal median, base short, and rays greatly elevated. Anal begins after dorsal base, its own base long, and front rays elevated. Caudal well forked. Pectoral almost reaches ventral. Ventral inserted before dorsal, reaches anal.

A single species, small fishes in the mountain streams of western Ecuador.

(Named for Mr. Samuel N. Rhoads, in slight recognition of his ability as a naturalist and explorer.)

Rhoadsia altipinna sp. nov. Fig. 2.

Head $3\frac{3}{5}$; depth $2\frac{1}{2}$; D. II, 9; A. IV, 24; P. I, 12; V. I, 7; scales in l. l. 38 to caudal base, of which 16 anteriorly with tubes; 4 scales in horizontal series medianly on caudal base; 9 scales above l. l. to dorsal origin; 11 scales below l. l. to ventral origin; 21 scales in vertical series between anal origin and last dorsal ray base; 22 predorsal scales; head width 2 in its length; head depth at occiput $1\frac{1}{6}$; snout $2\frac{3}{4}$; eye $4\frac{2}{5}$; maxillary $1\frac{1}{2}$; mandible $1\frac{3}{5}$; interorbital $2\frac{2}{5}$; dorsal base $1\frac{7}{8}$; least depth of caudal peduncle $2\frac{2}{5}$; adipose fin length 3; fourth branched anal ray $1\frac{1}{8}$; pectoral $1\frac{2}{5}$; ventral $1\frac{2}{7}$.

Body deep, well compressed, form elongately ovoid, and lower profile a little more evenly convex than upper. Owing to slope down posteriorly of dorsal base upper profile appears a little more bulging anteriorly as compared with lower profile. Greatest body depth at dorsal origin. Predorsal region trenchant, and postdorsal region narrowly convex. Behind adipose fin, just before and over anterior rudimentary caudal rays edge becomes trenchant. Breast and preventral region narrowly constricted, though with convex edge. Postventral region narrowly constricted, though scarcely trenchant. Postanal region similar, except edge becoming slightly trenchant over anterior rudimentary rays. Caudal peduncle well compressed, and its least depth about equals its length.

Head moderate, well compressed, flattened sides slightly approximated below and upper and lower surfaces evenly convex. Profiles similarly inclined, but very slightly convex. Snout moderately long, protruding slightly below closed mandible tip, length about $\frac{7}{8}$ its basal width, and surface evenly convex. Eye slightly ellipsoid, its centre level with snout tip and a little before middle in head length. Pupil slightly ellipsoid in vertical. Eyelid very narrow, free, not adipose-like. Mouth peculiar, large, and commissure very deep, extending back not quite opposite front pupil edge, though beyond front eye margin. Maxillary straight, of rather narrow and uniform width, well inclined back till its tip opposite hind eye

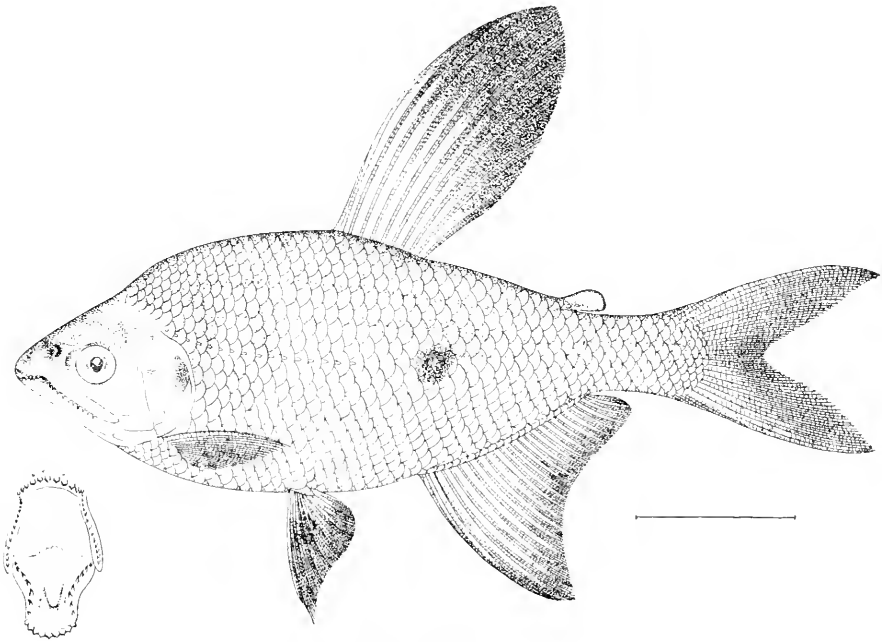

Fig. 2.—*Rhoadsia altipinna* Fowler. Type.

edge, and most its whole length free from the corresponding straight infraorbital edge. Mandible long, rami incised or emarginated in front, giving a chisel-like appearance. Rami also attain their greatest height anteriorly or opposite a corresponding notch in front of maxillary, after which they are continued back to their articulations of uniform height. A single series of compressed sharp teeth form cutting edge in front of upper jaw, consisting of 6 teeth each side. Each tooth with a median and slightly enlarged pointed cusp followed by 2 smaller ones each side, latter usually subequal. Front or incised portion of mandible with a series of somewhat similar teeth, about 5 each side, all rather broader than upper teeth and contour of cutting-edge of each tooth less triangular. A single series of large and erect conic canines along maxillary edge well down near its distal extremity, and at first a little closer together. Straight lateral mandibular edges with a single series of conic canines each side, first few slope forward, after which they all incine well back, most are also well curved. In both jaws the dentition is continuous anteriorly, as the premaxillary and the maxillary, and the anterior and posterior mandibular elements. Lips firm, upper with several short conic denticles, and lower conceals lower lateral teeth. Tongue thick, fleshy, rather narrow and not free. Snout tip extends a little before mandible tip. Nostrils moderate, together, and frenum about last third in snout. Interorbital well convex. Fontanel narrow, extends back from opposite front eye edge to occipital crest. Preorbital rim narrow, its width about half of eye. Greatest diameter of postero-infraorbital width equals eye. Postorbital width $1\frac{4}{7}$ in eye. Posterior edge of preopercle inclined a little behind, straight, and with a distinct and rather narrow triangular corner below. Opercle narrow, its width about $2\frac{1}{6}$ in its depth. Preopercle surface, postero-infraorbital and opercle with some rather coarse and inconspicuous striæ. Cutaneous opercular flap moderately broad behind.

Gill-opening extends forward opposite middle of eye. Rakers 8 + 14, rather slender, weak, pointed, and longest about half of filaments. Latter about $1\frac{1}{4}$ in eye. No pseudobranchiæ. Isthmus rather broad. Branchiostegals strong, subequal, 4 in number.

Scales moderately large, cycloid, well exposed, and largely of uniform size. Radiating striæ on scales all fine and obsolete. Edges of scales all entire, convex. Scales a little small on breast and anterior preventral region, also on caudal base. Along base of anal anteriorly row of low scales. No axillary scaly pectoral flap, and that of ventral about 5 in fin. Scales above and below l. l., and its course in series parallel. Below this axis and posteriorly they slope slightly obliquely to anal base. Fins except as mentioned above, together with head, naked. L. l. incomplete, extends but little beyond dorsal origin, its short course nearly horizontal from shoulder. Tubes simple, exposed until some extend over first half of scale exposures.

Dorsal origin about midway in vertical between snout tip and caudal base, almost all rays elongated with slender tips so depressed fin extends back to caudal base, though antero-median rays longest.

Adipose fin moderate, inserted about midway between last dorsal ray base and caudal base, fin $2\frac{1}{4}$ to latter. Anal inserted opposite last dorsal ray base, anterior rays elongated and second branched one longest, it extending about $1\frac{1}{4}$ to caudal base. Caudal deeply forked, lobes rather slender, pointed, tips damaged and apparently equal, fin also apparently a little longer than head length. Pectoral rather small, upper rays longest, fin a little falcate, not quite reaching ventral. Ventral origin slightly before dorsal, fin pointed, depressible back a little beyond anal origin. Vent midway between ventral and anal origins.

Color when fresh in alcohol largely pale umber-brown on back and upper surface, edges of scales darker. Median dorsal line also somewhat dusky. Sides and lower surface of body pale to whitish, and all more or less overshot with dull silvery, pale lilac in some lights. Upper surface of head brownish like back, sides and lower surface pale. Opercle with silvery-white reflections, and a dull indigo-black blotch level with eye on its upper portion. Snout entirely brownish to edge of upper lip, and mandible decidedly paler like whole of lower jaw. Iris silvery-white, with grayish tinge above. Transversely on back 2 broad deeper brown bands than body-color, first a little narrower and at first third in predorsal region, second at second third of same. An indistinct or nebulous pale brown blotch at beginning of l. l., followed by an indistinct pale gilt area to another indistinct brownish blotch within limits of second dark transverse band. Behind l. l., though on same level, opposite anal origin a distinct large rounded spot of dusky or blackish, this a little larger than eye. Along sides, following median axis, a streak of underlaid and rather dull silvery, though posteriorly becoming quite narrowed, or about $\frac{2}{5}$ of eye-diameter. Dorsal pale or grayish basally, becoming rather dusky on outer portions. Adipose fin pale grayish, edge narrowly dusky. Anal largely pale grayish, a little darker marginally, and only front edge of long anterior lobe slightly dusky. Caudal largely grayish like other fins, hind edges a trifle dusky. Pectoral pale brownish, distally a little darker brown. Ventral grayish basally, distal end of longest rays dusky slate-color. Peritoneum blackish.

Length 5 inches (caudal tips damaged).

Type, No. 2. Collection, S. N. Rhoads. Affluent of the Chimbo River near Bucay, Province of Guayas, Ecuador. July, 1911.

Also Nos. 3 to 6, paratypes, same data. Head $3\frac{1}{2}$ to $3\frac{2}{3}$; depth $2\frac{2}{5}$ to $2\frac{1}{2}$; D. III, 9; A. usually IV, 27, sometimes IV, 25 or IV, 28;

scales in median lateral series 38 to caudal base, and 4 more on latter, sometimes 3; 10 scales above l. l. to dorsal origin; 8 or 9 scales below l. l. to ventral origin; usually 20 scales, sometimes 19, between anal origin and last dorsal ray base; usually 20 predorsal scales, sometimes 21; usually 17 l. l. tubes, sometimes 15 or 16; snout $2\frac{4}{7}$ to $3\frac{1}{2}$ in head; eye $2\frac{3}{4}$ to $4\frac{1}{6}$; maxillary $1\frac{3}{5}$ to 2; interorbital $2\frac{2}{5}$ to 3; pectoral $1\frac{1}{4}$ to $1\frac{1}{3}$; ventral $1\frac{1}{3}$ to $1\frac{4}{7}$; length $2\frac{1}{2}$ to $4\frac{15}{16}$ inches.

Variation with age, as well as individually, is quite noticeable. In the type the right upper teeth forming the cutting edge are all more or less conic and with only obsolete cusps. The other examples have them symmetrically developed, and in the young examples all the cusps are all more on a uniform plane or line in both jaws. Small examples also have no external conic denticles on the upper lip. The smallest paratype also has no maxillary or lateral mandibular teeth, only the cuspidate anterior teeth being developed, and all the simple conic teeth apparently only appearing with age. The young also have a large eye, a much shorter maxillary, which only reaches back about opposite front edge of pupil, the articulation of the mandible before the hind pupil edge, predorsal scales much smaller than the others, the depressed dorsal fin not reaching adipose fin origin, and without traces of the dark predorsal bands. With advancing age a few conic teeth appear on the maxillary and lateral elevated portions of the mandibular rami, though only in the large examples is this bone elongated and well toothed.

The accompanying figure has the tail ends represented as restored, and the cut illustrating the dentition shows the left upper teeth as symmetrical.

(*Altus*, high; *pinna*, fin; with reference to the elevated dorsal of the adult.)

TETRAGONOPTERINÆ.

Brycon scapularis sp. nov. Fig. 3.

Head $3\frac{1}{5}$; depth 3; D. III, 9; A. IV, 25, I; P. I, 12; V. I, 7; scales in l. l. 51 to caudal base and 4 more on latter; 10 scales above l. l. to dorsal origin; 5 scales below l. l. to ventral origin; 6 scales below l. l. to anal origin; 22 predorsal scales; head width $2\frac{1}{5}$ in its length; head depth at occiput $1\frac{1}{3}$; snout 4; eye $3\frac{1}{4}$; maxillary $2\frac{1}{4}$; nterorbital $3\frac{2}{5}$; mandible $2\frac{1}{8}$; first branched dorsal ray $1\frac{1}{2}$; least depth of caudal peduncle $3\frac{1}{4}$; first branched anal ray $2\frac{1}{8}$; pectoral $1\frac{1}{3}$; ventral $1\frac{7}{8}$.

Body well compressed, contour rather evenly ellipsoid, greatest depth at dorsal origin, edges all convexly rounded or with only slight median preventral ridge or keel. Postventral region rather constricted. Caudal peduncle well compressed, its least depth about $1\frac{1}{5}$ its length.

Head well compressed, flattened sides slightly constricted below, upper and lower surfaces rather evenly convex, profiles similarly inclined and slightly convex anteriorly. Snout a little convex in profile, surface well convex, length about $\frac{3}{4}$ its basal width. Eye a trifle ellipsoid, rather high, its centre about first third in head. Eyelid narrow and thin. Pupil vertically ellipsoid. Maxillary well inclined, extends till below front pupil edge, and distally expanded till about $3\frac{1}{5}$ in eye. Jaws strong, firm, equal. Upper lip tough, firm, moderate. Lower lip thick, free in front, and rather fleshy.

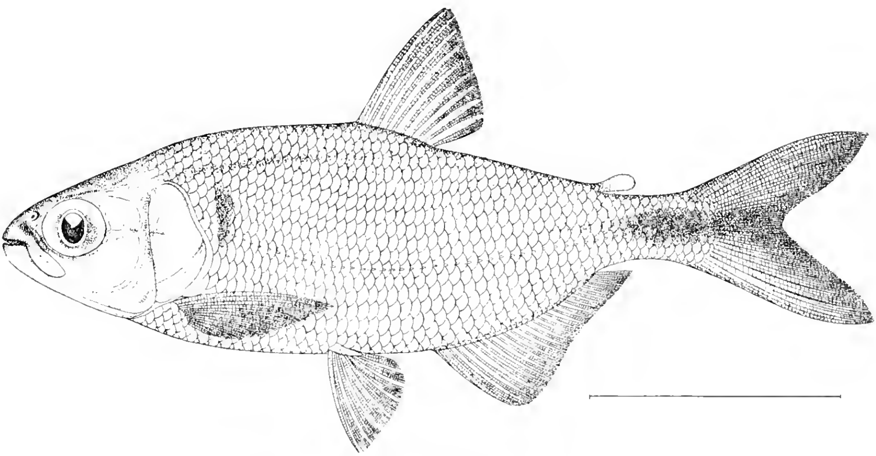

Fig. 3.—*Brycon scapularis* Fowler. Type.

Mouth moderate, commissure rather short, horizontal. Premaxillary teeth triserial, mostly with an enlarged median denticle and a rather obtuse small denticle or cusp each side basally, former much in contrast with latter. Posterior premaxillary teeth similar, only broader and a little larger. All premaxillary teeth rather thick, with entire edges, surfaces convex, strong and firm. Maxillary with a series of rather small close-set conic short teeth over about first or upper $\frac{2}{3}$ of its lower edge, these also all more or less concealed by membrane over bone. Mandibular teeth uniserial, first 3 each side of symphysis enlarged, largest of all teeth, and laterally on each mandibular ramus those following quickly decreasing in size, and some becoming minute, so that dentition does not extend more than first $\frac{2}{3}$ of mandible length. Mandibular teeth strong, thick-rooted, surfaces convex, edges entire, each with an enlarged median cusp, and one or two smaller basal cusps on each side, all of which sharp and triangular. Two small conic canines close inside outer symphyseal teeth. No other teeth in mouth. Buccal membranes well developed, upper especially broad. Tongue thick, fleshy, rather depressed above and scarcely free in front. Mandible strong and rami little elevated in mouth. Nostrils rather large, close together, anterior simple pore and posterior exposed in crescent, close before upper front eye edge or about last fourth in snout. Interorbital broadly convex. Preorbital quite narrow and maxillary slipping below its lower edge. Antero-infraorbital broadly triangular, small. Postero-infraorbital large, its length equals snout and half of eye. Postorbital small, its width $1\frac{2}{3}$ in eye. Opercle width $2\frac{1}{4}$ its depth. Preopercular edge nearly vertical, but slightly inclined behind, and its lower corner rounded. Bones of head all smooth, without striæ. Cutaneous edge of gill-opening moderately broad.

Gill-opening extends forward about opposite hind pupil edge. Rakers about 9 + 13, lanceolate, slender, pointed, a little less than longest filaments. Filaments about $1\frac{1}{2}$ in eye. No pseudobranchiæ. Isthmus narrow, surface rather rounded, and membranes form slight free fold anteriorly for short space. Branchiostegals 4, strong, and subequal.

Scales cycloid, all rather more or less narrowly imbricated, disposed in series parallel with l. l., and becoming but a trifle smaller along edges of body and breast. Many as 6 radiating striæ visible on scale exposure and usually well marked. Caudal base covered with scales but little smaller than those on rest of body. Slight pit, formed by membrane above, in pectoral axilla. Axillary ventral scaly flap pointed, slender, free, about 3 in fin. Anal base with low sheath of thin small scales. Scales passing over all body edges. L. l. complete, begins sloping down from shoulder in even curve till about opposite ventral origin, where near lowest third in body depth, and then gradually slopes up, low along caudal peduncle side at first to middle of caudal base. Tubes all simple, short and but little exposed.

Dorsal origin about midway between hind nostril and caudal base, first branched and third simple ray longest and subequal, depressed back far as tips of any others, fin $1\frac{2}{3}$ to adipose fin origin. Adipose fin moderate, $1\frac{2}{5}$ in eye, origin about midway between depressed dorsal tip and caudal base, fin 2 to latter. Caudal (damaged) well forked, lobes apparently pointed and slender, also likely equal ?, and fin about equal to head in length ?. Anal origin about opposite last dorsal ray base, first branched ray longest, though second and third branched and fourth simple subequal, with anterior rays of fins thus much longer than others, and last fin ray about half way to caudal base. Pectoral long, rather slender, upper rays longest, and fin extends a little beyond ventral origin. Latter inserted before dorsal, though nearer anal origin than pectoral, and depressed fin reaching anal origin. Vent close before anal.

Color in alcohol largely brownish or dull olivaceous, with lilac tinge on back, sides and lower surface brilliant silvery-white. In some lights body more or less reflected greenish or lilac. Head above olivaceous-brown, color including upper lip and upper portion of maxillary, sides and lower surface, silvery-white, mandible pale. Iris silver-gray, varied, with narrow golden circle around pupil. Inside gill-openings pale. A short, narrow and rather dull vertical leaden streak opposite eye after and superior to third scale in l. l. Caudal peduncle, at caudal base, with a large dusky blotch, equal to the eye in extent, extending out on caudal base, and reflected back to include median caudal rays as a dusky streak, though latter a little paler than blotch. Dorsal grayish, membranes medianly tinged with dusky. Caudal grayish, edges of fin all slightly dusky. Other fins pale or whitish, membranes of anal grayish distally. Peritoneum rather dusky.

Length $3\frac{5}{16}$ inches (caudal tips damaged).

Type, No. 7. Collection of S. N. Rhoads. Affluent of the Chimbo River near Bucay, Province of Guayas, Ecuador. July, 1911.

In the accompanying figure I have restored the caudal fin ends.

This species differs from *Brycon atrocaudatus* (Kner)[2] in the dark humeral blotch. If, as Boulenger suggests,[3] *B. moorei* Steindachner[4] is identical with *B. atrocaudatus* (Kner), *B. scapularis* further differs in the absence of an inner lateral mandibular series of simple or conic teeth. Steindachner says of *B. moorei* that the dark

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[2] *Chalceus atrocaudatus* Kner, *Sitz. Ak. Münch.*, II, 1863, p. 227. *Western Andes of Ecuador.*

—— Kner and Steindachner, *Abh. Kön. Bayer. Ak. Wiss.*, X, 1870, p. 44, Pl. 4, fig. 3 (type).

[3] *Brycon atricaudatus* Boulenger, *Boll. Mus. Z. Anat. Torino*, XIII, No. 329, 1898, p. 3. Paramba, in Rio Mira.

[4] *Denks. Ak. Wiss. Wien*, XXXIX, 1879, p. 58, Pl. 5, figs. 2, 2*a*, 2*b*. *Magdalena River.*

humeral blotch is indistinct. *B. scapularis* differs also from all the species mentioned in its vertically ellipsoid pupil.

(*Scapula*, shoulder, referring to the shoulder-spot.)

Astyanax notemigonoides sp. nov. Fig. 4.

Head 4; depth $2\frac{7}{8}$; D. III, 9; A. IV, 37, I; P. I, 13; V. I, 7; scales 45 in l. l. to caudal base, and about 4 ? more on latter (squamation slightly injured); 9 scales above l. l. to dorsal origin; 7 scales below l. l. to ventral origin; 8 scales below l. l. to anal origin; 17 predorsal scales; head width 2 in its length; head depth at occiput $1\frac{1}{10}$; mandible $2\frac{2}{3}$; first branched dorsal ray 1; first branched anal ray $1\frac{1}{2}$; least depth of caudal peduncle $2\frac{1}{4}$; pectoral $1\frac{1}{10}$; ventral $1\frac{3}{5}$; snout 4 in head measured from upper jaw tip; eye 3; maxillary $2\frac{3}{4}$; interorbital $3\frac{1}{10}$.

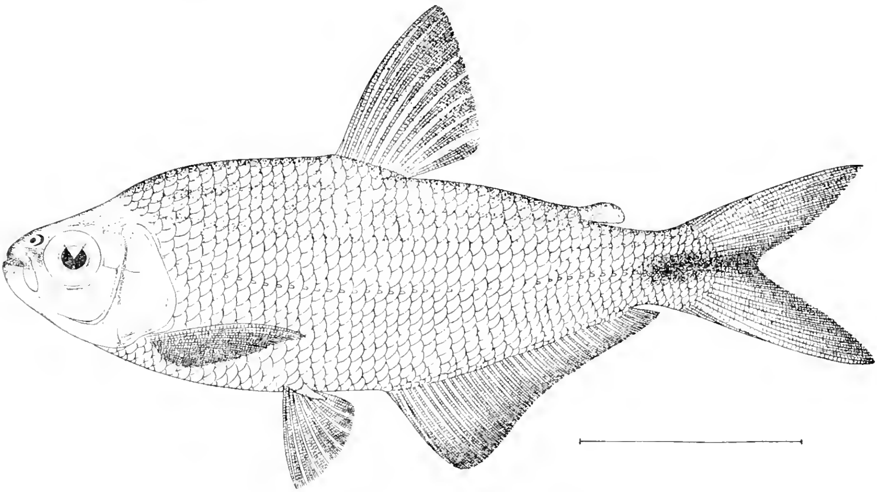

Fig. 4.—*Astyanax notemigonoides* Fowler. Type.

Body well compressed, lower profile deeper and more evenly convex than upper, greatest depth at dorsal origin. Predorsal region slightly trenchant with obsolete median keel. Postdorsal region convexly rounded. Preventral region with slight median keel, becomes obsolete and region flattened immediately before ventral bases. Postventral slightly trenchant with median keel. Postanal region convexly rounded. Caudal peduncle short, well compressed, length about $\frac{2}{3}$ least depth.

Head moderate, well compressed, flattened sides becoming a little constricted below, upper and lower surfaces convex, upper profile much less inclined than lower, at first convex and then a little concave just before occiput. Lower profile slightly convex. Snout short, convex over surface and in profile, its length about $\frac{3}{5}$ basal width. Eye large, circular, rather high, its centre about first $\frac{2}{5}$ in head. Pupil circular. Eyelid very narrow, thin. Mouth small, moderately wide and commissure short and nearly horizontal. Upper lip firm, tough, not free. Lower lip thick, free and rather broad. Premaxillary teeth biserial, rather irregular, strong, broadly triangular, somewhat compressed with each face convex, tricuspid, with median cusp enlarged and lateral cusp each side basally quite broad. Maxillary with 3 minute teeth on its lower edge anteriorly inside upper jaw. Mandibular teeth with symphyseal pair largest, others graduated back soon, so that dentition only extends over anterior half of mandible. Anterior mandibular teeth tricuspid, median cusp much largest, bases strong, surfaces convex and edges entire. Only first 4 mandibular teeth each side at all large. No other teeth in mouth. Buccal folds broad, especially upper. Tongue thick, fleshy, rather oblong, rounded and not free in front. Maxillary rather small, narrow or width about 4 in eye, inclined vertically, and scarcely extends beyond eye front. Mandible strong, powerful, protrudes in front slightly beyond upper jaw tip, rami but little elevated in mouth, and articulation taking place below front edge of eye. Nostrils together, close before upper front eye edge, anterior simple round pore, and posterior exposed in crescent. Interorbital space evenly convex. Preorbital narrow, width about equals maxillary width, and maxillary slips below lower edge anteriorly. Infraorbital quite large, length greater than eye, and covering most of cheek. Postorbital rather narrow, width about $2\frac{1}{4}$ in eye. Opercle narrow, width $2\frac{2}{3}$ in its depth. Hind preopercle edge nearly straight and sloping a little forward. Cutaneous flap along opercular edge rather broad.

Gill-opening forward well before front pupil edge, though not quite opposite front edge of eye. Rakers about 10 + 13, rather weak, lanceolate, sharp-pointed, and longest about $1\frac{1}{2}$ in filaments. Filaments about 2 in eye. No pseudobranchiæ. Gill-membranes well separated, forming a short free fold over narrowly constricted isthmus anteriorly. Branchiostegals 4, strong and nearly subequal.

Scales moderate, rather narrowly imbricated, disposed in longitudinal series parallel with l. l., sometimes each with as many as 12 radiating striæ, and mostly of more or less uniform size. Along edges of body and on base of caudal scales a little smaller than others.

A narrow area of small scales all along anal base, though best developed anteriorly. In other respects all fins, together with head, naked. Squamation passing completely over all edges of body. No axillary pectoral scaly flap, though that of ventral pointed, narrow, free and about $2\frac{2}{5}$ in fin. L. l. complete, moderately decurved till a little below median axis of body and then continued up a little low along sides of caudal peduncle to median caudal base. Tubes simple, at first little exposed and at most not extending more than half-way in exposures of scales.

Dorsal origin about midway between snout tip and caudal base, first branched ray longest, second branched and third simple rays subequal, and depressed fin a trifle over half way to caudal base. Adipose dorsal origin a trifle behind last third in space between dorsal origin and caudal base, fin nearly half way to latter. Anal base long, straight, origin about opposite seventh dorsal ray base, first branched ray longest with fourth simple and second branched rays subequal, so that slight elevated lobe forms anteriorly. Caudal well forked, lobes slender, pointed, and lower much longer (upper a little damaged) or about equals head length with $\frac{3}{4}$ of eye-diameter. Pectoral long, upper rays longest, fin reaches trifle beyond ventral origin. Latter inserted a little before dorsal origin, though a little nearer anal origin than that of pectoral, and depressed fin reaching anal origin. Vent about last fifth in space between ventral and anal origins.

Color when fresh in alcohol largely pale olivaceous-brown on back, with sides becoming pale or whitish, also below, and whole overshot with bright silvery-white. A broad silvery-white band extends from eye to caudal base, width about equal to eye-diameter, this conspicuously contrasting coloration of back with that of lower regions. No dark humeral blotch. At base of caudal and on contiguous region of caudal peduncle dusky blotch, this extending out on median caudal rays to edge of fin, though area on latter paler and variegated with deeper marblings. Head brownish-olive above, color including all of upper lip, also lower lip. Head sides and below, also iris, bright silver-white. Dorsal grayish basally, becoming pale olivaceous distally. Anal similar, only largely tinged with pale dusky on outer portions. Caudal grayish basally, edges of fin slightly deeper. Pectoral and ventral pale grayish, distally slightly deeper in color. Peritoneum dusky to blackish.

Length $3\frac{7}{8}$ inches.

Type, No. 8. Collection of S. N. Rhoads. Affluent of the Chimbo River, near Bucay, Province of Guayas, Ecuador. July, 1911.

Also Nos. 9 to 16, paratypes, same data. Head $3\frac{2}{3}$ to 4; depth $2\frac{3}{5}$ to $3\frac{2}{5}$; D. III, 9; A. usually IV, 35, frequently IV, 32, or IV, 37, sometimes IV, 39; scales in l. l. usually 44 to 46, sometimes 43 or 47 + 3 or 4 more on caudal base; usually 9 scales above l. l. to dorsal origin, seldom 8; 7 scales below l. l. to ventral origin; usually 9 scales below l. l. to anal origin, seldom 8 or 10; predorsal scales 18 to 20 usually, sometimes 17 or 21; snout 4 to $4\frac{1}{4}$ in head measured from upper jaw tip; eye $2\frac{4}{7}$ to 3; maxillary $2\frac{3}{5}$ to 3; mandible $2\frac{1}{2}$ to $2\frac{7}{8}$; interorbital 3 to $3\frac{1}{4}$; pectoral $1\frac{1}{10}$ to $1\frac{1}{5}$; ventral $1\frac{3}{5}$ to $1\frac{4}{5}$; length $2\frac{7}{16}$ to $3\frac{3}{4}$ inches.

Young examples do not differ much from the adults in appearance, showing the same general coloration, though perhaps more silvery-white. They are also more elongate or slender, with a larger eye, and with very minute or obsolete maxillary teeth.

This species appears to be related to *Astyanax festæ* (Boulenger)[5] but differs in several respects. *A. festæ* has: Head 4 to $4\frac{1}{3}$, depth $2\frac{1}{2}$ to 3, eye twice length of snout or $2\frac{1}{2}$ to $2\frac{2}{3}$ in head, maxillary toothless, pectoral longer than head, and 2 blackish spots at front of l. l.

(Νωτος, back; ἡμι, half; γωνία, angle; εἶδος, appearance; with reference to the superficial resemblance to *Notemigonus*, the roach or bream of the eastern United States.)

Astyanax scierus sp. nov. Fig. 5.

Head $3\frac{3}{4}$; depth $2\frac{3}{4}$; D. III, 9; A. V, 29, I; P. I, 11; V. I, 7; scales 37 in l. l. to caudal base and 4 ? more on latter; 8 scales above l. l. to dorsal origin; 6 scales below l. l. to ventral origin; 8 scales below l. l. to anal origin; 15 predorsal scales; head width $1\frac{9}{10}$ its length; head depth at occiput $1\frac{1}{10}$; snout $3\frac{7}{8}$; eye $3\frac{2}{7}$; mandible $2\frac{2}{5}$; maxillary $2\frac{2}{5}$; interorbital $2\frac{4}{5}$; first branched dorsal ray $1\frac{1}{4}$; first branched anal ray 2; least depth of caudal peduncle $2\frac{2}{7}$; lower caudal lobe 1; pectoral $1\frac{1}{5}$; ventral $2\frac{1}{10}$.

Body elongately ovoid, well compressed, greatest depth at dorsal origin, and profiles nearly alike. Predorsal edge rounded convexly, also postdorsal. Preventral and postanal regions convex, post-ventral trenchant, though without distinct keel. Caudal peduncle well compressed, about long as least depth.

Head moderate, well compressed, nearly flattened sides very slightly constricted below, upper and lower surfaces convex, profiles

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[5] *Tetragonopterus festæ* Boulenger, *Boll. Mus. Z. Anat. Comp. Torino*, XIII, No. 329, 1898, p. 2. *Rio Vinces, Ecuador.*

similarly inclined and both a little convex. Snout short, convex over surface and in profile, length about $\frac{2}{3}$ its basal width. Eye circular, a little elevated, and its centre about first $\frac{3}{8}$ in head. Eyelids narrow, thin. Pupil circular. Maxillary vertically inclined, narrow, with greatest expansion about $3\frac{1}{2}$ in eye, extends back a little behind front eye edge, though not to front pupil edge. Upper lip firm, tough, lower thick, fleshy and free in front. Mouth rather small, short, commissure nearly horizontal, and powerful jaws with lower not protruding when closed. Premaxillary teeth biserial, anterior a little smaller and tricuspid, and posterior quincuspid and broad. All premaxillary teeth with convex surfaces, median

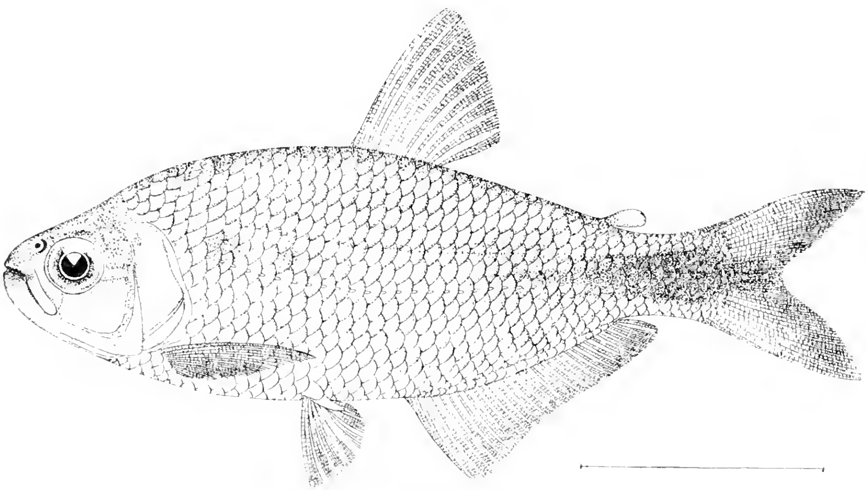

Fig. 5.—*Astyanax scierus* Fowler. Type.

cusp much largest, and edges of all denticles entire. Two small teeth on lower edge of each maxillary inside mouth. Mandibular teeth uniserial, symphyseal pair enlarged, quincuspid, others, of which 3 follow graduated slightly back on each ramus, similar. Mandibular dentition extends about half way on each ramus. No other teeth. Upper and lower buccal folds broad, especially former. Tongue a little long, depressed, rounded and not free in front. Mandible strong, convex over surface, and rami moderately elevated inside mouth. Nostrils together, close before upper front edge of eye, anterior simple pore and posterior exposed in crescent. Interorbital evenly convex. Preorbital narrow, similar to maxillary, and latter mostly slipping below its lower edge. Infraorbital covering most of cheek, larger than eye. Postorbital small, its width about 2 in eye. Opercle width about $2\frac{2}{3}$ in its depth. Hind preopercle edge nearly straight, inclined slightly posteriorly. Occipital fontanel rather broad. Head bones all smooth. Opercle membrane over gill-opening rather broad.

Gill-opening forward about opposite front eye edge. Rakers 8 + 9, lanceolate, compressed, pointed, longest about $\frac{3}{5}$ of filaments. Latter $1\frac{3}{4}$ in eye. No pseudobranchiæ. Gill-membranes largely separate, only forming short fold anteriorly over narrow and rather convex isthmus. Branchiostegals 4, strong, subequal.

Scales moderate, well exposed, in longitudinal series parallel with l. l., sometimes with many as 18 radiating striæ, edges entire and convex. Scales mostly a trifle smaller along edges of body, especially supra-anal region. Caudal base scaly, though scales a little smaller than on body. Base of anal with a row of moderately small scales. Other fins, together with head, naked. No scaly axillary pectoral flap, though that of ventral free, elongate, pointed, and about $\frac{3}{7}$ length of fin. Scales passing completely over all body edges, except apparently postanal region, though on latter no median naked strip. L. l. complete, decurved a little below median axis of body and extending a little low along caudal peduncle side up to median caudal base. Tubes simple, at first little exposed, but gradually extend till nearly over first half of scale exposures.

Dorsal origin about midway between snout tip and caudal base, first branched ray longest with second branched and third simple rays subequal, these all reaching about far back as tips of last rays, and depressed fin nearly half way to caudal base. Adipose fin inserted trifle nearer depressed dorsal tip than caudal base, fin half way to latter. Anal inserted below sixth branched dorsal ray base, first branched ray longest with second branched and fourth simple rays subequal, thus forming slightly elevated anterior lobe. Caudal well forked, lobes pointed and lower (slightly damaged) evidently a little longer. Pectoral with upper rays longest, reaches trifle beyond ventral origin. Latter inserted well before dorsal or a trifle nearer anal than pectoral origin and fin $1\frac{1}{8}$ to anal. Vent about last fourth in space between ventral and anal origins.

Color when fresh in alcohol rather dark olivaceous-brown above, paler to dull whitish below. All upper surface of body with dark or swarthy appearance, being dusted with minute dusky or blackish dots broadly over edges of scales, this also extending well down over sides or till opposite bases of pectorals. Almost all of body overshot with dull silvery reflections. Head dark olivaceous-brown like back, this color including all of upper lip and snout. Maxillary and mandible rather grayish. Sides of head and below whitish, former silvery and opercle with some golden reflections. Almost all of side of head with minute brownish dots, which a little enlarged and quite distinct on postorbital. Iris grayish-dusky, with silvery reflections. On side of body a broad underlaid plumbeous streak, ill defined and less in width than eye-diameter, extends from shoulder to caudal base. In third to fifth scales of its course a nebulous dusky blotch a little less than eye, and followed by a similar one at eighth and ninth scales. At end of plumbeous band a large dusky to blackish blotch, and this reflected out on median caudal rays to their tips. Dorsal dark gray. Caudal lobes grayish basally, becoming brownish distally. Paired fins and anal grayish, latter with membranes dull dusky on outer portions. Pectoral and ventral also slightly darker on outer portions. Adipose fin brownish. Inside gill-opening with some minute dusky dots, otherwise pale. Peritoneum silvery below.

Length $3\frac{11}{16}$ inches.

Type, No. 17. Collection of S. N. Rhoads. Affluent of the Chimbo River, near Bucay, Province of Guayas, Ecuador. July, 1911.

Also Nos. 18 to 30, paratypes, same data. Head $3\frac{3}{7}$ to $3\frac{7}{8}$; depth $2\frac{3}{5}$ to $3\frac{1}{5}$; D. III, 9; A. usually IV, 27, I, frequently IV, 25, I, IV, 26, I, IV, 28, I, or IV, 29, I; scales in l. l. usually 35, frequently 36 or 37, sometimes 38, seldom 34 + usually 4, sometimes 3; usually 7 scales above l. l. to dorsal origin, frequently 8; 6 scales below l. l. to ventral origin; usually 7 scales below l. l. to anal origin, frequently 8, seldom 6; usually 15 predorsal scales, often 16 or 17; snout $3\frac{3}{4}$ to $4\frac{1}{4}$ in head measured from upper jaw tip; eye $2\frac{4}{5}$ to $3\frac{1}{5}$; maxillary $2\frac{1}{6}$ to $2\frac{5}{6}$; mandible $2\frac{1}{10}$ to $2\frac{2}{5}$; interorbital $2\frac{1}{3}$ to 3; pectoral $1\frac{1}{8}$ to $1\frac{1}{4}$; ventral $1\frac{2}{3}$ to 2; length $1\frac{5}{8}$ to $3\frac{1}{8}$ inches. Small examples are usually more elongate, paler or more silvery, and have the mandible slightly protruding. They show the maxillary teeth, however.

This species appears related to *Astyanax simus* (Boulenger),[6] a species originally confused with *A. mexicanus* (Philippi), as *Tetragonopterus petenensis*, by Günther. It differs in the size of head and depth of the body. Boulenger gives the former as $3\frac{2}{3}$ to 4 and the latter as 3 to $3\frac{1}{2}$. If this refers to the total length, my examples

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[6] *Tetragonopterus simus* Boulenger, *Boll. Mus. Z. Anat. Comp. Torino*, XIII, No. 329, 1898, p. 2. *Valley of Chota, north of Ecuador.*

show the head $4\frac{1}{5}$ to $4\frac{7}{8}$ and the depth as $3\frac{1}{5}$ to $3\frac{4}{5}$. Further, *A. simus* is said to be without a humeral blotch, while *A. scierus* has two. *A. simus* is about $3\frac{5}{16}$ inches in length. In any case the account of *A. simus* is not in agreement with my material representing the present species.

(Σκιερός, dusky.)

PIABUCININÆ.

Piabucina aureoguttata sp. nov. Fig. 6.

Head 4; depth 4; D. II, 8; A. III, 8, I; P. I, 14; V. I, 7; 25 scales in a lateral series from shoulder to caudal base, and 4 more on latter; 8 scales between dorsal and ventral origins transversely; 14 predorsal scales; head width $1\frac{3}{4}$ its length; head depth at occiput $1\frac{1}{2}$; mandible $2\frac{2}{7}$; first branched dorsal ray 2; first branched anal ray $2\frac{1}{10}$; least depth of caudal peduncle $2\frac{2}{5}$; upper caudal lobe $1\frac{1}{10}$; pectoral $1\frac{5}{6}$; ventral 2; snout 4 in head measured from upper jaw tip; eye 6; maxillary $2\frac{3}{4}$; interorbital $2\frac{3}{5}$.

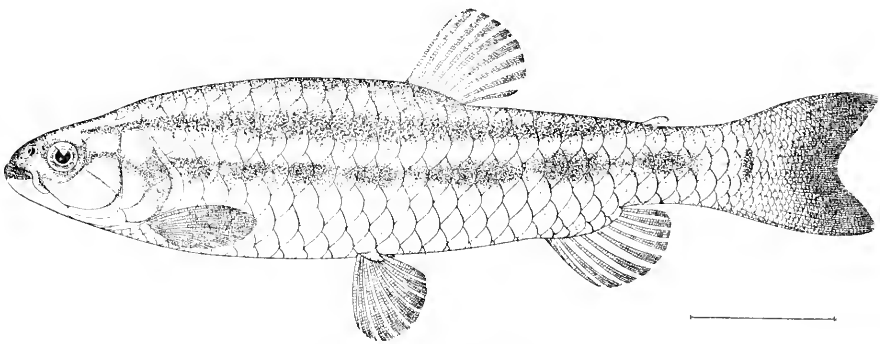

Fig. 6.—*Piabucina aureoguttata* Fowler. Type.

Body elongate, compressed, rather heavy forward, profiles similar so contour rather fusiform, greatest depth about ventral origin, and edges all broadly convex. Caudal peduncle well compressed, least depth about $1\frac{1}{8}$ its length.

Head moderate, profiles slightly convex, surfaces convex above and below, broad, and sides slightly convex. Snout convex over surface and in profile, broad, short, length about $1\frac{3}{5}$ its basal width. Eye small, rounded, but little elevated, and in profile centre about first third in head. Eyelid free, narrow. Pupil large, circular. Maxillary nearly vertical, extends back about opposite front pupil margin, its upper edge slips well below preorbital, bone notched above, and greatest distal width about $\frac{4}{7}$ of eye. Upper lip thin, tough, tight. Lower lip similar, only a little more fleshy on each side of mandible. Teeth in jaws rather small, strong, tricuspid, slightly compressed with median cusp greatly enlarged and pointed, edges of teeth otherwise entire, and all uniserial. At base of each maxillary a series of 4 small teeth, continuous with others in upper jaw, and otherwise similar. No other teeth. Upper and lower buccal folds rather broad, well developed. Tongue broad, fleshy, depressed, front edge free and convex as seen from above, surface finely papillose. Mandible strong, rami low, surface convex and anteriorly well protruding in front beyond snout tip. Nostrils together, anterior in a short cutaneous tube, forming behind into a rather broad flap, and posterior a bean-shaped aperture close behind. Interorbital broadly convex. Broad suborbital chain completely covering cheek. Preorbital narrowest of suborbital chain, and narrowest portion about half of eye. Postero-infraorbital largest, its length about twice eye-diameter. Lower postorbital larger than upper. Hind preopercle edge nearly straight and inclined a little behind. Opercle width about $1\frac{3}{4}$ its length. Hind cutaneous edge of gill-opening broad.

Gill-opening forward about opposite hind pupil edge. Rakers 8 + 12, rather slender, elongate, lanceolate, tips pointed, about $\frac{3}{5}$ of filaments. Latter $1\frac{1}{2}$ in eye. No pseudobranchiæ. Isthmus broadly convex, membranes forming narrow free fold anteriorly. Branchiostegals 4, subequal, strong.

Scales large, firm, well exposed, free edges convex, cycloid, with about 10 more or less reticulated radiating striæ over exposures, and all distributed in nearly even longitudinal series. Scales along edges of body but little smaller than others. Body scales extend out on anal base, where not much smaller than others and form a sheath into which anal fin depresses. Caudal largely scaly basally, scales at base but little smaller than others on side of body, though becoming quite small out on lobes of fin sub-basally. Pectoral with rather deep axillary depression. Ventral axilla with short and free pointed scaly flap a little less than 3 in fin. Fins otherwise, and head, naked. L. l. evident only as first 3 tubes in course from shoulder. Tubes simple, small and extend over first third in scale exposures.

Dorsal origin about midway between caudal base and hind eye edge, first and second branched rays subequal and longest, depressed fin half way to adipose fin origin. Adipose fin small, inserted a little before last fourth in space between dorsal origin and caudal base, fin less than half way to latter. Anal inserted behind depressed dorsal tip, first to third branched rays subequally longest, fin $1\frac{2}{5}$ to caudal base, lower edge rounded. Caudal broad, slightly emarginated, upper lobe a little longer than lower. Pectoral broad, rounded, $1\frac{9}{10}$ to ventral, and upper rays longest. Ventral inserted a little before dorsal origin, fin $1\frac{4}{5}$ to anal origin. Vent close before anal.

Color in alcohol rich umber-brown on back, becoming paler on sides below and lower regions, where largely whitish. From occiput along each side of back to end of upper surface of caudal peduncle a broad dusky to blackish band, this well separated from an inferior lower similar band. This latter narrow, rather ill-defined, extends back from eye across opercle along middle of side and becomes more or less obsolete after anal. It seems to be obscurely broken up into a number of blackish blotches, of which one above anal base and another below adipose fin most distinct. A narrow dusky-black vertical bar at caudal base. Almost all of scales along side below with a gilt or golden blotch at inner basal region, and these fading out after being in alcohol some time. Head brownish above, sides paler, with lower surface whitish. Lips both deep brown, maxillary but little paler. Tongue largely pale, front edge dusky. Inside gill-opening pale. Iris brownish. Dorsal grayish. Caudal pale olivaceous-brown. Other fins all pale or whitish. Peritoneum silvery-white.

Length $6\frac{3}{16}$ inches.

Type, No. 31. Collection S. N. Rhoads. Affluent of the Chimbo River, near Bucay, Province of Guayas, Ecuador. July, 1911.

This species differs from *Piabucina astrigata* Regan, and in fact all the others in the genus by its coloration.

(*Aureus*, golden; *gutta*, spot; with reference to the coloration.)

CICHLIDÆ.

Æquidens azurifer sp. nov. Fig. 7.

Head $2\frac{4}{5}$; depth $2\frac{1}{3}$; D. XIV, 11; A. III, 9, I; P. I, 13; V. I, 5; scales 16 in upper branch of l. l., 9 in lower branch; 4 scales between spinous dorsal origin and l. l.; 2 scales between rayed dorsal origin and l. l.; 6 scales obliquely back from anal origin to beginning of lower branch of l. l.; 9 predorsal scales; head width $1\frac{2}{3}$ its length; head depth at occiput 1; snout $2\frac{2}{7}$; eye $5\frac{1}{8}$; maxillary $3\frac{1}{10}$; interorbital $2\frac{5}{7}$; mandible $2\frac{2}{5}$; fourth dorsal spine $3\frac{1}{4}$; tenth dorsal spine 3; fourteenth dorsal spine $2\frac{3}{4}$; sixth branched dorsal ray $1\frac{1}{4}$; third anal spine $2\frac{2}{3}$; fifth branched anal ray $1\frac{2}{7}$; least depth of caudal peduncle $2\frac{2}{7}$; caudal $1\frac{1}{10}$; pectoral $1\frac{1}{10}$; ventral $1\frac{1}{4}$.

Body oblong, well compressed, deep, rather robust, back well elevated with upper profile bulging somewhat anteriorly, lower profile rather evenly and shallowly convex and greatest depth about opposite depressed ventral spine tip. Body edges all rounded convexly. Caudal peduncle well compressed, length about $\frac{3}{4}$ in least depth.

Head large, compressed, upper profile steeply inclined, slightly concave before eye, and lower profile little inclined. Sides of head slightly convex, becoming a little more approximated above than

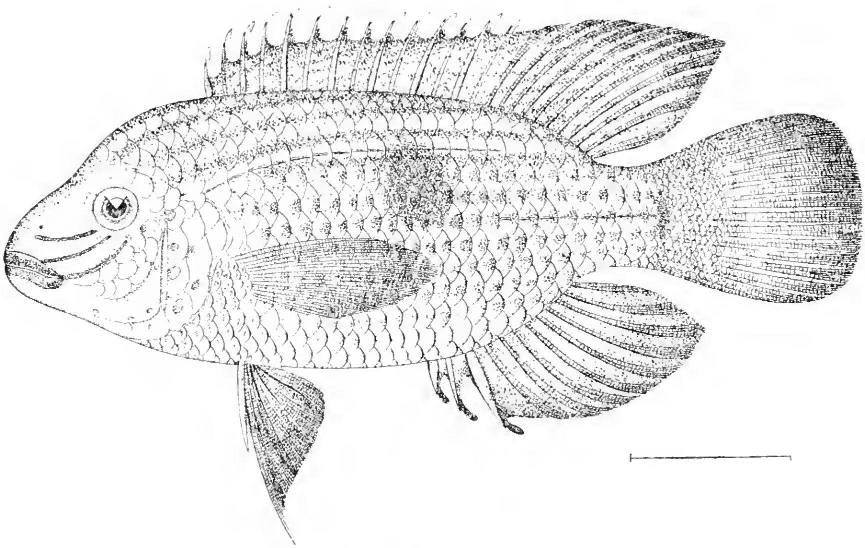

Fig. 7.—*Æquidens azurifer* Fowler. Type.

below. Snout large, profile slightly convex, surface well convex, and basal width at front of eyes equals its length. Eye circular, rather well elevated, close to front profile, and a little anterior in head length. Eyelid free, narrow. Pupil circular. Mouth wide, small, commissure slightly inclined. Muzzle rather prominent, somewhat protruding, and jaws equal. Premaxillary quite protractile. Maxillary narrow, extends about half way in snout length, and concealed by preorbital. Lips thick, fleshy, tough, not free, at corners of mouth somewhat conspicuous. An outer series of enlarged conic teeth in each jaw, followed by a broad inner band of villiform teeth. Apparently no other teeth. Upper and lower buccal folds present, upper well developed. Tongue thick, fleshy, end thickened conic tip, not free. Mandible shallow, rami low, and surface convex. Nostrils small, anterior larger, a trifle nearer eye than upper jaw end, and posterior inconspicuous opposite front eye edge medianly. Interorbital convex. Hind preopercle edge straight, nearly vertical or but slightly inclined forward. Membrane along hind edge of gill-opening narrow.

Gill-opening extends forward about midway in head. Rakers $3 + 8$, short, weak, rather fleshy and rather conic, about 3 in filaments. Latter $1\frac{1}{4}$ in eye. No pseudobranchiæ. Isthmus broadly convex, membrane forming rather broad free fold across. Branchiostegals 5, rather long, narrow.

Scales rather large, well exposed, finely ctenoid, in longitudinal series, and a little smaller on breast than elsewhere on trunk. Fins scaleless, except caudal base, and that covered with numerous small scales. Head largely naked, except 3 series of scales on cheek, 3 rows on opercular region, and occipital region. No pointed axillary scaly flaps. On mandible below 4 pores on each ramus, and along each preopercular edge 4 more large pores. L. l. interrupted below front of soft dorsal, begins at shoulder and curves up till a little above eye, after which nearly straight. Lower portion of l. l. begins opposite end of upper, well below eye, straight or horizontal, and extends out on caudal base. Tubes simple, well exposed, in some cases nearly or quite to edges of scales.

Spinous dorsal inserted nearer snout tip in vertical than rayed dorsal origin, spines graduated up to fourth after which subequal to tenth, and then last graduated still a trifle longer. Edge of spinous dorsal deeply notched, tip of each spine with a well-developed cutaneous flap. Rayed dorsal with postero-median rays longest, forming an elongated point to fin, begins before end of upper l. l. or beginning of lower l. l., and edge entire. Anal with spinous origin about opposite twelfth dorsal spine base, spines graduated up to last, which longest, membranes notched, and tip of each spine with a well-developed free cutaneous flap. Rayed anal like rayed dorsal, and origin of fin about opposite that of rayed dorsal, with postero-median rays longest, and edge entire. Caudal with hind margin convex, median rays longest. Pectoral large, long, fin reaches opposite second anal spine base, superior rays longest. Ventral origin a little behind that of pectoral, fin pointed, reaches anal origin, spine strong and about 2 in fin. Vent close before anal.

Color in alcohol largely olivaceous-brown on back, becoming paler below and on sides. On lower surface color pale gray-brown, much paler on lower surface of head, and on breast about gill-opening. Along each series of scales on back at upper and lower junctions of scales longitudinal or horizontal dark lines. These latter at first dusky or deep slaty-brown, but as they follow below upper l. l. become pale blue, so that over greater or lower half of trunk they have this tint. Along middle of side opposite hind end of depressed pectoral, just below and partly on upper l. l. a large slaty-black blotch, but it also perforated by regular slaty longitudinal streaks, giving an underlaid appearance. This dark slaty-black blotch formed only as broad dark edges to scales involved, and even olivaceous streaks also showing in the interstices. Along costal region, and that above spinous anal, pale blue streaks become connected at bases of scales and thus expose olivaceous ground-color as rounded spots, one on each scale. These pale blue streaks extend completely along caudal peduncle side to base of caudal. Head olivaceous-brown above, like back, becoming paler below. Lips brownish, cheek and opercular region with pale gray spot. Two deep blue narrow lines extend down from lower edge of eye to lower preorbital edge, and an upper parallel and similar extends towards snout tip till just below front nostril. Iris slaty. Inside gill-opening pale. Spinous dorsal and rayed dorsal dull olive-dusky, with indistinctly defined oblique streaks more or less longitudinally, also somewhat reticulated in places, with grayish. Upper edge of rayed dorsal narrowly, and cutaneous tips to dorsal spines dull ochraceous. Caudal dull olivaceous-brown, clouded indistinctly with dusky as several irregular darker transverse streaks. Edge of caudal behind narrowly dull ochraceous. Anal dull olivaceous, with grayish tinge basally and dull dusky distally, edge becoming narrowly slaty. Bases of rayed vertical fins, together with bases of last dorsal and anal spines with dull or pale bluish tinge. A short vertical dusky or slaty bar at caudal base. Pectoral and ventral pale brownish-gray, both pale basally, former more brownish distally and latter becoming dusky distally along first and second branched rays.

Length $5\frac{1}{4}$ inches.

Type, No. 32. Collection, S. N. Rhoads. Affluent of the Chimbo River, near Bucay, Province of Guayas, Ecuador. July, 1911.

Also Nos. 33 to 35, paratypes, same data. Head $2\frac{2}{3}$ to $2\frac{9}{10}$; depth $2\frac{2}{7}$ to $2\frac{2}{5}$; D. usually XIV spines, sometimes XIII, rays usually 11, sometimes 10; A. spines III, rays usually 9, sometimes 8; scales in upper branch of l. l. usually 16, sometimes 17; scales in lower branch of l. l. 7 to 10 to caudal base, and 2 more on latter (with tubes); 4 scales above upper branch of l. l. to spinous dorsal origin; 5 scales below lower branch of l. l. to spinous anal origin; usually 9 predorsal scales, sometimes 8; left gill-rakers 2 + usually 9, sometimes 10; right gill-rakers usually 2, sometimes 3 + usually 9, sometimes 10; snout 2 to 3 in head; eye $3\frac{2}{7}$ to $4\frac{1}{4}$; maxillary $3\frac{2}{5}$ to 4; interorbital $2\frac{2}{3}$ to 3; length $2\frac{1}{2}$ to $4\frac{1}{4}$ inches. Some variation is noticed in these examples, but mostly in the smallest. Though it also has the coloration with the six broad dark transverse bands distinct, these are not very evident in the type. In all, the fourth to tenth dorsal spines are more or less equal, and not regularly graduated from the anterior to the last.

This species is close to *Æquidens rivulatus* (Günther), but differs in several respects when examples of similar size are compared. According to Regan,[7] *Æ. rivulatus* has the head 3; eye $3\frac{2}{3}$ to 4, interorbital 3 to $3\frac{1}{4}$, 7 or 8 rakers on lower part of gill-arch, dorsal spines increasing in length to last, longest dorsal rays extend back to middle or beyond in caudal length, caudal peduncle long or nearly long as deep, a blackish vertical stripe below eye, 3 blue lines from eye to maxillary, etc.

(*Azureus*, blue; *fero*, to bear; with reference to the pale bluish in the coloration.)

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[7] *Acara rivulata* Regan, *Ann. Mag. Nat. Hist.*, (7) XV, 1905, p. 338 (type). *Rio Peripa, W. Ecuador.*

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OCTOBER 3.

MR. CHARLES MORRIS in the Chair.

Seventeen persons present.

The Secretaries, the Curators, and the Librarian reported on the work of the summer.

The Publication Committee reported that papers under the following titles had been considered for publication since the meeting held May 16:

"Some Fishes from Venezuela," by Henry W. Fowler (May 20).
"The Lyriform Organs and Tactile Hairs of Araneads," by Norman Eugene McAdoo (May 25).
"Some Arachnida from North Carolina," by Nathan Banks (June 14).
"Observations on Sarcocystis rileyi (Stiles)," by Howard Crawley (July 7).
"Notes on the Anatomy and Classification of the Genera Omphalia and Mesomphix," by Henry A. Pilsbry (July 24).
"A new California Chiton," by S. S. Berry (August 1).
"New Freshwater Fishes from Western Ecuador," by Henry W. Fowler (September 22).
"A new East Indian Euciroa," by Henry A. Pilsbry (September 28).

The deaths of Mrs. Gulielma M. S. P. Jones, a member, February, 1910, and of Francis William Rawle, a member, June 12, 1911, were announced.

The deaths of the following Correspondents were also announced:

Thomas Rupert Jones, April 13, 1911.
Charles M. Scammon, May 2, 1911.
Samuel H. Scudder, May 17, 1911.
Nevil Story Maskelyn, May 27, 1911.
Ralph Tate.
Hennadius D. Romanowsky.

The following Standing Committees appointed by the Council, December 24, 1910, were inadvertently omitted from the proceedings of January 3, 1911:

FINANCE.—John Cadwalader, Edwin S. Dixon, Effingham B. Morris, William D. Winsor, and the Treasurer (George Vaux, Jr.).
PUBLICATIONS.—Henry Skinner, M.D., Witmer Stone, A.M., Henry A. Pilsbry, Sc.D., William J. Fox, and Edward J. Nolan, M.D.

LIBRARY.—Thomas H. Fenton, M.D., Thomas Biddle, M.D., George Vaux, Jr., Henry Tucker, M.D., and Frank J. Keeley.

INSTRUCTION AND LECTURES.—Henry A. Pilsbry, Sc.D., Charles Morris, Witmer Stone, A.M., Henry Tucker, M.D., and George Spencer Morris.

OCTOBER 17.

PHILIP P. CALVERT, PH.D., in the Chair.

Twenty-one persons present.

The reception of papers under the following titles was reported:

"Mollusca of Arkansas, Louisiana and Mississippi," by E. G. Vanatta (October 16).

"Notes on some Pleurotomariidæ of the Cretaceous of New Jersey," by Henry A. Pilsbry, Sc.D. (October 17).

The death of Florentino Ameghino, a Correspondent, was reported.

MR. WITMER STONE spoke of the fauna and flora of western Maryland and their relationships. (No abstract.)

Uhlic Dahlgren and John Sinnott were elected members.

The following were ordered to be printed:

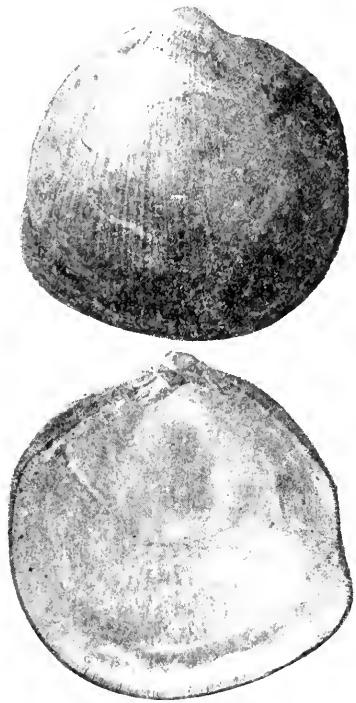
A NEW EAST INDIAN EUCIROA.

BY H. A. PILSBRY.

In a collection of invertebrates from the East Indies there was a single right valve of *Euciroa*, differing from all described species of the genus by its great size and by the orbicular shape.

Euciroa dalli n. sp.

The shell is rather plump, subcircular, slightly inequilateral, the length and height about equal. Anterior margin broadly rounded; posterior margin obtusely subangular near the base, with a shallow emargination above the angle. Dorsal and ventral margins about equally convex. Beaks small, slightly projecting above the margin and turned forward. The exterior is evenly convex except for a low, rounded ridge running to the posterior angle, the area above it being flattened. Surface sculptured with many unequally spaced low radii bearing small, well-raised pustules, the slightly concave intervals between the radii irregularly, rather closely and minutely granular. The posterior flattened area has no radial rows of pustules, but is densely granular. Lines of growth are scarcely visible except near the basal and posterior margins, where they are rather strong and irregular. It is light buff with some reddish stains.



E. dalli. (About ⅔ natural size.)

The interior is brilliantly pearly, with some iridescence of the silvery surface chiefly towards the margins. The adductor muscle impressions are large and deep. Within the smooth pallial band there is a broad roughened area. The lower margin of the valve has a very narrow, dull, minutely pitted border, within which the nacreous layer is finely, almost regularly grooved at right angles to the edge, with some coarse, unequal and irregularly placed wrinkles in the same direction. The cartilage pit is deeply excavated, the tooth stout, erect and triangular.

Length 67, alt. 65½, semidiameter 21 mm.

Near Sibuko Bay, Borneo.

This species is much larger than any of the known Poromyaceous clams. It is far larger and shorter than the Hawaiian *Euciroa pacifica* Dall.[1]

A very similar, perhaps identical species from the Philippines is contained in the collections made by Dr. Paul Bartsch while on the "Albatross," which I was able to inspect through the kindness of Dr. William H. Dall.

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[1] Report on Mollusca and Brachiopoda dredged in Deep Water, chiefly near the Hawaiian Islands, *Proc. U. S. Nat. Mus.*, XVII, p. 688, 1895.

MOLLUSCA OF ARKANSAS, LOUISIANA AND MISSISSIPPI.

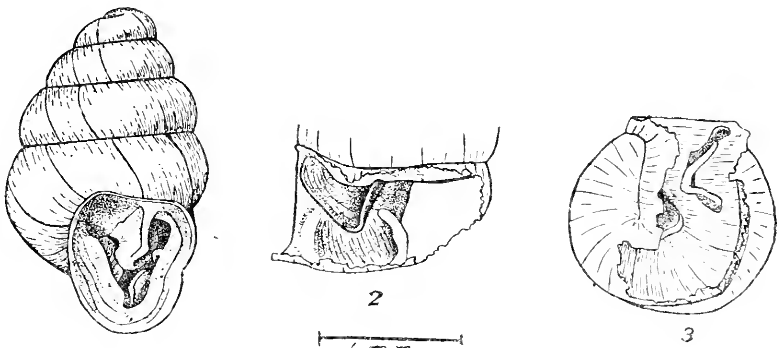
BY E. G. VANATTA.

The following species of shells were collected by Mr. Clarence B. Moore and presented to the Academy of Natural Sciences. In the absence of any records covering the region, it was thought desirable to list the species found.

Bifidaria contracta climeana n. var. Figs. 1 2, 3.

Shell similar to typical *contracta* Say, but the parietal tooth lacks the inner continuation, being L-shaped.

Alt. 2.29, diam. 1.43 mm.



1 2 3

Type in the collection of the Academy number 97,605 from near Anderson Landing, on the Sunflower River near the confluence with the Yazoo River, Sharkey Co., Miss. Also in the collection from near Blakeley, Baldwin Co., Ala.; Simpson Island, Baldwin Co., Ala. (Clarence B. Moore); Calera and Wetumpka, Ala. (H. H. Smith); O'Neil Landing, Yazoo Co., Miss. (C. B. Moore); City Park, New Orleans, La. (S. N. Rhoads); above Eagle Island Landing, Franklin Parish and Sycamore Landing, Morehouse Parish, La. (Clarence B. Moore); Carlock Place and Tebbs Place, Ashley Co., and near Menard Landing, Arkansas Co., Ark. (C. B. Moore); Navidad River bottom, Jackson Co., Tex. (J. D. Mitchell).

Named in honor of Mr. Arthur W. Clime, one of Mr. Moore's assistants.

St. Francis River, Cross Co., Ark., collected by Arthur W. Clime:

Polygyra thyroidus Say.
Polygyra denotata Fer.
Circinaria concava Say.
Zonitoides minuscula Binn.
Mesomphix lævigata Beck.

St. Francis River, seven miles above Parkin, Cross Co., Ark., collected by Arthur W. Clime:

Circinaria concava Say.
Omphalina friabilis W. G. B.
Zonitoides singleyana Pils.

Near Wampoo Landing, Arkansas River, Pulaski Co., Ark.:

Polygyra leporina Gld.
Vitrea indentata Say.
Zonitoides arborea Say.
Zonitoides minuscula Binn.
Helicodiscus parallelus Say.

About twenty-five miles below Pine Bluff, Arkansas River, Jefferson Co., Ark.:

Polygyra thyroidus Say.

About thirty miles above Pine Bluff, Arkansas River, Jefferson Co., Ark.:

Polygyra albolabris alleni Weth.

Sladers Landing, Arkansas River, Jefferson Co., Ark.:

Polygyra inflecta Say.
Bifidaria corticaria Say.
Strobilops labyrinthica Say.
Vitrea significans Bld.
Vitrea hammonis Ström.
Euconulus chersinus trochulus Reinh.
Helicodiscus parallelus Say.
Pyramidula alternata Say.

Old River Landing, Arkansas River above Arkansas Post, Arkansas Co., Ark.:

Polygyra thyroidus Say. Imperforate.

Between South Bend and Douglas, Arkansas River, Arkansas Co., Ark.:

POLYGYRA THYROIDUS Say. Umbilicate and imperforate.

Near Menard Landing, Arkansas River, Arkansas Co., Ark.:

POLYGYRA INFLECTA Say.
BIFIDARIA CONTRACTA CLIMEANA Van.
STROBILOPS STREBELI AENEA Pils.
MESOMPHIX LÆVIGATA Pfr.
VITREA INDENTATA Say.
STRIATURA MILIUM Mse.
ZONITOIDES ARBOREA Say.
ZONITOIDES MINUSCULA Binn.
PYRAMIDULA ALTERNATA Say.

Near Douglas, Arkansas River, Lincoln Co., Ark.:

BIFIDARIA PENTODON Say.
ZONITOIDES ARBOREA Say.
ZONITOIDES MINUSCULA Binn.
PYRAMIDULA ALTERNATA Say.

A few miles below Camden, Ouachita River, Ouachita Co., Ark.:

POLYGYRA THYROIDUS Say.
POLYGYRA OBSTRICTA CAROLINENSIS Lea.

Kent, near Camden, Ouachita Co., Ark., about two miles from the Ouachita River:

POLYGYRA THYROIDUS Say. Imperforate.
POLYGYRA INFLECTA Say.
POLYGYRA LEPORINA Gld.
POLYGYRA OBSTRICTA CAROLINENSIS Lea.
BIFIDARIA CONTRACTA Say.
VERTIGO MILIUM Gld.
STROBILOPS STREBELI AENEA Pils., Young.
VITREA INDENTATA UMBILICATA Ckll.
STRIATURA MILIUM Mse.
ZONITOIDES ARBOREA Say.
CARYCHIUM EXILE Lea.

Friar's Bluff, Ouachita River, Ouachita Co., Ark.:

STROBILOPS STREBELI AENEA Pils.

Zonitoides arborea Say.
Omphalina cuprea Raf.
Striatura milium meridionalis Pils.
Euconulus chersinus trochulus Reinh.
Helicodiscus parallelus Say.

Near Purdue Wood Camp, Ouachita River, Calhoun Co., Ark.:

Polygyra thyroidus Say. Imperforate.
Polygyra inflecta Say.
Polygyra leporina Gld.
Vitrea indentata umbilicata Ckll.
Zonitoides arborea Say.
Zonitoides minuscula Binn.
Euconulus chersinus trochulus Reinh.

Keller Place Landing, Ouachita River, Calhoun Co., Ark.:

Polygyra thyroidus Say. Imperforate.
Polygyra leporina Gld.
Bifidaria contracta Say.
Vertigo oscariana St.
Strobilops texasiana Pils.
Vitrea indentata umbilicata Ckll.
Striatura milium meridionalis Pils.
Zonitoides arborea Say.
Omphalina cuprea Raf.
Euconulus chersinus trochulus Reinh.
Carychium exile Lea.

Carlock Place, Bayou Bartholomew, Ashley Co., Ark.:

Polygyra thyroidus Say. Imperforate.
Polygyra inflecta Say.
Polygyra leporina Gld.
Bifidaria contracta climeana Van.
Strobilops labyrinthica Say.
Vitrea indentata Say.
Vitrea hammonis Ström.
Zonitoides arborea Say.
Zonitoides minuscula Binn.

Tebbs Place, Bayou Bartholomew, Ashley Co., Ark.:

Polygyra inflecta Say.

Bifidaria contracta climeana Van.
Vitrea indentata Say.
Striatura milium Mse.
Zonitoides arborea Say.
Zonitoides minuscula Binn.

Lovett Landing, Bayou Bartholomew, Morehouse Parish, La.:

Zonitoides arborea Say.
Zonitoides singleyana Pils.
Vertigo rugulosa St.

Sycamore Landing, Bayou Bartholomew, Morehouse Parish, La.:

Bifidaria contracta climeana Van.
Bifidaria pentodon tappaniana Ad.
Strobilops texasiana Pils.
Zonitoides arborea Say.

Wards Place near Wardville, Bayou Bartholomew, Morehouse Parish, La.:

Strobilops strebeli aenea Pils.
Zonitoides minuscula Binn.
Zonitoides singleyana Pils.

Near Miller Landing, Bayou Bartholomew, Morehouse Parish, La.:

Polygyra thyroidus Say.
Zonitoides arborea Say.
Zonitoides minuscula Binn.
Pyramidula alternata Say. Young.

Mound Landing, Bayou Bartholomew, Morehouse Parish, La.:

Polygyra thyroidus Say.

Near Jones, Bayou Bartholomew, Morehouse Parish, La.:

Polygyra thyroidus Say.
Polygyra inflecta Say.
Bifidaria pentodon tappaniana Ad.
Strobilops strebeli aenea Pils.
Vitrea indentata Say.
Omphalina friabilis Binn.
Mesomphix lævigata Beck.
Pyramidula alternata Say.

Wilson Landing, Bayou Bartholomew, Morehouse Parish, La.:

Strobilops labyrinthica Say.
Vitrea indentata umbilicata Ckll.

Above Charlieville, Boeuf River, Richland Parish, La.:

Strobilops strebeli aenea Pils.
Zonitoides arborea Say.

Port Union Landing, Ouachita River, Ouachita Parish, La.:

Zonitoides arborea Say.

Myatt's Landing, Ouachita River, Ouachita Parish, La.:

Zonitoides singleyana Pils.

Stubbs Plantation, Ouachita River, Ouachita Parish, La.:

Zonitoides arborea Say.

Above Eagle Landing, Bayou Boeuf, Franklin Parish, La.:

Polygyra thyroidus Say.
Bifidaria contracta climeana Van.
Strobilops strebeli aenea Pils.

Dailey Landing, Boeuf River, Franklin Parish, La.:

Polygyra thyroidus Say. Nearly imperforate.
Polygyra inflecta Say.
Zonitoides arborea Say.
Mesomphix lævigata Beck.
Pyramidula alternata Say.

Jones Landing, Bayou Boeuf, Franklin Parish, La.:

Polygyra thyroidus Say. Imperforate.
Euglandina rosea bullata Gld.

Blue Cane Landing, Black River, Catahoula Parish, La.:

Polygyra thyroidus Say.
Bifidaria pentodon tappaniana Ad.
Strobilops strebeli aenea Pils.
Vitrea indentata Say.
Zonitoides arborea Say.

One mile below Harrisonburg, Ouachita River, Catahoula Parish, La.:

Vitrea indentata Say.
Zonitoides arborea Say.

Welch Landing, Ouachita River, Catahoula Parish, La.:

Strobilops strebeli Pfr.
Vitrea indentata Say.
Zonitoides arborea Say.
Pyramidula alternata Say.

Junction of Bushley Creek and Old River, a fork of Little River, Catahoula Parish, La.:

Zonitoides arborea Say.

Donohue Ferry, Little River, Catahoula Parish, La.:

Strobilops labyrinthica Say.
Vitrea indentata umbilicata Ckll.
Zonitoides arborea Say.
Zonitoides minuscula Binn.
Euconulus chersinus dentatus St.

Two miles above Jonesville, Little River, La.:

Polygyra thyroidus Say.
Polygyra monodon friersoni Pils. A small form.
Polygyra leporina Gld.
Pyramidula alternata Say.
Vitrea indentata Say.
Zonitoides arborea Say.
Euconulus chersinus Say.

Mr. Cody's Place, O'Neil Landing, Yazoo River, Yazoo Co., Miss.:

Polygyra appressa perigrapta Pils.
Bifidaria contracta climeana Van.
Bifidaria pentodon Say.
Strobilops strebeli aenea Pils.
Vitrea indentata Say.
Zonitoides arborea Say.
Pyramidula alternata Say.

Near Anderson Landing, Sunflower River, Sharkey Co., Miss.:

Polygyra albolabris Say. Young.
Polygyra denotata Fer.

Bifidaria pentodon Say.
Bifidaria contracta climeana Van.
Strobilops strebeli Pfr.
Vitrea indentata Say.
Zonitoides arborea Say.
Zonitoides singleyana Pils. Greenish-yellow.
Pyramidula alternata Say.

November 7.

Mr. Charles Morris in the Chair.

Twenty persons present.

The reception of the following papers was reported:

"A Monograph of the Procyonidæ," by R. W. Shufeldt, M.D. (October 17).

"The Formation of Ripple-marks, Tracks, and Trails," by Amos P. Brown (October 25).

The death of Ernest André, a correspondent, June 14, was announced.

In announcing the death on October 31 of the Rev. Henry C. McCook, D.D., the Recording Secretary stated that he had been elected a member August 31, 1875, and had served as Vice-President from May, 1882, to December, 1900.

He was earnest and efficient as the Chairman of the Committee on Lectures and Instruction from 1880 to 1887. During the period of his active association he was always energetic in the enforcement of what he regarded as best for the welfare of the Academy.

His work on the natural history of ants and spiders will give him a permanent place in the history of Science in America.

A more extended notice of Dr. McCook's scientific work will be published by the Entomological Section of the Academy.

John W. Harshberger, Ph.D., made a communication on the vegetation of extreme southern Florida. (No abstract.)

Captain Hugh L. Willoughby, in continuation, spoke of the physiography and primitive vegetation of Lake Ochichobee and the Everglades.

November 21.

The President, Samuel G. Dixon, M.D., LL.D., in the Chair.

Thirty-two persons present.

The reception of a paper entitled "Notes on Salmonoid and related Fishes," by Henry W. Fowler, was reported.

The death of Malcolm Lloyd, a member, September 27, was announced.

Mr. Charles Morris made a communication on the extinction of the giant reptiles. (No abstract.)

The following were ordered to be printed:

NOTES ON SOME PLEUROTOMARIIDÆ OF THE CRETACEOUS OF NEW JERSEY.

BY HENRY A. PILSBRY, Sc.D.

The following notes are based upon a study of the type specimens of the species discussed, together with other examples in the collection of the Academy. The generic term *Pleurotomaria* is here used in the older, wide sense.

Pleurotomaria crotaloides (Morton).

Cirrus crotaloides Morton, Synopsis Organic Remains Cretaceous group of the U. S., p. 49, pl. 19, fig. 5, 1834.
Pleurotomaria crotaloides Pils., Proc. A. N. S. Phila., 1896, p. 11 (notes on Morton's type specimen).

This species is represented in the collection of the Academy by the type specimen from Erie, Ala., figured by Morton, and a smaller example from Uniontown, in which the slit is well shown. It is 17 mm. long, so far as preserved, probably about 20 when perfect, and 1 mm. wide (fig. 1). Both specimens are internal casts.

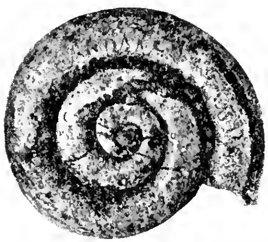


Fig. 1.—*P. crotaloides.*

In 1896 the writer identified a much larger cast from Mullica Hill with *P. crotaloides*, a conclusion which renewed study shows was erroneous. The Mullica Hill example differs in several important particulars, as indicated below under *P. woolmani*.

In 1907 Professor Stuart Weller understood *P. crotaloides* to include *Architectonica abbotti* Gabb as well as the form now differentiated as *P. woolmani*. This course seems to me untenable, for reasons given below. So far as present information and collections show, *P. crotaloides* (Morton) is not known to occur in New Jersey.

Pleurotomaria abbotti (Gabb.).

Architectonica abbotti Gabb, Proc. A. N. S. Phila., 1861, p. 321.
Margaritella abbotti Gabb, Whitfield, Gastrop. and Ceph. of the Raritan Clays and Greensand Marls of New Jersey, p. 134, pl. 17, figs. 12–15.
Pleurotomaria crotaloides Morton, Weller, Rep. on the Cret. Paleont. of New Jersey, 1907, p. 665. Not of Morton.

Professor Whitfield's figures give a good idea of this species, though they are somewhat "restored," the plication below the suture being made continuous, whereas in the shells it has been partially effaced;

moreover, the spiral striation depicted is far less distinct in the specimens themselves. One of the two cotypes shows the trace of a slit, a short distance above the periphery, narrower and nearer to the periphery than in *P. crotaloides.* The specimens are internal casts composed of coarse glauconitic sand. The fact that they show sculpture indicates that the shell was quite thin, its inner surface being modified in conformity with the external ornamentation. *P. crotaloides* was probably thicker, since the casts, although in fine material, show no trace whatever of sculpture. This alone would indicate the specific diversity of *P. crotaloides* and *P. abbotti;* but an inspection of the fossils shows that the spire was a little higher in *P. abbotti,* and the greatest convexity of the upper surface of the whorls is not quite so close to the suture. The umbilicus is about equal in the casts of the two species, being somewhat less than one-third the total diameter of the shell. In *P. woolmani* it is more than one-third the diameter. There can, I believe, be no reasonable doubt that *P. abbotti* is specifically distinct from *P. crotaloides.*

Pleurotomaria woolmani n. sp.

Pleurotomaria crotaloides Pilsbry, Proc. A. N. S. Phila., 1896, p. 10, pl. 1. Not of Morton.

This species differs from both *P. crotaloides* and *P. abbotti* by its broad umbilicus, which is contained $2\frac{4}{5}$ times in the diameter of the shell, while in the other species it is contained more than three times ($3\frac{1}{4}$ to fully $3\frac{1}{2}$) in the diameter. The earlier whorls are evenly rounded above, oval in section, not irregularly swollen as in the other species. There is no trace of the radial sculpture of *P. abbotti,* although the cast is very perfectly preserved. The unique type, an internal cast, has been described and figured in my paper cited above. It measures 70 mm. in diameter. The type is No. 1625 A. N. S. P.

This species is named in honor of the late Lewis Woolman, whose work on well-borings contributed important facts relative to the stratigraphy of New Jersey. He was also a successful collector of fossils.

THE FORMATION OF RIPPLE-MARKS, TRACKS, AND TRAILS.

BY AMOS P. BROWN, PH.D.

In the summer of 1902 I spent a portion of August in camp near the head of Sandwich Bay, Labrador. Our camp was located at a place called Dove Point on the charts, near the mouth of Dove Brook and at the mouth of the estuary of White Bear River, which latter empties into this arm of the bay some three miles above the Point. Dove Point extends out from the north shore of Sandwich Bay for more than a mile, nearly to the channel leading to the river mouth, the deep-water portion of which is here about one-third of a mile wide. Extending to the northeast, towards Dove Brook and the Mealy Mountains, are wide mud flats, laid bare with each low tide; beginning with a breadth of a mile and a half at the Point and gradually narrowing until they disappear altogether at some 4 or 5 miles along the shore. To the northwest of the Point they extend for some three miles, beginning with a width of half a mile and gradually narrowing to the mouth of White Bear River.

The higher ground at the Point, about 20 feet above the water level, is composed of sand and gravel with occasional boulders, which probably represents the *Saxicava* sands or Upper Boulder deposits of Canada, although no fossils were found in the sands. At their base and underlying these san ls is the clay deposit, in which is found numerous shells of the *Leda* clays, such as *Saxicava arctica* Desh., *Serripes groenlandicus* (Chem.), *Astarte elliptica* McGill, *Macoma sabulosa* Mörch, etc., and scattered over the surface of the clay flats are many large boulders left by the erosion of the clays by the water. As the tide is not very high here, about three feet on the average, these flats are gradually covered by a shallow layer of water, which ripples in over the flat with each rising tide. It is generally accompanied by wind, which makes little wavelets that break on the shore when the water finally reaches it. The level of the flats is so nearly perfect that when they are completely covered by the rising tide this layer of water is in general but a few inches deep near the shore, though at some distance from the shore it may be three feet deep over some parts of the flat that were laid bare at low tide. The clay is particularly firm and compact, and retains impressions made upon it for many succeeding tides. As the bay freezes to the bottom in winter, even down to a much greater depth than is exposed by the receding tide, the firm character of the clay may be due in part to the effect of ice pressure, but this clay deposit was doubtless covered by the sand and gravel of which a remnant remains in the raised ground on the Point, and this being some 20 feet thick would have compressed the clay to the firmness which it exhibited upon these flats. To the northwest of our camp it was beautifully rippled for a mile or more and for the full width of the flats. The sandy strand on the west side of Dove Point was also rippled with each tide. I thus had an excellent opportunity to study the formation of *water-formed* ripple-marks and other impressions made upon this clay surface, and I was at once struck by their close resemblance to similar markings so common in the continental deposits of the Triassic of the State of Pennsylvania, which I had studied while connected with the Geological Survey of that State. Other markings on these clay surfaces closely resembled the tracks and trails described and figured by Hitchcock in the rocks of this age in the Connecticut Valley.[1] Their origin on these mud flats could readily be seen and, as they so exactly resemble the formations found in the rocks, a description of them may throw some light upon the markings observed by Hitchcock and others.

No living mollusks were seen on the mud flats, being doubtless killed by the freezing of the bay in winter, but species of *Mya* are evidently living in the deeper water of the bay, as their shells were occasionally encountered in places where they had been stranded by the tide. To the east, towards the Mealy Mountains along the shore, a few specimens of gastropods were seen, some three or four miles down the bay.

While mollusks are rare, the sea weeds in some parts of the bay flourish in great luxuriance. Where the shore is rocky and the bottom is composed of sand and shingle rather than clay, as is the case to the east side of the bay, especially from East Arm to Cartwright, and, in fact, along all the shores examined where the conditions were favorable, the bottom is covered with a dense growth of *Fucus*, probably *F. vesiculosus* L., which here attains a height of three or four feet and forms dense masses of several feet in diameter. In the deeper water, especially in the channels, are seen the broad fronds of *Laminaria longicrucis* De la Pyl., extending up from the bottom and the laminæ waving about in the current. When seen

[1] Edward Hitchcock, *Ichnology of New England*, 1858; *Supplement to the Ichnology of New England*, 1865.

stranded on the shore, the fronds are found to be twenty or twenty-five feet long or even more, including six or eight feet of stipe. Along the rocky shores everywhere towards the head of the bay, and even on the clay flats, attached to stones and pebbles, the *Ulva enteromorpha* Le Jolis was seen growing abundantly. When I add that the shores of the point were covered with pieces of drift wood of all sizes so thickly that we were not in need of other fuel for our camp during our stay there, and that various species of ducks, snipe and other water birds frequently traversed the surface, while occasional bear and caribou came close up to our camp across the flats, I have

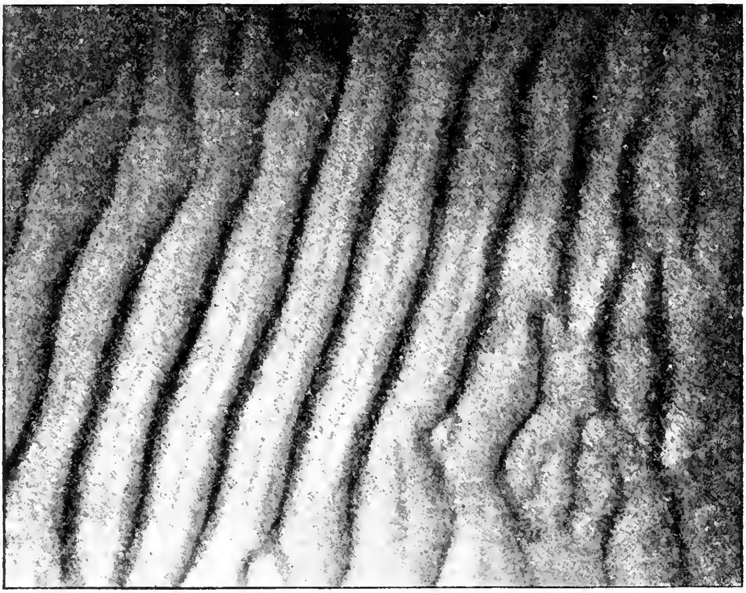


Fig. 1.—Ripples of deposition.

enumerated nearly all the factors concerned in the formation of the markings noted.

The Ripple-marks.—The study of recent ripple-marks seems to have been largely confined to wind ripples on sandy surfaces and to current ripples in channels and along the shore. A study of these ripples formed along the strand and on the clay flats at Dove Point discloses at once the fact that they are of two kinds; and these two kinds are formed at the sandy strand and on the clay flats, respectively. They are, on the shore, ripples of *deposition* (mainly), and on the clay flats they are ripples of *erosion*.

The sandy strand was always ripple-marked after each tide, if the surface of the water in the bay was somewhat ruffled by the wind. The incoming tide pushed the sand along and, combined with the wave motion in the shallow water, moulded the sandy surface into a series of ripples which closely resemble those made by the wind on dry, sandy surfaces. They are mainly ripples of deposition, the sand surface moving with the advancing water as the dry sand surface, thrown into wind ripples, advances under the force of the wind. But there is also a little erosion in the shaping of these ripples, although the main action of the water is to deposit material.

The sand ripples which form along the strand are quite large; they range from three to four inches from crest to crest, and sometimes are even wider. The depth of the trough is $\frac{3}{4}$ inch or more in some cases. Their general appearance is well shown in fig. 1, which is a photograph of this rippled surface taken looking vertically down

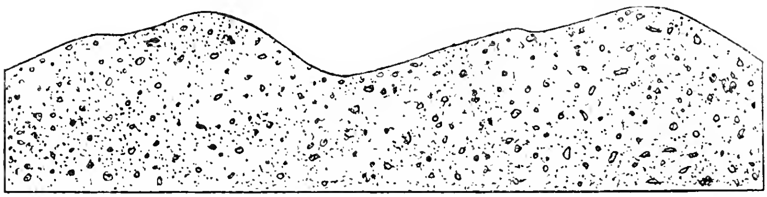


Fig. 2.—Section of ripples of deposition.

from above. Here the left of the picture is that portion of the strand towards the open water of the bay and the right is towards the land. When the tide is coming in the water and sand transported by it are moving from the bay towards the land. The slope of the ripple towards the water or bay side is gentle; up this slope the advancing water pushes the sand grains, which, after they pass the crest, fall down the steeper landward slope of the ripple and assume the angle of repose, making the ripple steeper on this landward side. The advancing water strikes the bay slope of the next ripple and removes a portion of its surface, from the fainter, smaller crest seen on this slope in the photograph up to the crest itself. The result is that the landward slope continually advances, while parts are cut away from the bay-side slope so that the one grows by deposition of the material removed from the other. The top of the ripple is rounded with one steep side, sloping down to a rather sharp trough, and one gently sloping side, running from this trough to the next crest, and this gentle slope having its upper part continually cut away by the water action, making a little subsidiary ripple-mark (fig. 2). During the advance of the tide these ripple-marks are formed over large strand surfaces, and when the tide recedes they are often modifed and the troughs deepened by erosion. In some cases they are obliterated, in other cases they may be covered up by other sand deposits and preserved; but in general this last will only happen occasionally, when an exceptionally high tide or a flood from a river brings down an unusual amount of material from

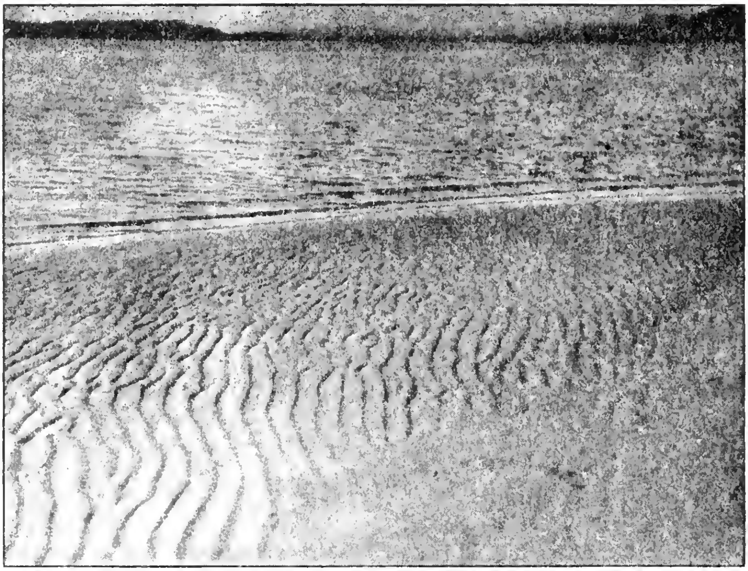


Fig. 3.—View of rippled strand.

the shore. As the streams here are mostly bog-fed, this can only happen by landslide or other cause that adds a large amount of detritus to the stream water. At Dove Point the ripples in the sand of the strand could hardly be preserved, except in case of very high tide. This double form of ripple of *deposition* is found in wind-swept sand also, but does not seem to be very common among the ripple-marked surfaces that are preserved in the rocks. It is quite probable that the bulk of these are produced by erosion alone, not by deposition, and the ripples made by erosion are of a different form.

Where these strand ripples of deposition are reworked by the receding tide they are deepened in the trough, the steep side becomes rather steeper and the crest crumbles away, becoming sometimes narrower, sometimes even sinking locally by the softening and collapse of the sand when impregnated with water. The waves in the water undoubtedly condition the formation of the ripples in the sand. In fig. 3 the rippled strand is shown after the tide has partly receded and the small water waves seen on the surface of the bay are similar to those that have rippled the sandy shore. The sands here are derived from the raised beach of the *Saxicava* sands, which formation is formed on both sides of the estuary of White Bear River. They are being continually washed down from the banks of this raised beach upon the *Leda* clays, which they overlie stratigraphically.

The clays of the flats are finely rippled in some places over large surfaces. The appearance of these rippled surfaces is well shown

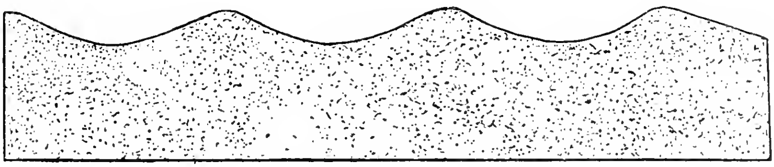


Fig. 4.—Section of ripples of erosion.

in the photograph, Plate XLI, fig. 1, which was taken on the flats about one-quarter of a mile to the west of our camp. The boulder-strewn surface of the flat is very noticeable at the back of the picture. These ripples were carved out of the hard, tough surface of the *Leda* clay, and were so firm that in walking over them in the Eskimo skin boots we wore we left scarcely any impression; and even a bear, traversing this ripple-marked surface, did not flatten down the crests of the ripples very much. They were quite uniform in dimensions, as the picture shows, with a width from crest to crest of the ripples of about one and three-quarters to two inches and a depth amounting to not more than one-quarter of an inch. Unlike the ripples of deposition, these erosion ripples had a rather sharp crest, about one-quarter of an inch broad; the trough was concave, nearly or quite symmetrically so, and rounded out with a gentle curve (see fig. 4). They did not cover the entire surface of the flat, but were more pronounced where the water had to travel a greater distance over the flat, and where, therefore, there was more current.

As the tide rose continuously, and the water advanced regularly over the flat, there was a progressive flow of the water over the surface of the mud; but, in some places, ripples were regularly produced; in other places, especially near the shore, the surface was nearly plane and free of ripples, Plate XLI, fig. 2. On these surfaces other markings were produced. The rippling of the water by the winds is the cause of the formation of these erosion ripples. Their formation was investigated by wading about in the shallow water, two to six inches deep, while the tide was advancing over the flats. It was then seen that at the passage of each wave there was raised a slight cloud of muddy water from the concave of the ripple. The surface of the clay was softened for about one or two millimeters in depth when the tide was in over the flats, and in this soft surface impressions could be made by any object moving over the bottom and touching it, from time to time or continuously. But the ripples were very permanent, remaining in the same place for days. That they have the origin assigned to them there can be no doubt, they are not of the form of the ripples of deposition and they are firm and persistent. They closely resemble the ordinary forms of ripples that are seen on the rock surfaces in the Trias, for example; and that erosion was the source of these Triassic ripples in many cases, I have very little doubt. They are very constant in form, as has been noted, and very persistent, owing to the tough and tenacious character of the *Leda* clay. That such ripple-marked surfaces should be preserved if the flats were subject to inundations by water highly charged with sediment seems certain; and while such was not the case here, the water would be just as efficient as an erosive agent if it contained a charge of sediment. The wind waves start the erosion of the ripple; but, as it develops, it reacts upon the water, producing waves when the wind is not blowing as well as when the surface of the water is rippled by the wind. That this form of erosion ripples is more common on hard mud bottoms than the ripple of deposition and that on sandy bottoms the ripple produced by deposition is more common, is indicated, too, by an examination of rippled surfaces of rock. The finer material seems to be more often marked with the symmetrically concave, sharp crested, erosion ripples; while the coarser materials, such as sands, show more often the rounded crest and peculiar unsymmetrical shape of the deposition ripples.

The Tracks of Animals.—As has been noted above, large mammals and birds, moving over the clay flats, left their foot-marks upon the surfaces. On one occasion a caribou almost walked into camp during the early morning and it traversed about two miles of the flat to the west. Its foot-prints were deeply impressed into the clay surface; on the rippled parts they were more than the depth of the ripple-mark. The median digits were impressed below the level of the trough of the ripple, and even the lateral digits sometimes made a mark, especially where the foot had slipped slightly. The clay was so firm, however, that the foot-prints did not exceed one inch in depth at any place, although this deer is a heavy animal. The impressions were very persistent, they continued to be distinctly outlined for days after they had been formed; and, indeed, were quite distinguishable when we left the camp, about a week after they had been impressed in the clay. They probably lasted much longer, yet they were covered by the tide twice in each twenty-four hours during the period of observation. If this water had contained any considerable amount of sediment they might have been covered and preserved.

At another time one or two bears were roaming about on the flats; they left a much less distinct impression, scarcely flattening out the ripples in the clay, though in some cases their claws were deeply impressed. This indicates the hard character of the clay, for these animals have considerable weight. Being plantigrade, the larger surface distributes the weight, so that the foot-prints were not deeply impressed. Nevertheless, they could be traced after the flats had been covered by several succeeding tides, and the claw portion of the track was visible after 5 or 6 tides.

Some dogs (temporarily abandoned by their owners, who had gone out to the coast to fish during the summer) attached themselves to our camp; and their tracks, made when they were coming in for their meals, were also found to last for two or three days. Our own tracks were about as permanent, unless in the softened clay, where they were of course more deeply impressed and therefore much more permanent. The tracks made by the birds only affected the shallow layer of soft clay, perhaps about one-eighth of an inch deep, and they generally could not be seen after one tide had covered them. In some of the unrippled places, however, the bird tracks seemed to be covered by clay, and were doubtless preserved until the surface was again eroded. Of course, if much sediment were being deposited, they might be preserved permanently, but here they were generally only temporary.

These animal tracks, when deeply impressed into the clay surface, could all be permanently preserved in places where the rivers are bringing considerable sediment into the water; where the flats are less frequently covered by the water, as, for instance, in the case of the flood plains in the estuary of a river, they would have more chance to be permanently preserved. From observations made elsewhere, where a river that was subject to freshets after heavy rains covered such flood grounds, the sediment after one rise would often amount to one-quarter of an inch of silt, which would dry to about one-third of this thickness. Such a layer would be quite enough to cover and preserve all but the deeper tracks; and even these might be filled in some cases. But the permanence and sharply defined character of the impressions were the most significant facts observed at this locality.

The Trails and other Impressions on the Clay Flats.—In his "Ichnology of New England," 1858, and the "Supplement to the Ichnology of New England," 1865, Edward Hitchcock has described, besides undoubted reptilian and batrachian tracks, many other markings which he observed on the shale and sandstone layers of the Connecticut Triassic. Some of them he ascribes to fishes, Crustaceans, Annelids, and insects, as well as some which he calls "fucoids," or simply "plants," and a few that he did not assign to any group. The illustrations of these irregular markings ascribed to fishes, such as his genus *Ptilichnus*, as well as some that he calls "of doubtful character," such as his *Grammichnus* and *Ænigmichnus*, and some of the "crustacean" and "insect" tracks, are very much like forms that I observed on some of the smoother parts of these flats. Continuous trails, such as he calls annelid tracks, were also common, and in all cases the manner of production of these trails was observed. They were not here produced by living animals in any case. For instance, when the incoming tide carried along with it a bunch of *Ulva enteromorpha* attached to a small gravel stone, it might make a continuous line in the clay, as shown in Plate XLII. This line would take any direction, depending upon the eddies in the water; it would even double upon itself and the tracks would cross. When the tide was receding the movements were often more linear and the trails left were much straighter. Those photographed were obtained after the tide had receded and the bunches were left stranded. The *Ulva enteromorpha* grows in tufts of some six to eight inches high, attached to stones and pebbles which serve to anchor it. As the plant increases in size, the flotation of the bushy fronds becomes, in moving water, sufficiently strong to move the small pebbles, up to three-quarters of an inch in diameter, for instance. Where these are caught by the incoming tide they are carried along in the water at a rate that depends upon the drag of the anchor. Observations were made upon them in water varying from six to ten inches deep, by wading out on the flats from the shore, and in deeper water by observing the motion from a boat. The fronds of the *Ulva* stood upright from the anchoring pebble and waved back and forth with the passage of the wind waves. But as the fronds are exceedingly flexuous, the anchor was not lifted from the bottom, as a rule, by the passage of a wave; the frond simply expanded and collapsed, or rose and fell, with the up and down movement of the surface of the water; and as far as the graving action of the pebble was concerned, it was continuous or nearly so. The trails made were more or less deeply impressed according as the muddy surface was more or less yielding, and also according as the anchor was pressing with full force or with a diminished pressure, as the frond of the *Ulva* was extended or collapsed by the movement of the waves. In some cases the trails were made by the advancing plant being dragged towards shore by the incoming tide, in other cases by the receding tide carrying it away from shore.

The form of the trail that was left depended upon the shape of the pebble. Thus some were simply single concave grooves, the sides being raised a little above the general surface of the mud, and these look like what are called molluscan or annelid trails in such structures when found fossil. They are very much like Hitchcock's *Unisulcus*. Others were double grooves, when the shape of the anchoring pebble was more irregular or when it had a groove in its lower side. These were like Hitchcock's *Bisulcus*. It should be borne in mind that the *Ulva* is attached to one point on the anchoring pebble, and hence that one side of the pebble is *always* uppermost, so that the surface which makes the impressions is always the same one.

Hitchcock's genus *Ptilichnus* is represented by a track which consists of a very irregular series of markings that recur at regular intervals, but that could not be made by the feet or other appendages of passing animals. He assigns them to markings made by fishes. Of these tracks he describes several species, distinguished by the varying forms of the tracks. Such are *Ptilichnus anomalus*, *P. pectinatus*, *P. hydrodromus*, etc. Another such track is what Hitchcock calls *Saltator*, under the impression that the regularly recurring impressions were made by some leaping animal. All of these, which will be found figured in the "Ichnology," are very similar to the trails left by a piece of seaweed rolled along the bottom by the advancing or receding tide. I watched this movement of tufts of *Fucus vesiculosus* L., many times and the impressions formed certainly bear a very close resemblance to many of the forms described and figured by Hitchcock.

These tufts are the ends of fronds, pieces varying from four or five inches up to eight or ten inches in length, more or less conical in general outline and in all cases broader at the outer end of the frond than at the stem end. The advancing tide rolls them over and over, generally more or less in a curved line, due to the somewhat conical or pear shape of the tuft. The stem end thus touches from time to time and makes a series of irregular impressions, somewhat removed from the main line of impressions of the fruiting ends of the frond. The marks made by the stem are deeper, but smaller than those made by the fruiting terminations of the branches These fruiting tips of the branches are bifid or trifid as well as simple, conical, bladder-like expansions and they sometimes make impressions that simulate the tracks of three-toed reptiles or other animal tracks. They look, however, as though only one foot were touching, as they all point in one way. In the more globular tufts of the weed the rolling motion is more irregular and the stem does not always point in one direction, but the bunch may turn over, end for end, occasionally; then the arrangement of the series of impressions formed will often suddenly reverse right and left. In nearly all cases where these impressions were seen they were observed under water only, the weed drifting in from the channel off Dove Point, and hence no photographs were obtained. Hitchcock's *Ptilichnus anomalus* trails, as well as most of the impressions that he calls *Ænigmichnus multiformis*, probably had some such origin as that indicated above.

A small branching twig of, say, a spruce or cedar would make a trail like the *Saltator* impression which he describes, if it were rolling over and over on the bottom under the influence of the advancing or receding tide. A piece of a branch or a trunk, without notable projections, being advanced along the bottom by rolling under the influence of the rising tide, would make an impression like Hitchcock's figure of *Ænigmichnus multiformis* given on Plate XIV of the "Supplement to the Ichnology of New England." This slab was $3\frac{1}{2}$ feet by $4\frac{1}{2}$ feet. The slab is crossed by "numerous rows of impressions, certainly not less than thirty-five, the impressions are circular as though made by a punch, or they are elongated or even linear." There are also "linear furrows nearly parallel to the other impressions, but crossing at a small angle," which were made, no doubt, by some other object subsequently, perhaps during a different tide.

He also describes another slab with *Ænigmichnus* on which were "a trifid arrangement of somewhat triangular toes with two dents behind and two or three on one side, and this arrangement is repeated about once in an inch. The axis of the foot in this case is turned aside from the line of direction as much as 30°, but I cannot decide in which direction the animal was moving nor find a series of impressions to the right or left corresponding to this one."

This description (and the figure on Plate I, "Supplement") represent very exactly the kind of impressions made by a rolling piece of *Fucus*. Thus only the feet on one side of the hypothetical animal make any impression, or else it must move sidewise, but the impressions recur at perfectly regular intervals. That is exactly the character of impressions made by an object rolling over the bottom, and it is also the character of the impressions made by the rollers in a print mill manufacturing cotton prints. That the "footmarks" were all *right* or all *left* might have suggested this analogy, if the idea of a rolling object had occurred to Prof. Hitchcock.

From the foregoing, it is evident that markings closely simulating molluscan and annelid trails *may* be produced without animal agency, and even such markings as may be mistaken for those made by fishes, crustaceans or reptiles may be similarly produced.

Explanation of Plates XLI and XLII.

Plate XLI.—Fig. 1.—Rippled surfaces of the *Leda* clay on the flats northwest of Dove Point, looking westward.

Fig. 2.—A nearer view of the erosion ripples on the clay flats, looking east towards Dove Point.

Plate XLII.—Fig. 1.—Trail made by a pebble attached to a tuft of *Ulva enteromorpha*, and dragged over the bottom. The attached tuft of the *Ulva* may be seen in a collapsed condition at the end of the trail.

Fig. 2.—A part of the clay flats, covered with pebbles with their attached *Ulva* tufts, that have left markings by their movement over the bottom.

Fig. 3.—A portion of fig. 2, enlarged, showing some of the markings in more detail.

December 5.

The President, Samuel G. Dixon, M.D., LL.D., in the Chair.

Forty-three persons present.

The death of James W. McAllister, a member, May 28, 1911, was announced.

The Publication Committee reported the acceptance of a paper, entitled *A Monograph of the Procyonidæ*, by R. W. Shufeldt, M.D., as a contribution to the Journal.

R. A. F. Penrose, Jr., Chairman of the Committee on the Hayden Memorial Geological Award, reported for the Committee in favor of conferring the medal this year on John Casper Branner, Professor of Geology in Leland Stanford Jr. University.

On favorable report of the Council the award was made as recommended by the Committee.

Dr. John Casper Branner was born at New Market, Tenn., July 4, 1850. He was educated at Maryville College, Tenn., and at Cornell University, New York, graduating from Cornell in 1874 with the degree of B.S. In 1885 he received the degree of Ph.D. from the University of Indiana, and in 1897 the degree of LL.D. from the University of Arkansas.

Dr. Branner went to Brazil in 1874 and was for some years a geologist on the Imperial Geological Commission of that country, which was then under the directorship of Professor Hartt. In 1878 and 1879 he was assistant engineer and interpreter for the S. Cyriaco Mining Company, in the State of Minas Geraes. In 1880 to 1881 he carried on special botanical investigations in Brazil, and in 1882 to 1883 he was agent there of the United States Department of Agriculture.

Dr. Branner then returned to the United States. He has since made many trips to Brazil and elsewhere in South America, his geological and other scientific work there being well known to scientists. His special fields of operation in recent years have been in the neighborhood of Rio de Janeiro and thence northward to Bahia and beyond. His work on the stone and coral reefs of the coast, published by the Museum of Comparative Zoology of Harvard University, is well known. His investigations of the black diamond fields of Bahia have been productive of most important scientific results, and have shown the source of the diamonds to be in certain rocks, from which they were derived by erosions and buried in the gravels where they now occur. This source of the black diamonds of Bahia had been unknown until Dr. Branner discovered it.

Among the most important of his recent trips to Brazil was his expedition in 1899 as head of the Branner-Agassiz Expedition. He made other expeditions in 1907 and 1911. Some seventy papers and books on Brazilian geology, with many papers on zoological, botanical and other subjects, have resulted from Dr. Branner's work in that country. He has also published in the Portuguese language a text-book on geology for the use of Brazilian students, and many papers for the benefit of the people of that country, where he is held in the highest regard as a man and a scientist.

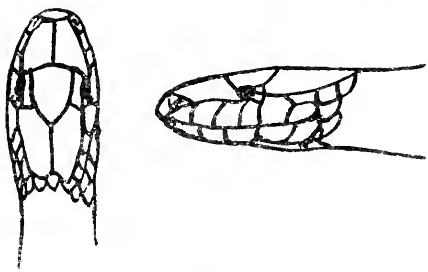
Since his return from Brazil in 1883, Dr. Branner has been active in geological work in the United States. From that year to 1885 he served as topographic geologist on the Geological Survey of Pennsylvania under Professor Lesley; and from 1885 to 1892 he was professor of geology at the University of Indiana.

From 1887 to 1893 he was State Geologist of Arkansas, in which position his work was of scientific and economic value. About twenty volumes bear witness to the diligence and ability with which he conducted the exploration of a State until then almost unknown in its geological features. Dr. Branner continued the work after the survey had been disbanded, largely at his own expense, and gave his results to the State, to be published by it for the benefit of its people.

In 1892 Dr. Branner became professor of geology at Leland Stanford Jr. University, California; in 1898–99 he was acting President, and in 1899 he became Vice-President of the institution. He still holds both positions. After the California disaster of 1906, Dr. Branner was appointed by the Governor a member of the committee to investigate the earthquake, and did much valuable work in this connection.

Mr. Stewardson Brown made a communication on the expedition of Francis E. Bond to Venezuela in the interest of the Academy. (No abstract.)

Scale Variations in Stilosoma extenuatum (A. E. Brown).[1]—Dr. Henry Tucker remarked that the type had been described as having the prefrontals fused with the internasals; no loreal, or preocular; internasals extend to supralabials, also enter orbit; parietals extend behind postoculars to fifth labial; nostril in the centre of a single scale; labials, six upper, fifth largest; lower five, fourth largest. Three horizontal temporals. Three pairs of



Type.

chin shields. Nineteen rows of smooth lozenge-shaped dorsal scales. Anal entire; body slender; tail short; head not distinct; rostral prominent; ventrals, 223 to 260; subcaudals, thirty-three to forty-four pairs; teeth, ten upper, twelve lower, all smooth; pupil round. Color, silvery-gray, with sixty to seventy irregular dark brown dorsal blotches with narrow blackish borders, ten to twelve on tail; interspaces mottled with pale red; belly blotched with black, which extends on sides and often breaks, so forming lateral spots; the scales on sides are finely spotted with black; a dark patch on parietals; a small one on each side of neck; a dark postocular streak; fore part of chin and head peppered with black.

The following descriptions are based on six hitherto undescribed specimens from Lake Kerr and Norwalk, Marion County, Fla., in the collection of the late Dr. Arthur E. Brown. Color scheme in all, same as in the type. Scales smooth, in nineteen dorsal rows;

[1] A. E. Brown, *Proc. Acad. Nat. Sci. Phila.*, 1890, p. 199.

head not distinct, smaller than thickest part of body. Ventrals two hundred and thirty to two hundred and sixty. Anal entire; subcaudals forty to forty-six pairs; tail about one-fifteenth of entire length. Individually, the head scaleation of each specimen varies from the type, as follows:

No. 1. Prefrontals fused with internasals, in contact with second labial, separated from orbit by a single preocular; parietals extend behind postoculars to fifth labial, separated from sixth by first temporal; chin shields two pairs.

No. 2. Prefrontals two, not fused with internasals, laterally in contact with second labial, separated from orbit by a single preocular; right parietal in slight contact with fifth labial behind orbit, left completely separated by first temporal.

No. 3. Prefrontals two, not fused with internasals, laterally in contact with second labial, separated from orbit by a single preocular; parietals in contact with fifth labial behind orbit; chin shields two pairs.

No. 4. Juvenile, size small. Right prefrontal partly fused with internasal, both in contact with second labial, separated from orbit by a single preocular; parietals in contact with fifth labial behind orbit; chin shields three pairs.

No. 5. Juvenile, small size. Both prefrontals fused with internasals, in contact with second labial, entering orbit on left side, separated on right by a single preocular; parietals in contact with fifth labial behind orbit; chin shields three pairs.

No. 6. Juvenile, small size. Prefrontals fused with internasals, in contact with second labial, separated from orbit by a small preocular; parietals in contact with fifth labial behind the eye; chin shields two pairs.

The preocular is absent and the anterior orbital boundary is formed by the fused internasal-prefrontal in the type and one specimen only of ten in the Academy's collection, so that the chief point of diagnosis in this variety is the replacement of the loreal by either the downward curving of the normal prefrontal or the fused prefrontal-internasal, plus the postocular contact of the parietals with the fifth labials.

The color scheme strongly suggests that this reptile is derived from some member of the *Ophibolus* group, as the marking and color are almost identically those of *Ophibolus calligaster*, but the fused and unstable scaleation of the head are evidence of degeneration and make it impossible to determine the probable line of descent.

DECEMBER 19.

The President, SAMUEL G. DIXON, M.D., LL.D., in the Chair.

Twenty-eight persons present.

The death of Sir Joseph Hooker, a Correspondent, December 11, 1911, was announced.

The following were ordered to be published:

NOTES ON SALMONOID AND RELATED FISHES

BY HENRY W. FOWLER.

The Salmonoidea and Iniomi in the collection of the Academy of Natural Sciences of Philadelphia are listed in this paper, as many have not been recorded before or show interesting localities in their distribution. Three species, apparently new, are described.

SALMONIDÆ

Coregonus quadrilateralis Richardson.

One from "Lake Superior."

Coregonus fera (Jurine).

One labeled "Italy," identified by Bonaparte with this species, may have been taken in the Swiss lakes?.

Coregonus maræнula albellus (Fatio).

Two from Lake Lucerne. One without data labeled "Italy" (Bonaparte) may have been taken in Switzerland?.

Coregonus wartmanni (Bloch).

One labeled "Italy" (Bonaparte) probably from Switzerland?.

Coregonus wartmanni nobilis (Haack).

Two from Lake Lucerne.

Coregonus olupeaformis (Mitchill).

One from Lake Champlain and three others from Lake Superior, Lake Michigan and Georgian Bay, respectively.

Coregonus albus Le Sueur.

I examined a number at Erie, Pa., taken in Lake Erie during July of 1907. One now in the Academy.

Leucichthys artedi (Le Sueur).

Abundant at Erie, Pa., in Lake Erie in July, 1907, where I examined many. Several were secured and are now in the Academy. Four small examples without data and an adult from Lake George.

Leucichthys eriensis (Jordan and Evermann).

One from Lake Superior at Port Arthur, which agrees with the original account. This species was described from the north shore of Lake Erie, and said to be occasional in Lake Huron, but unknown in Lake Superior. Its equal jaws seem to be a good character.

Leucichthys prognathus (H. M. Smith).

One from Milwaukee, Wis.

Leucichthys nigripinnis (Milner).

One from Milwaukee, Wis.

Leucichthys albula (Linnæus).

One labeled "France" most likely from Scandinavia.

Oncorhynchus kisutch (Walbaum).

Four from Alaska, one from the Frazer River in British Columbia, and six from Osatsuba in Japan.

Oncorhynchus tschawytscha (Walbaum).

Two probably from the Columbia River?, another from the McCloud River in California, and one from Silver Lake Camp in Maine (introduced).

Oncorhynchus nerka (Walbaum).

One from Alaska and one from Kootenay Lake at Nelson in British Columbia.

Salmo salar Linnæus.

Three labeled "Europe," two without data, and two from the St. Croix River in Maine.

Salmo salar lacustris (Linnæus).

Two from Italy, according to the Bonaparte Catalogue "lago Maggio."

Salmo eriox Linnæus.

Five from Italy, of which one dried. A large one from Tasmania (introduced).

Salmo fario Linnæus.

A number of examples from France, Switzerland and Italy, others labeled "Europe." One from Lake Lucerne.

Salmo perryi Brevoort.

One from Nikko, Japan, and in each gill-opening a number of parasitic crustacea.

Salmo mykiss Walbaum

One from Alaska.

Salmo clarkii Richardson.

One from Puget Sound.

Salmo clarkii lewisi (Girard).

> *Salmo carinatus* Cope, Rep. Geol. Surv. Hayden, 1871, p. 471. Locality unknown, perhaps Yellowstone Geyser basin.

Nos. 7,835 and 7,836, A. N. S. P., cotypes of *S. carinatus* Cope. Also example with deformed snout probably this species.

Salmo clarkii virginalis (Girard).

One labeled "Buffalo Co., California," likely an error?.

Salmo clarkii pleuriticus (Cope).

> *Salmo pleuriticus* Cope, Rep. Geol. Surv. Hayden, 1871, p. 471. Heads of Green River, Medicine Lodge Creek, Idaho. The Junction, Montana.

No. 16,472, A. N. S. P., cotype? of *S. pleuriticus* Cope.

Salmo clarkii stomias (Cope).

> *Salmo* (*Salar*) *stomias* Cope, Rep. Geol. Surv. Hayden, 1870, p. 433. Fort Riley, Kansas.

Nos. 7,825 and 7,826, A. N. S. P., cotypes of *S.* (*S.*) *stomias* Cope. One probably from Kansas? and one from the North Fork of Saint Vrain Creek in the S. Platte River basin, Boulder County, Colo. Also three small ones from Ute Creek at Camp Garlan in the Canadian River basin in Union? County, N. Mex.

Salmo rivularis Ayres

One from the Chewauca River, Oregon.

Salmo irideus Gibbons.

One from the Russian River, California.

Salmo irideus gilberti (Jordan).

Two from the Kern River and one from Kern Lake, California.

Salmo irideus roosevelti (Evermann).

> *Salmo roosevelti* Evermann, Bull. U. S. Bur. Fisher., XXV, 1905, p. 26, Pl. 1. Volacano Creek, California.

No. 38,036, A. N. S. P., paratype of *S. roosevelti* Evermann.

Salmo irideus whitei (Evermann).

> *Salmo whitei* Evermann, Bull. U. S. Bur. Fisher., XXV, 1905, p. 20, Pl. 16. Coyote Creek, California.

Nos. 38,037 to 38,039, A. N. S. P., paratypes of *S. whitei* Evermann.

Salmo irideus shasta (Jordan).

One from the Middle Fork of the Tule River and another from the McCloud River, California.

Salmo irideus agua-bonita (Jordan).

One from the South Fork of the Kern River, California.

Hucho hucho (Linnæus).

One labeled "Europe."

Hucho blackistoni (Hilgendorf).

One from the Ishikari River near Sapporo, Japan.

Salvelinus fontinalis (Mitchill).

I have examined many examples from: ? young from Marguerita River, lower Canada; Pierce Pond in Somerset County, Me.; Lake George, N. Y.; Morris County, N. J.; Port Kennedy, Loyalsock Creek, Newton Hamilton, Newgarden, Bridgeport, Indiana County and Warren County in Pa.; head of the James River, Little Stony Creek and Walker's Creek, Va.; Lake Superior; Milwaukee, Wis. Besides these two others, of which one dried.

Salvelinus malma (Walbaum).

Salmo tudes Cope, Proc. Amer. Philos. Soc., XIII, 1873, p. 24. Captain's Harbor, Unalaska.

Nos. 7,847 and 7,848, cotypes of *S. tudes* Cope.

Another obtained by Dr. Benjamin Sharp on June 11, 1895, at the same locality, two from St. Paul on Kadiak Island, badly preserved, and one from "Alaska."

Salvelinus alpinus umbla (Linnæus).

One from Italy, one from France and one without data a dried skin.

Salvelinus alpinus willughbii (Günther).

One from Lake Windermere.

Salvelinus alpinus perisii (Günther).

One from Wales.

Salvelinus alpinus killinensis (Günther).

Scotland, one example.

Salvelinus alpinus stagnalis (Fabricius).

One from Holstensborg and another from Godhavn, Greenland.

Salvelinus oquassa (Girard).

One from the Rangeley Lakes in Maine, one from New York and another without data.

Salvelinus oquassa marstoni (Garman).

One from Lake Cassette, Riwouski in Quebec, Can.

Cristivomer namaycush (Walbaum).

Four from Wilwaukee, Wis.

Plecoglossus altivelis Schlegel.

Nine from Morioka, one from Tsuruga and four from Kurume, Japan.

THYMALLIDÆ.

Thymallus thymallus (Linnæus).

Two from Italy and one from France.

Thymallus tricolor Cope.

Proc. Acad. Nat. Sci. Phila., 1865, p. 80. Au Sable River, Michigan.

No. 7,796, A. N. S. P., type.

Another from the Au Sable River and a dry skin from Michigan.

ARGENTINIDÆ.

Mallotus villosus (Müller).

Two from Groswater Bay, Labrador; one from Wood's Holl in Mass., and three labeled "North America."

Thaleichthys pacificus (Richardson).

One from the Frazer River in British Columbia and another from the Naas River in Oregon.

Osmerus eperlanus Linnæus.

Osmerus sergenti Norris, Proc. Acad. Nat. Sci. Phila., 1868, p. 95. Schuylkill River, Philadelphia.

Nos. 7,751 to 7,753, A. N. S. P., cotypes of *O. sergenti* Norris.

Two examples from France do not differ in any way from American specimens from: Mt. Desert, Me.; Boston, Nahant and Wood's Holl, Mass.; Long Island, N. Y.; Jersey City, the Delaware and Raritan Rivers, N. J. The alleged greater number of scales for the latter, also the supposed shorter gill-rakers and weaker teeth are evidently fallacious. I shall therefore be obliged to follow Smitt in allowing them identical.

Osmerus thaleichthys Ayres.

One from Monterey, Cal.

Mesopus pretiosus (Girard).

One from Puget Sound.

Mesopus olidus (Pallas).

Twenty-eight from Aomori, Japan. Jordan and Snyder state that *M. japonicus* (Brevoort) differs in having the ventral inserted below the second or third dorsal ray, D. 10 and A. 12 or 13. All of these characters are found in at least some of my examples of the present species, none of which are over $2\frac{5}{8}$ inches, and in many cases the afore-mentioned characters are found in combination with those of undoubted examples of *M. olidus*.

Argentina sphyræna Linnæus.

Seven from Italy.

MICROSTOMIDÆ.

Microstoma microstoma (Risso).

Four from Italy.

SALANGIDÆ.

Salanx hyalocranius J. F. Abbott.

Proc. U. S. Nat. Mus., XXIII, 1901, p. 490, fig. Tien Tsin, China.

Nos. 26,800 to 26,840, A. N. S. P., paratypes.

STOMIATIDÆ.

Stomias bonapartei sp. nov. Fig. 1.

Stomias barbatus Bonaparte, Icon. Faun. Ital., Pesc. III, pt. 1, XXX, 1841, descr., Pl. fig. 3. Sicily. Probably not of Cuvier.

Head $7\frac{3}{4}$; depth about 9; D. III, 9?; A. III, 14; P. I, 6?; V. I, 5; scales (according to pockets) about 77 in lateral series to caudal base; about 8? scales (pockets) in transverse series, at centre of abdomen; about 70? vertebræ according to myocommas; head width about $2\frac{1}{4}$ its length; head depth at occiput $1\frac{1}{5}$; snout $4\frac{2}{3}$ in head measured from upper jaw tip; eye 4; maxillary $1\frac{1}{10}$; interorbital 4; lower caudal lobe $1\frac{1}{2}$; pectoral $2\frac{1}{2}$?; ventral $2\frac{1}{2}$?; front longest anal ray $2\frac{1}{4}$?.

Body very elongated, greatly compressed, edges apparently somewhat trenchant?, and sides flattened. Trunk constricted at neck, abdomen with swollen appearance and thus forming greatest depth. Caudal peduncle compressed, its least depth about 2 in its length.

Head compressed, deep, upper profile horizontal and a little convex, lower more inclined and a little convex, sides flattened. Snout short, evidently with surface convex, length about $\frac{2}{3}$ its width. Eye rounded, near first third in head close to upper profile. Maxillary slender, extends far back nearly to hind preopercle edge. Premaxillary toothed, with five large slender curved thin fangs, second fang longest and fourth larger than others. Last $\frac{3}{5}$ of lower maxillary edge finely toothed, denticles very small, of about uniform size, and all directed posteriorly. On each side of vomer a large slender sharp fang, and behind each also another similar pair, but so approximated that their tips cross. Still posterior and external to latter also another shorter fang, similarly directed, though each one much smaller. Along mandible edges 9 + 8 fangs, as 2 small ones at each side of symphysis, then larger curved fang, then little shorter curved fang, alternately followed by short curved fang, then larger fang, then (asymmetrical on left side 2) small tooth, finally still smaller one. Tongue not differentiated from base of hyoid arch. Mandible with rami low, well curved up in front where also tapering in thickness, and extended back behind as short angular process. Nostrils close before eye?. Interorbital broad, slightly convex. Preopercle edge curved back convexly. Opercle small, not quite large as eye.

Gill-opening forward before eye, about midway in snout. Rakers conic, strong, sharp-pointed, only on ceratobranchial, as 9 graduated

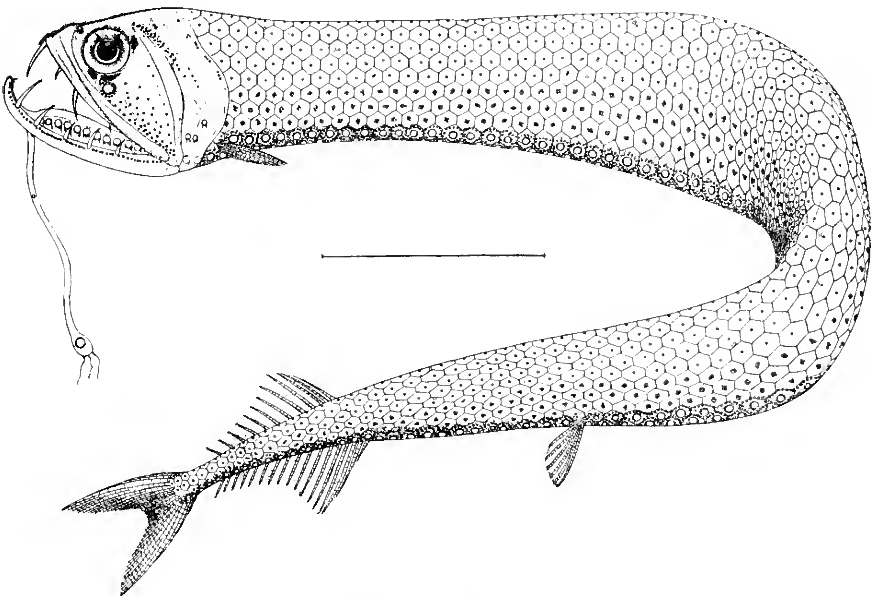


Fig. 1.—*Stomias bonapartei* Fowler. Type.

denticles, anteriorly largest, of which first a cluster of 4 graduated cusps with last longest and curved back, second of 2 cusps with first longer and curved forward, third of 2 cusps with second longer and curved back, and third smaller, of 3 graduated cusps with last longest, though all directed back. Largest rakers about size of symphyseal teeth. Filaments about equal longest rakers. Pseudobranchiæ absent. Isthmus long, slender, narrowly constricted. Branchiostegals 17 each side, short, slender, of about uniform length, except shorter or graduated down at each end of hyoid arch.

Scales deciduous? (entirely fallen from my example), but apparently of hexagonal shape, thin and smooth, disposed in even longitudinal series, of nearly uniform size and but little crowded on caudal peduncle. Head, caudal and fins naked. Long hyoid flattened filament equal to about $1\frac{1}{2}$ times head in length, slightly expanded at end within which a photophore, and terminated by 3 short thin filaments, longest of which not quite equal to eye. Two smaller photophores at lower basal surface and another about first fourth in length of hyoid filament. Two? (at least one) rather large photophores, their diameter less than 4 in eye, just below and close to latter. Behind eye and just above maxillary concurrently on cheek, 2 rows of quite small photophores, these continued up concurrently with preopercle edge to supra-postocular region. Within lower triangle of cheek also numerous small photophores, like those just described, though becoming sparse toward eye. Along outer mandibular edge series of small photophores where anteriorly they are interrupted by fangs. Within branchiostegal membrane between bases of each branchiostegal ray, a large photophore, though none so large as infraorbital. Three similar photophores at lower posterior articulation of opercle. About 10 pairs of similar large photophores along isthmus. Along ventral edge of entire trunk length 2 rows of large photophores, apparently 1 in centre of each scale, and extending back to caudal base, though only a single series after ventrals and along lower caudal peduncle surface. Each scale (according to pocket) with at least 1 small photophore medianly on dorsal region, though below vertebral axis anteriorly on costal region each scale with a median cluster of at least 4 minute photophores. Posteriorly on body laterally, as above ventral base cluster reduced to 3 photophores and in region above anal only 2 photophores. Along side of caudal peduncle almost all photophores single. Over abdominal scales very numerous small photophores, mostly arranged as marginal series, or at least as reticulations, around larger photophores.

Dorsal origin a trifle before last seventh in space between caudal base and mandible tip, base apparently little shorter than that of anal (fin damaged). Anal inserted apparently before dorsal origin, rays graduated up to fourth, after which all a little shorter (damaged). Caudal distinctly forked nearly a third its length, and lobes apparently pointed sharply. Pectoral short (damaged), inserted low. Ventral inserted about last third in space between pectoral origin and caudal base, fin short (damaged). Vent apparently close before anal.

Color in alcohol pale or dull brownish, largely uniform, photophores all paler or whitish. Abdominal edge and isthmus all dusky or blackish, photophores conspicuously white with black pigment about their edges. All photophores with deep brown edges. Fins pale or whitish-brown. Iris slaty.

Length $6\frac{3}{4}$ inches.

Type, No. 7,955, A. N. S. P. Italy. C. L. Bonaparte, No. 349. From Dr. T. B. Wilson.

The above-described example apparently represents a rare species entirely distinct from any in the genus *Stomias*. Several authors[1] have recently[2] confounded it with *Stomias boa* (Risso). It differs from that species, however, in many respects. *S. boa* is said to have the upper jaw furnished with 8 separated unequal curved teeth, and those on the premaxillaries small. It is also said to have the mandible well protruded and furnished with 14 curved teeth, and the ventrals very long and filiform. Risso's rude figure[3] shows them about the last third in the space between the hind eye edge and the caudal base, and if depressible but little short of the anal origin. Risso also shows the caudal greatly forked, no barbel, and only about 3 teeth in each jaw. Valenciennes, in giving a detailed account[4] of the *Esox boa* Risso, shows the type of Cuvier's genus *Stomias* to have been based on Risso's specimen. *Stomias barbatus* Cuvier[5] was surely an unsatisfactory species, distinguished from *S. boa* by the supposed difference in having a hyoid barbel or filament, the latter having been entirely overlooked in *S. boa*. Cuvier's account is thus very incomplete and unsatisfactory, merely a line of valueless diagnosis, and must therefore be submerged in the synonymy of *Esox boa* Risso. For these reasons I have been obliged to rename the present species. Günther very properly allowed the Bonaparte species as distinct, and the subsequent confusion with *S. boa* (Risso) may have been due to Moreau's remarks.[6]

I may here note that *Stomias* dates from Oken,[7] Cuvier's account[8] being in the vernacular, and the type *Esox boa* Risso.

The accompanying figure is somewhat restored, and for this allowance must be made.

(Named for Charles Lucien Bonaparte.)

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[1] *Ocean. Ich.*, 1895, p. 106, Pl. 34, fig. 28.
[2] *Wiss. Ergeb. Deutsch. Tiefs. Ex.*, XV, 1906, p. 49.
[3] *Hist. Nat. Eur. Mer.*, III, 1826, p. 440, Pl. 16, fig. 40.
[4] *Hist. Nat. Poiss.*, XVIII, 1846, p. 273, Pl. 545.
[5] *Règne Animal*, Ed. 2, II, 1829, pp. 283, 284.
[6] *Hist. Nat. Poiss. France*, III, 1881, p. 490.
[7] *Isis*, 1817, p. 1183.
[8] *Règne Animal*, II, 1817, p. 184.

CHAULIODONTIDÆ.

Chauliodus sloani Schneider.

Head 5; depth (of head) about 7; depth (at dorsal origin) about 13; D. 6; A. 12; P. 15; V. I, 5; scales about 52 (according to pockets and pigment spots) in median lateral series; about 7 scales in transverse series (pockets) at dorsal origin; about 5 scales in transverse series between adipose dorsal origin and that of anal (pockets counted); head width about 3 in its length; head depth at occiput about $1\frac{1}{8}$; mandible $1\frac{1}{8}$; rayed dorsal base 3; anal base 2; lower caudal lobe (damaged) about $1\frac{3}{4}$?; pectoral (damaged) about $1\frac{4}{5}$?; snout 4 in head measured from upper jaw tip; eye 4; maxillary $1\frac{1}{10}$; interorbital $4\frac{1}{3}$; anterior mandibular fang $1\frac{1}{5}$.

Body greatly elongated, slender, tapering evenly back to caudal base from head, at which point greatest depth, sides compressed and edges rounded. Caudal peduncle slender, compressed, its least depth $2\frac{3}{4}$ its length.

Head compressed, deep, obtuse in front, flattened sides not converging above or below, upper profile a little convex and lower nearly horizontal. Snout short, ending in short obtuse constricted process, about broad as long. Eye circular, anterior about first third in head length near upper profile, which deeply concave in course just before eye. Mouth very large, not completely closing, with upper jaw edge well inclined and lower jaw edge nearly horizontal. On each side of upper jaw anteriorly, or in premaxillary, first tooth slender, simple, thin, slightly curved and awl-shaped. Second tooth longer and stouter with an obsolete terminal barb, third similar to second, but shorter than first, and fourth like third only trifle longer, but not long as first. Maxillary with a series of compressed short attenuated teeth along lower edge, graduated to first third, after which of about uniform length. Maxillary extends obliquely down straight to mandible articulation or hind preopercle edge. Mandible with 7 pairs of large canines, first enormous, slender, curved slightly back, and when mouth closes extend up along each side of snout well above upper eye edge, tip of each with small barb behind. Second pair simple and slender, about $\frac{1}{4}$ length of first. Third trifle curved back at tip, about half length of first, others all graduated down smaller than second and similar. In upper jaw on left side directly after base of first canine another, but depressible transversely across roof of upper jaw. A similar and slightly longer one behind base of second right canine. Each palatine with 7 short conic straight teeth, first about $\frac{1}{8}$ length of first premaxillary fang, and others all graduated down till minute. No other teeth on roof of mouth. Tongue small, bony, not free, with median osseous keel. Nostril simple pore close before front orbital edge. Mandible large, greatly compressed, rami not elevated in mouth, conic process at symphysis, and slight flange along lower external edge of each branch. Interorbital depressed, and like rest of cranium bones thin. As viewed from above, brain easily distinguished through thin cranial walls. Along each side of head above an osseous keel. Opercle narrow, deep. Subopercle smaller than eye. Hind preopercle edge slightly convex, inclined down behind.

Gill-opening forward about opposite first third in snout. Rakers about 4 + 15 minute firm pointed denticles along inner edge of gill-arch. Filaments $1\frac{3}{4}$ in eye. No pseudobranchiæ. Branchiostegals about twenty each side, mostly uniform, short, slender, only little shorter each end. Isthmus long, slender, compressed narrowly and scarcely tapering back behind.

Scales small, thin, smooth, mostly all fallen, and now distinguished only from pockets as apparently of mostly uniform size and disposed in several even longitudinal series. Head and fins entirely naked. A single crescentic series of small infraorbital photophores, first largest and begins in small dark pigment blotch opposite front edge of eye, and entire series close to eye. Below this directly opposite eye centre close to maxillary edge a rather large and conspicuous photophore. Along outer surface of maxillary medianly and continued well down its course a single series of small photophores, anteriorly quite small and enlarged a little posteriorly. In lower corner of cheek a series of 5 photophores, and opposite just behind preopercle edge another photophore. Behind upper edge of preopercle articulation a large photophore, and still another at lower edge of subopercle. A rather large photophore between base of each branchiostegal ray on branchiostegal membrane. On inner surface of preopercle, within gill-opening, a series of small photophores close together. Photophores from isthmus to pectoral 11, from pectoral to ventral 19, from ventral to anal 25, from anal to caudal 10. Abdominal photophores as double median row, and another row each side, preventral 19, postventral 26, though median double row with series very close. Upper row well separated and along parallel in space below, or between it and lower series, a parallel series of numerous minute or close-set photophores. This series disappears at anal, likewise median double series. Along anal base each side a series of about 12 rather small photophores. On lower caudal peduncle surface a series of minute photophores. On predorsal region of trunk a pair of minute photophores, close together medianly within each scale pocket. On rest of trunk usually a single minute median photophore, though within median lateral series, apparently 2 sometimes, and some of pockets medianly along caudal peduncle sides even with a cluster of 3. At base of lower caudal lobe medianly 3 small photophores in a series. No evidence of l. l. About 6 or more photophores in row medianly a little anterior on inner branchiostegal membrane.

Dorsal origin inserted about first $\frac{2}{7}$ in head and trunk length, base well elevated, apparently no small anterior rudimentary rays, first ray very long, slender, filamentous and depressible a little beyond ventral origin, other rays all much shorter and graduated well down. Elongated dorsal ray about $2\frac{1}{2}$ to caudal base?. Opposite middle of anal base a thin moderately long adipose fin, its length about $1\frac{1}{3}$ eye-diameters. Caudal well forked or emarginate (damaged), and lobes apparently equal. Anal with base produced or elevated, fin inserted near last fourth in space between its origin and head, first ray apparently longest, others all graduated down. Pectoral with its base but slightly inclined, broad, and fin directed obliquely up posteriorly (damaged), and apparently reaching a little beyond dorsal origin. Ventral inserted near first third in space between pectoral origin and caudal base, fin long (damaged), rays apparently graduated anteriorly to middle, or longest, though last filamentous and depressible $\frac{2}{3}$ to anal origin. Vent close before anal, not opening from elevated anal base, but from abdominal surface.

Color in alcohol largely faded dull or pale brown, nearly uniform, except blackish of belly or under surface. Photophores each with a little brownish or dusky pigment. Iris pale slaty.

Length $4\frac{7}{8}$ inches (caudal tip damaged).

Italy (C. L. Bonaparte No. 348). From Dr. T. B. Wilson. I extracted a scopelid about an inch long from this example.

Head about $6\frac{1}{3}$; head depth about $6\frac{1}{2}$; D. 7; A.?; P. 13; V. 7. Teeth in premaxillary differ a little from those in above example in having an accessory fang close, similar, or very little shorter, beginning at base of second fang on left side. Base of second right premaxillary fang short, and similar to one depressible from base of first premaxillary fang, this latter of course transversely across roof of mouth. Also small similar accessory fang close behind base of third right premaxillary fang. On each premaxillary on outer surface and outwardly inclined, about midway between second and third normal erect fangs a short slender conic tooth. Still another posterior, or about opposite base of accessory fang to third erect normal fang. Left mandibular ramus with short accessory conic cusp just behind each tooth, except first, and last teeth as 3 small short cusps. Each palatine with 6 conic erect teeth anterior, largest about $\frac{1}{5}$ length of longest maxillary cusp, and others all graduated down smaller. Branchiostegals 20 each side. Photophores from isthmus to hind pectoral base 12, from latter to ventral origin 17, from latter to anal 24, from anal origin to caudal base 12. Upper enlarged lateral photophores 18 to ventral, and 26 from ventral to anal. Photophores otherwise as in preceding example. Length (caudal damaged) 7 inches. Same data as above example.

I have given the above detailed account of these specimens of this scarce deep-sea fish as the striking features of variation in some of the structural characters have not been noted before. My examples show the rudimental median mental barb but slightly, probably because both are in poor preservation. There are several points at variance with Bonaparte's figure,[9] he showing 62 scales in the lateral line, for instance.

AULOPIDÆ.

Aulopus filamentosus (Bloch).

Six from Italy.

Chlorophthalmus agassizi Bonaparte.

Icon. Faun. Ital., Pesc. III, pt. 1, XXVIII, 1840, descr., Pl., fig. 2. Italy.

No. 7,939 (type) to 7,954, A. N. S. P., cotypes of *C. agassizi* Bonaparte.

SYNODONTIDÆ.

Trachinocephalus myops (Schneider).

One from Yokohama, Japan.

Synodus saurus (Linnæus).

Five from Italy.

Synodus fœtens (Linnæus).

Many examples, from: Beesley's Point, Longport, Atlantic City and Corson's Inlet, N. J.; Ft. Macon, N. C.; S. Carolina; Bayport and Marquesas Keys, Fla.

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[9] *Chauliodus setinotus* Bonaparte, *Icon. Faun. Ital.*, Pesc. III, pt. 1, XXX, 1841, descr., Pl., fig. 2.

Synodus intermedius (Agassiz).

A dry skin from St. Croix, W. I.

Synodus lucioceps (Ayres).

One from San Francisco and another likely from California?.

Synodus dominicensis sp. nov. Fig. 2.

Head $3\frac{2}{3}$; depth $6\frac{1}{4}$; D. II, 9, I; A. 10, I; P, I, 11; V. I, 6, I; scales in l. l. 43+6; 4 scales above l. l.; 6 scales below l. l.; 14 predorsal scales; head width $2\frac{1}{5}$ its length; head depth at occiput $2\frac{1}{3}$; mandible $1\frac{2}{5}$; first branched dorsal ray $1\frac{2}{5}$; third anal ray $2\frac{3}{4}$; least depth of caudal peduncle $4\frac{1}{5}$; caudal $1\frac{3}{5}$; pectoral $2\frac{1}{6}$; ventral $1\frac{2}{5}$; snout $3\frac{3}{4}$ in head measured from upper jaw tip; eye 4; premaxillary $1\frac{2}{3}$; interorbital $4\frac{3}{4}$.

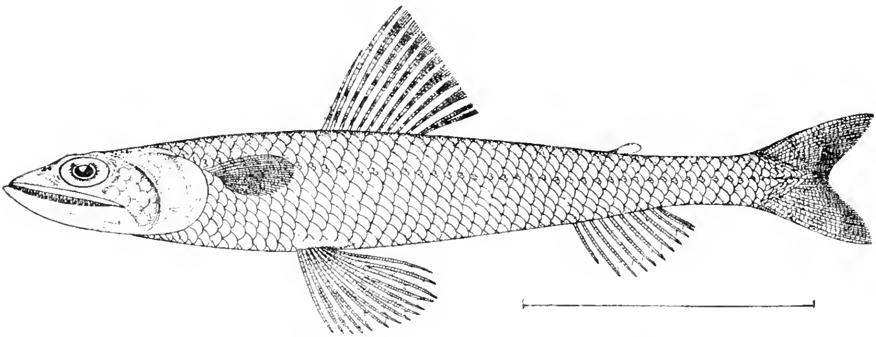

Fig. 2.—*Synodus dominicensis* Fowler. Type.

Body elongated, rather slender, apparently deepest about dorsal origin and though trunk now compressed this may be due to preservation?. Trunk seems to taper each end from greatest depth. Caudal peduncle now compressed, least depth half its length.

Head elongated, depressed above, lower profile little more evenly convex than upper, sides somewhat constricted below. Snout with slight concave profile, depressed, surface generally convex, length about $\frac{5}{6}$ its basal width. Eye a little ellipsoid, impinging on upper profile, about first $\frac{2}{5}$ in head. Mouth large, a little inclined. Premaxillary slender, extends beyond eye about $\frac{1}{3}$ eye-diameter, and greatest expansion about 6 in eye. Lips thin, not concealing entirely single series of erect firm sharp compressed elongated premaxillary teeth. Another series of similar longer depressible teeth along upper jaw edge inside maxillary series. Mandibular teeth similar, triserial, outer series smallest and firm. and 2 inner series depressible with innermost largest. Teeth not united across symphysis of either jaw in front. Palatine teeth biserial, inner series elongated, larger and depressible, and outer mostly firm and erect. Otherwise no teeth on mouth roof. A few minute asperities on upper pharyngeal region. Tongue triangular, free in front, with 2 rows of slightly depressible backwardly directed teeth above, and continued back over surface of basibranchial arch above where much smaller. Mandible surface convex, rami not elevated but tapering to slight fleshy symphyseal knob which projects slightly beyond snout tip. Nostrils together, about last third in snout, and anterior without cutaneous flap. Interorbital slightly concave. Anterosupraorbital ridge well developed. Postorbital quite narrow, surface roughened. Upper naked surface of head behind eyes with few striæ and ridges, little roughened. Preopercle ridge curving back and more convexly below, where at least $\frac{2}{3}$ of eye distant from latter. Opercle width $1\frac{1}{2}$ its depth.

Gill-opening extends forward about opposite hind eye edge. Rakers minutely spinescent, numerous, much smaller than filaments. Latter about 3 in eye. Pseudobranchiæ a little less than filaments. Isthmus narrowly constricted, trenchant. Branchiostegals 16, slender.

Scales moderately large, cycloid, well exposed, edges entire, in longitudinal series parallel with l. l., smaller on caudal base except elongated flap at middle of each lobe basally, where elongate. Axillary ventral flap?. L. l. complete, straight from shoulder to caudal base medianly, tubes simple, and small exposed crimped scale at base of each scale in course anteriorly. Cheek scales in 4 rows. Opercle, subopercle and interopercle scaly.

Dorsal origin trifle nearer origin of adipose fin than snout tip, first branched ray longest and depressible behind far as tip of last branched ray at least, fin 3 to caudal base. Adipose fin inserted about midway between depressed dorsal tip and caudal base, fin about 5 to latter. Caudal forked nearly half its length, free pointed tips nearly equal. Anal inserted about midway between dorsal base centre and caudal base, third ray longest. Pectoral short, inserted nearly midway between eye centre and dorsal origin, fin reaches ventral origin. Latter inserted about last fourth between pectoral and dorsal origins, fin $1\frac{1}{5}$ to anal, outermost and innermost rays simple, others branched, and membranes of all latter deeply notched externally. Vent close in front of anal.

Color in alcohol largely faded dull brownish, paler below. Back with traces of fine and slightly darker mottlings made up of small spots and lines. Head brownish above, paler below. Scapular arch above with several faded small dark brown spots. Each dorsal ray with 5 deep brown spots, rest of fin pale. Caudal pale, except about 3 diffuse brownish shades over each lobe along inner edge. Other fins all pale, unicolor. Iris coppery.

Length $3\frac{1}{16}$ inches.

Type, No. 15,883, A. N. S. P. Santo Domingo, W. I. William M. Gabb.

This species seems to be closely related to *Synodus poeyi* Jordan, differing in the longer premaxillary, ventrals reaching less close to vent, smaller pectoral and the barred dorsal fin.

(Named for Santo Domingo.)

Synodus dermatogenys sp. nov. Fig. 3.

Head $3\frac{1}{2}$; depth $6\frac{1}{2}$; D. II, 10, I; A. 10, I; P. I, 12; V. I, 6, I; scales in l. l. 64 + 4; 5 scales above l. l.; 7 scales below l. l.; 20 predorsal scales; head width $2\frac{1}{8}$ its length; head depth at occiput

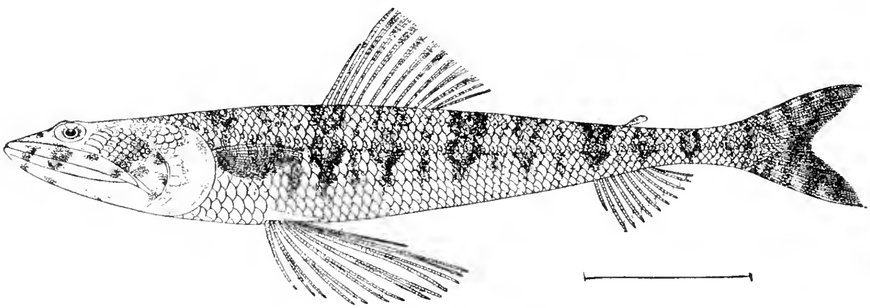

Fig. 3.—*Synodus dermatogenys* Fowler. Type.

$2\frac{1}{10}$; snout $4\frac{1}{4}$; eye $6\frac{1}{2}$; premaxillary $1\frac{3}{7}$; interorbital 6; mandible $1\frac{1}{3}$; first branched dorsal ray $1\frac{4}{5}$; second anal ray $3\frac{2}{3}$; least depth caudal peduncle 6; upper caudal lobe $1\frac{2}{3}$; pectoral $2\frac{1}{4}$; ventral 1.

Body elongate, nearly cylindrical or edges all convex, apparently deepest about dorsal origin. Caudal peduncle cylindrical, least depth about $2\frac{3}{4}$ its length.

Head depressed, lower profile more inclined, though slightly less convex than upper, sides converging below. Snout depressed, profile straight, surface convex, length about $\frac{3}{4}$ its width. Eye a little ellipsoid, impinging on upper profile, about first $\frac{2}{7}$ in head. Mouth well inclined, with firm jaws, large. Premaxillary broad, extends beyond eye about $1\frac{1}{2}$ eye-diameters, greatest median expansion 2 in eye. A series of firm erect sharp-pointed slender teeth concealed by lip along premaxillary, inside another series of longer depressible ones, all directed at least a little forward. Mandible with similar teeth, outer series smallest, but 2 inner rows both depressible and of these inside row longest of all. Palatines with 2 rows of small slender teeth, inner longer and more depressible. Band of teeth in jaws and on palatines not continuous in front. Tongue triangular, rather narrow, free in front, with about 6 rows of irregular slender pointed and depressible teeth. These continued back on basibranchial arch as more narrow band, and all teeth much smaller. Mandible low, surface convex and tip little short of snout tip. Nostrils together, near last fourth in head, anterior with small flap, apparently not fringed. Interorbital well concave. Postorbital width about 2 in eye. Hind preopercle ridge a little more curved back below, where about an eye-diameter distant from hind premaxillary edge. Opercle width about half its length. Upper suprascapular edge entire. Anterosupraorbital processes well developed. Cranium roughly striate and rugose.

Gill-opening forward trifle before middle in head. Rakers as minute fine denticles, numerous, sharp. Filaments $1\frac{4}{5}$ in eye. Pseudobranchiæ little smaller than filaments. Isthmus narrowly constricted, slender. Branchiostegals about 17, slender.

Scales in even longitudinal series parallel with l. l., axis of each well inclined posteriorly, all rather narrowly exposed, edges entire, reduced and smaller on breast and caudal base, latter with 2 elongated flaps, one at base of each lobe. Pointed free slender axillary ventral scaly flap, $3\frac{1}{2}$ in fin. Cheek scales in 7 series, lower hind portion for nearly half its area naked. Opercles below naked, only few scales above. L. l. complete, sloping gently from shoulder to median caudal base, each scale in its course marked by small accessory basal or crimped scale.

Dorsal origin a little nearer adipose fin origin than snout tip, first branched ray longest, but only extending about first fourth in length of last, fin $2\frac{1}{2}$ to caudal base. Adipose fin small, inserted about midway between dorsal tip and caudal base, fin 5 to latter. Anal inserted about midway between last dorsal ray base and caudal base, fin $1\frac{3}{4}$ to latter, first branched ray longest, fin edge below notched. Caudal deeply forked, sharp-pointed lobes about equal. Pectoral short, reaches $\frac{4}{5}$ to dorsal origin. Ventral inserted before pectoral tip, trifle nearer pectoral than dorsal origin, depressed fin $1\frac{3}{5}$ to anal, with innermost branched ray longest. Vent about $\frac{2}{3}$ an eye-diameter before anal.

Color in alcohol pale brownish generally, but slightly dark above, or more grayish. About 6 rather broad deeper gray-brown transverse saddles across back, each obscurely edged in front and behind with deeper or more dusky, and edges of scales within each all darker than ground color. Alternating are 5 paler and narrower similar saddles. Alternating still, between darker and paler saddles, other lighter and more obsolete streaks, mostly broken into obscure pale blotches. All lateral saddles become constricted above l. l. where they appear as hour-glass-shaped ocelli, lower bulge of each continued down as dark streak short distance each side of abdomen. Between are slightly paler streaks continued from palest alternating streaks of back, though these mostly with detached appearance. Jaws with 3 broad deep brown transverse bands, paler below. Head above, and cheek, mottled deep brown. Each dorsal ray with about 4 obscure brown blotches. Each caudal lobe with about 5 transverse deep brown bands, narrower at rudimentary rays and posterior wider. Fins otherwise all pale or brownish. Iris brownish.

Length $5\frac{3}{8}$ inches.

Type, No. 28,130, A. N. S. P. Hawaiian Islands. From the U. S. F. Com. in 1901.

Also Nos. 28,131 to 28,134, paratypes, same data. Head $3\frac{1}{8}$ to $3\frac{4}{7}$; depth $6\frac{2}{7}$ to 7; D. II, 10, I or II, 11, I; A. 8, I or 9, I; scales in l. l. 60 to 62 + 4; usually 6, sometimes 5, scales above l. l.; usually 6, sometimes 7, scales below l. l.; usually 18 predorsal scales, sometimes 19 or 20; snout $4\frac{1}{4}$ to $4\frac{1}{2}$ in head; eye 6 to $6\frac{2}{5}$; maxillary $1\frac{1}{2}$ to $1\frac{2}{3}$; interorbital $5\frac{1}{8}$ to $6\frac{1}{4}$; length $5\frac{1}{16}$ to $5\frac{3}{4}$ inches.

This species is closely related to *Saurus variegatus* Quoy and Gaimard, whose plate quite agrees with the figure of *Synodus varius* by Jordan and Evermann,[10] in having the cheek entirely covered with large scales. *Synodus dermatogenys* differs from *Synodus variegatus* in having the posterior portion of the cheek naked. Lacépède's *Salmo varius* has been considered identical with *Cobitis japonica* Houttuyn by Jordan and Herre,[11] the latter evidently having in mind the Hawaiian material identical with the figure of *Synodus varius* of Jordan and Evermann. As I shall later show that *Synodus sharpi* Fowler is a *Saurida*, the present species seems justified in bearing a new name.

(*δέρμα*, skin; *γένειον*, cheek: with reference to the lower cheek being naked.)

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[10] *Bull. U. S. F. Com.*, XXIII, pt. 1, 1903 (1905), p. 63, fig. 14.
[11] *Proc. U. S. Nat. Mus.*, XXXII, 1907, p. 516.

Saurida tumbil (Bloch).

Three from Padang, Sumatra, one of which now in Stanford University.

Saurida gracilis (Quoy and Gaimard).

Synodus sharpi Fowler, Proc. Acad. Nat. Sci. Phila., 1900, p. 497, Pl. 19, fig. 2. Sandwich Islands.

Nos. 16,084 (type) to 16,086, A. N. S. P. Type and paratypes of *S. sharpi* Fowler. These examples were first wrongly identified by Jenkins[12] with *Salmo varius* Lacépède, and afterwards the error was perpetuated by Jordan and Evermann,[13] Günther,[14] and Jordan and Herre.[15] In 1900 I wrongly identified two Hawaiian examples of this species as *Saurida tumbil*.[16] Besides the above material there are four examples in the collection from Hilo. I may here state that my paper containing the description of *Synodus sharpi* very evidently has priority over that by Steindachner[17] in Schauisland's collection. Only a synopsis of the new species[18] from Hawaii was published by Steindachner in 1900, the complete account being reserved till later. The actual date of publication for my paper was November 6, 1900, while the volume containing Steindachner's full account is not mentioned until the meeting of March 13, 1902, at the Vienna Academy,[19] and it was not received in the library of the Academy of Natural Sciences of Philadelphia until October 31, 1902.

Harpadon nehereus (Hamilton-Buchanan).

One from Padang, Sumatra.

MYCTOPHIDÆ.

Ceratoscopelus maderensis (Lowe).

One labeled "Atlantic Ocean" (Tyson) from the stomach of a shark. Also 5 from N. Lat. 36° 24′ W. Long. 71° 24′.

Lampanyctus gemellarii (Cocco).

Two from Italy (Bonaparte).

Lampanyctus crocodilus (Risso).

Two from Italy (Bonaparte).

Nannobrachium macdonaldi Goode and Bean.

Ocean Ich., 1895, p. 94, fig. 110. N. Lat. 39° 41′ 30″ W. Long. 71° 01′ in 1,022 fathoms.

No. 7,978, A. N. S. P., paratype, with above data.

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[12] *Bull. U. S. F. Com.*, XXII, pt. 1, 1902 (1903), p. 433.
[13] *L. c.*, XXIII, pt. 1, 1903 (1905), p. 63 (65).
[14] *Journ. Mus. Godef.*, XVI, 1909, p. 376.
[15] *Proc. U. S. Nat. Mus.*, XXXII, 1907, p. 516.
[16] *Proc. Acad. Nat. Sci. Phila.*, 1900, p. 497.
[17] *Denk. Ak. Wiss. Wien*, LXX, 1901, p. 513.
[18] *Anz. Ak. Wiss. Wien*, XXXVII, 1900, pp. 174–178.
[19] *L. c.*, XXXIX, 1902, p. 77.

Æthoprora metopoclampa (Cocco).

One from Italy (Bonaparte).

Collettia rafinesquii (Cocco).

Two from Italy (Bonaparte).

Rhinoscopelus cocco (Cocco).

One from Italy (Bonaparte); one from off Havre, France (Jones); 5 from between Norfolk, Cape de Verde Islands and Montevideo, Uruguay, in 1891–92 at the surface (Rush); 2 from S. Lat. 20° W. Long. 75° (Sharp); 5 from N. Lat. 39° 50′ 45″ W. Long. 71° 43′ at the surface (U. S. F. C.); 1 without locality (Jones).

Centrobranchus chœrocephalus Fowler.

Proc. Acad. Nat. Sci. Phila., 1903, p. 754. Near the Sandwich Islands.

Nos. 7,972 (type) to 7,977 (paratypes), A. N. S. P., of which one now in Stanford University.

Electrona risso (Cocco).

One from Italy (Bonaparte).

Myctophum punctatum Rafinesque.

Four from Italy (Bonaparte). The example from the Atlantic between Greenland and N. America in 60° N. Lat., I recorded as *M. phengodes*,[20] is also identical.

Myctophum affine (Lütken).

One from Lat. N. 8° 37′ Long. W. 168° (Jones); and 2 without locality (Jones); 1 no data; 1 from Lat. N. 5° 11′ Long. W. 151° (Jones); 2 from between Norfolk in Cape de Verde Islands and Montevideo, Uruguay, in 1891–92 at the surface (Rush).

Myctophum hygomi (Lütken).

One from Lat. N. 36° 45′ W. Long. 74° 28′ 30″ (U. S. F. C.), at the surface probably.

Myctophum reinhardti (Lütken).

One from Lat. S. 20° Long. W. 75° (Sharp).

Benthosema mülleri (Gmelin).

One from Lat. N. 40° 4′ 20″ Long. W. 68° 43′ 50″ in 373 fathoms (U. S. F. C.).

MAUROLICIDÆ.

Ichthyococcus ovatus (Cocco).

Three from Italy (Bonaparte).

Maurolicus attenuatus (Cocco).

Four from Italy (Bonaparte).

[20] *Proc. Acad. Nat. Sci. Phila.*, 1901, p. 620.

PLAGYODONTIDÆ.

Plagyodus ferox (Lowe).

One young from N. Lat. 5° W. Long. 164° (Jones), evidently this species.

PARALEPIDÆ.

Sudis hyalina Rafinesque.

Two from Italy (Bonaparte).

Paralepis pseudocoregonoides Serato.

One from Italy (Bonaparte).

Paralepis barracudina Fowler and Phillips.

Proc. Acad. Nat. Sci. Phila., 1910, p. 403, fig. Corson's Inlet, N. J.

No. 37,627, A. N. S. P., type.

STERNOPTYCHIDÆ.

Argyropelecus hemigymnus Cocco.

Seven from Italy (Bonaparte).

THE LAND MOLLUSCA OF MONTEGO BAY, JAMAICA; WITH NOTES ON THE LAND MOLLUSCA OF THE KINGSTON REGION.

BY H. A. PILSBRY AND A. P. BROWN.

1. The Mollusca of Montego Bay.

The species included in this list were taken on the Orange Hill and Rose Mount estates, which lie to the east of the town of Montego Bay, and along the roadsides in this direction. The hills which enclose Montego Bay on the east rise rather abruptly from the sea level, but are dissected by many ravines. One of these, on the Orange Hill estate, is deep enough to produce permanently moist conditions during the summer months. This gully is generally without running water; but when the ground is thoroughly saturated by rains, a heavy thunder shower "makes the gully come down," as the natives express it, in a raging torrent. This depression is probably formed by the falling in of the roof of a cave, and indeed a cave still exists leading off from one side of this gully, the mouth of which is some 20 feet above the bottom of the present gully. The sides of the gully are densely wooded, as are many of the lateral branches which drain into it; the trees may be original forest. It can be travelled for about a mile to a neighboring estate known as Rose Mount, where the ground rises considerably higher and exposures of the limestone in place are met with upon the hill tops. Here again are some patches of original forest. But the land about Montego Bay, with exception of a few places, has all been cleared of its original forest many years ago, and much of this cleared land has been at some time under cultivation.

Where the cleared land was planted in orange or logwood, it is now often grown up in a thicket; this is especially true of the old logwood plantations on the Orange Hill estate. These occupy the tops of dry hills, where the limestone soil, although dry, harbors many small snails which prefer a dry habitat. The greater part of the cleared fields on these estates are used for pastures, but these are sometimes stony and dry also. In the lower grounds, on some of the adjoining estates, sugar-cane is grown, and this was found to be poor collecting ground.

Messrs. Henderson and Simpson[1] have noted 37 species as occurring in their collections at Montego Bay. Seventeen of these are also in the collection here listed, leaving 23 species of the present list new records for Montego Bay, while about 20 species of their list are not represented in the present collection. They probably included species from some miles on either side.

HELICIDÆ.

Pleurodonte lucerna (Müll.).

Recent shells were sparingly found at Orange Hill and Rose Mount. Semi-fossil shells were plentiful in the clay-filled fissures in the limestone in the Orange Hill gully. It is perhaps extinct at Montego Bay, as all shells found were old.

Pleurodonte sloaneana (Shutt.).

Orange Hill and Rose Mount, abundant. It was generally found crawling on the ground, but during very rainy weather was seen ascending the trees in great numbers to escape the wet in the Orange Hill gully.

Pleurodonte sinuata (Müller).

Semi-fossil in the clay veins in the limestone at Orange Hill gully, also at the cave on the Orange Hill place, imbedded in clay. These semi-fossil shells are smaller than those of the living species found elsewhere in the island.

Dimensions range from alt. 12.4 mm., diam. 22.5 mm., to alt. 16 mm., diam. 27.3 mm.

Pleurodonte (Dendrocochlis) aspera (Fér.).

Orange Hill. The specimens collected had been used by land hermit crabs, but the species is arboreal and not uncommon in the cocoanut and banana plantations.

Pleurodonte (Eurycratera) jamaicensis (Gmel.).

Orange Hill. Semi-fossil in the clay-filled fissures in the limestone, but probably extinct at this place, though found living somewhere in the vicinity.

Zaphysema columellata (C. B. Ad.).

Semi-fossil in the clay-filled fissures in the limestone at Orange Hill gully; no living forms were observed; perhaps extinct.

Proserpinula infortunata (Bland).

Orange Hill.

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[1] *Nautilus*, VIII, 1894, pp. 1, 19, 31.

Thysanophora spreta (C. B. Ad.).

Orange Hill and Rose Mount. Found plentifully in the logwood plantations and the dry pasture fields.

Thysanophora apex (C. B. Ad.).

Orange Hill. This small species is evidently rare; but few specimens were taken.

Thysanophora diminuta (C. B. Ad.).

Orange Hill and Rose Mount. Very abundant in the dry logwood plantations.

Thysanophora dioscoricola (C. B. Ad.).

Orange Hill.

Thysanophora inconspicua (C. B. Ad.).

Orange Hill.

Sagda montegoensis n. sp.

Orange Hill and Rose Mount. Living individuals of this species were very plentiful in August, moving about in the damp gullies, especially at Orange Hill.

ACHATINIDÆ.

Opeas micra (Orb.).

Orange Hill. Very plentiful in the old logwood plantations.

Opeas gracile (Hutt.).

Orange Hill.

Opeas pumilum (Pfr.).

Orange Hill.

Subulina octona (Brug.).

Orange Hill, Rose Mount, and Catharine Hall. Plentiful along roadsides with exposures of dry limestone rock near Montego Bay.

Leptinaria pallida (C. B. Ad.).

Orange Hill.

Leptinaria striosa (C. B. Ad.).

Orange Hill.

UROCOPTIDÆ.

Urocoptis gravesii (C. B. Ad.).

Orange Hill and Rose Mount.

Brachypodella robertsi (C. B. Ad.).

Orange Hill.

Brachypodella alba striata Pils.

Orange Hill. Very plentiful after rains, crawling on the moist rocks in the gully.

Spirostemma tenella (C. B. Ad.).

Orange Hill and Rose Mount. Very common in the dry logwood plantations at Orange Hill.

OLEACINIDÆ.

Varicella blandiana (C. B. Ad.).

Orange Hill.

Varicella propinqua (C. B. Ad.).

Orange Hill and Rose Mount.

Sigmataxis læviusculus (C. B. Ad.).

Orange Hill.

FERUSSACIDÆ.

Cecilioides (Cæcilianopsis) iota (C. B. Ad.).

Orange Hill.

SUCCINEIDÆ.

Succinea latior C. B. Ad.

Orange Hill. Found rather sparingly along the roadsides and in the logwood plantations.

TRUNCATELLIDÆ.

Geomelania vicina C. B. Ad.

Orange Hill, in the dry logwood plantations.

Geomelania pygmæa C. B. Ad.

Orange Hill.

Geomelania (Chittya) sinuosa Chitty.

Orange Hill. A small species of *Geomelania*, about half the size of *G. pygmæa*, was collected at Orange Hill, but while about ten specimens were taken, none are sufficiently well developed for a satisfactory description.

The species listed as "*Geomelana gracilis* (C. B. Ad.)" from Bloomfield and Benmore, Mandeville, in our former paper on the Mollusca of Mandeville[2] is *Geomelania vicina* C. B. Ad.

CYCLOPHORIDÆ.

Aperostoma (Ptychocochlis) corrugatum (Chitty).

Orange Hill and Rose Mount. Semi-fossil shells were very plentiful in the clay-filled rifts in the limestone at Orange Hill gully; fresh

[2] The Mollusca of Mandeville, Jamaica, and its Environs. Proc. Acad. Nat. Sci. Phila., 1910, p. 521.

shells were common in the same locality. This seems a favorite species with the land hermit crab.

Aperostoma dubiosum (C. B. Ad.).

Orange Hill. Found living in the Orange Hill gully, also in the clays with the other semi-fossil specimens.

ERICIIDÆ (CYCLOSTOMATIDÆ).

Colobostylus bronni (C. B. Ad.).

Orange Hill, Rose Mount. Very plentiful in the Orange Hill gully, moving over the moist rocks. After rains, this species was seen at both localities ascending trees to escape the wet, and resting upon the trunk under shelter of the branches. They frequently ascended the trees for 20 or 30 feet. Many of the specimens collected were paired when taken.

Adamsiella irrorata Gloyne.

Orange Hill. Very common in the Orange Hill gully, moving about upon damp rock surfaces.

HELICINIDÆ.

Helicina neritella angulata C. B. Ad.

Orange Hill and Rose Mount.

Stoastoma.

Eight species of this genus were collected at Orange Hill and Rose Mount.

Eutrochatella pulchella (Gray).

Orange Hill and Rose Mount.

Alcadia palliata (C. B. Ad.).

Semi-fossil in the clay-filled fissures in the limestone, Orange Hill gully.

Lucidella aureola (Fer.).

Orange Hill and Rose Mount. Very plentiful in the dry logwood plantations and among the rock exposures on the Rose Mount estate.

Lucidella persculpta n. sp.

Orange Hill and Rose Mount.

PROSERPINIDÆ.

Proserpina nitida Gray.

Orange Hill.

2. Notes on the Mollusca of the Kingston Region.

Collections in the vicinity of Kingston were made at Rockfort, on the slopes of Long Mountain; near Constant Spring; at Stony Hill—all in the parish of St. Andrew. Rockfort and Constant Spring are easily reached by trolley from the centre of Kingston; Stony Hill is within easy walking distance from the end of the trolley line at Constant Spring or it may be reached by driving from the same point.

The Rockfort station is at the base and on the slope of Long Mountain, a hill which divides the Liguanea plain in which Kingston lies from the valley of Hope River. The collections were made near the quarry in the soft limestone that is located near the old fort; also on the raised beaches and the lower slope of the hill. The hillside is grown up in "bush," lignum vitæ, logwood, tree cactus, "wild pines," or species of the *Bromeliaceæ*, and various thorny shrubs make progress through the thickets rather slow. The raised beach is some 20 or 30 feet above the present water level in the bay and is covered with fragments of limestone mixed with recent marine shells. It is wooded like the rest of the hillside and is very porous and dry.

Ascending the hill slope, the surface becomes covered by loose pieces of the limestone and is even more dry than the raised beach. When this locality was visited in the previous March, during the dry season, very few living mollusks were seen except the arboreal *Oxystyla undata jamaicensis* Pils., which was observed on the tree cactus as well as in the branches of the other trees and shrubs growing near Rockfort Garden, and *Tudora armata* (C. B. Ad.), which was found sparingly, moving about on a damp exposure of the limestone. In the summer, however, when showers are more frequent, a considerable number of the species were taken alive. The prevailing characteristic of this Rockfort station is its general dryness throughout most of the year.

The plateau of limestone rock which forms the high land in the centre of the island, as at Mandeville, extends to the east as far as Constant Spring, where it abuts against the older rocks of the Blue Mountain. Certain spurs of this plateau, reaching out to the northeast, form by their dissection isolated limestone hills, rising from the Liguanea plain. These are near the hotel at Constant Spring, and from some of these little isolated hills the species recorded as from Constant Spring were obtained. The main mass of one of these spurs, rising rather steeply from the Constant Spring level to an elevation of 1,000 feet, becomes the hill marked on the maps as Stony Hill, and the same name has been given to the small village at the top of the hill along the main post road across the island from Kingston to St. Mary Parish.

HELICIDÆ.

Cepolis (Hemitrochus) graminicola (C. B. Ad.).

Roadsides near Constant Spring.

Cepolis (Dialeuca) subconica (C. B. Ad.).

Stony Hill.

Pleurodonte acuta semperfluens n. subsp.

Near Constant Spring and at Stony Hill.

Pleurodonte acuta sublucerna Pils.

Rockfort. Found abundantly on the raised beaches and lower hill slopes. Only weathered shells were collected, but it is probably living at this station. The size varies much; the teeth are two, variable in size, but the outer is more regular. Dimensions of four specimens follow:

Alt.	19,	diam.	37.3	mm.	
"	18,	"	35	"	
"	17.8,	"	32.5	"	
"	14,	"	27	"	

Pleurodonte sinuosa (Fer.).

Stony Hill and Constant Spring.

Pleurodonte (Eurycratera) jamaicensis (Gmel.).

Stony Hill. Only one rather weathered shell was found.

Thysanophora spreta (C. B. Ad.).

Stony Hill.

Thysanophora turbiniformis (Pfr.).

Stony Hill.

Thysanophora apex (C. B. Ad.).

Stony Hill; rare.

Thysanophora diminuta (C. B. Ad.).

Rockfort, Constant Spring, and Stony Hill.

Thysanophora dioscoricola (C. B. Ad.).

Stony Hill.

Thysanophora epistyliulum (C. B. Ad.).

Stony Hill.

Sagda spei P. & B.

Only found at Rockfort.

Sagda cookiana (Gmel.).

Constant Spring and Stony Hill.

Sagda jayana (C. B. Ad.).

Stony Hill. Probably topotypes; this is very likely where C. B. Adams's original specimens of this species were collected. See descriptions of new species below.

BULIMULIDÆ.

Oxystyla undata jamaicensis Pils.

Rockfort. Arboreal in the logwood and lignum-vitæ trees, also in the tree-cactus, upon which they were very plentiful in August.

ACHATINIDÆ.

Opeas micra (Orb.).

Stony Hill and Constant Spring, St. Andrews.

Subulina octona (Brug.).

Stony Hill and Constant Spring, St. Andrews.

UROCOPTIDÆ.

Urocoptis sanguinea (C. B. Ad.).

Constant Spring and Stony Hill, St. Andrews. Very plentiful along the roadsides and in the limestone exposures at both of these localities.

Urocoptis brevis (Pfr.).

Rockfort. Crawling about on the exposed rocks after rain.

Brachypodella seminuda (C. B. Ad.).

Stony Hill.

Brachypodella chemnitziana (Fér.).

Stony Hill.

OLEACINIDÆ.

Varicella dissimilis Pils.

Stony Hill.

Varicella costulata (C. B. Ad.).

Stony Hill.

CYCLOPHORIDÆ.

Aperostoma (Ptychocochlis) varians (C. B. Ad.).

Constant Spring and Stony Hill.

ERICIIDÆ (CYCLOSTOMATIDÆ).

Tudora fecunda (C. B. Ad.).

Constant Spring.

Tudora armata (C. B. Ad.).

Rockfort. Upon visiting this locality after a rain, the individuals of this species were so plentiful that their movement could be heard as a continuous rustling of the dry fallen leaves under the trees. They were pairing actively. During dry times large numbers were seen collected under stones in a resting condition.

Adamsiella grayana Pfr.

Stony Hill.

HELICINIDÆ.

Eutrochatella pulchella (Gray).

Stony Hill.

3. Descriptions of New Species, etc.

Pleurodonte acuta semperfluens n. subsp. Pl. XLIII, figs. 15, 16.

This form is rather thinner than *P. a. goniasmos*, with the peripheral angle in the last third of the last whorl becoming subobsolete or the periphery may be flattened and obliquely weakly corrugated; *the last whorl is convex or swollen below the suture*, as in *P. subacuta*, not flattened as in *acuta* and *goniasmos*. The columella is longer than in *goniasmos*, basal lip generally more erect, white, with a brown edge. Base green (becoming dull greenish-brown with age), with a chestnut zone below the periphery. Aperture broadly open, truncate-oval, the outer arc broadly rounded; teeth small, one or two, the inner tooth inconstant.

Alt. 28,	diam. 51.3 mm.		Constant Spring.
" 26,	" 44	"	Constant Spring.
" 30.5,	" 57	"	Stony Hill.

Only "dead" shells were picked up on Stony Hill. They are much larger than the types from Constant Spring. Shells from Bog Walk, collected by Mr. Wm. J. Fox in 1891, are evidently referable to the same race.

Sagda.

Beck based the genus *Sagda* on two species: *S. alveolata* Beck, based on Férussac, *Histoire*, etc., pl. 51A, fig. 1 (a false reference, possibly intended for pl. 51B, fig. 4), and *S. australis*=*S. cookiana* (Gmel.). The first of these was selected as type of the genus by Gray and Herrmannsen, in 1847; but since its identity is uncertain, no later author having determined the species, the subsequent selection of *S. cookiana* Gmel. as type by von Martens, should be accepted.

Much confusion in collections existed among the larger species for many years, and indeed still exists. Even with the series we now have they are difficult, although the recognition of a greater number of species does away with much of the variability formerly thought to exist. The specific characters, once mastered, appear to be rather constant, though sometimes not conspicuous at first sight. *Helix epistylium* Müller, formerly thought to be a *Sagda* and variously identified, has been shown by Mörch to be a *Streptaxis*, not a Jamaican shell. *H. epistylioides* Fér. we have not satisfactorily identified, and it probably has not been rediscovered. As figured and described, it is more strongly sculptured than any of the known species.

Sagda jayana (C. B. Adams). Plate XLIII, figs. 8 to 12.

Helix jayana C. B. Ad., Proc. Boston Soc. Nat. Hist., II, p. 17, 1845.
(?) *Epistylia conica* Swainson, Malacology, p. 165, fig. 18*a*, 1840.

This species was described by a parallel-column comparison with "*Helix epistylium* Müll." of C. B. Adams = *Sagda cookiana* Gmel. The description might apply to several of the large obtusely pyramidal forms, except for the phrase "t. latiore, subtus *latissime et profunde indentata*," which unmistakably indicates the *Sagda* of the region about Stony Hill, in St. Andrew Parish, some eight miles from Kingston.

The shell is pyramidal, with dome-shaped summit, the spire very wide and steep-sided as far up as the upper third or fourth; last whorl much depressed, the base deeply and very broadly excavated around the axis, its greatest convexity nearer the periphery than to the axis. Surface very finely but distinctly striate, and having a microscopic sculpture like a woven fabric. Aperture less deeply lunate than in *S. adamsiana*. Basal lamella slightly over a half whorl long, its lower end visible deep in the throat. Columellar lamella longer, very stout, extending strongly nearly to the edge of the columellar margin. Alt. $24\frac{1}{2}$, diam. 26 mm. with 10 whorls, or larger, diam. $29\frac{1}{2}$ mm.

Up to the half-grown stage, 5 to 8 whorls, the shell is much depressed, the last whorl subangular, base flattened and not much excavated at the axis; aperture narrowly lunate; lamellæ as in the adult stage. A shell of $6\frac{1}{2}$ whorls measures: alt. 10.3, diam. 18 mm.

The specimens described and figured are from Stony Hill, near Constant Spring, where it lives in company with *S. cookiana* Gmel., a circumstance which probably influenced Prof. Adams to compare them in his original description.

The most important features differentiating this species from *S. adamsiana* are: the very broad excavation of the base, the wide spire, and the nearly emerging columellar lamella. We may add also the shape of the shell in the half-grown and younger stages, wherein the base is far less convex than in *S. adamsiana*, and the aperture much narrower. The lamellæ are substantially alike in the two species except that the columellar lamella extends strongly upon the columellar margin, so that it is visible in the aperture of *S. jayana*, but not visible or only weakly in *S. adamsiana*.

The half-grown young shells resemble *S. connectens* (C. B. Ad.) very closely in shape, but they differ by the columellar lamella, which appears strong in a view in the aperture, while in *S. connectens* it is not visible from the mouth.

Swainson's figure of *Epistylia conica* (*Malacology*, p. 165, fig. 18*a*), has perhaps more resemblance to *S. jayana* than to any other species, but it is rude and of very uncertain application to this or any species. Later in the same work Swainson has an *Epistyla conica* (p. 331) based on fig. 281 of Sowerby's *Manual*, which represents *Sagda cookiana*. We have confirmed the synonymy of *S. jayana* given in the *Manual of Conchology*, IX, p. 64.

A small race of *S. jayana* occurs at Bog Walk, where it was collected by Messrs. Wm. J. Fox and C. W. Johnson. The shell measures: alt. 16.3, diam. 20 mm., with nearly 8 whorls. It will probably prove to be a distinct subspecies.

Sagda adamsiana n. sp. Plate XLIII, figs. 1 to 7.

Sagda jayana Pilsbry and Brown, Proc. A. N. S. Phila., 1910, p. 517, and probably of other authors on the Mandeville fauna.

The shell is pyramidal, with dome-like summit and an enlarged, prominent, well-rounded last whorl, more ample than that of *S. jayana;* base convex, rather deeply but narrowly impressed in the centre, its greatest convexity midway between axis and periphery. Surface finely, rather weakly striate, and in places showing traces of a microscopic woven texture. Aperture deeply lunate. Basal lamella somewhat over a half whorl long, situated outside of the greatest convexity of the base, its end visible deep in the throat. Columellar lamella as long as the other, its lower end weakly or not visible in the mouth.

Alt. 27,	diam. $29\frac{1}{2}$	mm.;	$10\frac{1}{2}$ whorls.
" $23\frac{1}{2}$,	" 28	"	$9\frac{3}{4}$ "
" $21\frac{1}{2}$,	" 24	"	$9\frac{1}{2}$ "

Young shells of 6 or 7 whorls are depressed with very convex base and narrow axial impression, the basal margin of the aperture much more deeply curved than in *S. jayana*. Basal lamella nearly a whorl long, extending almost to the lip. Columellar lamella about a half whorl long, and immersed, as in adults. A shell of $6\frac{1}{2}$ whorls measures: alt. $9\frac{1}{2}$, diam. $15\frac{1}{2}$ mm. At this and earlier stages the axis is perforate. This species, commonly known in collections as *S. jayana*, inhabits the region of Mandeville in Manchester, where it is very abundant and generally dispersed. The types are 100,868, A. N. S. P., from the ridge near Lincoln. They were catalogued as *S. jayana* in our former paper (these PROCEEDINGS, 1910, p. 517).

Besides the several differences noticed under *S. jayana*, the last whorl is both deeper and broader in this species, in its fullest development projecting beyond the general outline of the side, and appearing somewhat disproportionately enlarged beyond the preceding whorls. The adolescent stages are even more distinct from corresponding stages of *S. jayana* than the adult shells. With several hundred shells before us for study, we find the differential characters of *S. adamsiana* remarkably constant.

Named in honor of Professor C. B. Adams, whose *Contributions to Conchology* form the foundation of Jamaican malacology.

Sagda montegoensis n. sp. Plate XLIII, figs. 13, 14.

The shell resembles *S. adamsiana* in shape and the internal lamellæ, but it is smaller; the last whorl is less convex above, more flattened below, the suture; the aperture is decidedly higher, the basal margin being more deeply curved. *The surface has a varnish-like gloss*, and under the compound microscope shows no minute sculpture; the last two or three whorls are only weakly, irregularly striate.

Alt. 20,	diam. 23	mm.; 9	whorls.
" 21.1,	" 21.4	" $9\frac{1}{4}$	"
" 17.2,	" 21	" 8	"

Orange Hill, Montego Bay; types No. 104,452, A. N. S. P., collected by Dr. A. P. Brown, 1910.

This is probably the form listed from Montego Bay by Messrs. Henderson and Simpson as *S. epistylium* Müll.,[3] but, as noted above, that is not a Jamaican species.

Young shells, down to $4\frac{3}{4}$ whorls, diam. 9 mm., are imperforate. By breaking down a shell it appears that only about two whorls following the embryonic stage (of $1\frac{1}{2}$ whorls) have the axis perforate. The perforate stage is therefore much shorter than in *S. adamsiana*.

S. montegoensis differs from *S. spei* by having the basal lamella nearer the periphery, being situated as in *S. adamsiana*. It was found in great profusion.

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[3] *Nautilus*, VIII, p. 2, No. 22.

Lucidella persculpta n. sp. Fig. 1.

The shell is related to *L. lineata,* and more especially to *L. foxi.* It differs from both by its much more depressed shape, smaller size and coarser spiral sculpture, which continues undiminished on the base to the axial callus. Whorls 4½, the last rounded peripherally, impressed around the axial callus. The edge of the well-expanded peristome is slightly scalloped above, but not so strongly as in *L. foxi.* The tooth within the upper lip is very small, that upon the basal lip strong and squarish, as in *L. foxi;* but, unlike that species, there is no tooth within the outer margin.

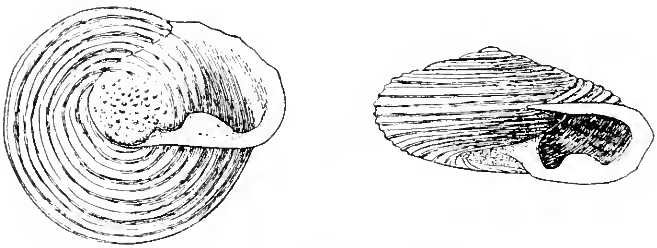

Fig. 1.—*Lucidella persculpta.*

Alt. 1.4, diam. 3 to 3.3 mm.; 4¼ whorls.

Orange Hill and Rose Mount, Montego Bay. Types No. 104,402, A. N. S. P., collected by A. P. Brown, September, 1910.

The nearest relative of this species is *L. foxi* Pilsbry, taken by Mr. Wm. J. Fox at a cave near Port Antonio,[4] much further east, on the northern shore. In *L. lineata* (C. B. Ad.) the spiral sculpture fails near the axial callus, leaving a small smoothish area; the spiral threads are finer, less unequal, and one is generally prominent at the periphery, which is thereby made angular or carinate, as described by Professor Adams. We consider Mandeville the type locality of *L. lineata,* as Adams's description applies exactly to the form found there.[5]

Lucidella trochiformis Pilsbry[6] is possibly identical with *L. nana* Pfr., but if so the radial undulation, producing nodules on the liræ, was not noticed by Pfeiffer.

[4] So far as we know, this species does not inhabit the "Hôtel Fichfild," as Herr Wagner has it, Conchylien Cabinet, *Helicinidæ,* p. 343. The Tichfield Hotel is at Port Antonio.

[5] We were in error in writing *L. nana* Pfr. a synonym of *L. lineata* in these PROCEEDINGS for 1910, p. 525. It is a distinct species.

[6] *Nautilus,* XIII, p. 56.

The above-mentioned species are evidently related to *L. lirata* (Pfr.) = *Helicina lirata* and *unidentata* of authors, a species found on the mainland from Vera Cruz to the Orinoco River; also to *L. lamellosa* (Guppy) of Trinidad. For this little group the name *Perenna* Guppy might be used in a subgeneric sense.

The typical group of *Lucidella* consists of the larger Jamaican species: *L. aureola* Fér. (the type of *Lucidella*), *L. granulosa* C. B. Ad., 1850 (of which *L. undulata* Pfr., 1861, seems to be a synonym), *L. depressa* Gray (the type of *Pænia* H. and A. Ad.), and *L. adamsiana* Pfr.

Lucidella yallahsensis n. sp. Fig. 2.

The shell is nearly white, smaller than *L. lineata*, a little more depressed, with *rounded periphery*. Apex smooth, the rest of the shell finely and densely striate spirally; the *base striate throughout*. Peristome expanded, thick, notched at the columella; the basal tooth large and squarish, as in *L. lineata;* the tooth within the upper lip rudimentary, represented by a slight swelling of the inner margin.

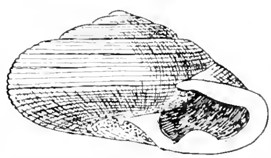

Fig. 2.—*Lucidella yallahsensis.*

Alt. 1.5, diam. 2.8 mm.; $4\frac{1}{3}$ whorls.

Yallahs, parish of St. Thomas. Types No. 10211, A. N. S. P., from the Robert Swift collection (probably collected by Gloyne).

A series of over 30 individuals shows constant differences from *L. lineata* of the Mandeville region, differences which we must look upon as specific in the present state of our collections. Of this group of *Lucidella* we now know five or six Jamaican species:

L. yallahsensis n. sp. of the southern shore, eastward from Kingston.
L. lineata (C. B. Ad.) of the high interior, westward.
L. foxi Pils. and *L. persculpta* n. sp. of the north shore.
L. nana Pfr. "Jamaica."
L. trochiformis Pils. "Jamaica."

Geomelania.

Of the genus *Geomelania* there have been described from the island of Jamaica 29 species and varieties. We append an analytical key to these species, which has been found useful.

A. Whorls with transverse (axial) ribs and microscopic spiral striæ.
- *a.* Length of shell, 10 mm. or more.
  - *b.* Labium separated by a groove or space from the penultimate whorl.
    - 1. Labrum not separated from labium by a sinus, well produced obliquely and downward; size, 16 x 3.8 mm. *procera* C. B. Ad.
  - *bb.* Labium not separated from penultimate whorl.
    - *c.* 2. Labium expanded convexly, not much produced below; size, 11 x 3.5 mm. *minor* C. B. Ad.
    - *cc.* Labrum produced below.
      - 3. Linguiform part of labrum much produced, subacute, 40 ribs per whorl; size, 14 x 3.3 mm., *gracilis* C. B. Ad.
      - 4. Linguiform part excessively produced, very narrow and subacute, 26–30 ribs per whorl; size, 12 x 3.2 mm. *typica* C. B. Ad.
- *aa.* Length of shell less than 10 mm.
  - *d.* Labium detached from the penultimate whorl.
    - *e.* Labium widely detached from the penultimate whorl.
      - 5. Labium very widely detached from the penultimate whorl, linguiform part obtuse and produced laterally, 40 arcuate ribs per whorl; size, 9.4 x 3 mm. *costulosa* C. B. Ad.
      - 6. Labium rather widely detached, linguiform part on lower half of labrum and scarcely produced; ribs, 35 per whorl; size, $6\frac{3}{4}$ x 1.6 mm. *exilis* C. B. Ad.
    - *ee.* Labium moderately or only slightly detached from the penultimate whorl.
      - 7. Labrum separated from labium by a keyhole sinus, labium distinctly detached from the penultimate whorl; size, $5\frac{1}{2}$ x 1.2 mm., *sinuosa* Chitty.
      - 8. Entire end of last whorl a little detached from the penultimate whorl and angular above, lip sharp, labium reflected (opposite the penultimate whorl); labrum (otherwise) scarcely reflected; size, 7.5 x 1.7 mm. *beardsleyana* C. B. Ad.
      - 9. Labium slightly detached, prominent, thickened; labrum but little produced below, moderately thickened and reflexed, *elegans* C. B. Ad.
      - 10. Labium slightly detached and separated from labrum by a slight sinus; ribs widely spread, 8 to a whorl, excessively elevated,

practically varices; the spiral striæ show strongly on the ribs; size, 7 x 2 mm.,
grayana C. B. Ad.

11. Labium slightly separated except at its upper extremity; 16 arcuate ribs per whorl; size, 9.7 x 2 mm. *striosa* C. B. Ad.

dd. Labium not detached from the penultimate whorl.

12. Linguiform part much produced below, subacute; 36 ribs per whorl; length, 9.2 mm.,
gracilis var. parva C. B. Ad.

13. Linguiform part excessively produced below; very narrow and subacute; length, 7.5 mm.,
typica var. pygmæa C. B. Ad.

14. Labrum but little produced below, moderately thickened and reflexed, not separated from labium by a sinus, whorls remaining five; size, 4.1 x 1.3 mm. *parvula*[7] P. & B.

15. Labrum rounded, not produced into a linguiform portion, separated from the labium by a sinus; size, 4.5 x 1 mm. *pygmæa* C. B. Ad.

16. Labrum obtuse, expanded, rounded, 40–50 ribs per whorl, 36 spiral striæ on the penultimate whorl; size, 4.1 x 1.1 mm. *microglypta* P. & B.

B. Whorls with transverse (axial) ribs, but without microscopic spiral striæ.

a. Length of shell, 10 mm. or more.

b. Labium separated by a groove or space from the penultimate whorl.

17. Labrum separated from labium by a sinus, reflexed and thickened, very much produced in the lower part; size, 17 x 5 mm *jamaicensis* Pfr.

18. Labium separated from the penultimate whorl except at its upper extremity. Linguiform part of labrum at the anterior extremity of the right side, well produced obliquely, not narrow, subacute; ribs 35 per whorl, prominent, acute-edged; size, 10 x 2 mm.,
media C. B. Ad.

19. Labium thickened and separated from penultimate whorl. Linguiform part excessively produced obliquely downward, narrow and acute; ribs 36 per whorl; size, 15 x 4.5 mm *fortis* C. B. Ad.

20. Labium separated from the penultimate whorl; linguiform part produced obliquely and laterally, wide, obtuse; ribs 38 per whorl, slender and arcuate; size, 16.5 x 4.75 mm. *magna* C. B. Ad.

bb. Labium not separated from the penultimate whorl.

[7] This is the species described by Edward Chitty (*Cont. Conch. of Edward Chitty*, No. 1, Kingston, Jamaica, 1853, p. 6) under the name *Geomelania parva* Chitty. This name being preoccupied by *G. gracilis parva* C. B. Adams, we would propose the name *Geomelania parvula* for Chitty's species.

21. Labium thin, reflexed into the cavity of the penultimate whorl and appressed thereto; labrum slightly reflexed above, spreading widely and reflexed below. Ribs strong, flattened on forward side and obsolete on the anterior half of the last whorl; size, 13 x 4.7 mm. .... *expansa* C. B. Ad.
22. Labium produced below; linguiform part of labrum much produced, subacute; 40 ribs per whorl; size, 14 x 3.3 mm. .... *gracilis* C. B. Ad.
23. Linguiform part of labrum excessively produced obliquely and narrow; size, 13 x 4.7 mm. .... *affinis* C. B. Ad.
24. Linguiform part excessively produced obliquely and acute at the lower part of the right side; size, 10 x 2.3 mm. .... *conica* C. B. Ad.

aa. Length of shell less than 10 mm.

c. Labium separated from the penultimate whorl.

25. Whorls remaining, 7 or 8; linguiform part of labrum but slightly produced; ribs 25 per whorl, broad, obtuse; size, 5.3 x 1.2 mm. .... *pauperata* C. B. Ad.
26. Labium thickened and slightly separated from the penultimate whorl; labrum well expanded, thin, reflexed; linguiform part moderately produced obliquely at the side, obtuse; ribs 33–35 per whorl; size, 6.3 x 2.2 mm. .... *hilliana* C. B. Ad.

cc. Labium not separated from the penultimate whorl.

27. Appears smooth until the lens is used, then covered with rounded, close-set, transverse ribs; labrum produced on the right, labium appressed to the penultimate whorl at the upper half and separated from the labrum by a slight sinus; size, 9.1 x 2 mm. .... *inornata* Chitty.
28. Labrum produced obliquely forward, rounded at the apex and reflexed; ribs 30 per whorl, coarse; size, 8 x 2.7 mm. .... *vicina* C. B. Ad.
29. Labrum thin, slightly reflexed; linguiform part obtuse, moderately produced laterally at the lower part of the right side; labium a little thickened and reflexed; 28 small, obtuse ribs, which, on the last whorl, terminate a little below the periphery; remaining whorls 7 or 8; size, 8.1 x 2.2 mm., *pyramidatus* C. B. Ad.

Explanation of Plate XLIII.

Figs. 1–5.—*Sagda adamsiana* n. sp.
Fig. 6.—*Sagda adamsiana* n. sp., showing interior of last whorl from above.
Fig. 7.—*Sagda adamsiana* n. sp., half-grown specimen.
Figs. 8, 9, 11, 12.—*Sagda jayana* C. B. Ad.
Fig. 10.—*Sagda jayana* C. B. Ad., showing interior of last whorl from above.
Figs. 13, 14.—*Sagda montegoensis* n. sp.
Figs. 15, 16.—*Pleurodonte acuta semperfluens* n. subsp.

The following Reports were ordered to be printed:

REPORT OF THE RECORDING SECRETARY.

The sixteen meetings provided for by the By-Laws were held during the year from the last of November, 1910, to the beginning of December, 1911, with an average attendance of thirty-two. A few reports of original investigations were presented and communications were made by Benjamin Sharp, James A. G. Rehn, Henry A. Pilsbry, Frank J. Keeley, E. G. Conklin, Herbert Fox, H. Van Sickle, Hugo Bilgram, Charles S. Boyer, Mr. Owen, Thomas S. Stewart, Samuel G. Dixon, Henry Skinner, Philip P. Calvert, Henry Tucker, Thomas H. Montgomery, Jr., Edgar T. Wherry, Spencer Trotter, Edwin S. Balch, Witmer Stone, John W. Harshberger, Charles Morris, and Stewardson Brown. Most of these were illustrated by lantern slides. They were not reported for publication.

Thirty-four papers were presented as follows: Henry W. Fowler, 6; Henry A. Pilsbry, 5; Amos P. Brown, 3; Edw. G. Vanatta, 2; Thomas H. Montgomery, Jr., 2; Ralph V. Chamberlin, 2; S. Stillman Berry, 2; H. A. Pilsbry and James H. Ferriss, 1; Amos P. Brown and H. A. Pilsbry, 1; Frank J. Keeley, 1; J. Percy Moore, 1; Witmer Stone, 1; James A. G. Rehn, 1; Clarence B. Moore, 1; Norman E. McIndoo, 1; Nathan Banks, 1; Howard Crawley, 1; Friedr. Dahl, 1; and R. W. Shufeldt, 1.

Of these, two were accepted for publication in the Journal, three were returned to the authors, and two await the action of the Publication Committee. Mr. Clarence B. Moore has again borne the entire cost of publication of a beautifully illustrated part of the Journal, forming No. 3 of Volume XIV.

The issue of publications during the year has been as follows: Proceedings, 674 pages and 41 plates; Journal, 113 pages and 8 plates; Entomological News, 480 pages, 19 plates; Transactions of the American Entomological Society (Entomological Section of the Academy), 380 pages and 13 plates; Manual of Conchology, 175 pages and 26 plates, forming part of Volume XXI.

The volume had been completed by Dr. Pilsbry before the end of November, but owing to a mishap with the lithographic printer the concluding number was not issued until later, so that it will be included in the statistics of publication of next year.

Thirty members and six correspondents have been elected. The deaths of seven members and fourteen correspondents were announced. In recording the death of the Rev. Henry C. McCook, the Secretary referred briefly to the value of his work and to the very important services rendered by him to the Academy as Vice-President, and especially in connection with the Committee on Instruction and Lectures. A much more adequate memorial has been published by Dr. Philip P. Calvert in the current volume of the Entomological News.

The appointments made by the President on the recommendation of the Council are noted in the report of the Corresponding Secretary.

Resignations of membership were received from Wm. J. Sinclair, H. R. M. Landis, H. T. Wolf and T. Guilford Smith.

A successful meeting of the American Ornithologists' Union was held in the Lecture Hall and Reading Room, November 13–16.

The Committee on Instruction and Lectures reports that the usual course of free popular evening lectures was conducted in conjunction with the Ludwick Institute, January 9–April 20, 1911, this being the second series delivered in the new Lecture Hall of the Academy.

Five lectures on Bird Life about Philadelphia were delivered by Mr. Witmer Stone; three on the Conservation of Human Energies and Resources by Dr. Seneca Egbert; two on the Mammalia by Dr. Spencer Trotter; five on Scientific Explorers of America and their Discoveries by Dr. H. A. Pilsbry; five on Entomology by Dr. Henry Skinner; five on Local Wild Flowers by Mr. Witmer Stone (in the absence of Mr. Stewardson Brown); five on Animal Coloration and its Significance by Dr. J. Percy Moore.

Beginning September 13, 1911, an afternoon course was given to students of the Girls' High Schools of Philadelphia, who visited the Academy in company with their teachers. This course was very largely attended. Two lectures each were delivered by the following speakers: Mr. Witmer Stone on Local Birds, Dr. J. Percy Moore on Mammals and Reptiles, Dr. Henry Skinner on Insects, Mr. Stewardson Brown on Plants, and Dr. Henry A. Pilsbry on Mollusks.

Early in the year resolutions were adopted by the Council approving of a fitting celebration of the Centenary of the Academy on the 19th, 20th, and 21st of next March. The President appointed a committee of forty-one to make arrangements for such celebration.

The General Committee has been divided into sub-committees on Printing and Publications, Meetings and Addresses, Invitations, Finance, and Entertainment. In harmony with a preliminary report of this committee, the publication of three volumes has been decided upon: A commemorative quarto volume of scientific memoirs, an index to the series of PROCEEDINGS and JOURNALS up to and including 1910, and a detailed history of the Academy by the Recording Secretary, of which the chapter contributed to the *Founders' Week Memorial Volume* may be regarded as a prodromus. It has been decided to hold the first session on the meeting night of the Academy, March 19, when historical addresses will probably be delivered; two morning sessions will be devoted to the reading of scientific papers; on the afternoon of the second day a microscopical exhibition will be given and the resources of the Academy demonstrated; on the evening of that day a reception will be tendered to members, guests and friends, and the proceedings will probably end with a banquet on the evening of March 21st, the official birthday of the Academy.

The preparation of the proposed publications is progressing satisfactorily, and it is hoped that a united effort may be made to secure for the occasion a success commensurate with its importance in the history of the Academy and in its relation to the advancement of science in America.

EDWARD J. NOLAN,
Recording Secretary.

REPORT OF THE CORRESPONDING SECRETARY.

During the year just closed death claimed the following named correspondents: Charles Otis Whitman, Ernest André, Thomas Rupert Jones, Samuel H. Scudder, C. M. Scammon, Maskelyne N. Story and Florentino Ameghino. The death of Professor Ralph Tate, in 1901, was also announced.

The election of six correspondents has been recorded in the current PROCEEDINGS. A revised list of correspondents has been prepared for publication by the Assistant Librarian.

Invitations to participate in the following events of interest to the scientific world were received: The International Hygiene Exhibition in Dresden; the learned congress in connection with the Millenary Fêtes in celebration of the one thousandth anniversary of the freedom of Normandy; the international programme in honor of the memory of Amedeo Avogadro; the one hundredth anniversary of the founding of the Natural History Society of Görlitz; the presidential inauguration exercises of the University of Minnesota; the Tenth International Congress of Geography, to which Mr. Henry G. Bryant was appointed a delegate, and which has been postponed until 1912; the jubilee of Giovanni Capellini, at which Carlo Emery represented the Academy; the proposed acquisition of the birthplace of Louis Pasteur; the fiftieth anniversary of the founding of the Natural Science Association of Cassel; and the centennial anniversary of the founding of King Frederic's University at Christiania, to which Professor G. O. Sars was appointed as the Academy's representative. In cases where it was found impracticable to appoint delegates, suitable letters of congratulation were forwarded on behalf of the Academy.

In addition to the regular correspondence, the Corresponding Secretary, on behalf of the Sub-committees on Publication and on Meetings and Addresses of the proposed Centenary Celebration of the Academy, issued a letter inviting the contribution of memoirs to the Academy's programme to a selected list of correspondents, many of whom have responded encouragingly and with expressions appreciative of the work of the society. As a member of the Sub-committee on Invitations, the Corresponding Secretary assisted in the preparation of an invitation and of the list of societies and institutions to be invited to send delegates to the proposed celebration.

The following communications have been received:

Acknowledging the receipt of the Academy's publications	214
Transmitting publications to the Academy	60
Requesting exchanges or the supply of deficiencies	7
Invitations to learned gatherings, etc	17
Notices of deaths of scientific men	5
Circulars concerning the administration of scientific institutions, etc	19
Photographs and biographies of correspondents	8
Letters from correspondents	45
Miscellaneous letters	89
Total received	464

The following communications have been forwarded:

Acknowledging gifts to the Library	1,212
Requesting the supply of deficiencies	17
Acknowledging gifts to the Museum	64
Acknowledging photographs and biographies	6
Letters of sympathy or congratulation, addresses, etc	7
Diplomas and notices of election of correspondents and delegates	20
Letters to correspondents	119
Miscellaneous letters	96
Annual reports and circulars sent to correspondents	326
Total forwarded	1,967

Respectfully submitted,

J. Percy Moore, *Corresponding Secretary.*

REPORT OF THE LIBRARIAN.

The past year has been uneventful but prosperous, so that there is but little to be reported except the statistics of additions and distribution.

There has been received since the first of December, 1910, a total of 9,158 accessions, 7,769 of which were pamphlets and parts of periodicals; 1,243 volumes. and 146 maps.

They were derived from the following sources:

Exchanges from publishing societies	3,690
I. V. Williamson Fund	2,196
United States Department of Agriculture	809
General appropriation	794
American Entomological Society	709
Mrs. Joseph M. Gazzam	275
Authors	136
J. Aiken Meigs Fund	124
Editors, in exchange	90
United States Bureau of Education	58
United States Department of the Interior	47
Thomas B. Wilson Fund	34
United States Treasury Department	24
Pennsylvania Department of Health	20
Witmer Stone	13
Pan-American Union	12
Ministerio de Agricultura, Argentine Republic	10
Imperial Department of Agriculture, British West Indies	9
New York Agricultural Experiment Station	8
Dr. Edw. J. Nolan	7
Duc d'Orleans	6
Dr. Henry Tucker	6
Commissioners of Fisheries and Game, Massachusetts	5
Pennsylvania Department of Agriculture	5
Publication Committee of the Academy	5
Natural Ice Association of America	4
War Department	4
Danish Government	4
Department of Commerce and Labor	3
Osservatorio "Baldini"	3
East Indian Government	3
George F. Kunz	3
Commission of Conservation, Canada	3
Dr. S. Solis Cohen	2
Dr. H. A. Pilsbry	2
New Zealand Department of Lands	2
Estacion Sismologica de Cartuja	2
Massachusetts Agricultural Experiment Station	2
Department of Fisheries, New South Wales	2
French Government	2
Warren M. Foote	2
Delaware County Institute of Science	2
Wisconsin Geological and Natural History Survey	2
Geological Survey of Georgia	2
Geological Survey of Alabama	2
Dr. Thomas Biddle	1
Dr. J. W. Harshberger	1
Botanical Survey of India	1
Madame Leo Errera	1
Florida State Geological Survey	1
Isthmian Canal Commission	1
Bureau of Surveys Philadelphia	1
Sir Robert W. Best	1
Amos P. Brown	1
Illinois Bureau of Labor Statistics	1
Augustana College	1
Department of Fisheries, Pennsylvania	1
Dr. Samuel G. Dixon	1
William J. Fox	1
Minnesota Historical Society	1

These additions were distributed to the several departments of the library as follows:

Journals	5,871
Agriculture	1,690
Geology	603
Botany	217
General Natural History	116
Entomology	102

Geography	102	Mineralogy	18
Voyages and Travels	82	Physical Sciences	18
Anatomy and Physiology	74	Helminthology	10
Anthropology	37	Medicine	10
Ornithology	31	Mammalogy	7
Conchology	30	Chemistry	4
Encyclopedias	29	Mathematics	4
Bibliography	19	Herpetology	2
Ichthyology	18	Unclassified	64

Among the more important of these accessions may be mentioned:

Encyclopedia Britannica. Twenty-nine volumes. 11th edition.
Poda, N., *Insecta Musei Græcensis.* 1761.
Mission du Service Géographique de l'Armée pour la Mesure d'un Arc de Méridien équatorial en Amérique du Sud.
Denton, S. F., *Moths and Butterflies of the United States.*
Felder, S., *Lepidoptera of the Novara Expedition,* with colored plates.
Spalowsky, J. J., *Prodromus in Systema historicum Testaceorum.*
Sprengel, C., *Das entdeckte Geheimniss der Natur.* 1793.

The exchange list has been increased by the addition of the following:

Queensland Naturalist. Brisbane.
Forestry Quarterly. Ithaca.
Jahresbericht und Verhandlungen des Ornithologischen Vereins zu München.
Bulletin et Mémoires, Société Fribourgeoise des Sciences Naturelles. Fribourg.
Lloyd Library (Publications). Cincinnati.
Atti delle I. R. Accademia di Scienze, Lettere ed Arti degli Agiati in Rovereto.
Actes de la Museum d'Histoire Naturelle de Rouen.
Bulletin de la Société Botanique des Deux Serres. Niort.
Mittheilungen der Wiener Mineralogischen Gesellschaft. Wien.
Annals of the Cyprus Natural History Society. Nicosia.
Bulletin of the Natural History Society of British Columbia. Victoria.
Mededeelingen, Phytopathologisch Laboratorium "Willie Commelin Scholten." Amsterdam.
Arhiva, Organul Societatii Stiintifice si Literare di Iasi. Jassy.
Bulletin, Société des Sciences historiques et naturelles de la Corse. Bastia.
Bulletin of Southern California Academy of Sciences. Los Angeles.
Mittheilungen der Naturforschenden Gesellschaft in Solothurn.
Proceedings of the University of Durham Philosophical Society. Durham.
Bulletin of the Philosophical Society of the University of Virginia. Charlottesville.
American Forestry. Washington.
Agricultural Bulletin of the Straits and Federated Malay States. Singapore.
Agri-Horticultural Society of Madras. Madras.
Journal of the Washington Academy of Sciences. Washington.
Zeitschrift der naturwissenschaftlichen Abtheilung (Deutsche Gesellschaft f. Kunst und Wissenschaft in Posen). Posen.
Annual Reports and Proceedings of the Chester Society of Natural Science, Literature and Art. Chester.
Botanikai (Novenytani) Kozlemenyek. Budapesth. Complete set.

The following new journals have been purchased:

Bulletin de la Société Royale Linnéenne de Bruxelles. Annee 17–31.
Wiltshire Archeological and Natural History Magazine, Devizes. Vols. 1–32.
Cactus Journal, London. Two volumes.
Natural History Journal and School of Arts, London. Seven volumes.
Report and Proceedings of the Manchester Field Naturalists' and Archeologists Society, Manchester. 1860–1887.

Physikalische Belustigungen, Berlin. Ten parts in two volumes (1751–55).
Flore des Serres, Gand. Twenty-three volumes.
Memorie della Società Crittogamologica Italiana, Varese. Two volumes.
Proceedings of the Zoological and Acclimatisation Society, Victoria, Melbourne. Five volumes.
Transactions of the Philosophical Society of New South Wales, Sydney. One volume.
Tasmanian Journal of Natural Science, etc., Hobarttown. Three volumes.
Giornale di Anatomia, Fisiologica e Patologica degli Animali, Pisa. Twenty-three volumes.
Flora, Regensburg. Vols. 3–25.
Garden and Forest, New York. Ten volumes.
Rheinisches Magazin zur Erweiterung der Naturkunde, Giessen. One volume (1793).

The following have been added to the subscription list, complete sets having been secured when desirable:

Journal of Genetics. Cambridge.
Das Weltall, Berlin.
Denkschriften, Medicinisch-Naturwissenschaftliche Gesellschaft zu Jena.
American Botanist, Joliet.
Archives de Psychologie, Genève.
Abhandlungen und Sitzungsberichte, Heidelberger Akademie der Wissenschaften, Math.-naturwissenschaftliche Klasse, Heidelberg.
Zentralblatt f. Roentgenstrahlen, Radium, etc., Wiesbaden.
Revista de Ciencias, Lima.
Beiträge zur Pflanzenwelt, Berlin.

Notwithstanding the fact that the annual appropriation for the purchase of books was somewhat curtailed, the additions made to the library number 1,555 more than those of the preceding year. This is partly accounted for by Mrs. Gazzam's gift of 275 duplicate volumes of Pennsylvania Geological Survey Reports, and the transfer from the library of the Entomological Section of 709 reports of Agricultural Stations, but it is mainly owing to successful efforts to secure exchanges and deficiencies.

Thirty-two pamphlets received in duplicate from the Department of Agriculture were, as required by law, returned to Washington.

An oil portrait of Dr. John L. LeConte, by L. G. Seybert, the gift of Mrs. LeConte, was formally presented at the meeting of April 18, by Dr. Henry Skinner, who commented on the work and services of the distinguished entomologist.

I am indebted to my assistant, Mr. William J. Fox, for the performance of much of the routine work of the year, thereby enabling me to give more time than would otherwise have been possible to the interests of the approaching Centenary, about which more is said in the Report of the Recording Secretary.

My junior assistant, Mr. Furman Sheppard Wilde, has also been, in the discharge of his duties, intelligent and loyal.

EDWARD J. NOLAN, *Librarian.*

REPORT OF THE CURATORS.

During the past year the Academy received from the Commonwealth of Pennsylvania an appropriation of $75,000 for the purpose of completing the alterations and additions to the building outlined in the plans prepared several years ago, and intended to safeguard the institution against fire and to render more complete the library, museum, and teaching plant.

The alterations now under way comprise a brick casing to the south wall of the old green stone building, the addition of two stories to the connecting building on Nineteenth Street, containing the local museum, and the addition of granite and terra-cotta trimmings to make it uniform with the other buildings; the complete remodelling of the old library hall for museum purposes, the walling off of the herbarium rooms, recoating of the roof of the main museum and the addition of new skylights; also the fireproofing of exposed iron work, the substitution of concrete for wooden floors, improvement of the old cellar, and the extension of the electric lighting and plumbing systems. Metal cases are also to be provided in the hall formerly used for the library.

The work was begun in October, and is to be finished in time for the Academy's Centennial Celebration, in March. The preparations for the alterations involved the closing of the entire museum except the Archæological and Mineralogical and the Mammal floors and the removal of most of the exhibits, as well as the entire Entomological Department to temporary quarters. It has therefore been impossible to institute any improvements in the arrangement of the exhibition collections, although certain important additions have been made to them.

A large amount of research and routine work has, however, been accomplished by the members of the scientific staff, as outlined in the accompanying special reports. In addition, Dr. J. Percy Moore has continued his studies on the deep-sea Annelids dredged in the North Pacific by expeditions of the U. S. Bureau of Fisheries, Leland Stanford Junior University, and the University of California, and on collections made by several persons along the coast of California. Descriptions of new forms have been published in the PROCEEDINGS and cotypes and duplicates reserved for the Academy's collection. The collections of worms have been cared for as usual and assistance has been rendered to various individuals and institutions in the identification of specimens and in giving information.

Mr. H. W. Fowler has continued the care of the collection of fishes and has critically studied the Apodal and Salmonoid groups and prepared a number of papers for the PROCEEDINGS. Miss H. N. Wardle has looked after the Archeological collections as heretofore.

In addition, the Curators are indebted to Mr. Morgan Hebard for having a large number of the Orthoptera obtained on recent expeditions mounted; and to Messrs. S. S. Van Pelt and Bayard Long for valuable aid in the care of the local collection of plants.

Numerous local field trips have been taken during the year by members of the staff and considerable additions made thereby to the collections of fishes, insects and plants. Mr. Rehn, accompanied by Mr. Morgan Hebard, also visited Georgia and Florida, and Mr. Stone the mountains of western Maryland.

Early in the year, through the liberality of Mr. Francis E. Bond, an expedition was undertaken to the Orinoco delta and other parts of northern Venezuela, in the interests of the Academy. Mr. Bond was accompanied by Mr. Stewardson Brown and Mr. Thomas S. Gillen, and valuable collections, especially of birds, insects, and plants, were obtained. Several groups of the birds and mammals have been mounted and placed on exhibition and reports are being prepared on the various collections.

Mr. Clarence B. Moore has continued his investigation of the Indian mounds of the Southern States and has added many valuable specimens to his collection, for the accommodation of which he has presented another mahogany and plate-glass case. The Academy also supported in part an expedition made by Mr. H. W. Wenzel, Jr., to the mountains of southern Texas, from which it received a valuable series of insects and a few reptiles.

Noteworthy among the accessions of the year is a skeleton of an adult male sperm whale, which came ashore at Ocean City, N. J., and was secured for the Academy through the prompt and intelligent action of Mr. William B. Davis and the generosity of the Ocean City Life-Saving Crew.

An important collection of East Indian birds was obtained by purchase and also a fine bull Buffalo, the latter from the Zoological Society of Philadelphia.

Seventy-three storage cases, 250 insect boxes and six plate-glass and mahogany exhibition cases were purchased during the year.

There has been a marked increase in the attendance of visitors to the Museum, especially of classes of school children accompanied by their teachers.

Specimens have been loaned to Samuel G. Dixon, Henry A. Pilsbry, Witmer Stone, Henry Tucker, C. S. Sargent, Thomas Barbour, E. W. Nelson, Robt. Ridgway, Geo. H. Girty, Edgar A. Mearns, R. W. Shufeldt, Julia A. Gardner, Mary J. Rathbun, and H. C. Oberholser.

SAMUEL G. DIXON,
HENRY A. PILSBRY,
WITMER STONE,
HENRY TUCKER.

REPORT OF THE DEPARTMENT OF MOLLUSCA.

Work on the collection of mollusks has been confined to the study-series during this year, as it has seemed inexpedient to begin projected changes in the public exhibition until the alteration of the building is completed. Fifteen new storage cases gave opportunity for the arrangement of the current additions to the collection, with the exception of the Unionidæ, which remain unprotected for the time being. The dust-proof storage cases now installed number 156, each holding 16 trays of 3.38 square feet area. The total space now occupied by the dry collection of mollusks is as follows:

Double table-cases, glazed tops	43, with an area of	2,057 sq. ft.
Drawers below same	624, " " "	2,121 " "
Storage cases	156, " " "	7,914 " "
Total area		12,092 sq. ft.

From South America we have received valuable lots from Venezuela, collected by Mr. S. Brown, of the F. E. Bond Expedition; from Ecuador, collected by Mr. S. N. Rhoads, and from Jamaica, collected by Dr. Amos P. Brown. Dr. C. M. Cooke, of Honolulu, and D. D. Baldwin, of Maui, have contributed needed material from the Hawaiian Islands, and Mr. A. Haycock gave paratypes of the new species discovered by him in Bermuda. Our North American collection has been increased by gifts from Messrs. J. A. Allen, J. H. Ferriss, L. E. Daniels, C. B. Moore, G. H. Clapp and many others.

In the MANUAL OF CONCHOLOGY a monograph of the sub-family Amastrinæ has been completed, and our very large collection of these snails has been revised and arranged. The American *Sphæriidæ* and the mollusks of Bermuda in our collection have been worked over by Mr. Vanatta.

The assistance rendered by Dr. Amos P. Brown, who has co-operated with the Curator in working up collections made by him in Jamaica, is gratefully acknowledged.

In the absence of a palæontologist, the Curator has, with the volunteer assistance of Dr. A. P. Brown, taken up much-needed work on the paleontological collection, which, on account of the large number of type specimens, is one of the most important in America. Various brief publications on Miocene and Cretaceous Mollusca have grown out of the work done on the collections. Dr. Brown has collaborated in studies on the Oligocene fauna of the Isthmus of Panama. The results have been published in the PROCEEDINGS, and the material, comprising numerous types, placed in the Museum.

H. A. PILSBRY,
Special Curator Department of Mollusca.

REPORT OF CURATOR OF WILLIAM S. VAUX COLLECTION.

During the past year there has been added to the William S. Vaux Collections eleven specimens of minerals, which, while few in number, are of exceptional value and interest. Among those deserving special mention are meteorites from York County, Pa., a large twin titanite from Canada, and two native silvers from Lake Superior.

Respectfully submitted,
F. J. KEELEY,
Curator Wm. S. Vaux Collection.

REPORTS OF THE SECTIONS.

BIOLOGICAL AND MICROSCOPICAL SECTION.

Nine stated and several informal meetings of the Section have been held during the year, with the usual attendance. Two new members have been added and one resignation has occurred.

The work of the year has consisted of miscellaneous communications, the most important of which, *Micro-Spectroscopic Observations*, by Mr. F. J. Keeley, was presented at the meeting with the Academy and is published in the PROCEEDINGS.

The Conservator reports an addition to the Museum of three hundred and ten slides of microscopic objects, the gift of Dr. J. Cheston Morris.

The officers elected for the year 1912 are as follows:

Director	J. Cheston Morris, M.D.
Vice-Director	T. Chalkley Palmer.
Recorder	Charles S. Boyer.
Treasurer	Thomas S. Stewart, M.D.
Corresponding Secretary	Silas L. Schumo.
Conservator	F. J. Keeley.

Charles S. Boyer,
Recorder.

Entomological Section.

The usual meetings of the Section have been held and the communications made have been published in Entomological News.

During the year 8,398 specimens of insects have been added to the collection, and a considerable part of this number have been incorporated with the various sections of the cabinet. Sixteen tin cases have been purchased, fifty glass-covered boxes, and 201 Schmidt boxes.

The determination of the Diptera is being continued and several lots sent in by collectors have contained species that were new to the cabinet. These additions have in some cases necessitated the rearrangement of families. The collection of southwestern Hemiptera determined by Mr. E. P. Van Duzee last year is being incorporated into the general collection. In the Orthoptera a large amount of work has been done on African material; the North American series has been rearranged and the exotic collections as far as determined.

The Bruner collection of Orthoptera, containing 22,000 specimens and 600 types, purchased by Mr. Morgan Hebard, has been deposited.

When the new rooms for the department are completed Mr. Hebard will also place on deposit his own large collection of these insects.

In the order Hymenoptera the family Microgasterinæ has been rearranged.

The Micro-lepidoptera have all been mounted preparatory to the rearrangement of these moths.

The F. E. Bond Collection made in Venezuela by Prof. Stewardson Brown, contained over a thousand specimens. These, as well as the material collected in southern Texas by Henry A. Wenzel, have been mounted.

Dr. Calvert has continued to care for the Odonata and the thanks of the department are due him.

Volume XXII of the ENTOMOLOGICAL NEWS has been completed with 480 pages and 19 plates; TRANSACTIONS OF THE AMERICAN ENTOMOLOGICAL SOCIETY (Entomological Section), 380 pages and 13 plates.

At a meeting of the Section held December 11 the following were elected officers to serve for the coming year:

Director	Philip Laurent.
Vice-Director	Henry W. Wenzel.
Treasurer	E. T. Cresson.
Conservator	Henry Skinner.
Secretary	J. A. G. Rehn.
Recorder	Henry Skinner.
Publication Committee	E. T. Cresson, E. T. Cresson, Jr.

HENRY SKINNER,
Recorder.

BOTANICAL SECTION.

During the year, twenty metal dust- and insect-proof cases have been added to the furnishing of the herbarium, and six wooden cases transfered from the general herbarium to the local room, to provide additional space for that rapidly growing collection.

Early in the year, the Conservator went to Venezuela as a member of the Francis E. Bond Expedition, when a collection of 850 sheets of plants was made. The herbarium of the late Robert E. Griffiths, presented by Dr. Astley P. C. Ashhurst and Dr. William Ashhurst; the herbarium of Dr. Thomas S. Githens, presented by the collector, and a collection of plants of the Yellowstone made by Mr. Benjamin H. Smith have also been added. There have been received through exchange, 112 sheets from the New York Botanical Garden, 102 sheets from the Gray Herbarium and 60 sheets from the United States National Museum. The Section has purchased a series of 181 sheets of North American Violets from Prof. Ezra Brainard and 395 sheets of Nevada and Oregon plants from A. A. Heller.

The local herbarium, under the care of Mr. Samuel S. Van Pelt, has been increased during the year by 3,768 sheets, received principally from members of the Philadelphia Botanical Club. In addition, the local plants in the general herbarium have been transferred, thus bringing all the collections of our region together in one series. Mr. Bayard Long has continued his valuable services during the year, and acknowledgment is made of the continued services of Miss Ada Allen as assistant in the herbarium.

At the annual meeting of the Section, held November 23, the following officers were elected:

Director	Benjamin H. Smith.
Vice-Director	Joseph Crawford.
Recorder	Charles S. Williamson.
Treasurer and Conservator	Stewardson Brown.

Respectfully submitted,

STEWARDSON BROWN,

Conservator.

MINERALOGICAL AND GEOLOGICAL SECTION.

The Section has held four meetings this year, with about the average attendance. A communication was made by Mr. S. Harbert Hamilton on exact surveying methods for the geological delineation of ore bodies, especially magnetite, besides some shorter communications and various discussions.

There were five field excursions, with an average attendance of 20. The parties visited: (1) A line of Cambrian quartzites and limestones between Westtown and Brinton's Bridge, Delaware County; (2) Crystalline rocks and their minerals near the southern edge of Delaware County; (3) The New Red rocks near Jacksonwald, Berks County; (4) The New Red rocks near Mt. Monocacy, Berks County; (5) The New Red rocks near the Ecton and Perkiomen Mines and Valley Forge, Montgomery County.

The following officers of the Section have been elected for the year 1912:

Director	Benjamin Smith Lyman.
Vice-Director	Frank J. Keeley.
Recorder and Secretary	Silas L. Schumo.
Treasurer	William B. Davis.
Conservator	George Vaux, Jr.

Respectfully submitted by order of the Section,

BENJAMIN SMITH LYMAN,

Director.

Report of the Ornithological Section.

Work in the Ornithological department during the past year has consisted mainly in the labelling and cataloguing of the numerous accessions and in the rearrangement of a large portion of the Passerine birds in the exhibition series and a number of families in the study series. In this work the Conservator is much indebted to Mr. J. A. G. Rehn for valuable assistance.

Twelve storage cases and two large exhibition cases have been procured for the better accommodation of the collections.

Among the most important accessions were a collection of birds from the East Indies, obtained by purchase, a fine series of Venezuelan bird secured by the Francis E. Bond Expedition, and a large number of local birds, nests and eggs for the Delaware Valley Ornithological Club from the late Francis W. Rawle, Robert T. Moore, and others.

The Delaware Valley Ornithological Club, Spencer F. Baird Club and the Pennsylvania Audubon Society have held their meetings at the Academy during the year, and November 13–16 the American Ornithologists' Union assembled at the Academy for their twenty-ninth stated meeting, which proved to be one of the most successful in the history of the society.

The annual meeting of the Section was held on December 5, and the following officers were elected for the ensuing year:

Director	Spencer Trotter, M.D.
Vice-Director	George Spencer Morris.
Recorder	Stewardson Brown.
Corresponding Secretary	William A. Shryock.
Treasurer and Conservator	Witmer Stone.

Witmer Stone,
Conservator.

The annual election of Officers, Councillors and Members of the Committee on Accounts to serve during 1912 was held, with the following result:

President	Samuel G. Dixon, M.D., LL.D.
Vice-Presidents	Edwin G. Conklin, A.M., Ph.D., Sc.D.,
	John Cadwalader.
Recording Secretary	Edward J. Nolan, M.D.

Corresponding Secretary	J. Percy Moore, Ph.D.
Treasurer	George Vaux, Jr.
Librarian	Edward J. Nolan, M.D.
Curators	Samuel G. Dixon, M.D., LL.D., Henry A. Pilsbry, Sc.D., Witmer Stone, A.M., Henry Tucker, M.D.
Councillors to serve three years	Charles B. Penrose, A. M., LL.D., Ph.D., M.D., Charles Morris, Spencer Trotter, M.D., William E. Hughes, M.D.
Committee on Accounts	Charles Morris, Samuel N. Rhoads, John G. Rothermel, Thomas H. Montgomery, Ph.D., Thomas S. Stewart, M.D.

COUNCIL FOR 1912.

Ex-Officio.—Samuel G. Dixon, M.D., LL.D., Edwin G. Conklin, A.M., Ph.D., John Cadwalader, Edward J. Nolan, M.D., J. Percy Moore, Ph.D., George Vaux, Jr., Henry A. Pilsbry, Sc.D., Witmer Stone, A.M., Henry Tucker, M.D.

To serve three years.—Charles B. Penrose, A.M., M.D., LL.D., Ph.D., Charles Morris, Spencer Trotter, M.D., William E. Hughes, M.D.

To serve two years.—Thomas H. Fenton, M.D., Edwin S. Dixon, Henry Skinner, M.D., Sc.D., Robert G. LeConte, M.D.

To serve one year.—Philip P. Calvert, Ph.D., Thomas Biddle, M.D., Frederick Prime, A.M., Ph.D., Frank J. Keeley.

Councillor	George Vaux, Jr.
Curator of Mollusca	Henry A. Pilsbry, Sc.D.
Curator of the William S. Vaux Collections	Frank J. Keeley.
Assistant Librarian	William J. Fox.

Assistants to Curators	Henry Skinner, M.D.,
	Stewardson Brown,
	J. Percy Moore, Ph.D.,
	Edward Vanatta,
	Henry W. Fowler,
	James A. G. Rehn,
	Ezra T. Cresson, Jr.
Aid in Archæology	Harriet Newell Wardle.
Aid in Herbarium	Ada Allen.
Assistant in Library	Furman Sheppard Wilde.
Taxidermist	David N. McCadden.
Janitors	Charles Clappier,
	Daniel Heckler,
	James Tague,
	Jacob Aebley,
	Adam E. Heckler.

STANDING COMMITTEES.

Finance.—John Cadwalader, E. S. Dixon, Effingham B. Morris, William D. Winsor, the Treasurer.

Publications.—Henry Skinner, M.D., Sc.D., Witmer Stone, A.M., Henry A. Pilsbry, Sc.D., William J. Fox, Edward J. Nolan, M.D.

Library.—Thomas H. Fenton, M.D., George Vaux, Jr., Henry Tucker, M.D., Frank J. Keeley, Thomas Biddle, M.D.

Instruction and Lectures.—Henry A. Pilsbry, Sc.D., Charles Morris, Witmer Stone, A.M., Henry Tucker, M.D., George Spencer Morris.

Committee of Council on By-Laws.—Thomas Fenton, M.D., John Cadwalader, Charles B. Penrose, M.D., Witmer Stone, A.M.

ELECTIONS IN 1911.

Members.

January 17.—Bertram Lippincott, David E. Dallam, Thomas G. Ashton, M.D., William Pepper, M.D., George W. Norris, M.D., Wilmer Krusen, M.D., Wm. J. Conlen, Parke Longnecker, D.D.S., Francis E. Bond, G. L. S. Jamison, M.D., Lynford

Biddle, E. Hollingsworth Siter, M.D., Charles Stewart Wurts, Collier F. Martin, M.D., W. S. Newcomett, M.D.

February 21.—Edward A. Schumann, M.D., Alexander Brown, William H. Rau, Alexander A. Uhle, M.D., Mrs. Arthur Biddle.

March 21.—John Howard McFadden, Bayard Long, Edwin S. Stuart.

April 18.—George B. Wood, M.D., David Greg Methany, M.D.

May 16.—Henry Morris, M.D., H. C. Meyer, G. Carl Huber, M.D.

October 17.—Ulric Dahlgren, John Sinnott.

CORRESPONDENTS.

January 17.—Walter Rothschild, Ph.D., of Tring.

May 16.—David Starr Jordan, M.D., Ph.D., LL.D., of Leland Stanford Junior University; Jacques Loeb, M.D., Ph.D., of New York; Edmund Beecher Wilson, M.D., Ph.D., LL.D., of New York; Thomas Wayland Vaughan, A.M., Ph.D., of Washington; William Bullock Clark, LL.D., Ph.D., of Baltimore.

ADDITIONS TO THE MUSEUM, 1911.

Ethnology and Anthropology.

Miss Sarah Benners. Javanese basket.

Dr. A. E. Brown Estate. Collection of African and Philippine weapons, Indian moccasins, etc.

E. K. Bispham. Indian stone ball.

F. E. Bond Venezuelan Expedition. Curial (native canoe), Venezuela. Baskets, machets, and paddles. Two ornaments, made by coolies of Trinidad.

Capt. George L. Dardeau. One whaling spade.

Miss A. L. Flannigen. Russian fur slippers.

Rear-Admiral George W. Melville. Battle-axe, Norton Sound, Alaska; Eskimo soapstone lamp, Greenland.

Clarence B. Moore. Archæological material from Ontario, New York, Pennsylvania, Ohio, Illinois, Mississippi, Arkansas, Georgia, Florida and California.

Miss Emily S. Musgrave. Plaited fan, Samoa.

Mrs. Charles Shaeffer. Nine Alaskan spoons, pipe and other implements.

Miss H. N. Wardle. Artifacts from ancient quarry sites, Berks and Lehigh Counties, Pa.

Mammals.

Mrs. R. L. Ashhurst. Skin of Polar Bear (*Thalarctos maritimus*), Greenland.

Wilson B. Atkins. Silky guinea-pig (*Cavia porcellus*), mounted.

F. E. Bond Venezuelan Expedition. Collection of thirteen mammals from Venezuela.

Alexander Brown. Two mounted heads of Osborn's Caribou (*Rangifer osborni*), Stikeen River, B. C.

Ocean City Life-saving Crew. Skeleton of Sperm Whale (*Physeter macrocephalus*), Ocean City, N. J.

Purchased. Male American Bison (*Bison bison*) [skin and skeleton].

Purchased. Bonaparte's Weasel (*Putorius cicognani*), Walnut Hill, Philadelphia.

Purchased. Five mounted local shrews, bats and rodents.

S. N. Rhoads. Two Franklin's Spermophiles (*Citellus franklini*), Tuckerton, N. J.

Dr. Robert W. Shufeldt. Skin of Grivet Guenon (*Cercopithecus sabæus*), Abyssinia.

E. F. Stewart. Gray Fox (*Urocyon cinereoargenteus*), Palermo, N. J.

Herman Walters. Skin and skull of variety of domestic Cat (*Felis domesticus*).

Lieut. Hugh Willoughby. Skin and skull of Syke's Guenon (*Cercopithecus albigularis*).

Zoological Society of Philadelphia. Specimens presented as follows:

Mounted—Suricate (*Suricata tetradactyla*) [skull preserved separate]; Long-tailed Weasel (*Putorius longicauda*); Dwarf Lemur (*Microcebus myoxinus*); Texan Ocelot (*Felis limitis*); Oak Dormouse (*Dryomys nitedula*); European Hamster (*Cricetus cricetus*). To be mounted—White-collared Mangabey (*Cercocebus collaris*) [skull preserved separate]. Skin and Skull—Arctic Fox (*Vulpes lagopus*); Wallaby (*Macropus* sp.?); Beech Marten (*Mustela foina*); Sable Antelope (*Hippotragus niger*); California Sea-lion (*Zalophus californianus*); Oak Dormouse (*Dryomys nitedula*); Stair's Guenon (*Cercopithecus stairsi*); Guenon (*Cercopithecus* sp.). Skeleton—Zebra (*Equus burchelli* subsp.). Skull—Chimpanzee (*Pan troglodytes*). Female Brazilian Tapir (*Tapirus terrestris*) preserved as skin and skeleton with fœtus and placenta in alcohol.

Birds.

Mrs. Samuel B. Ashmead. Two cases of mounted birds.

Dr. Conrad Behrens. Male Red-breasted Merganser (*Mergus serrator*), Rehoboth, Del.

Miss Sarah Benners. Bird of Paradise (*Paradisea apoda*).

F. E. Bond Venezuelan Expedition. Collection of 500 skins of Venezuelan birds.

Mrs. C. E. Darr. Java Sparrow (*Munia oryzivora*).

Delaware Valley Ornithological Club. One hundred and fifty birds, twelve nests and eggs, mainly from Francis W. Rawle and Robert T. Moore.

Exchange with H. W. Coale. Six skins of exotic birds.

John L. Ferguson. Case of mounted birds.

Wm. Guier. Two Resplendent Trogons (*Pharomacrus mocinno*), Costa Rica.

T. R. Hill. Yellow-headed Conure (*Conurus pertinax*).

Dr. Wm. E. Hughes. Mounted Canvas-back Duck (*Aythya vallisneria*) and skin of Ring-necked Duck (*Aythya collaris*), Chesapeake Bay.

Hon. David Martin. European Starling (*Sturnus vulgaris*), Philadelphia.

Mrs. Walter Murphy. Loon (*Gavia imber*), Maine.

C. J. Pennock. Horned Lark (*Otocoris alpestris*), Delaware City, Del.

Purchased. Two Dusky Seaside Sparrows (*Passerherbulus nigrescens*), Florida.

Purchased. Fifteen hundred skins of Celebean and Bornean birds.

S. N. Rhoads. European Starling (*Sturnus vulgaris*), Camden County, N. J.; Screech Owl (*Otus asio*), Haddonfield, N. J.; Woodcock (*Philohela minor*), Camden County, N. J.

F. H. Senft. One Honey-creeper (*Cœreba*).

Charles Stafford. Two European Starlings (*Sturnus vulgaris*), Camden County, N. J.

Lauren Tremper. Nest and eggs of White-eyed Vireo (*Vireo griseus*).

Zoological Society of Philadelphia. Australian Cassowary (*Casuarius australis*); Papuan Cassowary (*Casuarius papuanus*); mounted. Whooping Swan (*Cygnus olor*), skin and sternum; Kaffir Barbet (*Trachyphonus cafer*), skin; Great Vasa Parrot (*Coracopsis vaza*), skin; Chough (*Monedula pyrrhocorax*), skin; Rhinoceros Hornbill (*Buceros rhinoceros*), skeleton.

Reptiles and Amphibians.

Academy Expedition, 1911 (Rehn). Collection of reptiles and amphibians, Florida, Georgia, South and North Carolina.

Herman Behr. Jar of amphibians, Jennings, Md.

William Beisel. Jar of salamanders (*Desmognathus fusca*), Pennsville, N. J.

Victor Blucher, Albert Thompson and H. L. Mather, Jr. Collection of salamanders, Gladwynne, Pa.

F. E. Bond Venezuelan Expedition. Collection of reptiles and batrachians from Venezuela.

Estate of Dr. A. E. Brown. A collection of reptiles and batrachians.

Miss H. L. Cooke. Carapace of Tortoise.

Dr. Ellersly. *Chrysemys marginata*, Indiana.

H. W. Fowler. *Spelerpes ruber*, Philadelphia.

Morgan Hebard. Small collection of reptiles and amphibians, Florida Keys, Fla.

Dr. C. F. Martin. Painted Turtle (*Chrysemys picta*).

H. L. Mather, Jr. Six lots of local reptiles and amphibians.

W. M. Meigs. Young Siren (*Siren lacertina*), Florida.

Richard F. Miller. Small lot of reptiles and amphibians, Philadelphia.

Robert Morris. *Thamnophis sirtalis*, Philadelphia.

Dr. H. A. Pilsbry. Painted Turtle (*Chrysemys picta*), Riverside, N. J.

Silas L. Schumo. Carapace of *Malacoclemys*, Barnegat Bay, N. J.; Young turtle.

Samuel C. Scoville. Timber Rattlesnake (*Crotalus horridus*), Litchfield County, Conn.

Witmer Stone. Collection of salamanders and frogs and snakes, Garrett County, Md.

A. Thompson and H. L. Mather, Jr. Three amphibians, Montgomery County, Pa.

Dr. Henry Tucker. Fence Lizard (*Sceloporus undulatus*), Cape May, N. J.

R. W. Wehrle. Twenty-two small collections of amphibians, Indiana County, Pa.

H. W. Wenzel. (Academy Expedition in part). Collection of reptiles, southwestern Texas.

Fishes.

Dr. C. C. Abbott. Young *Pseudopleuronectes* and two *Gasterosteus aculeatus*, Raritan Bay, N. J.

Dr. C. C. Abbott and H. W. Fowler. Jar of fishes, Trenton, N. J.

C. S. Abbott, Jr. Two teeth of *Carcharodon* and rostrum of young Saw-fish (*Pristis*).

Herman Behr. Jar of fishes, Jennings, Md.

Miss Sarah Benners. Jaws of Scaroid fish (*Scarus* sp.).

F. E. Bond Venezuelan Expedition. Collection of fishes, Venezuela.

Hon. N. R. Buller. Four Short-nosed Sturgeons (*Acipenser brevirostrum*), Torresdale, Pa.

H. W. Fowler. *Achirus* and young *Centropristis*, Cape May County, N. J.; *Microgadus tomcod*, Philadelphia Market; *Pseudopleuronectes*, *Perca* and *Micropogon*, Baltimore, Md.; barrel of fishes, Watchapreague, Va.; four lots of local fishes, Pennsylvania and New Jersey.

W. J. Fox. *Rachycentron canadus* (young), Sea Isle City, N. J.; *Alutera* and *Squatina*, Sea Isle City, N. J.

B. H. Gledhill. *Lepomis incisor*, Tomlin, N. J.

Morgan Hebard. Small collection of fishes, Lake Superior region, Michigan.

Academy and Hebard Expedition of 1910. Three species of fishes, Santa Catalina Island, California.

C. J. Hunt. Eight *Notropis atherinoides*, Chicago, Ill.

W. T. Innes, Jr. Jar of fishes, California and British Columbia.

W. T. Innes, Jr., and H. W. Fowler. Collection of fishes, Maryland and Delaware.

T. D. Keim. Jar of fishes, Long Island, N. Y.

T. D. Keim and H. W. Fowler. Five jars of fishes, Maryland and Pennsylvania.

Frank Leaming and H. W. Fowler. Three jars of fishes, Cape May County, N. J.

D. McCadden. Small collection of fishes, Ocean City, N. J.; Young Tautog (*Tautoga*), Ocean City, N. J.

H. L. Mather, Jr. Numerous small collections of fishes, Pennsylvania and New Jersey.

Dr. D. G. Metheny. Keg of fishes, Yarmouth, Nova Scotia.

Richard F. Miller. Small collection of fishes, Philadelphia.

W. B. Morrell. Black Bass (*Micropterus dolomieu*), Darby Creek, Pa.

Robert Morris and H. W. Fowler. Collection of fishes, Walnut Hill, Pa.

Dr. R. J. Phillips. Several collections of marine fishes, Corson's Inlet, N. J.

Purchased. Collection of fishes, Portuguese West Africa; two Garpikes (*Lepisosteus osseus*), Florida.

L. S. Snyder and H. L. Mather, Jr. Small collection of fishes, Schuylkill River, Pa.

F. L. Tappan. *Labidesthes sicculus*, Minnesota.

Joseph Tytus. Skin of *Salvelinus oquassa marstoni*, Lake Cassette, Quebec.

R. W. Wehrle. Numerous lots of fishes, totalling several thousand specimens, Indiana County, Pa.

Vertebrate Fossils.

Mrs. L. A. Poole. Tooth of *Isurus hastalis*, Miocene of Choptank, Maryland.

Invertebrate Fossils.

Dr. A. P. Brown. Collection of Oligocene fossils from Panama.

F. S. Manderson. Miocene corals from Yorktown, Va.

Dr. V. Oberholtzer. Collection of Palæozoic fossils from Oeland, Sweden.

Minerals and Rocks.

Foote Mineral Co. Large specimen of Diabase Dike in granite Rock. St. Cloud, Minn.

Mrs. M. J. Galloway. Collection of minerals.

J. Q. A. Haughton. Specimen of plumbago and serpentine, New Hampshire.

T. W. Huidekoper. Small collection of minerals.

Mrs. Charles Schäffer. Small collection of minerals.

Joseph Willcox. Corundum, North Carolina.

Purchased for the William S. Vaux Collection. Twenty-four specimens.

Insects.

Academy Expedition, 1911 (Rehn and Hebard). Two thousand seven hundred and fifty Orthoptera, Southeastern States.

American Museum of Natural History. Three Orthoptera, United States.

N. Banks. Fifty-one Myrmeleonidæ, thirteen Diptera, ten Hemiptera, twenty-four Psychodidæ, United States.

F. E. Bond Expedition. Ten hundred and three insects from Venezuela.

H. E. Brandt. One Coleopter, Arizona.

M. A. Carriker. Twenty-nine Coleoptera, Venezuela.

D. M. Castle. Fifty-six Coleoptera, Florida, Georgia; five Mutilla, Florida.

W. J. Coxey. One Lepidopter, Wyoming; four Lepidoptera, Africa; one Lep-Het., Australia.

E. T. Cresson, Jr. Two hundred and thirteen Diptera, United States.

E. Daecke. Fifteen Micro-lepidoptera, Pennsylvania, New York, New Jersey.

W. J. Gerhard. Five Orthoptera, Illinois.

G. M. Greene. Three hundred and twenty-eight Coleoptera, United States.

E. D. Harris. Sixteen Coleoptera, North Carolina.

J. H. Harshberger. Four Orthoptera, Florida.

G. C. Hewitt. Three Lepidoptera, Canada.

G. Horvath. Eighty-seven Chrysididæ, Europe. Exchange.

F. M. Jones. Nine Lepidoptera, United States.

P. Jorgensen. One thousand Orthoptera, Argentina.

R. N. Keely. One Orthopter, United States.

E. M. Ledyard. One Orthopter, Philippines.

Purchased. Two thousand insects from Ceylon.

C. T. Ramsden. One Lepidopter, Cuba.

S. N. Rhoads. One Orthopter, United States.

L. E. Ricksecker. One Lepidopter, California.

H. Skinner. Forty-five Lepidoptera, Utah; fourteen Coleoptera, Pennsylvania; two Anopheles, Pennsylvania.

A. T. Slosson. Three Lepidoptera, Florida.

Helen Louise Smith. One Coleopter.

J. B. Smith. Six Orthoptera, United States.

Rosella Stuart. One Lepidopter, Pennsylvania.

T. Spalding. Ten Lycæna, Utah.

Henry Tucker. One Lepidopter, Nova Scotia.

University of Kansas. Four Orthoptera, United States.

U. S. National Museum. One Orthopter, United States; one hundred and sixteen Hymenoptera, United States. Exchange.

E. G. Vanatta. Twenty insects, United States.

E. C. Van Dyke. Four Lepidoptera, California.

R. W. Wehrle. Seven insects, Pennsylvania.

L. H. Weld. One Hymenopter, United States.

H. W. Wenzel. Five hundred and eighty-three insects, Texas.

W. M. Wheeler. Two Orthoptera, United States.

C. S. Williamson. Two Lepidoptera, Labrador; Nova Scotia.

W. C. Wood. Eight Lepidoptera, North and South America; two Lepidoptera, New Mexico.

Recent Mollusca.

T. H. Aldrich. Cotype of *Somatogyrus walkerianus* Ald. from Conecut River, Escambia County, Alabama.

John A. Allen. One hundred and eighteen trays of shells from Tahiti, Ohio and Maine.

Dr. Fred Baker. *Strophocheilus* from Brazil; two species of marine shells from California.

Frank C. Baker. Ten trays of *Lymnæa*.

Francis N. Balch. *Drymæus flavotinctus* from Maracas Valley, Trinidad.

D. D. Baldwin. Eight species of *Amastra* from Hawaiian Islands.

Nathan Banks. Two species of land shells from Cayuga Lake, N. Y.

Paul Bartsch. *Planorbis eucosmius* Bartsch from Wilmington, N. C.

H. Basedow. *Acanthopleura spinosa* Brug.

Miss S. Benners. Two species of marine shells from Java.

S. S. Berry. Forty-three trays of shells from California.

F. E. Bond Venezuelan Expedition. Forty-nine trays of land and fresh-water shells.

Dr. J. Chester Bradley. Twenty-one species of land and fresh-water shells from British Columbia and Georgia.

Dr. A. P. Brown. Two hundred trays of shells from Jamaica and Panama.

F. W. Bryant. Two species of fresh-water shells from Warner, Cal.

H. C. Burnup. *Pupisoma orcula* Bens. and *Fossarus capensis* Pils. from Natal, South Africa.

George W. Caffrey. Twenty-five species of shells from Bethlehem, Pa.

Dr. P. P. Calvert. Fifty-five trays of land and fresh-water shells from Costa Rica.

E. R. Casey. Five trays of land shells from near Philadelphia, Pa.

George H. Clapp. Ten species of American shells.

W. F. Clapp. Twelve species of land shells from Duxbury, Mass.

T. D. A. Cockerell. *Vertigo basidens* P. and V., Rio Blanco, Colo.

C. H. Conner. Six species of fresh-water shells from Pennsylvania.

C. M. Cooke, Jr. Thirteen species of Hawaiian shells.

L. E. Daniels. Thirty trays of shells from Indiana, etc.

J. H. Ferriss. Twenty-five trays of shells from Arizona and Illinois.

L. S. Frierson. *Unio tenuisculus* Frierson, Rudy Lake, Fla.

H. W. Fowler. Sixty-seven trays of shells from Pennsylvania and Maryland.

C. W. Gripp. Two species of shells from San Diego, Cal.

S. H. Hamilton. Fifteen species of shells from Cuba.

G. D. Hanna. *Vitrea* from Virginia.

H. Hannibal. Five trays of shells from California.

Prof. J. W. Harshberger. Thirteen trays of shells from Florida.

Arthur Haycock. Fifteen species of shells from Bermuda.

Academy and Hebard Expedition. *Physa*, *Epiphragmophora*, etc., California and Arizona.

Junius Henderson. Ten trays of shells from Colorado and Nebraska.

J. B. Henderson, Jr. Six species of shells from Cuba.

Edward Hopkinson. Eggs of *Nassa?* from Edson, S. C.

W. T. Innes. Three species of marine shells from San Diego, Cal.

T. D. Keim. *Littorina palliata* Say from near Darien, Conn.

BAYARD LONG. Seven trays of shells from Canada.

BENJAMIN SMITH LYMAN. Two species of bivalves from Japan.

J. G. MALONE. Five species of marine shells from Lower California.

W. J. MAZYCK. *Ancylus peninsulæ* P. and J. from Otranto Creek, S. C.

DR. D. G. METHENY. *Loligo pealii* Les. from Cranberry Head, Nova Scotia.

CLARENCE B. MOORE. One hundred and fifty-one trays of shells from Florida and Arkansas; also one hundred trays of shells from Florida collected by H. A. Pilsbry.

DR. J. P. MOORE. Thirty-two marine shells from the Pacific Ocean.

DR. A. E. ORTMANN. Seven species of fresh-water shells from Pennsylvania and New Jersey.

H. A. PILSBRY. Eighteen trays of shells from Arizona and New Jersey.

E. POMEROY. Two species of land shells from Texas.

PRINCETON EXPEDITION TO GREENLAND. Ninety-three trays of marine shells.

PURCHASED. Two hundred and sixty-two trays of shells.

C. T. RAMSDEN. Two species of Cuban shells.

J. A. G. REHN. *Nassa obsoleta* Say from Cumberland Island, Ga.

E. E. REINKE. *Littorina nebulosa* Lam. from Kingston, Jamaica.

S. RAYMOND ROBERTS. *Columbella avara* Say from Vineyard Haven, Mass.

REV. J. ROWELL. Six species shells from Egypt and California.

MRS. M. P. SAUNDERS. Two marine shells.

SILAS L. SCHUMO. Twelve species of marine shells from Florida.

ALVIN SEALE. One hundred and three species of marine shells from Philippine Islands.

DR. V. STERKI. Two species of shells from Kentucky and Michigan.

WITMER STONE. Thirteen species of shells from Jennings, Md.

UNIVERSITY OF WISCONSIN. Seven species of *Amastra* from Hawaiian Islands.

E. G. VANATTA. Fifteen species of shells from Pennsylvania and Maryland.

BRYANT WALKER. Fourteen specimens of shells from North America and West Africa.

H. E. WHEELER. *Arkansia wheeleri* W. and O., Old River, Arkansas.

R. W. WEHRLE. Eleven species of shells from Indiana County, Pa.

W. W. WELCH. Two species of *Polygyra* from Torresdale, Pa.

H. A. WENZEL. Three species of land shells from Macdona, Texas.

JOSEPH WILLCOX. Three marine shells from Florida.

CHARLES S. WILLIAMSON. Five species of shells from Newfoundland.

OTHER INVERTEBRATES.

ACADEMY EXPEDITION, 1911 (Rehn). *Gelasimus* from Cumberland Island, Ga.

JOHN A. ALLEN. *Lepas anatifera* L. from Tahiti.

HERMAN BEHR. *Cambarus* from Jennings, Md.

MISS SARAH BENNERS. Fragment of a brain-coral.

VICTOR BLUCKER. A collection of crustacea and myriapods from Pennsylvania.

BRITISH MUSEUM. *Balanus nubilus* Darw. from Vancouver Island.

DR. A. P. BROWN. Three trays of invertebrates.

H. W. FOWLER. Two jars of crustacea from Pennsylvania and Virginia.

EDWARD FOX. One tray of hermit crabs from Sea Isle City, N. J.

PROF. J. W. HARSHBERGER. One tray of hermit crabs from Miami, Fla.

ARTHUR HAYCOCK. *Argyrotheca bermudana* Dall. from Bermuda.

J. B. Henderson, Jr. Seven species of barnacles from Key West, Fla.

Edward Hopkinson. Three species of invertebrates from Edisto Island, S. C.

H. L. Mather, Jr. A collection of myriapods and crustacea from Pennsylvania.

W. M. Meigs. A collection of prawns from Florida.

Clarence B. Moore. Three crabs from Florida collected by H. A. Pilsbry.

Dr. Percy J. Moore. One hundred and fifty-one bottles of polychaeta, dredged off California; also a collection of cretaceous fossils from Martha's Vineyard, Mass.

Dr. R. J. Phillips. A *Balanus* from Corson's Inlet, N. J.

H. A. Pilsbry. Five trays of invertebrates from New Jersey and Florida.

Dr. R. W. Shufeldt. One Tarantula.

Silas L. Schumo. One species of sponge from St. Petersburg, Fla.

Alvin Seale. Fifteen species of invertebrates from Philippine Islands.

Albert Thompson. A collection of crustacea and myriapods from Pennsylvania and Virginia.

U. S. Fish Commission. Seventy-four species of invertebrates from Hawaiian Islands and California.

E. G. Vanatta. Four species of invertebrates from Bermuda and Maryland.

W. Webb. *Melitodes esperi* W. and S. and *Melitodes flabellifera* K. from Japan.

R. W. Wehrle. A collection of crustacea and myriapods from Indiana County, Pa.

Joseph Willcox. Nummulites from Pemberton Falls, Florida.

Plants.

Dr. Astley P. C. Ashhurst and Dr. William Ashhurst. Herbarium of the late Dr. Robert E. Griffiths.

Charles C. Bachman. Eighty-two specimens.

Edwin B. Bartram. One hundred and eighty-seven specimens.

Francis E. Bond Expedition. Eight hundred and fifty Venezuelan specimens.

O. H. Brown. Two hundred and twenty-seven specimens.

Dr. John W. Eckfeldt. Eleven specimens.

William Findlay. Forty-seven specimens.

Gray Herbarium. One hundred and two Newfoundland specimens. Exchange.

Dr. Thomas S. Githens. Seven hundred and fifty specimens.

Dr. John W. Harshberger. Eight specimens.

William E. Haydock. *Pericome caudata.*

Morgan Hebard and J. A. G. Rehn. *Dionæa muscipula.*

Zephaniah Hopper. Five specimens.

Miss Keeney. One specimen.

Dr. Ida A. Keller. One specimen.

Dr. A. F. K. Krout. One hundred and twenty-five specimens.

Charles H. La Wall. Two specimens.

Bayard Long. Twelve hundred specimens.

New York Botanical Garden. One hundred and twelve specimens in exchange.

FRANCIS W. PENNELL. One thousand one hundred and seventy-six specimens.

HAROLD W. PRETZ. One specimen.

EVAN RANDOLPH, JR. *Monarda fistulosa*, *Dipsacus sylvestris*.

B. H. SMITH. Thirty-eight specimens from Yellowstone National Park.

WITMER STONE. Three specimens.

UNITED STATES NATIONAL HERBARIUM. Sixty Violets. Exchange.

CHARLES S. WILLIAMSON. One hundred and sixteen specimens.

BOTANICAL SECTION—PURCHASED. One hundred and eighty-one sheets of violets from Prof. Ezra Brainerd; three hundred and ninety-five sheets of Nevada and California specimens from Dr. A. A. Heller.

INDEX TO GENERA, SPECIES, ETC., DESCRIBED AND REFERRED TO IN THE PROCEEDINGS FOR 1911.

Species described as new are indicated by heavy-faced, synonyms by italic numerals.

GENERAL INDEX.

1911.

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A. P. BROWN: RIPPLE-MARKS, TRACKS AND TRAILS.

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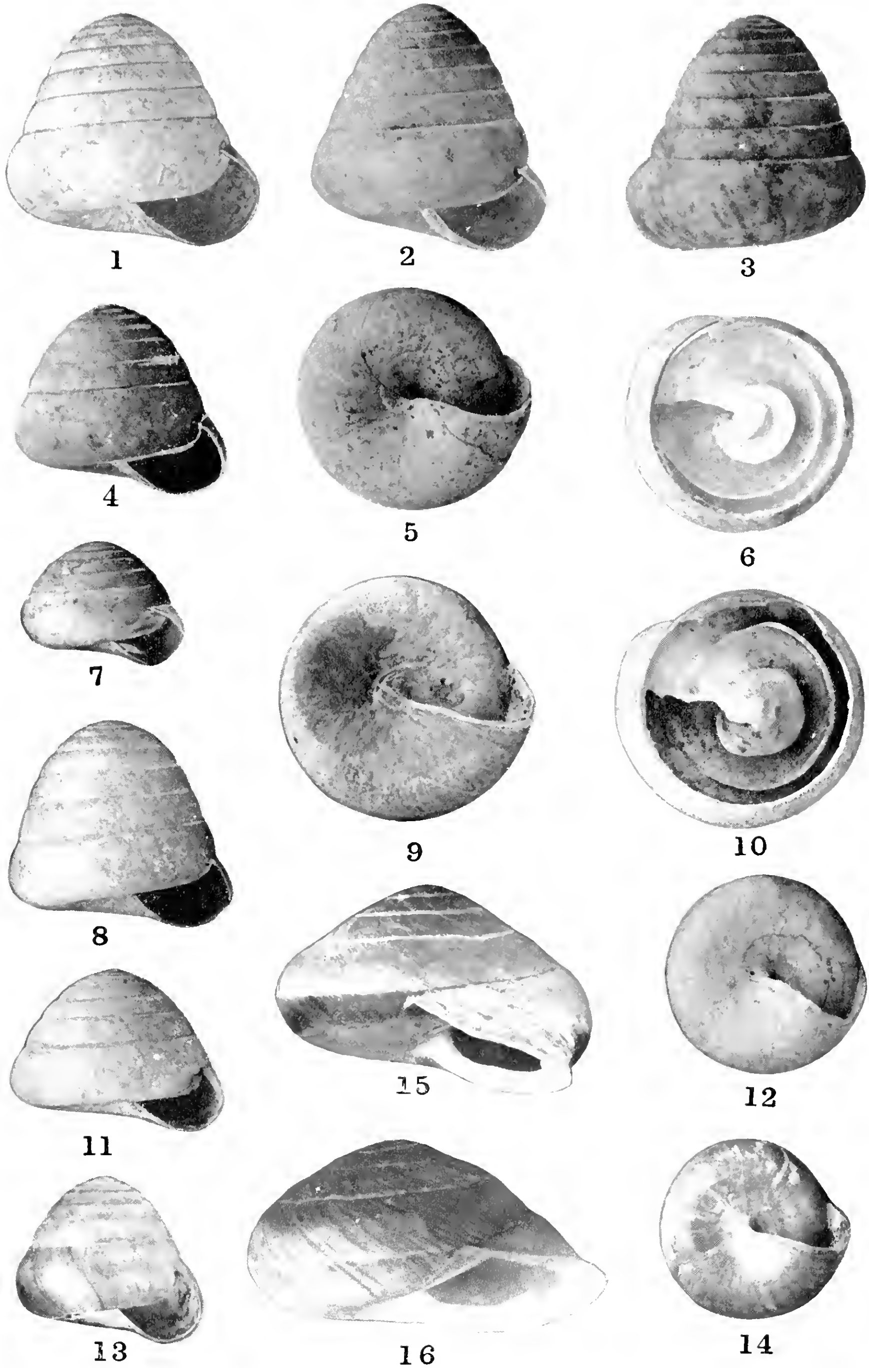
A. P. BROWN: RIPPLE-MARKS, TRACKS AND TRAILS.



PILSBRY AND BROWN: LAND MOLLUSCA OF MONTEGO BAY.