

PROCEEDINGS

OF

The Academy of Natural Sciences

OF

PHILADELPHIA

VOLUME LXIX

1917

PHILADELPHIA :
THE ACADEMY OF NATURAL SCIENCES
LOGAN SQUARE

1918

THE ACADEMY OF NATURAL SCIENCES OF PHILADELPHIA.

March 1, 1918.

I hereby certify that printed copies of the PROCEEDINGS for 1917 were mailed as follows:—

Pages 1-80.....	April 6, 1917.
" 81-128.....	April 24, 1917.
" 129-148.....	May 1, 1917.
" 149-202.....	May 5, 1917.
" 203-218.....	August 8, 1917.
" 219-250.....	August 20, 1917.
" 251-304.....	October 16, 1917.
" 305-336.....	February 1, 1918.
" 337-352.....	February 27, 1918.

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JANUARY 16.

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

Two hundred and forty-eight persons present.

A paper entitled "Oligocene fossils from the neighborhood of Cartagena, Colombia, with notes on some Haitian species," by Henry A. Pilsbry and Amos P. Brown, was presented for publication (December 30, 1916).

DR. WILLIAM E. HUGHES made a beautifully illustrated communication on Japan of To-day. (No abstract.)

Samuel J. Castner was elected a member.

The following were ordered to be printed:

ON MOSCHITES VERRUCOSA (Verrill) AND ITS ALLIES.

BY S. STILLMAN BERRY.

Striking instances of anomalous distribution of Cephalopoda are not frequently encountered during a perusal of the literature, especially among the less active, bottom-loving forms, most of which, so far as known, are prone to inhabit each its own definitely circumscribed district or faunal area. It therefore becomes of especial importance to subject such apparent exceptions as we do find to the most careful scrutiny, to ascertain whether they really exist, and then, if they seem so to do, to discover a reason. One of the most interesting and frequently quoted cases of this sort is that of Verrill's *Moschites* [= *Eledone*] *verrucosa*, originally described from 466-810 fathoms, off the coast of southern New England, again reported from considerably deeper water off Delaware Bay, and since recorded from 630 fathoms off the Kermadec Islands, and from 1,020 fathoms in the Gulf of Panama by Hoyle (1886, 1904).

So far as we know now, the Atlantic records for *verrucosa* are unimpeachable, and in any case they fail to offer such zoogeographic peculiarities that they need concern us here. That the case with the Pacific citations is altogether otherwise, it is the aim of the present paper to show.

The first of these is based upon a single male specimen taken by the Challenger Expedition in 1874, reported upon by Hoyle in 1886, and now preserved in the British Museum (Natural History) at South Kensington. Though Hoyle's remarks are brief (1886, p. 104), they show that he fully appreciated not only the specimen, but the peculiar interest which his identification gave to it. He wrote under "*Eledone verrucosa*" as follows:

"The agreement between the Challenger specimen and the admirable drawings and description of Professor Verrill is so close that there can be no doubt as to the correctness of this identification. The only differences appear to be that in the American specimens the cirri round and above the eyes are a little more prominent than in that from the Pacific, while the latter has the extremity of the hectocotylized arm formed like that of an *Octopus* rather than like that of an *Eledone*, as shown in Verrill's figure. The Challenger

specimen, moreover, has the second pair of arms the longest, the first come next, while the third and fourth are subequal and still a little shorter; but as appears from Verrill's measurements (*loc. cit.*), these proportions are liable to variation.

"The point of greatest interest in connection with this specimen is its capture so far away from the original habitat of the species, but this, as will appear in the sequel, is not without parallel (see p. 223)."

Believing that Hoyle's own notes, more particularly the observations on the hectocotylus, are a self-evident disproof of his identification, I recently (1916, p. 49) expressed my dissent from his conclusions and proposed the name *Moschites challengerii* for the Kermadec Island species. By way of more completely establishing the point in question I have obtained photographs both of the type specimen of *Eledone verrucosa* Verrill in the Museum of Comparative Zoology and of the "Challenger" specimen which is now the type of *M. challengerii*.¹ From these it would appear that while the general facies of the two species is indeed quite similar, the differences between them are none the less well marked. At the time the Challenger report was written, the great importance of the hectocotylus in classification was not so fully realized as at the present time, but reliance need not be had upon this alone. The curious stellate tubercles, which occur scattered over the dorsal surface of both forms, and which undoubtedly furnished the principal cause for their confusion, are in the case of *M. challengerii* much more numerous, more closely placed, and have a more general distribution over the body than in the Atlantic species. Where with *M. verrucosa* one counts but 13 or 14 of these tubercles in a line running transversely across the middle of the back, in the Kermadec species there are easily twice as many; and where in *verrucosa* the tubercles extend only slightly past the boundary between the head and umbrella (see Verrill's second figure), leaving most of the outer surface of the arms and umbrella smooth, in *M. challengerii* the tubercles extend down over the entire upper portion of the umbrella and even well out upon the basal portions of the arms. I think there is no doubt that a direct comparison of the specimens themselves would reveal other and doubtless more far-reaching differences, but those

¹For the photographs of *Eledone verrucosa* I am indebted to Mr. Samuel Henshaw, of the Museum of Comparative Zoology; for those of *M. challengerii* to Mr. G. C. Robson, of the British Museum (Natural History), South Kensington.

enumerated above should be sufficient to prevent a further confusion of the species.

Miss A. L. Massy has suggested in correspondence that *M. challengerii* may be identical with the *M. charcoti* Joubin of the Antarctic, but in the absence of better evidence than that afforded by the literature I am unable to arrive at the same conclusion.²

The remaining Pacific record of *verrucosa* (Hoyle, 1904, p. 21) is admitted as doubtful by Hoyle because of the inadequate preservation of his material, so I am sure can on *a priori* grounds be rejected without hesitation. Quite possibly the specimens represent an undescribed species. In any case *M. verrucosa* must now be eliminated from our lists of the Pacific fauna.

Omitting from consideration the Antarctic members of the genus, several of which possess stellate tubercles somewhat resembling those of the species described, we arrive at the following summary of this group of *Moschites* as it has appeared in the literature to date:

1. *Moschites verrucosa* (Verrill, 1881). Pl. I.

1881. *Eledone verrucosa* Verrill, Bull. Mus. Comp. Zool., v. 8, p. 105, pls. 5, 6.

1881a. *Eledone verrucosa* Verrill, Trans. Conn. Acad. Sci., v. 5, p. 380, pls. 52, 53.

1882. *Eledone verrucosa* Verrill, Rep. U. S. Fish Com. 1879, pp. 393, 435 [183, 225], pl. 44, figs. 3, 3a.

1884. *Eledone verrucosa* Verrill, Trans. Conn. Acad. Sci., v. 6, p. 248.

466-1,255 fathoms, New England region (*Blake, Fish Hawk, Albatross*).

2. *Moschites challengerii* Berry, 1916. Pl. II.

1886. *Eledone verrucosa* Hoyle, Challenger Rep., p. 104 (not of Verrill, 1881).

1915. *Eledone verrucosa* Oliver, Trans. N. Z. Inst., v. 47, p. 559 (merely noted).

1916. *Moschites challengerii* Berry, Proc. Acad. Nat. Sci. Phila., v. 68, p. 49.

630 fathoms, off the Kermadec Islands (*Challenger*).

3. *Moschites* (species?).

1904. *Moschites verrucosa* Hoyle, Bull. Mus. Comp. Zool., v. 43, p. 21 (not of Verrill, 1881).

1,020 fathoms, Gulf of Panama (*Albatross*).

The foregoing history well illustrates how much more apt to lead to erroneous theories of distribution and how much more difficult finally to rectify, is the improper union of species than, if we have

²As this paper is in final proof I am informed that Miss Massy has just published some further observations on this group in her report on the Cephalopoda of the "Terra Nova" Expedition, though the paper itself has been delayed in reaching me. It was in deference to this that consideration of the Antarctic forms was omitted from the present paper.



Fig. 1.—*Moschites verrucosa*. Distal portion of right third arm of type, showing hectocotylus, enlarged about four diameters.

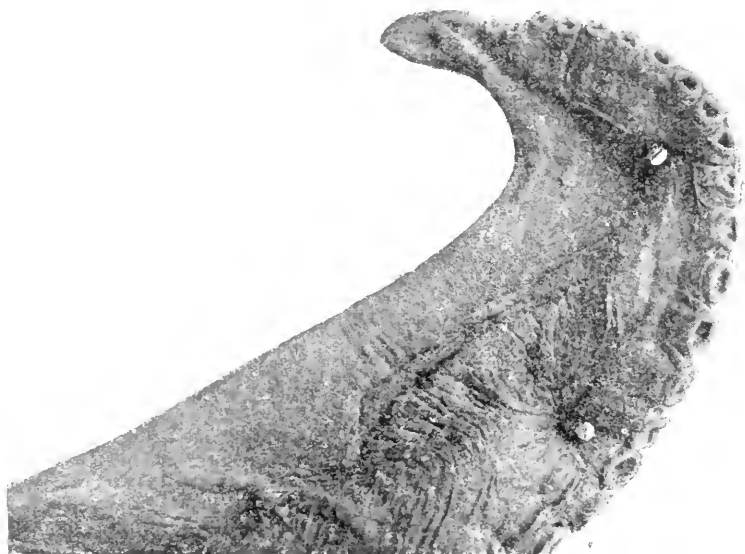


Fig. 2.—*Moschites challengerii*. Distal portion of right third of arm of type, showing hectocotylus; enlarged about two diameters.

but the two evils to choose from, their undue separation in the first place. With specimens from widely separated geographical areas, the presumption is that greater knowledge will generally increase rather than diminish the dependable differences.

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EXPLANATION OF PLATES I AND II.

- PLATE I.—*Moschites verrucosa* (Verrill). Dorsal view of type specimen, approximately natural size.
- PLATE II.—*Moschites challengerii* Berry. Dorsal view of type specimen, a little less than $\frac{1}{2}$ natural size.

NOTES ON SALAMANDERS.

BY HENRY W. FOWLER AND EMMETT REID DUNN.

An annotated list of the tailed amphibians contained in the collection of The Academy of Natural Sciences of Philadelphia is given in this paper. In some cases pertinent notes and remarks are added, and in the Plethodontidae, as now understood, some taxonomic relations are suggested and one new species is described from western Pennsylvania.

AMPHIUMIDÆ.

Amphiuma means Garden.

Thirteen examples, six without data, others from South Carolina (Dr. J. E. Holbrook), Georgia (Dr. Jones), and Mobile, Alabama (Dr. Nott). All have two toes.

Amphiuma tridactyla (Fitzinger).

Four examples without data, all three-toed. Also one labelled "Colorado Springs" (Tatnall).

SIRENIDÆ.

Siren lacertina Linné.

Nineteen examples, four without data, and others from: Alton, Illinois; Savannah, Georgia (Dr. Egging); Alabama; Pecos (Dr. A. E. Brown) and San Diego (W. Taylor), Texas; Volusia and Argo, Pasco County, Florida.

Pseudobranchius striatus Le Conte.

Four from Georgia (Major Le Conte and Dr. W. L. Jones). Five from Argo, Pasco County, Florida (G. Pine).

PROTEIDÆ.

Proteus anguineus Laurenti.

Five from Adelsberg (Dr. H. H. Smith and Dr. Folz), Styria (Capt. McClellan), Carniola (M. Van Schraiber), and Illyria. Also five without locality (C. L. Bonaparte).

Proteus anguineus var. *carraræ* (Fitzinger).

One without locality (Bonaparte).

Necturus maculosus Rafinesque.

Ten without data, and fifteen from New York and Ithaca (Dr. A. E. Brown); Essington (J. T. Gardiner on March 2, 1900) and Indiana (R. W. Wehrle), Pennsylvania; Ohio (J. Speakman);

Wabash River, Indiana (Dr. Blackwood and A. C. Hill); Michigan and Portage Lake (Mr. Hoopes and W. E. Dickinson) and Lansing.

Necturus punctatus Gibbs.

One from Ogden, South Carolina. Possibly its characters may be due to growth.

CRYPTOBRANCHIDÆ.

Megalobatrachus maximus (Schlegel).

Two large examples from Japan.

Cryptobranchus alleganiensis (Daudin).

Forty-two examples (sixteen without data), from Pennsylvania (Pittsburgh, Beaver, Two Lick Creek, Yellow Creek and Newton Hamilton); Maryland (Allegany County); Tennessee (Knoxville). The Knoxville material (four examples) shows the hind toes free, as in our regular series. As Cope had but one example, we do not admit *C. fuscus* Holbrook to specific rank.

AMBYSTOMIDÆ.

Ambystoma tigrinum (Green). Plate III.

Salamandra ingens Green, Journ. Acad. Nat. Sci. Phila., VI. pt. 2, 1830, p. 254. In fresh-water stream near New Orleans. (No. 1309, A. N. S. P., type.)

Siredon lichenooides Baird, Proc. Acad. Nat. Sci. Phila., 1852, p. 68. Lake at head of the Santa Fé Creek, in New Mexico. (Nos. 1375 and 1376, A. N. S. P., topotypes. Col. Abert.)

Ambystoma nebulosum Hallowell, Rep. Exped. Zuni, Sitgreaves, 1853, p. 143, Pl. 20. San Francisco Mountain, New Mexico. (No. 1,294, A. N. S. P., type. Dr. S. W. Woodhouse.)

Ambystoma bicolor Hallowell, Proc. Acad. Nat. Sci. Phila., 1857, p. 215. Beesley's Point, New Jersey. (No. 10,584, A. N. S. P., type.)

A large series of examples, all ages, from: New York (Long Island); New Jersey (Nesco, Beesley's Point and Crosswicks); Georgia; Texas (Staked Plain, north of Staked Plain and south of Clarendon); Mexico (Lakes Chalco and Xochimilco and Sierra Madre near Colonia Goreia in Chihuahua); New Mexico (Sapello Canyon in San Miguel County and Santa Fé); Oklahoma (Fort Supply and North Fork of Canadian River); Ohio (Columbus); Michigan (Kalamazoo and Ann Arbor); Wisconsin; Kansas (Fort Harker, Platte River 300 miles from Fort Riley, and Fort Washackee); Colorado (Colorado Springs); Wyoming (Bridger Pass and Como); Montana (Yellowstone Park); California (McCloud River and spring at 1,500 feet elevation in Coast Range of Humboldt County). Also examples from "Pou Creek" and "Rocky Mountains," besides others without data. No. 1,300, A. N. S. P., may be type? of *Ambystoma maculata* Hallowell, New Mexico (Dr. McClelland).

As the allied *Lingualapsus* Cope has been merged with *Ambystoma*, it is also likely that the intermediate *Chondrotus* Cope is also a synonym.

This salamander is extremely variable in color. The newly developed axolotl is largely dark brownish above, from nearly uniform to finely speckled, dotted, spotted or marbled with darker. Some examples show the upper surface largely of uniform tint, though with a number of rather large dusky to blackish spots on the sides, and fewer on the tail (second figure from bottom). The lower surface of the axolotl is uniform brownish-yellow. The yellow spots then appear and with complete metamorphosis are often quite pronounced. Sometimes the yellowish predominates and the darker brownish becomes black, or the dark color may be of greatest extent. As the yellowish predominates it often leaves the darker color as narrow reticulating irregular lines (fourth figure from bottom). Often along the sides the reticulations may form numerous crowded rounded spots or blotches, frequently variable in size. On the back they are usually not so crowded. As the dark color predominates usually the yellow is restricted rather narrow and regular transverse bands (uppermost figure). Sometimes some examples appear to retain the dusky blotches of the axolotl along with the yellow and dusky markings of the adult (second figure from bottom). We have not seen examples "uniform brown above, yellow below, sides darker brown," as mentioned by Cope.¹ A Mexican example from near Colonia Goreia is remarkable for having a few yellow spots above and but a few along the sides, the dark color greatly predominating.

Ambystoma punctatum (Linné).

Forty-one examples: New Hampshire (Franconian Notch in White Mountains); Rhode Island (Slocum); New York (West Chester County and Raquette Lake); Pennsylvania (Philadelphia, York County, Ardmore, Clifton, Indiana and Chambersburg); North Carolina (Mitchell County); Kentucky (Mammoth Cave); Ohio; Indiana (Hanover College); Illinois (Chicago); Missouri: Lake Superior.

Ambystoma opacum (Gravenhorst).

Salamandra fasciata Green, Journ. Acad. Nat. Sci. Phila., I, 1818, p. 350.
No locality. (Nos. 1,420 to 1,423, A. N. S. P., types.)

Twenty-eight examples: Massachusetts (Berkshire Hills?); New York (Catskills); New Jersey (Medford, Staffords Forge, Hammon-

¹ Bull. U. S. Nat. Mus., No. 34, 1889, p. 71.

ton, Atlantic City, Beesley's Point); Delaware (Newark); Virginia; North Carolina (Lake Waccamaw); Tennessee (Raleigh); Indiana (Hanover College); Georgia; Louisiana; Texas (Wichita River). Six examples represent the material from Lake Waccamaw, obtained in 1908. This is the only record for North Carolina. The Catskills example is small and uniform in color.

Ambystoma talpoideum (Holbrook).

One from Henderson County, North Carolina. The hind foot has two tubercles on the sole.

Ambystoma conspersum Cope.

Amblystoma conspersum Cope, Proc. Acad. Nat. Sci. Phila., 1859, p. 123. Londongrove, Chester County, Pennsylvania. (No. 10,589, A. N. S. P., type.)

Also four other examples: South Carolina (Charleston) and Georgia.

Ambystoma jeffersonianum (Green).

One example in very poor condition from "near Philadelphia" received from Dr. E. Hallowell. Seven from Brookville, Indiana (E. Hughes).

Ambystoma jeffersonianum fuscum (Hallowell).

Amblystoma fuscum Hallowell, Journ. Acad. Nat. Sci. Phila., (2) III, January 1858, p. 355. Indiana, near Hanover College. (No. 1,379, A. N. S. P., type. Prof. King.)

Ambystoma jeffersonianum platineum (Cope).

Amblystoma platineum Cope, Proc. Acad. Nat. Sci. Phila., 1867, p. 198. Cleveland, Ohio. (No. 1,299, A. N. S. P., type. Dr. J. P. Kirtland.)

This is a much more slender form than the preceding, otherwise, and in its color, appearing much the same. The appressed toes of the hind and fore limbs meet.

Ambystoma jeffersonianum laterale Hallowell.

Amblystoma laterale Hallowell, *l.c.*, p. 352. Borders of Lake Superior. (No. 1,377, A. N. S. P., type. Dr. Le Conte.)

An example from the Green collection, received through Dr. Bache, and like the type, in poor preservation.

Ambystoma macrodactylum Baird.

Five examples from Hatzic, British Columbia (Dr. Bodington).

Dr. Ruthven says: "*A. stejnegeri* is with little doubt, most nearly related to *A. macrodactylum*. It may easily be told from the latter by the longer and more compressed tail. The anterior digits also appear to be larger in *macrodactylum*. In the specimens of the

latter examined the distance from the wrist to the tip of the longest finger is contained in the length of the head and body 12.6 to 12.7 times as compared with 9.27, 9.7, 10, and 10.6 times in *A. stejnegeri*." Our specimens of the present species show the same measurements as about 8 or 9. Possibly *A. macrodactylum*, *A. epixanthum*, and *A. stejnegeri* may represent simply variations of one wide-ranging species. Also an example in the collection from La Grande in Union County, Oregon (M. Hebard and J. A. G. Rehn on August 15, 1910).

Amblystoma altamirani Dugès.

Amblystoma altamirani Dugès, La Natureza, (2) II, 1896, p. 459, Pl. 49.
A 3,100 metros de altura—en la serranía de las Cruces perteneciente al Valle de Mexico. (Nos. 10,562 and 10,563, A. N. S. P., topotypes.)

These examples both in the axolotl stage, larger nearly transformed, gills gone and mouth in the larval stage.

Amblystoma epixanthum Cope.

Amblystoma epixanthum Cope, Proc. Acad. Nat. Sci. Phila., 1883, p. 16.
Swamp near the head of the South Boise River, on the south side of the Sawtooth Mountain Range, Idaho. (Nos. 3,880 to 3,883, A. N. S. P., types.)

Amblystoma tenebrosus (Baird and Girard).

Five examples, from Body Bay and Felton, California.

Amblystoma microstomum (Cope).

Amblystoma microstomum Cope, Proc. Acad. Nat. Sci. Phila., 1861, p. 123.
"Ohio" (= Wabash River, Indiana). (No. 1,285, A. N. S. P., type.
Wabash River, Indiana. Dr. McMurrie.)

Nine examples: Ohio (Columbus); Missouri (St. Louis); Texas (Houston and Dallas). Two examples from St. Louis show two or three costal spaces (in one case two on each side and three or four in the other) between the fore and hind limbs when appressed to the sides. The Columbus specimen has about three on one side and four on the other. A specimen without locality has but a single costal space and of small size. The type contains about two or three spaces, so far as may be determined, as it is soft. In most of the examples probably three costal spaces would be the average.

As the type locality appears wrongly quoted, the following is explanatory. The original account says, "another specimen of an *Amblystoma* on the table, from Ohio, Mr. Cope observed, had been regarded as belonging to the *Sal. porphyritica* of Green. Prof. Baird having shown that that species is the *S. salmonea* of Storer, or *Pseudotriton salmoneus* Baird, he would call the Ohio species *Amblystoma microstomum*." This refers³ to a description

³ PROC. ACAD. NAT. SCI. PHILA., 1856, p. 8.

of *Ambystoma porphyriticum* Hallowell, which Hallowell wrongly confused with *Salamandra porphyritica* Green. Now Hallowell's material is based on "One specimen in Mus. Acad. Nat. Sc., presented by Dr. McMurtrie" and "Prof. Green's specimens were found in French Creek, near Meadville, Crawford County, Pennsylvania." As we have the McMurtrie example, labelled "Wabash River, Indiana," we assume "Ohio" mentioned in 1861 to be erroneous.

PLETHODONTIDÆ.

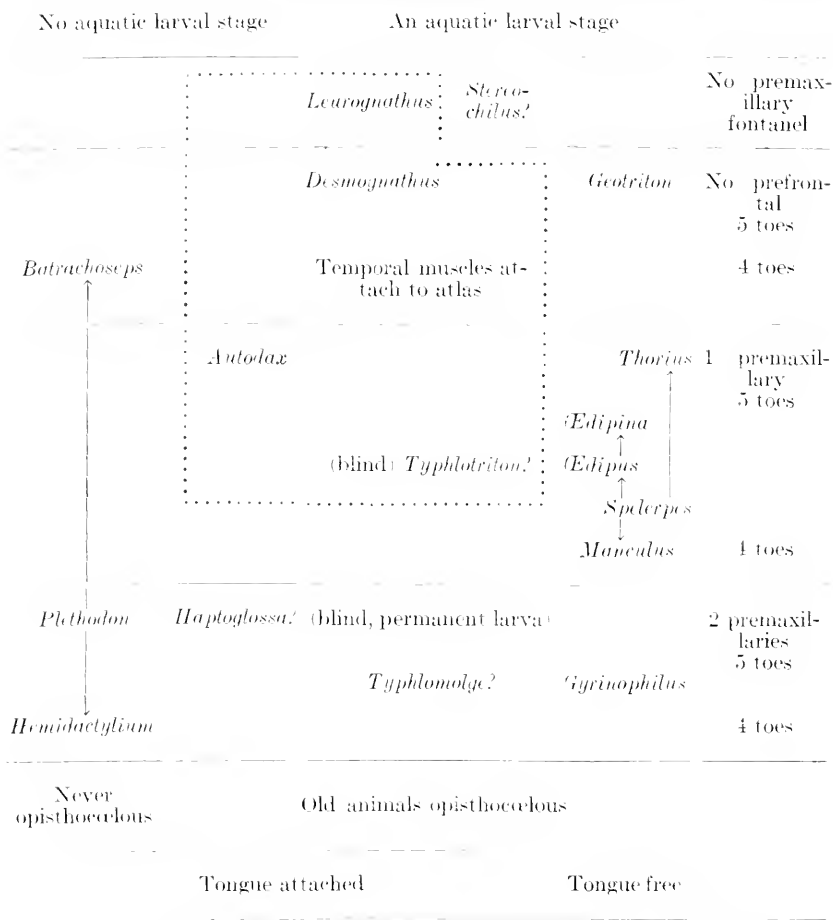
The present state of our knowledge of the genera of this family will not permit us to advance any new rules, though Moore in abolishing the family Desmognathidæ renders it imperative that the generic relationships be revised. The value of the characters which can be used must always remain more or less doubtful. Sometimes the same character in one group may not be of the same value in limiting the genera as in another. Nevertheless, it appears to us that the bofetoid tongue characterizes a very natural group, *i.e.*, *Spelerpes* and allied genera. All the species of this group of genera display that tendency towards opisthocelous vertebrae which led Cope to place *Thorius* in the Desmognathidæ. Most, if not all, have an aquatic larval stage, in some cases, as *Spelerpes ruber* and *Gyrinophilus porphyriticus*, of long duration. Separate premaxillaries compel us to place *G. porphyriticus* and *Gcotriton fuscus* at the bottom of the list. These forms are generically separated by the very doubtful character of webbed toes in *Gcotriton*, *Spelerpes* follows *Gyrinophilus*, both with free toes, *Manculus* with only four toes, *Ædipus* and *Ædipina* with webbed and united digits, respectively, and *Thorius* with webbed toes and extremely large nostrils. It may be here stated that the young of *Gcotriton fuscus* also have extremely large nostrils. Probably further studies may reduce some of the above to subgenera and even create a new subgenus for *Spelerpes ruber*, which seems sufficiently distinct from *S. longicaudus*, the type of the genus. *Manculus*, *Ædipus*, and *Ædipina* may be derived from *Spelerpes*, which in turn may be derived from *Gyrinophilus*, probably through *Spelerpes ruber*. The direct relations of *Thorius* and *Gcotriton* are less certain, but that they are closely allied is unquestionable. Next to the free-tongued group would come *Stereochilus*, a little-known form, which in color and dentition approaches *Spelerpes ruber*. The tongue is more free than in any of the other remaining genera. The cranial structure is comparatively unknown. Cope's statement that it lacks the

premaxillary fontanel and that "in the only skeleton I have examined the prefrontal is present one side and wanting on the other" would bring it near *Leurognathus*.

The next group, *Desmognathus* and *Leurognathus*, agree in the absence of prefrontals, poorly developed vomerine teeth, and in a peculiar collar on the atlas where the temporal muscles originate. But the absence of a premaxillary fontanel in *Leurognathus* and the presence of well-developed vomerine teeth in some male and all female *Desmognathus* prevent us dividing one genus from the other. All the preceding genera have typically aquatic larvæ. *Desmognathus* seems to tend towards terrestrialism in that one species lays eggs on land and the aquatic larva of another is unknown and may not exist. *Typhlotriton* and *Autodax* stand between this group and the *Plethodon* group, but there is some uncertainty as to the actual relations. Both have prefrontals and one premaxillary with a fontanel. *Autodax* is a Pacific-coast form with absolutely terrestrial existence. *Typhlotriton* is a blind cave form from Missouri with an aquatic larval stage. In both the vertebræ become opisthocœlous with age. Both, according to Cope, have the temporals originating on the atlas. *Typhlotriton*, whose cranial structure we recently examined, has not the transverse dorsal ridge on the atlas which characterizes *Desmognathus* and *Leurognathus*. Whether *Autodax* has it is not known, but the tendency of the temporal muscles to originate on the atlas is accentuated in these forms, as Cope pointed out. Geographical probabilities and life histories suggest *Typhlotriton* as next of kin, while the hooked jaw of the most terrestrial species of *Desmognathus* (*ochropea*) would indicate *Autodax*.

The next group is *Plethodon* and its two derivatives, *Hemidactylium* in the east and *Batrachoseps* in the west, is, so far as known, entirely terrestrial. The vertebræ appear to remain amphicœlous throughout life. *Plethodon* with two premaxillaries stands at the base. *Hemidactylium* differs in the loss of a toe, *Batrachoseps* in the loss of prefrontals, the consolidation of the premaxillaries and the loss of a toe. *Heptoglossa* known only from one specimen, has the tongue attached, the toes webbed and opisthocœlous vertebræ. Beyond this it is unknown. Probably it should stand between *Plethodon* and *Autodax*. *Typhlomolge* is a permanent larva of some plethodont. More cannot be said of its relations other than its affinities are more likely at the aquatic *Spelerpes* end of the series rather than at the terrestrial *Plethodon* end.

There are several examples of independent and parallel evolution in these genera. The most obvious is the loss of a toe, which has been undoubtedly independent in the three reduced genera. The loss of the prefrontal in *Batrachoseps* and the *Desmognathus* group is another case. The consolidation of the premaxillaries has probably been independent, likewise the acquiring of terrestrial habitat. A scheme is here added, followed by a key to the genera, which may show more clearly the relationships as understood by us.



Key to the genera.

<i>a.</i> —Permanent larvæ, blind	<i>Typhlomolge</i>
<i>aa.</i> —Larva not permanent, develop eyed adults.	
<i>b.</i> —Tongue free.	
<i>c.</i> —Premaxillaries two	<i>Geotriton</i>
<i>d.</i> —Toes 5, webbed	<i>Gyrinophilus</i>
<i>dd.</i> —Toes 5, free.	
<i>cc.</i> —Premaxillary single.	
<i>e.</i> —Toes 5, free	<i>Spelerpes</i>
<i>ee.</i> —Toes 5, webbed.	
<i>f.</i> —Nostrils small	<i>Ædipus</i>
<i>ff.</i> —Nostrils large	<i>Thorius</i>
<i>cee.</i> —Toes 5, fused.....	<i>Ædipina</i>
<i>cccc.</i> —Toes 4	<i>Manculus</i>
<i>bb.</i> —Tongue not free.	
<i>f.</i> —No premaxillary fontanel.	
<i>g.</i> —Vomerine teeth present . . .	<i>Stereocheilus</i>
<i>gg.</i> —No vomerine teeth	<i>Leurognathus</i>
<i>ff.</i> —Premaxillary fontanel present.	
<i>h.</i> —Toes 5.	
<i>i.</i> —No prefrontal	<i>Desmognathus</i>
<i>ii.</i> —Prefrontal present.	
<i>j.</i> —One premaxillary.	
<i>k.</i> —Blind	<i>Typhlotriton</i>
<i>kk.</i> —Eyes functional	<i>Autodax</i>
<i>jj.</i> —Two premaxillaries.	
<i>l.</i> —Toes fused	? <i>Heptoglossa</i>
<i>ll.</i> —Toes free	<i>Plethodon</i>
<i>hh.</i> —Toes 4.	
<i>m.</i> —Prefrontal present	<i>Hemidactylium</i>
<i>mm.</i> —No prefrontal . . .	<i>Batrachoseps</i>

It seems useful to add a few remarks on the larvæ of some members of the present, as well as allied families. *Ambystoma* larvæ have the dorsal fin-fold extending forward to the head. The larvæ of the various species of the same genus seem difficult to separate and are rare in collections, as with the exception of the western species they remain larvæ only a few months.⁴ The larvæ of *Diemictylus* are, according to Banta and McAtee, "maculate at an early age, have a dark line through the eye, and when of fair size show the red lateral spots."⁵ In many cases the larvæ of species of the *Plethodontidae* are unknown, and larvæ have been seen which could not be identified. The species in the northeast present no great difficulties. The

⁴ B. G. Smith, *Bull. Wiscon. N. Hist. Soc.*, IX, April, 1911, pp. 14-27.

⁵ *Proc. U. S. Nat. Mus.*, XXX, 1906, pp. 67-83.

following tentative key, of the genera *Plethodon*, *Hemidactylium*, *Desmognathus*, *Gyrinophilus*, and *Spelerpes* follows, with the reservation that so far as known the first two do not have aquatic larvæ.

- a.*—Gills unpigmented, presenting a glistening white appearance;
legs stout *Desmognathus fusca*
- aa.*—Gills pigmented; legs slim.
- b.*—Dorsal surface lighter than sides.
- e.*—Dorsal surface immaculate save slight pigmentation
along median line; a black lateral band
Spelerpes longicaudus
- cc.*—Median dorsal surface immaculate; a lateral row of
dark spots *S. bislineatus*
- bb.*—Back and sides alike.
- d.*—Head short *S. ruber*
- dd.*—Head long *Gyrinophilus porphyriticus*

<i>D. fusca</i> ,	length of largest larva,	44	mm.;	smallest adult	27	mm.
<i>S. longicaudus</i> ,	"	"	"	"	49.5	"
<i>S. bislineatus</i> ,	"	"	"	"	47	"
<i>S. ruber</i> ,	"	"	"	"	74	"
<i>G. porphyriticus</i> ,	"	"	"	"	—	"

S. ruber and *G. porphyriticus* are seldom met with in the same locality.

The final color pattern of the plethodont salamanders is the result of the gathering of pigment on the sides of three rows of unpigmented spots. These spots vary with the species in number, size and date. In *D. fusca* the dorsal series is quite large and the two series are confluent at an early age and form the light dorsal area so characteristic of the young of that species. In *S. longicaudus* at 30 mm. (smallest larva seen), the dorsal areas have merged along the back and the pigment forms a definite lateral line. At this stage the lateral spots are not noticeable. In *S. bislineatus* at the earliest stage (17 mm.) the dorsal areas are very noticeable and the others are not evident. Up to the age of about a year (30 mm.) the dorsal areas retain their shape. As they break up, the lateral areas appear, and these sometimes last after transformation. The dorsal areas attract pigment which forms the lateral line at transformation. Until transformation, however, this line is much broken and very irregular more resembling a chain than a band. This difference as a chain and a band, connected with the lightness of the dorsal surface, serves to differentiate between this species and *S. longicaudus*. Furthermore, *S. longicaudus* has a shorter development than *S. bislineatus*, as it is a one-year instead of a two-year species. In examples of the same size (30 to 40 mm.) the dorsal areas have

completely disappeared in *S. longicaudus* while they are still quite distinct in *S. bislineatus*. The dorsal region of *S. longicaudus* has only a faint stripe down the median line. The larvæ of *S. bislineatus* have the dorsal region either uniform or darker towards the sides. In *S. ruber* the dorsal series is formed of a few very small areas, and is only distinct in smaller larvæ (40 mm.). This forms no part in the development of the color-pattern. The lateral series is of many small areas which form a dotted line down the side of the larva. It disappears before transformation, and also plays no part in the formation of the adult pattern, or rather the early disappearance of the larval series is responsible for the lack of pattern in *S. ruber*. The same may be said of *G. porphyriticus* and *D. quadrimaculata*. It is interesting to note in this connection that the pattern of *D. ochrophæa* is certainly the result of the development of the dorsal areas from their insignificance in *D. quadrimaculata*, their late coalescence in *D. monticola*, their early coalescence in *D. fusca*, to a coalescence in *D. ochrophæa*, which takes place so early that even in the smallest examples seen no trace of it has been observed. This suggests the absence of an aquatic larval stage, and indeed *D. ochrophæa* is the most terrestrial of the species of *Desmognathus*. The color pattern of the "red-back" stage of the entirely terrestrial *Plethodon erythronotus* is almost exactly like that of *D. ochrophæa*. The "cinereus" phase is certainly not to be explained in the same way, and the coloration of the species of *Plethodon* presents a different problem. It has been stated that the dark pigment underlies the red in *P. erythronotus*. Now the bleachment and the color pigment (usually red or yellow), in *Spelerpes* and *Desmognathus* are distinct, the black pattern being the result of the change in the larval areas already referred to, while the color pigment appears at transformation and usually is not localized. A possible suggestion of the coloration in the genus *Plethodon* is that the dark color is uniformly over the animal and the color pigment is localized or in scattered spots. Thus there would seem to be no trace in *Plethodon* of the influence of any larval areas on the coloration, which would be correlated with the apparent absence of any aquatic larval stage.

In order to make clear the relations of several recently described species, and a new species of *Plethodon* described later on in these pages, the analysis below is given. Species marked † are restricted to the southern Alleghanies and those marked * are northeastern in distribution.

Key to Eastern Plethodontida.

a.—Tongue free in front.

b.—Toes 5.

c.—A line from eye to nostril.

d.—Line from eye to nostril black and light... *Gyrinophilus danielsi*†

dd.—Line from eye to nostril light only... *G. porphyriticus**

cc.—No line from eye to nostril.

e.—Tail short; color red... *Spelerpes ruber** and allied forms

ee.—Tail long.

f.—Color orange; tail spotted... *S. maculicaudus*

ff.—Color yellow.

g.—Tail barred... *S. longicaudus**

gg.—Tail banded.

h.—Two lateral stripes, but no dorsal stripe... *S. bistriatus**

hh.—Two lateral stripes and a dorsal stripe... *S. guttolineatus*

bb.—Toes 4.

i.—Yellow, with dark lateral stripe... *Manculus quadridigitatus*

ii.—Black... *M. remifer*

aa.—Tongue not free in front.

j.—Toes 5.

k.—Internal nostrils very inconspicuous and twice as far apart as external nostrils... *Leurognathus marmoratus*†

kk.—Internal nostrils conspicuous, about far apart as external nostrils.

l.—Light line from eye to angle of jaw.

m.—Tail keeled.

n.—Belly plain, black... *Desmognathus quadrimaculata*†

nn.—Belly plain, light... *D. monticola*†

nnn.—Belly mottled lighter... *D. fusca**

nnnn.—Belly mottled dark... *D. fusca auriculata*

mm.—Tail cylindrical.

o.—Belly light... *D. ochrophæa**

oo.—Belly dark... *D. carolinensis*†

ll.—No light line from eye to angle of jaw.

p.—Vomerine and parasphenoid series of teeth continuous... *Stereochilus marginatus*

pp.—Vomerine and parasphenoid series of teeth not continuous.

q.—Body color uniform plumbeous.

r.—Legs red... *Plethodon shermani*†

rr.—A yellow stripe from eye to gular fold, *P. jordani*†

rrr.—No markings.

s.—Belly plain-colored.

t.—Costal grooves 14... *P. metcalfi*†

tt.—Costal grooves 17... *P. wehrlei**

ss.—Belly mottled; costal grooves 19,

*P. erythronotus**

- qq.*—Body color not uniform plumbeous.
u.—Costal grooves 19; red stripe down back,
*P. erythronotus**
uu.—Costal grooves 14; numerous white
spots present *P. glutinosus**
uuu.—Costal grooves 13; a yellowish-green
net-work *P. æneus*†
jj.—Toes 4 *Hemidactylum scutatum*

Typhlomolge rathbuni Stejneger.

Three from an artesian well, 152 feet deep, at San Marcos in Hays County, Texas (Dr. H. A. Pilsbry in 1903).

Geotriton fuscus Bonaparte.

Four from Piedmont and Italy.

Gyrinophilus danielsi (Blatchley).

Four from North Carolina (Roan Mountain), Tennessee (Roan Mountain), and Georgia. This species has divided premaxillaries and seems to be representative of the genus *Gyrinophilus* in the southern Alleghanies, rather than a *Spelerpes*, as so located originally by Blatchley. It differs from *G. porphyriticus* in that its color is lighter and finely dotted with darker, while in *G. porphyriticus* the color is more uniformly marbled. Also there is a black line as well as a light line from eye to nostril in *G. danielsi*, while in *G. porphyriticus* the dark line is obscured in the general dark color of the head.

Gyrinophilus porphyriticus.

Thirteen examples: Chenango County and central New York; Pennsylvania (near Philadelphia, Round Island, Altoona ?, Warren County, Indiana, Port Allegany); Maryland (Jennings).

Spelerpes ruber (Daudin).

Pseudotriton flavissimus Hallowell, Proc. Acad. Nat. Sci. Phila., 1856, p. 130.
Liberty County, Georgia. (No. 576, A. N. S. P., type. Major Le Conte.)

A very large series of all ages: New York (Staten Island); New Jersey (Camden, Staffords Forge and Cape May County at Petticoat Bridge and Crooked Creek); Pennsylvania (Philadelphia, Fairmount Park, Germantown, Holmesburg, Naylor's Run, Gladwyne, Devon, Woodbourne, Monocacy, Chester County, Round Island, Diamond Valley, Newton Hamilton, Brush Mountain in Blair County, Pine Grove in Cumberland County and Pine Creek in Indiana County); Delaware (Wilmington); Maryland (Jennings, Bacon Hill, Bohemia Manor, Elk Neck); Ohio; North Carolina (Cranberry and Henderson County); Tennessee (Sawyer's Springs); Alabama (Auburn).

The variation in this species is wide and excessive, and we find all

degrees in the vomerine dentition, from extremely obtuse to quite acute, and from widely separated to fairly close together. The color varies from rather light or clear and with small, well-defined, widely scattered spots to almost unicolor, in which spots have run together somewhat, to very thickly well-defined, prominent large spots covering the whole upper surface. A larva from Roan Mountain, Tennessee, of uncertain determination, differs in the presence of a narrow dark vertebral line. The example from Henderson County, North Carolina, has a long tail and lacks the black spot on the head. The specimen from Auburn, Alabama, in common with the type of *P. flavissimus*, and the Henderson County specimen, all have the series of teeth very closely approximated in the median line. Further, they have very small scattered spots. The Alabama specimen has the back covered by a dark ground-color, not caused by spots running together. In this it thus differs from the dark color of the usual old of *ruber* where the spots are very numerous and crowded together. No specimen which could be classed as *S. montanus* or *S. schencki* are in the collection. From the descriptions *schencki* appears a rather local race of *ruber*. *S. montanus* appears to be a different matter. Our only approach to the dentition described for *montanus* is found in the type of *P. flavissimus* and the two other specimens last mentioned. No approach to the color of *montanus* has been seen in our material. In this connection the junior author has examined the types of *montanus* and *schencki* in Washington.

Spelerpes maculicaudus (Cope).

Gyrinophilus maculicaudus Cope, Amer. Nat., XXIV, 1890, p. 966, fig. Brookville, Indiana. (Nos. 10,579 to 10,581, A. N. S. P., types. A. W. Butler.)

Also an example from Mammoth Cave, Kentucky (S. N. Rhoads).

Spelerpes longicaudus (Green).

Thirty examples: New Jersey (Atlantic City and White Pond); Pennsylvania (Wissahickon, Brandywine Summit, Valley Forge, Lancaster County, Cresson, Huntingdon, Round Island, Ohiopyle, Newton Hamilton, Indiana, Two Licks Creek, Two Licks Hills, Altoona); Maryland (Jennings); Virginia (Giles County); Georgia.

Spelerpes bislineatus (Green).

Salamandra bislineata Green, Journ. Acad. Nat. Sci. Phila., I, 1818, p. 352. No locality. (Nos. 695 to 698, A. N. S. P., types. Dr. Bache.)

Also a large series of all ages: Massachusetts (Nantucket and Berkshire Hills); New York (Casanova and Catskills); New Jersey (Morris County, Swartswood Lake, Atlantic City and White Pond); Pennsylvania (Philadelphia, Germantown, Holmesburg, Gladwyne,

Falls of Schuylkill, Monocacy, Brandywine Summit, Dingmans Ferry, Newton Hamilton, Brooklyn, Port Allegany; Maryland (Jennings and Bacon Hill); North Carolina (Roan Mountain, Black Mountain, Henderson County and Cranberry); Tennessee (Roan Mountain).

Spelerpes melanopleurus Cope.

Proc. Acad. Nat. Sci. Phila., 1893, p. 383. Riley's Creek, one of the head tributaries of the White River, southwest Missouri. (Nos. 10,456 to 10,460, A. N. S. P. types.)

Spelerpes multiplicatus Cope.

Four examples from Little Rock, Arkansas. Dr. A. E. Brown.

Spelerpes guttolineatus (Holbrook).

Salamandra guttolineata Holbrook, N. Amer. Herp., Ed. 2, V, 1842, p. 29, Pl. 7. Greenville, Carolina. (Nos. 716 and 717, types.)

Also thirty-three examples from Henderson County, North Carolina, and Mobile, Alabama.

Spelerpes belli Gray.

Seven examples from Mexico (Jalapa, Zacualtipan and Mex. Cientif. Com. 1885).

Edipus variegatus (Gray).

Geotriton carbonarius Cope, Proc. Acad. Nat. Sci. Phila., 1860, p. 373. No locality. (Nos. 503 and 504, A. N. S. P., types. Jalapa, Mexico.)

Also another example labelled Mexico.

Thorius pennatribus Cope.

Amer. Nat., 1869, p. 222. Mexico. (No. 1,269, A. N. S. P., cotype? Orizaba, Mexico.)

Another labelled Mexico (Dugès).

Edipina lineolus (Cope).

Spelerpes lineolus Cope, Proc. Acad. Nat. Sci. Phila., 1865, p. 197. Table Land of Mexico. (No. 735, A. N. S. P., type.)

Manculus quadridigitatus (Holbrook).

Salamandra quadridigitata Holbrook, *l.c.*, p. 65, Pl. 21. Middle section of our State, Georgia and Florida. (No. 490, A. N. S. P., type. South Carolina.)

Also thirteen examples: Georgia (Thomasville) and Florida (Enterprise).

Stereochilus marginatus (Hallowell).

Pseudotriton marginatus Hallowell, Proc. Acad. Nat. Sci. Phila., 1856, p. 130. Liberty County, Georgia. (No. 514, A. N. S. P., type. Major Le Conte.)

Leurognathus marmoratus Moore.

Proc. Acad. Nat. Sci. Phila., 1899, p. 316, Pl. 14, figs. 4-6, 10. In a large clear rocky pool beneath a waterfall of a stream on the south flank of Grandfather Mountain, North Carolina, and at an elevation of about 3,500 feet. (No. 19,610, A. N. S. P., paratype.)

Another example obtained at the same locality by Mr. S. N. Rhoads was wrongly determined by him as *Desmognathus nigra*.⁶

⁶ PROC. ACAD. NAT. SCI. PHILA., 1895, p. 400.

Desmognathus quadrimaculata (Holbrook).

Seventeen examples: Pennsylvania; Virginia (Giles County); North Carolina (Henderson County); Tennessee (Doe Run on Roan Mountain). Of this series two specimens without locality.

Desmognathus brimleyorum Stejneger.

One from Little Rock, Arkansas (Dr. A. E. Brown in 1902).

Desmognathus fusca (Rafinesque).

A very large series: New Brunswick (St. Johns River); Massachusetts (Berkshire Hills); New York (Haines Falls in Catskills); New Jersey (Swartswood Lake, Morristown, Trenton, Big Timber Creek, Clement's Bridge, Pennsville, Salem); Delaware (Brandywine Creek and Greenville); Maryland (Dove Run, Jennings, Piney Creek and Conowingo); Alabama (Auburn); Tennessee (Walden Ridge); Indiana (Hanover College).

The very large Pennsylvania series from the following counties: Allegheny (Pittsburgh), Berks (Monocacy), Blair (Altoona), Bucks (Langhorne), Chester, Clinton (Tamarack Swamp), Delaware (Naylor's Run, Wawa and Whetstone Run), Green (Waynesburg), Indiana (Brick Pond, Indiana, Marsh Run, Lucus Pond, Saltgiver Run, Two Lick Creek and Two Lick Hills), Juniata (Tuscarora), Lancaster (Paradise and Peters Creek), Lehigh (Lehigh Gap), McKean (Port Allegany), Mifflin (Newton Hamilton and Sugar Valley Run), Montgomery (Devon, Gladwyne, Mill Creek, Overbrook, opposite Lafayette), Northampton (Belfast), Perry (Fox Hollow), Potter (Brooklyn and Seven Bridges), Philadelphia (Schuylkill River, Fairmount Park, Olney, Frankford, Holmesburg, La Grange, Bustleton), Susquehanna (Broad Top Mountain), Warren (White Pond) and York (Peach Bottom).

Desmognathus fusca auriculata (Holbrook).

Twenty-two examples: North Carolina (Lake Waccamaw); South Carolina (Manning); Georgia; Florida (Miami). Three specimens are without data.

Desmognathus ochrophæa Cope.

A large series: New Brunswick (St. Johns River); New York (Clinton County, Haines Falls, Catskills); Pennsylvania (Tamarack Swamp in Clinton County; Indiana, Two Lick Creek and Two Lick Hills in Indiana County; Ganoga and Harvey Lakes in Luzerne County; Port Allegany in McKean County; Brooklyn, Gold and Seven Bridges in Potter County; Eagles Mere in Sullivan County; Broad Top Mountain in Susquehanna County; Warren in Warren

County); Maryland (Jennings and Garrett County). The further study of the allied species of *Desmognathus fusca* has convinced us that this species is valid, contrary to the views set forth by Allen⁷ and later by Fowler.⁸

Typhlotriton spelæus Stejneger.

Three from Marble Cave in Missouri (E. D. Cope in 1893).

Autodax lugubris (Hallowell).

Salamandra lugubris Hallowell, Proc. Acad. Nat. Sci. Phila., 1848, p. 126. Monterey, California. (No. 4,257, A. N. S. P., type. Dr. Townsend.)

Also twelve other examples from California (San Francisco, Santa Barbara and San José), eight of which without locality.

Autodax iecanus (Cope).

Plethodon iecanus Cope, Proc. Acad. Nat. Sci. Phila., 1883, p. 24. Near the United States fish-hatching establishment on the McCloud River, in Shasta County, California. (No. 14,061, A. N. S. P., paratype.)

Plethodon metcalfi Brimley.

Thirteen specimens collected by Mr. Rhoads on Roan Mountain at 4,000 to 5,000 feet elevation in Tennessee. They were wrongly identified as *Ambystoma jeffersonianum*.⁹ We refer them to the present species as Mr. Brimley states in his description¹⁰ that the dentition is like that of *Plethodon glutinosus*. In our specimens the vomerines extend beyond the nares, as they do in *P. glutinosus*, while in Brimley's figure they are shown just reaching the nares. The dentition of our examples is intermediate between that of *P. glutinosus* and the species from Pennsylvania we describe as new. The vomerine series are larger in the Roan Mountain specimens than in the Pennsylvania form, but shorter than in *P. glutinosus*. Costal grooves 14 or 15.

Plethodon wehrlei sp. nov. Plate IV.

Dentition about as in *P. glutinosus*. No white spots on back or color markings of any kind, and belly lighter than in *P. glutinosus*. Toes webbed at base. Body more slender than that of *P. glutinosus*, and with 17 costal grooves.

Vomerine series of teeth scarcely arched, extending anteriorly beyond the nares, internally far apart and scarcely would cross line drawn forward from outside edge of parasphenoid series. They contain but 8 teeth. The series are shorter than in *P. glutinosus*, not

⁷ Proc. Boston Soc. N. Hist., XXIX, 1901, p. 73.

⁸ Proc. Acad. Nat. Sci. Phila., 1906, pp. 356-357, Pl. 13.

⁹ Proc. Acad. Nat. Sci. Phila., 1895, p. 402.

¹⁰ Proc. Biol. Soc. Wash., XXV, 1912, p. 138, Pl. 6. Sunburst, Haywood County, North Carolina.

extending so far inward, and contain fewer teeth. Parasphenoids in an incompletely divided patch, as in *P. glutinosus*. Costal grooves 17, counting axillary and inguinal. Appressed limbs fail to meet by $4\frac{1}{2}$ interspaces, compared with 3 in *P. glutinosus*. The whole form of the body is much more slender, or slimmer, than that of *P. glutinosus*, the tail longer and the head and body cylindrical throughout. Toes webbed and with 2 joints free.

Color bluish-plumbeous above and unmarked. Below brownish-plumbeous, occasionally with a few small white spots along mid-lateral line, where dark dorsal color fades into lighter ventral color. Legs colored like body. Throat lighter than the belly and mottled with white.

Type, No. 19,123, A. N. S. P. Adult female 138 mm. long. Two Lick Hills, Indiana County, Pennsylvania. September, 1911. R. W. Wehrle.

Also paratypes, all A. N. S. P., as follows: No. 4,799, Tuscarora, Juniata County, Pennsylvania, September, 1896 (S. N. Rhoads); No. 17,231, Port Allegany, McKean County, Pennsylvania. June 9, 1906 (T. D. Keim and Henry W. Fowler); No. 19,066, Indiana, Indiana County, Pennsylvania, fall, 1908 (R. W. Wehrle); Nos. 19,114 and 19,115, Two Lick Hills, Indiana County, Pennsylvania, September, 1911 (R. W. Wehrle); Nos. 19,118 and 19,124, same data as last.

This new salamander appears to be closely related to *P. metcalfi* Brimley, except that it is slimmer and with more costal grooves. It is probably a northern offshoot of that form. Further, it appears isolated, and, with the present state of our knowledge, necessary to admit it as distinct. Quite remarkable is the fact that it should have remained so long unnoticed or confused with *P. glutinosus*. The maximum length of our examples is 139 mm., and the minimum length 44 mm.

(Named for Mr. R. W. Wehrle, who collected most of our examples, and also presented many local collections of cold-blooded vertebrates to the Academy.)

Plethodon erythronotus (Green).

Salamandra erythronota Green, Journ. Acad. Nat. Sci. Phila., I, 1818, p. 356. New Jersey. (Nos. 1,227 to 1,238, A. N. S. P., types of this and the following. Dr. Bache.)

Salamandra cinerea Green, *l.c.*, New Jersey.

A very large series of both color phases examined from: Quebec (Lac Aux Sables); Massachusetts (Nantucket); New Jersey (Sussex County, Swartswood Lake, Cedar Lake in Warren County, Borden-

town, Cape May, Dias Creek and Higbee's Beach); Delaware (Brandywine Creek between Du Ponts and Rockland, Greenville, Newark and Seaford); Maryland (Bohemia Manor, Chestertown, The Rocks, Willards, Jennings); North Carolina (French Broad River); Tennessee (Rock Creek, Roan Mountain and Bellevue); Missouri (Chadwick); Arkansas (Roger and Magazine Mountain).

Very many from the following counties in Pennsylvania: Berks (Monocacy), Bucks (Woodbourne and Langhorne), Delaware (Cobbs Creek, Chester Heights, Langford's Run, Wawa, Chadds Ford), Fayette (Ohiopyle), Luzerne (Ganoga Lake), McKean (Port Alleghany), Indiana (Indiana, Two Lick Creek and Besnham Run), Monroe (Saylor's Lake and Bartonville), Montgomery (Valley Forge, Gladwyne, Centerville and Devon), Philadelphia (Wissahickon Creek, Fairmount Park, Philadelphia, Germantown, Frankford, Holmesburg, Rowlands, La Grange), Pike (Dingmans Ferry), Potter (Gold), and York (York Furnace).

Plethodon glutinosus (Green).

A large series from: New York (Casanova); New Jersey (Kingwood and Swartswood Lake); Pennsylvania (Broad Top Mountain at Altoona, New Hope, Ohiopyle, Diamond Valley; Indiana County at Two Lick Hills, Two Lick Creek, Burnhamer Run and Indiana; Bartonville, Pike County, Eagles Mere, Franklin, Warren and York Furnace); Maryland (Jennings); South Carolina; Georgia (Chickamauga); Alabama (Uniontown); Ohio; Tennessee (Chattanooga, Raleigh, Sawyers Spring, Murfreesboro, Samburg at Reelfoot Lake and Knoxville); Missouri (Chadwick); Arkansas (Blue Mountain Station, Petit Jean Mountain and Magazine Mountain).

Plethodon æneus Cope.

Am. Nat., XV, 1881, p. 878. Nickajack Cave, Tennessee. (No. 10,461, A. N. S. P., type.)

Also three examples from Sawyer's Spring, Tennessee (S. N. Rhoads on May 29, 1895).

The type shows the parasphenoid with an imperfect median division, as teeth occur at several intervals in the line of division. In the largest example from Sawyer's Spring the parasphenoid patch is complete, and the smallest specimen is 31.5 mm. long.

Plethodon intermedius Baird.

One from Willamette Valley, Oregon (O. B. Johnson).

Plethodon crassulus Cope.

Two without locality (E. D. Cope).

Plethodon oregonensis (Girard).

Six examples from California (Sausalito and Russian River). Three also from the "Northwest Exploring Expedition."

Hemidactylum scutatum (Schlegel).

Thirteen from: New Jersey (Cape May and Swartswood Lake); Pennsylvania (Fallsington); Indiana (Brookville); Illinois (Chicago).

Batrachoseps attenuatus Eschscholtz.

Fifty examples from California (Russian River, Oakland, San Francisco, Santa Cruz and Santa Barbara). There is considerable variation in this series. Specimens from San Francisco and Santa Barbara are smaller and darker than specimens from the Russian River and Oakland. The proportions seem about the same, though the tails are longer in the Oakland lot than in any of the others.

Batrachoseps pacificus (Cope) is said by Van Denburgh¹¹ to be restricted to the islands off the coast, and thus Santa Barbara is not the type locality, as he points out very clearly. Our two specimens from Santa Barbara, though in rather poor condition, are certainly not this form, agreeing best with *B. attenuatus*.

A specimen from Pasadena, California (H. N. Rust), represents *B. major* Camp. The legs are stouter than in any of our large series of *B. attenuatus*. There is also no trace of the lateral stripe usually so prominent in that species.

Batrachoseps nigriventris Cope.

Proc. Acad. Nat. Sci. Phila., 1869, p. 98. Ft. Tejon, California. (Nos. 481 and 482, A. N. S. P., types, Dr. G. H. Horn.)

We cannot see that these two specimens differ in any way from small and dark examples of *B. attenuatus*. The fore limb does not reach to the angle of the mouth, much less "nearly to the orbit," and the hind limb extends over only four costal interspaces instead of six.

SALAMANDRIDÆ.**Salamandra perspicillata** (Savi).

Fourteen from Italy (C. L. Bonaparte) and four from Dalmatia.

Salamandra salamandra (Linné).

Twenty examples: Europe; Italy (C. L. Bonaparte); Taurus Mountains in Asia Minor (Drs. S. A. S. and D. G. Metheny).

Salamandra atra Laurenti.

Three from Europe.

¹¹ *Proc. Cal. Acad. Sci.*, (3) IV, No. 1, 1905, pp. 6-7.

Hemisalamandra cristata (Laurenti).

One hundred and eight from: Germany; Austria (Vienna); France (Paris); Italy (C. L. Bonaparte); England (Hampton and Middlesex).

Triturus marmoratus (Latreille).

Six examples from: Portugal; France (Nantes in Bretagne); Italy (C. L. Bonaparte).

Triturus italicus Peracca.

Two from Potenzo, Bosilicata.

Triturus alpestris Laurenti.

Fifty examples from Brussels in Belgium, and Switzerland (C. L. Bonaparte).

Triturus crocatus (Cope).

Neurergus crocatus Cope, Proc. Acad. Nat. Sci. Phila., 1862, p. 343. Oorcmiah, Persia. (No. 1,480, A. N. S. P., type. M. Amherst.)

This is undoubtedly a *Triturus*, as subsequently stated by Cope.

Triturus vulgaris (Linné).

Seventy-eight examples: Europe; England (London); Italy (C. L. Bonaparte).

PLEURODELIDÆ.

Diemictylus viridescens (Rafinesque).

A very large series from: New York (Catskills, Haines Creek, Adirondacks and Rockaway Beach on Long Island); New Jersey (Lake Mashipicong and Round Island in Sussex County); Delaware (Newark); Maryland (Oakland in Allegany County and Jennings); Virginia (Franklin County); North Carolina (Henderson County and Cranberry); South Carolina; Georgia; Florida (Jacksonville); Tennessee (Samburg at Reelfoot Lake); Ohio; Indiana (Brookville); Kentucky (Mammoth Cave); Indian Territory (Wister).

Also large series from the following counties in Pennsylvania: Berks (Douglassville), Blair (Altoona), Bradford (Minequa Springs), Cameron (Emporium), Carbon (Mauch Chunk), Chester, Clinton, Delaware (Whetstone Run), Fayette (Ohiopyle), Lehigh (Lehigh Gap), Luzerne (Ganoga and Harvey Lakes), Indiana (Two Lick Hills, Two Lick Creek, Simpson's Run and Indiana), Monroe (Saylor's Lake, Tunkhanna Creek and Mt. Pocono), Montgomery (Valley Forge), McKean (Cole Grove and Port Allegany), Northampton (Hellertown), Pike (Rocky Hill Pond), Potter, Sullivan (Shady Nook), York (York Furnace).

Diemictylus viridescens meridionalis Cope.

Four from Texas (Helotis and San Diego).

Diemictylus torosus (Eschscholtz).

Forty-six examples from: British Columbia (Victoria and Hatzic); Washington (Tacoma); Oregon (Willamette Valley and Astoria); California (Sausalito, San Francisco, Body Bay, McCloud and Russian Rivers, and Pasadena).

Diemictylus montandoni (Boulenger).

Six from Brosteni, Moldania.

Diemictylus palmatus (Schneider).

Forty-seven from: Europe; France (Paris); England (Epping Forest in Essex); Italy (C. L. Bonaparte).

Diemictylus ruseonii (Gené).

Seven from Italy and Sardinia (both C. L. Bonaparte).

Diemictylus vittatus (Jenyns).

Two labelled "France" likely from Syria ?

Diemictylus asper (Dugès).

Two from the Pyrenees.

Diemictylus pyrogaster (Boie).

Thirty-eight from Japan.

Pleurodeles waltlii Michah.

Three from Portugal and Spain (C. L. Bonaparte).

EXPLANATION OF PLATES III AND IV.

PLATE III.—*Ambystoma tigrinum* (Green). Showing extremes of variation. All slightly reduced.

PLATE IV.—*Plethodon wehrlei* Fowler and Dunn. Type.

FEBRUARY 20.

HENRY SKINNER, M.D., Sc.D., in the Chair.

Fifty-six persons present.

The Publication Committee reported that papers under the following titles had been presented for publication:

"Hunting Mollusca in Utah and Idaho in 1916. Part II," by Junius Henderson and L. E. Daniels. (January 19, 1917.)

"Notes on the anatomy of *Oreohelix*. II," by Henry A. Pilsbry. (January 19.)

"The reproductive organs of *Epiphragmophora callistoderma*," by Henry A. Pilsbry. (January 19.)

"The anatomy of an Eolid, *Chioræra dalli*," by Harold Heath. (February 8.)

"Mollusca of the Southwestern States. VIII: The Black Range, New Mexico," by H. A. Pilsbry and J. H. Ferris. (February 12.)

"Notes on fishes from New Jersey, Pennsylvania, and Maryland," by Henry W. Fowler. (February 21.)

"A second collection of fishes from the Panama Canal Zone," by Henry W. Fowler. (February 21.)

The deaths of Edwin A. Barber, December 12, 1916, and of Andrew C. Craig, Jr., January 18, 1917, members, were announced.

The death of H. Émile Sauvage, a correspondent, January, 1917, was also announced.

On the unanimous nomination of the Committee on the Hayden Memorial Geological Award and with the approval of the Council, the gold Hayden Memorial Medal was conferred on William Morris Davis, Ph.D., Emeritus Professor of Geology in Harvard University, in recognition of his distinguished work in geological science.

WILLIAM MORRIS DAVIS was born in Philadelphia on February 12, 1850. He was educated at Harvard University, where he received the degree of B.S. in 1869. He received the honorary degree of Sc.D. at the University of Cape of Good Hope at Cape Town in 1905, the degree of Ph.D. at the University of Greifswald in 1906, and the same degree at Christiana in 1911. He is a Chevalier de la Légion d'Honneur.

Dr. Davis has conducted many geological investigations, and in his work has travelled widely in the United States and foreign countries. His published writings show a remarkable versatility and

diversity in scientific interest, for he has become prominent not only in pure geology, but in geography, meteorology and other allied subjects.

His early geological efforts were devoted largely to structural geology, as seen in his work in Montana in 1883 and his later work on the Triassic Formation of Connecticut, published by the United States Geological Survey. Such researches led him into physiographic geology, which he aptly describes as "the relation of structure, process and stage in determining surface form"; and from physiographic geology he branched out into physical geography, which in later years has occupied much of his time, and in which he is recognized as one of the foremost authorities in the world. His conception of the relation of geology and geography is clearly brought out in his presidential address to the Geological Society of America, 1911-12.

In the meantime, however, he had not confined himself altogether to geology and geography. He was assistant at the Argentine National Observatory, Cordoba, Argentina, from 1870 to 1873; while later on at Harvard University he taught at different times geology, meteorology and geography. At Harvard he was successively Assistant 1876-7, Instructor 1878-85, Assistant Professor 1885-90, Professor of Physical Geography 1890-99, Sturgis-Hooper Professor of Geology 1899-1912, and Professor Emeritus 1912 to the present time.

Notwithstanding his many years of teaching at Harvard University, he found time to travel widely and write numerous scientific books and papers. In 1877-78 he toured the world in scientific study; in 1903 he was a member of Pumpelly's Carnegie Institution Expedition to Turkestan; in 1895 he visited South Africa as the guest of the British Association for the Advancement of Science. He was Visiting Professor at the University of Berlin in 1908-9, and at the University of Paris in 1911-12.

Among some of the most important contributions of Dr. Davis to science are his work in structural geology in Montana and Connecticut, already mentioned; his work on the evolution of form and drainage, as seen in his studies of the River Valleys of Pennsylvania in 1889, the River Valleys of Northern New Jersey in 1889, the Grand Canyon in 1890, and the Seine, Meuse, Moselle in 1896; his work on the nature of mountain forms, as seen in his studies of the Great Basin Ranges in 1903 and in the Turkestan Expedition in 1904. Glacial geology, the nature of arid regions in America and Africa, volcanoes and coral reefs are also subjects on which Dr. Davis has spent much time and thought and published numerous papers.

Thus the total contributions of Dr. Davis to science cover a wide field. His numerous text-books relate to various geological and allied subjects and are widely used; his many papers, memoirs, and other contributions to scientific literature include a remarkably broad range of subjects in geology, geography, meteorology, and allied sciences.

MRS. ARTHUR R. ILIFF made a communication on the Taos Indians of New Mexico, finely illustrated by photographs taken by herself. (No abstract.)

Ezra Allen was elected a member.

The following were ordered to be printed:

OLIGOCENE FOSSILS FROM THE NEIGHBORHOOD OF CARTAGENA, COLOMBIA,
WITH NOTES ON SOME HAITIAN SPECIES.

BY HENRY A. PILSBRY AND AMOS P. BROWN.

The material described below was collected by Mr. Lloyd B. Smith in 1914, in the course of professional work in the vicinity of Cartagena, chiefly near the so-called "mud volcanoes" and at Cenizas. Most or all of them seem to be from Upper Oligocene beds, about equivalent in age to the Gatun in the Canal Zone.

A few fossils collected by Mr. Smith in the following year in Haiti are also described. Their chief interest is in adding to the evidence of extensive Oligocene beds south of the main range of the island. The species made known up to this time are not sufficient to fix the position of these beds in the Oligocene series.¹

When not otherwise specified, the species mentioned are from near Cartagena.

Conus proteus Hwass.

A specimen showing fewer color-spots than the recent *C. proteus*.

Conus molis B. and P.

Conus imitator B. and P.

Conus æmulator B. and P.

Conus gaza P. and J.

These four species were described from the Gatun bed.

Turris cartagenensis n. sp. Pl. 5, fig. 1.

A species grouping with *T. henckeni* (Sowerby) of Santo Domingo, from which it differs by the greater number and smaller size of longitudinal folds—ten on the last whorl. Form, sculpture and structure of the anal fasciole are as in the Santo Domingan species. Length of the broken shell figured, 36.5 mm.

Drillia gatunensis Toula.

Cancellaria dariena Toula.

Mitra longa Gabb.

Marginella medioeris n. sp. Pl. 5, fig. 2.

A species related to *M. latissima* Dall, but differs from the narrowest specimens of that by its much narrower contour. The outline

¹ See also a brief paper by one of us in PROC. ACAD. NAT. SCI. PHILA., 1910, p. 487.

below the shoulder is but slightly convex. The spire is quite low, rising very little above the posterior level of the outer lip. The lip is not very broad, moderately thick, with a slight ledge behind; its inner edge bears about 16 small, unequal teeth. The four columellar folds are about equal, the lower ones being more oblique than in *M. latissima*, and not so strong.

Length 13.7, diameter 8.7 mm.

There is also a fragment of a much larger *Marginella*, not determinable.

Oliva sayana immortua n. subsp. Pl. 5, fig. 6.

The shell differs from the recent *O. sayana (litterata)* by being smaller, less broad at the base, the sutural channel broader and deeper, and the ledge which encircles the shell above the siphonal fasciole is closer to the upper siphonal plait at the edge of the apertural callus. The outer lip is well thickened, indicating maturity.

Length 41, greatest diameter 18.4 mm.

Three other specimens are somewhat smaller, but show the same characters.

Strombina cartagenensis n. sp. Pl. 5, fig. 3.

The shell is fusiform with a rather long spire of $7\frac{1}{2}$ whorls; the earlier ones worn, the later having sculpture of rather narrow, very slightly curved longitudinal ribs, crossed by a group of about 7 inconspicuous spirals in the upper part, and strongly developed spiral cords about as wide as their intervals on the lower half of the last whorl, about 18 in number. The longitudinal ribs, of which there are 12 on the penultimate whorl, become shorter on the back of the last whorl, where they scarcely extend to the middle. There is a very thick and high varix behind the outer lip. The aperture is about three-fifths the length of the shell, narrow; outer lip heavily calloused, the callus bearing about 10 teeth. The columellar lip forms a thin, raised ledge.

Length 26.8, diameter 11.3 mm.; length of aperture 15.2 mm.

This species differs from the Panamic and Santo Domingan forms by its rounded periphery, without dorsal or ventral humps.

Strombina lloydsmithi n. sp. Pl. 5, fig. 4.

The shell is quite small, with the greatest width about at the anterior third of the length. Whorls 9, the first three convex, forming the smooth embryonic shell. The remaining whorls of the spire are flat, sculptured with straight longitudinal ribs about equal to their intervals, faint traces of two or three impressed spiral lines

visible in some of the intervals. The last whorl is convex, having ribs like those of the spire on the front, none on the back, but two precede the small, smooth lip-varix. The intercostal intervals are marked with deeply impressed spiral grooves, obsolete on the crests of the ribs on the front, and on the smooth dorsal patch, but passing over the ribs behind the lip. The outer lip has a heavy callus within, bearing about 9 teeth, the upper ones stronger. The columella bears a series of 8 teeth. The columellar edge is slightly raised, and there is a very heavy callus upon the body at the posterior commissure of the aperture.

Length 10.5, diam. 5.7 mm.; length of aperture 6 mm.

Solenosteira dalli Brown and Pilsbry.

Murex gatunensis Brown and Pilsbry.

Murex pomum Gmelin.

Typhis linguiferus Dall.

Typhis linguiferus Dall, Trans. Wagner Inst., III, pt. 1, p. 152, Pl. 12, fig. 7.

The single specimen agrees well with the description and figure of Dall's *Chipola* species, except that the spines on the varices are erect instead of curved.

Cassis monilifera Guppy.

Polinices mammillaris (Lam.).

Potamides avus n. sp. Pl. 5, fig. 5.

A species closely related to *P. pacificus* Sowerby, but differing by the different shape of the last whorl. The coronal tubercles are situated higher, directed somewhat upward, and there is no hump on the base in front of the aperture. The surface is strongly striate spirally. The inner lip has a distinct callous ridge near the posterior commissure of the aperture. There are about ten of the pointed tubercles on the last whorl.

This appears to be an ancestor of the recent species, which has more exaggerated sculpture.

Turritella cartagenensis n. sp. Pl. 5, fig. 13.

The whorls are nearly flat, but there is a slight concavity in the upper half and they are a little prominent below the suture: the periphery has a rounded prominence, visible above the suture. The light lines of growth are strongly retractive from the upper edge to below the middle of the visible surface of each whorl, then curving and becoming vertical or slightly protractive in the rest of their course. Spiral sculpture of unequal, unevenly spaced threads of various sizes, distinct but in low relief. There is a noticeable cingulus

formed by a couple of contiguous threads on a slight elevation, at the lower fourth of the whorls. The base is somewhat convex, and shows four very low, wide spiral welts, with the same finer spirals as the upper surface. The parietal callus is heavy. Length of the fragment figured 47 mm.; diameter, 24.5 mm.

Turritella lloydsmithi n. sp. Pl. 5, fig. 11.

This large species has some resemblance to *T. gatunensis*, the taper being about the same. The whorls are flat except at the periphery (or above the suture) where they bulge a little. This is most marked on the later whorls. The very faint growth-lines are slightly arcuate. Sculpture of about six low spiral cords unevenly spaced, those on the bulging lower part being coarser. The base shows about 7 strong spiral cords; over all there is a minute sculpture of unequal spiral threads. The suture is impressed and distinct. A specimen retaining five whorls measures 64.6 mm. long, 23.8 mm. in greatest diameter.

This species differs from *T. subgrundifera* and its allies by the sculpture, and from *T. gatunensis* by sculpture and the shape of the whorls, which are not excavated above.

Turritella subgrundifera Dall.

Turritella subgrundifera Dall, Trans. Wagner Inst., III, pt. 2, 1892, p. 313, Pl. 22, fig. 23.

We are unable to distinguish these specimens from *subgrundifera* from near Bailey's Ferry, Chipola River, of which we have compared a good series. Whether *T. atacta* Dall of the Tampa silex bed differs specifically seems somewhat doubtful, but the specimens known are smaller.

Turritella domingensis n. sp. Pl. 5, figs. 7, 7a, 9.

In the adult stage there are two approximate spiral cords, one at, the other above the periphery. Above this there are five spiral threads, the upper two close together, the others about equally spaced. The median part of the whorl is lightly concave, with very strongly arched growth-ridges at wide intervals. Over all there is a minute sculpture of slightly waved, irregular, sometimes anastomosing striæ, spiral and parallel on the lower part of the whorl, converging forward from each growth-ridge on the median part of the whorl. In the young shells, up to over 20 mm. in length, the ridge above the suture is acute and strong, the median concavity and the superior convexity are much more marked, and usually some of the median threads are beaded. The largest piece, of about 3 whorls, measures: length 37.3, diam. 18 mm.

Santo Domingo, W. M. Gabb. Type No. 2611, A. N. S. P.

This is *T. exoleta* Linn. of Gabb's Geology of Santo Domingo, p. 240.

Differs from *T. megalobasis* by having the early whorls more elaborately sculptured than the later, not smoother, as in *megalobasis*. It also tapers more gradually. Fig. 7a was inadvertently inverted.

With the preceding species in the Gabb collection there is one specimen probably referable to *T. megalobasis*, from which it differs only by having the same microscopic sculpture described for *T. domingensis*, and which is not visible on the small specimens of *megalobasis* at hand. It tapers much more rapidly than *T. domingensis*. Part of a whorl is shown magnified in Pl. 5, fig. 14 (the figure inverted).

Turritella tornata Guppy.

Turritella tornata Guppy, Quarterly Journal of the Geological Society of London, vol. XXII, 1866, p. 580, Pl. 26, fig. 12 (Cumana, Venezuela, type loc.).

The Colombian specimens are all fragmentary, but have the typical shape and sculpture. The largest piece, of slightly over 3 whorls, measures 20 mm. in basal diameter, 41 mm. long.

This species was also taken by W. M. Gabb in Santo Domingo, the specimens smaller, and varying some in sculpture. An ancestral form of *T. perattenuata* was found with them in the Gabb collection.² *T. perattenuata* of the Pliocene is clearly distinct from *tornata* by its much slower taper, though all of the group are closely related. The sculptural development of the series reached its acme in the upper Oligocene when the most highly sculptured species, *T. altilira*, became extinct.

Turritella calostemma n. sp. Pl. 5, fig. 15.

The shell resembles *T. altilira* Conrad. It is very long and tapers slowly; the whorls are rather narrow, and the suture is not obvious. The growth-lines are deeply arched across the visible part of the whorls. On each whorl there is a high, narrow spiral ridge at the upper fourth, its summit set with oblique tubercles. In the concave interval following there are numerous spiral striae and a slightly

² *Turritella perattenuata praeclens* n. subsp., Pl. 5, fig. 12. Even more slender than *perattenuata*, the upper of the two prominent beaded cinguli being double, the lower more acute, and in the later stages both are higher. There are several small cords in the median concavity, three being more prominent than the others. The growth-lines are inconspicuous, and retract strongly in the upper half of the whorls. All of the specimens are broken.

Length 57.5, basal diam. 8 mm.; 18 whorls.

" 40 " " 13.7 " 5 $\frac{1}{3}$ "

Cotypes No. 2608, A. N. S. P., collected by Wm. M. Gabb in Santo Domingo.

larger beaded central thread. Below the middle there is a second but narrower spiral ridge, slightly tuberculate, and near the lower edge there is a stronger spiral ridge, with convex, spirally striate, weakly tuberculate summit. The specimens are fragmentary, but indicate a length of at least 75 mm.; diameter of the largest fragment, 18 mm. It tapers a little more rapidly than *T. altilira*.

Haiti, 20 miles west of Azua. Also from between Las Cahobas and Thomonde; collected by Mr. Lloyd B. Smith, 1914.

This species differs from *T. altilira* by having three major spiral ridges, the lower two nearer together. In *altilira* and *tornata* there are but two, and the upper one is sometimes doubled more or less distinctly. In *T. calostemma* the upper ridge is simple.

T. calostemma and *T. altilira* seem to be two lateral branches of the *T. tornata* stock, highly accelerated in sculpture, reaching their acme and becoming extinct in the upper Oligocene, while descendants of the less specialized *tornata* stock held on to the Pliocene. Its last incarnation, *T. perattenuata*, shows little advance in sculpture beyond the Oligocene *tornata*; but it is specialized—probably over-specialized—by its extraordinary length and large number of whorls.

***Petalococonchus domingensis* Sowb.**

***Dentalium solidissimum* n. sp.** Pl. 5, fig. 8.

Known by a fragment which tapers rather slowly and is almost circular in section. The shell is very solid, at the lower breach the walls at least 3 mm. thick. It is sculptured with high ribs slightly narrower than their intervals, their crests and the intervals being rather strongly erenulated by circular striæ. The superficial layer has scaled off in great part, so that the finer sculpture described may perhaps be due to wear. There are 28 primary ribs, and near the larger end a few small interstitial riblets appear. Total length of the fragment, 28.2 mm.; greatest diameter 15.8 mm.; diameter 14 mm. at the smaller end.

This is probably a *Fissidentalium*, and from the fragment seems intermediate between *candidum* and *megathyris* in taper.

***Dentalium cartagenense* n. sp.** Pl. 5, fig. 10.

A species of the group of *Dentalium disparile*. Moderately curved, having seven angles, the intervals concave at the smaller, flat at the larger end. The two intervals bounding the keel on the concave side are wider than the others, and the three forming the curve of the convex side are decidedly narrower than the rest. Intervals have a few longitudinal threads at the smaller end, increasing with

growth, so that at the larger end there are 27 cords in all. The growth-lines are inconspicuous. The shell is broken more or less at both ends.

Length 19.4 mm.; antero-posterior diameter at larger end 3.7; lateral diameter 3.9 mm.; lateral diameter at smaller end 2.4 mm.

Pitar (*Hysteroconcha*) *casta* n. sp. Pl. 6, fig. 4.

The shell is oblong with small, rather plump beaks. Sculpture of continuous, smooth concentric ridges, their edges overhanging the succeeding intervals a little, and some of them broadened into lamellæ at the anterior end. They are not enlarged or interrupted posteriorly, and there are no spines. Between the concentric ridges there are fine growth-lines, some of them larger, thread-like. Lunule defined by a groove, radially striate. Interior not seen. Length about 26 mm.; height 19 mm.; semidiameter 6 mm.

The sole specimen is partially imbedded in material too hard to be removed, so that the internal characters and posterior end could not be examined. The sculpture, however, is very perfectly preserved and characteristic, and leaves very little doubt that the shell is related to the recent *P. dione* (L.). The absence of spines would be expected in an early member of the group. The concentric lamellæ are developed less than in *P. dione*, and turn downwards at the edge. In contour *P. casta* stands nearer to *P. lupanaria*.

Yoldia *pisciformis* n. sp. Pl. 6, fig. 3.

The shell is much lengthened, the posterior part decidedly attenuated (end broken), anterior end rounded. Surface nearly smooth, but under a lens showing delicate, rather close grooves in harmony with growth-lines, from the middle downward. A pair of extremely low ribs run in a low curve from the beaks to the anterior-basal margin. The teeth are very numerous, and appear to be about equally so before and behind the beaks.

Length, as broken, 50 mm.; height 22.6 mm.; diameter 10.8 mm.

This is much broader than *Y. limatula* Say, with a situation in the basal margin and various other differences.

A small, very finely grooved *Leda* is represented by one broken specimen.

Arca *consobrina* Sowerby.

Glycymeris *tumefactus* n. sp. Pl. 6, fig. 7.

The shell is slightly inequilateral, very obese, with rather prominent beaks. Sculpture of many (about 55) extremely low radial ribs, somewhat wider than their intervals, and weak, coarse growth-lines.

The convexity of the ribs is, in fact, barely perceptible, though they are perfectly obvious to the eye. Where eroded quite superficially, the ribs are reduced to flat spaces between slightly raised radii of half their width, representing the intervals. With further erosion the ribs are transformed into slightly concave radii with the edges a little raised, and separated by very narrow, deeply bitten crevices occupying the middle of the original intercostal valleys. With further etching, the edges of the original ribs become more prominent, the middle being eaten out, so that the effect is an even radial striation. The basal margin is strongly toothed within. The cardinal area is moderately wide. Teeth not examined. Height 44.4, diam. 32 mm.: length about 42 mm.

This species resembles *G. gigantea* Reeve of the west coast, and also *G. jamaicensis* Dall, of the Bowden bed. It differs from both in wanting very minute radial striae.

Glycymeris trilobioosta n. sp. Pl. 6, fig. 5.

The shell is compressed, equilateral, with small beaks; rather thick. Sculpture of about 32 radial ribs, the small ones at the ends simple, the rest brace-shaped (—), their interstices narrow grooves; towards the beaks the cross-section becomes simpler, the ribs at first being convex. Over the ribs there is a very regular, close sculpture of minute concentric threads. The basal margin is toothed within, as usual. Cardinal area small, having about 3 V-shaped grooves. Teeth 12 on each side, rather long, smooth-sided, those of the median part a little bent angularly.

Height 14.6, length 14.5, semidiameter 4 mm.

The peculiar form of the ribs and the beautiful concentric sculpture over them are the chief characters of this species.

Glycymeris lloydsmithi n. sp. Pl. 6, fig. 6.

The shell is moderately convex, slightly inequilateral, the margins somewhat straightened on both sides of the umbo. Sculpture of about 27 very low, broad, rounded ribs, rapidly becoming weaker towards the base, faint on the anterior end, which is bisected by an indistinct radial angulation, as in *G. jamaicensis* and some recent Antillean species. No secondary radial striation can be seen. The cardinal area is very small, not grooved. There are 11 teeth before and 12 behind the beaks; most of the posterior teeth and a few of the anterior being angularly bent. The articulating faces of all of the teeth have very minute striation vertical to the tooth. The lower half of the inner margin of the shell shows about 20 prominences of the usual form.

Height 29.2, length 28, semidiameter 9 mm.

The ribs weaken rapidly towards the base, where they almost disappear, reminding one of *G. subovata* (Say). *G. jamaicensis* Dall differs by its greater length, much less arched hinge line and fine striation.

Ostrea vaughani insularis n. subsp. Pl. 6, figs. 1, 1a.

The common large oyster of Santo Domingo resembles *O. vaughani*, as described and figured by Dall, except in the following features: The beak is usually straight; the upper valve is very much smoother than the lower, marked with growth-lines only, and it is usually almost flat. The lower valve is thick, coarsely lamellar, not fluted, and has a rather deep beak cavity. The valves have a sparse denticulation inside near the hinge. Length of lower valve 106, width 58 mm. It may perhaps be well to signalize these differences by a subspecific name.

Santo Domingo, W. M. Gabb. No. 2635, A. N. S. P.

Ostrea cahobasensis n. sp. Pl. 6, fig. 8.

This oyster is similar to the preceding except that in a large series of specimens none were found to have the inner margins of the valves denticulate near the hinge. The upper valve is nearly flat and is perhaps somewhat rougher than in *insularis*. Length 85 mm. It often reaches a much larger size, length 190 mm. or more.

Haiti, in the mountains north of Lake Assuei, on the trail to Las Cahobas, W. W. Webster; Arrondissement de Las Cahobas, G. Roumain; also south of Thomonde, Lloyd B. Smith. Occurs in extensive beds composed almost wholly of oysters.

Type No. 1308, A. N. S. P.

Ostrea sculpturata osculum n. subsp. Pl. 6, figs. 2, 2a.

A small oyster of rounded or subtriangular shape, nearly equilateral. The umbonal half is more or less obviously cuneate in outline, with crenulated submargins; the opposite (basal) border is broadly rounded and extremely sinuous, typically having two deep, angular plications in each valve. The lower valve has a very shallow beak-cavity, the flatter upper valve none. The adductor impression is strongly lateral in position. Beaks are rather short and oblique, nearly equal in the two valves. Length 42.5, width 39, diam. 37 mm.

Some examples are flatter, with less emphatic and fewer plications. It is certainly not identical with the recent *O. megodon*. It differs from *O. sculpturata* by the reduced number and large size of the folds.

Type No. 3037, A. N. S. P.

EXPLANATION OF PLATES V AND VI.

PLATE V.—Fig. 1.—*Turris cartagenensis* n. sp.

Fig. 2.—*Marguella mediocris* n. sp.

Fig. 3.—*Strombina cartagenensis* n. sp.

Fig. 4.—*Strombina lloydsmithi* n. sp.

Fig. 5.—*Potamides arus* n. sp.

Fig. 6.—*Oliva sayana immortua* n. subsp.

Fig. 7.—*Turritella domingensis* n. sp.

Fig. 7a.—*Turritella domingensis*. Part of the last whorl, enlarged. The figure is inverted.

Fig. 8.—*Dentalium solidissimum* n. sp.

Fig. 9.—*Turritella domingensis*, n. sp. Young shell. $\times 3$.

Fig. 10.—*Dentalium cartagenense* n. sp.

Fig. 11.—*Turritella lloydsmithi* n. sp.

Fig. 12.—*Turritella prattenuata praxellens* n. subsp.

Fig. 13.—*Turritella cartagenensis* n. sp.

Fig. 14.—*Turritella megalobasis* Dall. Part of a whorl much enlarged. The figure is inverted.

Fig. 15.—*Turritella calostemma* n. sp.

PLATE VI.—Figs. 1, 1a.—*Ostrea raughani insularis* n. subsp.

Figs. 2, 2a.—*Ostrea sculpturata osculum* n. subsp. Ventral and lateral views.

Fig. 3.—*Yoldia pisciformis* n. sp.

Fig. 4.—*Pitar casta* n. sp.

Fig. 5.—*Glycymeris trilobocosta* n. sp.

Fig. 6.—*Glycymeris lloydsmithi* n. sp.

Fig. 7.—*Glycymeris tumefactus* n. sp.

Fig. 8.—*Ostrea cahobasensis* n. sp. Interior of deep valve.

NOTES ON THE ANATOMY OF OREOHELIX. II.

BY HENRY A. PILSBRY.

The following notes supplement those contained in these PROCEEDINGS for 1916, pp. 340-359. With one exception they deal with material collected by Professor Junius Henderson and Mr. L. E. Daniels in Utah and Idaho, in 1916. A single species taken by Mr. Ferriss in southern Nevada is also included.

Oreohelix haydeni and subspecies. Fig. 1.

The typical form has not been rediscovered, but it is not likely to differ materially in genitalia from the numerous forms of the species already dissected. The several subspecies are much alike in soft anatomy: the chief differentiation has been in the shells. The researches of Messrs. Henderson and Daniels in 1916 have added materially to our resources, particularly in northeastern Utah.

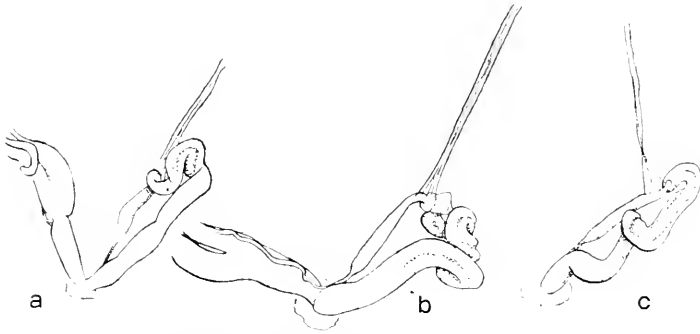


Fig. 1.—*a*, *Oreohelix haydeni hybrida*, St. Charles, Idaho; *c*, Devil's Slide, Utah, Station 54; *b*, *O. h. mixta*, Glenwood Springs, Colo., Station 134.

As the printer transposed several columns of my former table of measurements,¹ the entire series of measurements of genitalia is given below. This replaces the table given in 1916.

As *O. h. oquirrhensis* form *utahensis* Hemph. was very inadequately defined, and no type seems to have been selected, I name No. 23,051 A. N. S. P., as lectotype, in order to have a definite standard. This specimen was described in *Nautilus*, XXIX, p. 141, April, 1916.

¹ PROC. A. N. S. PHILA., 1916, p. 347.

SUB-SPECIES AND LOCALITIES.	Length of penis.	Length of internally costate part of penis.	Length of epiphallus.	Penial retractor mm.- etc.	Length of vagina.	Length of spermatheca and duct.	Approximate diameter of shell.	Collecting stations, etc.
<i>O. h. gabbiata</i> , Oquirrh Mts	16	6	5.5	11	5.5	20		Station 15.
<i>O. h. corrugata</i>	16.5	5	5	7	5	17	18	Station 40.
<i>O. h. hybrida</i> , near Logan Canyon.....	16	4	4	5	5	15	19	Station 42.
St. Charles, Idaho	12	5.3	4.7		4		13	Station 77.
	10	4	4					Station 77.
Deweyville, Utah	16	6	5	9.5			16	Station 104.
Devil's Slide, Utah	15	6.5	5.3	9.3			18	Station 54.
<i>O. h. "utahensis,"</i> Devil's Slide.....	12	5	4				17	Station 51.
<i>O. h. mixta</i> , Glenwood Springs, Colo.	15.5	5	5.3	10			15	Station 134.
	17	5.5	5.5		5.		16	Station 134.
Type	18	6.8	6.3	18	9		18.3	94058 A. N. S.
	17.5	7.7	6	8	6		18	94796 A. N. S.
<i>O. h. betheli</i>	19	6	7.5	18+	5	21	22.5	94059 A. N. S.

NOTE.—In the last three entries the diameter of shell is from the specimen dissected. In other cases it is from a medium specimen of lot. The collecting stations mentioned are those of Henderson and Daniels' expedition of 1916.

***Oreohelix peripherica* (Anc.).** Fig. 3b.

A view is given of the penis of a white specimen from Station 47, Morgan, Utah. Length of penis 13 mm., of ribbed portion 5, of epiphallus 4.5, of penial retractor 12 mm. (fig. 3b).

O. p. wasatchensis (Hemph.) from Station 108 shows the same proportions, though the absolute size is greater. Length of penis 20 mm., of internally ribbed part 8, of epiphallus 7, of penial retractor 15 mm. A specimen from Station 109 is identical in genitalia.

***Oreohelix strigosa depressa* (Ckll.).**

An example of the rather elevated form of the color-form *carnea* from City Creek Canyon, Salt Lake City, is similar to those already

figured in genitalia. Length of penis 27 mm., of internally ribbed part 11, of epiphallus 7 mm. The distal part has a trilobed section.

Oreohelix cooperi (W. G. B.).

Specimens dissected from four localities give the following measurements of the male organs:

	Sta. 68, near Montpelier, Idaho.	Sta. 69, near Montpelier, Idaho.	Sta. 73, Paris, Idaho.	Sta. 83, near Garden City, Utah.
Length of penis	12.3	11	17	12 mm.
L. internally ribbed part of penis	6.5	6.3	10	7 "
L. epiphallus	4.6	6	6	4 "
L. retractor penis	14			10 "
Diam. of shell (approximate)	19	14	25	17 "

As noted in a previous paper, this species is constantly distinguishable from *O. peripherica* and the several forms of *strigosa* and *haydeni* by having the internally ribbed part of the penis longer than the papillose part; but *O. rugosa* has the same proportions of the penis, and can be distinguished from *O. cooperi* only by shell characters, which are not very definite.

Oreohelix hendersoni dakani Henderson. Fig. 2.

Specimens from the type locality, Newcastle, Colo., were dissected. The genitalia are similar to *hendersoni*, and unlike *O. rugosa*, which

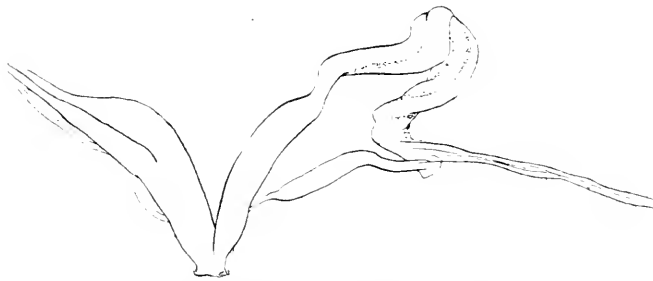


Fig. 2.—*Oreohelix hendersoni dakani*, genitalia.

resembles *O. cooperi* closely in soft anatomy. The distal part of the penis of *dakani* has a trilobed transverse section.

Length of penis,	21 mm.;	of ribbed lower part 7.3 mm.
Length of epiphallus,	6.3 mm.	
Length of retractor p.,	14 mm.	
Length of vagina,	6 mm.	

Oreohelix tenuistriata Hend. and Dan. Fig. 3a.

Topotypes dissected show that this is a species having genitalia like *haydeni* and *strigosa depressa*. The length of penis is equal to the diameter of the shell; the length of its internally ribbed lower portion is contained $2\frac{1}{2}$ times in the total length.

Length of penis,	10 mm.;	of its internally ribbed portion
		4 mm.
Length of epiphallus,	2 mm.	
Length of retractor p.,	6.5 mm.	
Length of vagina,	3 mm.	

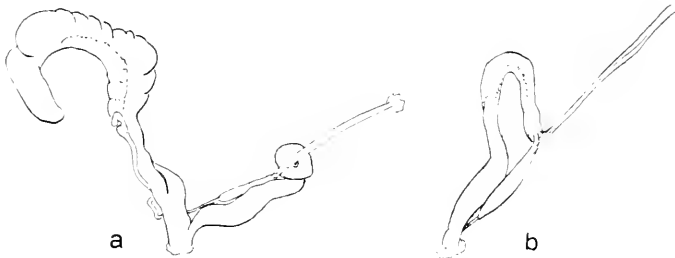


Fig. 3.—a, *Oreohelix tenuistriata*. b, *O. peripherica*, Morgan, Utah.

The central and lateral teeth have sharp side cutting points, the marginals with distinct cusps. There are about 6 lateral teeth; but the transition to marginals is very gradual. Jaw is striate, light yellow.

O. hemphilli and *O. carinifera*, which approach *tenuistriata* in characters of the shell, are unfortunately not known anatomically, but the forms nearest *hemphilli* have genitalia like *O. yarapai*.

Oreohelix hemphilli eurekensis Hend. and Dan. Fig. 4a.

Topotypes dissected. It groups with *O. yarapai*, having the internally ribbed part of the penis more than half the total length, the latter less than the diameter of the shell. We do not know the genitalia of typical *O. hemphilli*, but assuming that it is like *eurekensis*, both should be transferred to the group containing *O. yarapai*, *concentrata*, *metcalfei*, *pilsbryi* and *barbata*.

Length of penis,	4.4 mm.;	of ribbed portion 2.5 mm.
Length of epiphallus,	2 mm.	
Length of retractor p.,	6 mm.	

There are distinct side cutting points on the central and two or three lateral teeth, after which there are distinct side cusps. There are about 7 lateral teeth. Transition to marginals very gradual.

Oreohelix handi Pilsbry and Ferriss. Fig. 4b.

One of the original lot collected by Mr. Ferriss on Charleston Mountain in southern Nevada was dissected. The penis is 3 mm. long, epiphallus 1.3 mm. The internally thickened part of the penis is about half the total length and much swollen. It is closely related to *O. yavapai* and *O. hemphilli eurekaensis*.



Fig. 4.—a, *Oreohelix hemphilli eurekaensis*. b, *O. handi*.

THE REPRODUCTIVE ORGANS OF
EPIPHRAGMOPHORA CALLISTODERMA P. and F.

BY H. A. PILSBRY.

This species proves to belong to the subgenus *Helminthoglypta*. There is a large dart sack, bearing a two-branched mucous gland. The slender duct divides into two oblong bulbs, which end in slender terminal portions longer than the bulbs, and folded down upon them, as shown in the detail, fig. 1*a*, where the terminal branch of the left

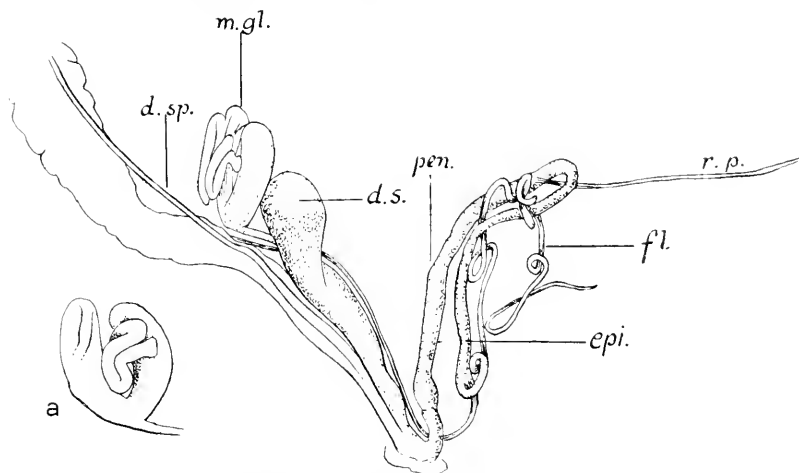


Fig. 1.—Genitalia of *Epiphragmophora callistoderma*, only the terminal ducts of the female organs drawn. *d.s.*, dart sack; *d.sp.*, duct of the spermatheca; *epi.*, epiphallus; *fl.*, flagellum; *m.gl.*, mucous gland; *pen.*, penis; *r.p.*, retractor muscle of the penis. At *a* the two-branched mucous gland is drawn.

bulb is cut off. The duct of the spermatheca is extremely long, and no branch or diverticulum was observed. The flagellum is longer than the penis + epiphallus. There is a short sheath about the slender base of the penis. The limits of penis and epiphallus are not obvious externally. The penial retractor is inserted 16 mm. from the base of the penis. The length of penis + epiphallus is 30 mm.; of flagellum, 36 mm.; of dart sack 13 mm.; vagina 4 mm. long. The spermathecal duct is slightly over 60 mm. long.

The specimen dissected was one of the original lot.

HUNTING MOLLUSCA IN UTAH AND IDAHO IN 1916.

BY JUNIUS HENDERSON AND L. E. DANIELS.

We were in Utah and southern Idaho from June 10 to July 24, 1916, continuing the work begun in 1915.¹ More attention was given to fresh-water species and the smaller land snails than before, with some interesting results. A vast amount of work remains to be done in this region before the molluscan faunas and the significance of their present distribution are thoroughly understood.

The known Tertiary and Pleistocene history of the Salt Lake Basin is such that it must vitally affect the present distribution of species, as well as possibly influencing local variations. Great Salt Lake and Utah Lake, both within the area covered by this report, are among the remnants of a much larger body of water known to geologists as ancient Lake Bonneville. During Pleistocene time it extended over a large part of Utah and into Idaho, with a depth of hundreds of feet. In its retreat it left a fine series of terraces around the margin of its basin to mark the various stages of its recession. The formations deposited beneath the waters of the ancient lake, the fluctuations of its water level, and its molluscan life as revealed by the numerous fossils contained in the lacustrine deposits have been subjects of extensive investigation and discussion.²

The aridity of the vast area between the Rocky Mountains and the Sierra doubtless dates well back into Pliocene time. The changes in the water level in the various lake basins do not necessarily imply periods of great humidity. Each receives the drainage of a large territory, and being completely land-locked, a slight increase in the precipitation for a short cycle may extend the borders of the lakes far out over the flat, low-lying area around the lake margins, and increased precipitation for a longer period may fill the basins to overflowing. The rise and fall of the waters of land-locked lakes constitute a complete and accurate record of the net result of all the

¹ PROC. ACAD. NAT. SCI. PHILA., LXVII, pp. 315-339, 1916.

² See especially the following: Gilbert, G. K., "Contributions to the History of Lake Bonneville," U. S. Geol. Surv., 2d Ann. Rept., pp. 167-200, 1882, with plates and map; "Lake Bonneville," U. S. Geol. Surv., Monographs, vol. 1, 1890, with plates and map. Call, R. Ellsworth: "On the Quaternary and Recent Mollusca of the Great Basin, with descriptions of new forms," U. S. Geol. Surv., Bull. No. 11, 1884.

climatic factors, chief of which are precipitation and temperature, evaporation being an expression of the relations of temperature to humidity. Even within the short period of occupation by the white race, notable changes in the area of Great Salt Lake and other lakes of the region have been recorded, but these changes have been insignificant when compared with those shown by the geological record. In Pleistocene time there were at least two periods of enormous expansion and contraction. During these expansions the Oquirrh and some of the other mountain ranges were peninsulas projecting far out into the lake, while the southern part of Promontory Range and many other small ranges were islands. Thus during the periods of great extension the direct intercommunication of the land-snail faunas of the several mountain ranges was either partially or wholly prevented by the intervening waters. During the recession periods between the major expansions, as well as during the long periods before the first expansion and after the last contraction, many of these mountain areas were nearly as well insulated by wide expanses of territory apparently quite unfavorable to land snails, especially the larger snails of the genus *Oreohelix*. It is well to note, however, that as work upon this genus progresses, flourishing colonies of the living snails are found from time to time in unexpected places, where the cover does not seem at all good. It should also be kept in mind that very few of the isolated mountain ranges have been explored at all, and none of them thoroughly explored, by conchologists. Hence the last word on this phase of the subject cannot be written, even aside from the possibility of the accidental transportation of snails by birds and other agencies. Turning now to the fresh-water mollusks, direct intercommunication of the faunas of such streams as the Bear River, flowing into Great Salt Lake from the north, and the Jordan, entering from the south, has been prevented ever since the last contraction of Lake Bonneville by the extremely saline waters of the lake, which form a complete barrier, as effectual as a land barrier. This salinity is due to the fact that the lake is land-locked. The streams pour their waters, containing salts dissolved from the soil and rocks, into the lake. There, in the absence of an outlet, the loss is wholly by evaporation, which leaves the salts in the water, thus maintaining a concentrated solution, while Utah Lake, Bear Lake and others with outlets remain fresh. However, during what is known as the "Lake Epoch," Lake Bonneville once or twice reached such depth that it established an outlet at the north end of the Cache Valley in Idaho, resulting in the

temporary freshening of the water. Hence it is not surprising that certain strata in the lacustrine deposits contain numerous fossil shells. Nearly all the species in this fossil fauna are still found living in some part of the Bonneville Basin, as was long ago pointed out by Call and Gilbert. The drainage during the overflow period also afforded communication between the various rivers of the basin and the Port Neuf River to the north, thus easily explaining the observed similarity in their faunas.

Our work in the region has developed a peculiar and as yet unsolved problem in the breeding habits of the genus *Orcohelix*. The genus is viviparous. In 1915 the snails of the genus collected in the last week in August contained many embryos, but those obtained after the first two or three days in September contained few or none. In 1916 we found very few embryos during the months we were in the field, June and July, yet if the embryos were to be so fully developed by the last of August as to be all gone early in September, as in 1915, it seems that they should have been developing by the middle of July. To add to our perplexity, a considerable number of live snails which were found among the dead shells in cleaning them in November and December, nearly all contained embryos of $1\frac{1}{2}$ or 2 whorls. These must have developed after July while the snails were dormant.

Over a large portion of the region covered by this report, the combined effects of brush fires and overgrazing, with the consequent erosion, have played sad havoc with the cover for land snails. In some places where the steep slopes below clumps of bushes were almost white with bleached *Orcohelix* shells, the washing of the soil and dead leaves from beneath the shrubs had totally destroyed the cover, so that not a living snail could be found, and the shrubs themselves must die as erosion continues to take the soil away from the roots.

We have continued our station numbers from the 1915 expedition, and revisited several of the 1915 stations to obtain more material and data. We also include in this report some material obtained by Daniels in 1915 at Idaho Falls, Dubois, McCammon, and Weston, but not hitherto recorded, together with some unrecorded material in the University of Colorado Museum, in order to keep all our Utah and Idaho records together.

We gratefully acknowledge the assistance of several who have aided in the determination of difficult material. The Sphaeriidae were examined by Dr. V. Sterki. Dr. Bryant Walker has identified

or confirmed the identifications of the Physas and Lymnæas, as well as some of the other fresh-water snails. Dr. H. A. Pilsbry has determined many of the smaller and more difficult land snails and has examined both shells and soft anatomy of the Oreohelices. The Physas and Sphæriidæ of the region are not well understood and difficult at the best. Hence many of the determinations must be considered tentative. In a number of instances, also, the material is in poor condition for determination.

RUPERT, IDAHO.

The following species in the University of Colorado Museum were collected by Mr. Fayre Kenegy, along the Snake River, near Rupert, in 1913:

<i>Pisidium</i> sp.	<i>Lymnaea</i> near <i>traskii</i> Tryon.
<i>Sphærium</i> sp.	<i>Physa</i> sp.
<i>Anodonta nuttalliana</i> Lea.	<i>Ancylus crassus</i> Hald.
<i>Fluminicola fusca</i> (Hald.).	

The *Sphærium* is apparently the same puzzling species as that from Sta. 74, near Ovid, Idaho.

IDAHO FALLS, IDAHO.

The following species were collected by Daniels, in and on the banks of Snake River, Idaho Falls, in August, 1915:

<i>Sphærium</i> near <i>aureum</i> Prime.	<i>Lymnaea humilis modicella</i> Say.
<i>Pisidium compressum</i> Prime, var.	<i>Lymnaea humilis rustica</i> Lea.
<i>Zonitoides nitida</i> (Müll.).	<i>Lymnaea apicina solida</i> Lea.
<i>Succinea haydeni</i> W. G. B.	<i>Planorbis parvus</i> Say.
<i>Succinea oregonensis gabbii</i> Try- on?	<i>Physa</i> near <i>gyrina</i> Say.
<i>Fluminicola fusca</i> (Hald.).	<i>Physa ampullacea</i> Gld.

The Lymnæas and Physas were identified by Walker. We record *Physa ampullacea* from a number of stations, all the material having been identified or identifications confirmed by Walker. Gould³ described this form from Oregon, under the name *P. bullata*, in 1855. In 1865 Binney⁴ republished the description, figured the species, and, at Gould's suggestion, renamed it *ampullacea*, the name *bullata* being preoccupied. He recorded it also from Washington. Mean-

³ *Proc. Boston Soc. Nat. Hist.*, V, p. 128, 1855.

⁴ Land and Fresh Water Shells of North America, Part II, p. 79, figs. 133, 134, 135, 1865.

time, in 1864, Lea⁵ described *Physa nuttallii*, from Lewis River, Oregon, but did not figure it. If, as we suspect and as Dr. Pilsbry (Mss.) concluded some years ago, these names are synonyms, *nuttallii* has priority. In that event, all our records of *P. ampullacea* should be changed to *nuttallii* Lea.

The *Sphærium* from Idaho Falls and the McCammon stations are doubtfully referred to *S. aureum* Prime by Sterki. The beaks of the McCammon examples are less elevated than the beaks of the Idaho Falls material.

The type locality of *Lymnæa hinkleyi* Baker is the North Fork of Snake River, eastern Idaho, and therefore must be not far north or northeast of Idaho Falls. The type locality of *Lymnæa jacksonensis* Baker is Jackson Lake, Wyoming, which is drained by the South Fork of Snake River, and the species is also recorded from Snake River. Baker, in his monograph, records *Lymnæa apicina solida* Lea from Salmon River, Idaho.

DUBOIS, IDAHO.

In August, 1915, Daniels collected the following species in Beaver Creek, at Dubois:

<i>Pisidium compressum</i> Prime.	<i>Lymnæa proxima</i> Lea.
<i>Pisidium</i> sp.	<i>Physa sparsestriata</i> Tryon?
<i>Lymnæa humilis rustica</i> Lea.	

THE McCAMMON, IDAHO, DISTRICT.

We revisited stations 1, 1½ and 2, of 1915, and also established several other stations.

Sta. 1, west side of Port Neuf River, about a mile north of McCammon. *Oreohelix cooperi* (W. G. B.) is very abundant under wild cherry, wild rose and various shrubs, among large blocks of lava at the foot of a low bluff. *Pyramidula cronkhitei anthonyi* Pils., three dead shells. On the banks of the near-by slough we found *Lymnæa proxima* Lea, *Pisidium* (Sterki says *P. huachucanum* Pils., compare also *P. ashmuni*), and *Physa ampullacea* Gld. In 1915 at this place Daniels found a few *Succinea*, doubtfully identified at the time by Walker as *S. oregonensis gabbi* Tryon. Pilsbry says: "It is not *gabbi*. Just what it is I do not know. Has the microscopic sculpture of *stretchiana*, but seems too big and too long. With a good series one might come to some conclusion."

Sta. 62, Port Neuf River, east of Sta. 1. *Sphærium* near *aureum*

⁵ PROC. ACAD. NAT. SCI. PHILA., XVI, p. 116, 1864.

Prime and *Fluminicola fusca* (Hald.), both abundant, one example of *Physa* identified by Walker as *P. ampullacea*, var. close to *propinqua*.

Sta. 1½, about ten miles above McCammon, on south side of Port Neuf River, north side of gulch on east side of mountain about three miles south of west from Lava Hot Springs.

***Oreohelix tenuistriata* H. and D.**

This is the type locality of the species, the description of which was based upon three imperfect and immature examples. We revisited the station, where a search of several hours resulted in obtaining about thirty specimens alive, mostly immature, and twice as many dead shells, under shrubs and mats of the radical leaves of *Balsamorhiza sagittata* (Nutt.), overhanging small piles of limestone, in open spaces among the mountain mahoganies, which are here the largest we have seen. The dense blanket of small leaves directly under the mahoganies is not favorable to the snails. This material shows that the species is a larger, finer one than was indicated by the type and co-types, and compels an amendment of the description, as follows: Shell rather depressed to moderately elevated; whorls 5, convex, carinated almost to the aperture; color very light brown, with two almost undiscernible darker spiral bands, one well above, the other scarcely below, the periphery. The spiral riblets on the best specimens, especially bleached ones, may be seen with the unaided eye. The two largest examples measured are each 13.5 mm. in major diameter, and one is 8 mm., the other 9.5 mm. in altitude. Otherwise the original description holds good. The beautiful sculpture distinguishes it from all other species of the genus we have examined. Pilsbry writes that in genitalia this species is of the *haydeni* type.

In the gulch bottom, just below the *Oreohelix* slope, among aspens and mountain maples, we obtained *Vitrina alaskana* Dall, *Zonitoides arborea* Say, *Vallonia cyclophorella* Ancy and *Euconulus fulvus alaskensis* Pilsbry.

Sta. 63, next gulch north of Sta. 1½. We found here a few *Oreohelix tenuistriata* H. & D.

Sta. 64, bank of Port Neuf River, two or three miles below Sta. 63. We obtained here the following:

<i>Sphaerium</i> near <i>aureum</i> Prime, abundant.	<i>Pyramidula cronkhitei</i> anthonyi Pils.
<i>Succinea arava</i> Say.	<i>Fluminicola fusca</i> (Hald.).
<i>Succinea rusticana</i> Gld.	<i>Lymnaea humilis modicella</i> Say.
	<i>Planorbis parvus</i> Say.

It is probable that the *Sphærium* and the *Fluminicola* may be found in favorable situations all along the stream, and the former was noted as a fossil in the alluvial banks of the river at several places.

Sta. 2, south side of Harkness Canyon, at the springs near a great white cliff plainly visible from McCammon. The large, heavy-shelled *Oreohelix strigosa depressa* (Ckll.), noted for this station in our former report, occurs in limestone slides on a steep slope almost concealed by a heavy cover of conifers, with an undergrowth of mountain maples and various shrubs. A conifer forest is an unusual habitat for such a fine colony of *Oreohelix*. In the bottomland below the slides we found dead shells of *Thysanophora ingersolli* (Bland) plentiful in fine drift wood, and a short distance down the canyon we obtained *Euconulus fulvus alaskensis* Pils., *Zonitoides arborea* (Say), *Vitrina alaskana* Dall and *Vallonia cyclophorella* Ancy.

Sta. 65, east side of gulch coming into Harkness Canyon from the north, above Sta. 2. Large *Oreohelix strigosa depressa* (Ckll.) abundant, in more open, cleaner slides than at Sta. 2, with few trees and much less shrubbery and herbage.

Sta. 66, Goodenough Canyon, on east side of a mountain range about five miles west of McCammon. We drove to the end of the road up the canyon, then walked a mile further. Found no limestone, no good rock slides and no *Oreohelix*, but under leaves and sticks we obtained the following:

<i>Zonitoides arborea</i> (Say).	<i>Euconulus fulvus alaskensis</i> Pils.
<i>Pyramidula croukhitei anthonyi</i>	<i>Punctum</i> n. sp.
Pils.	<i>Vertigo modesta parietalis</i>
<i>Vitrina alaskana</i> Dall.	(Ancy).
<i>Thysanophora ingersolli</i> (Bland).	

BEAR LAKE VALLEY IDAHO AND UTAH.

Bear Lake, at an altitude of 5,925 feet, is about nineteen miles long (north to south) and from six to eight miles in width, bisected by the Utah-Idaho boundary line. It is bounded on the east, west and south by mountains, but the broad valley extends to the northward beyond Montpelier to Bennington, thus giving the valley a length of forty miles, drained by the Bear River, which flows into Great Salt Lake. In the Geologic Atlas of the United States (United States Geological Survey) the region is covered by the Montpelier (Idaho) and Randolph (Utah) Quadrangle sheets. We did not visit the eastern or southern shores of the lake, but spent half a day at

the northern end and examined the western shore at various places. We found no living mollusks in the lake itself. This may be due to the fact that the water was considerably above the usual level and we were not prepared for dredging. The sloughs and streams of the valley furnished quite a number of species of fresh-water mollusks alive, and the mountains and canyons bordering the valley yielded land snails.

Sta. 67, just within the mouth of Montpelier Canyon, northwest of Montpelier, Idaho, on the south side of the canyon. *Oreohelix cooperi* (W. G. B.) abundant, mostly immature, under shrubbery on slope beneath a limestone ledge almost devoid of rock slides. Although the snow from a two days' storm (June 20-21) was just melting, on June 22 the snails were all active and hence easy to find. Mature examples from this station measure about 20 mm. in diameter. *Vitrina alaskana* Dall was noted on a ditch bank. This *Vitrina* we found at almost every station where we found *Oreohelix*, but we did not always collect it and perhaps in some instances failed to record it in the notebook.

Sta. 68, three miles up Montpelier Canyon, on the north side of a ravine that comes in from the east. *Oreohelix cooperi* (W. G. B.) plentiful, nearly all mature, in limestone rock slides, mature examples varying from 17 mm. to 21.5 mm. in diameter, mostly about 20 mm.

Sta. 69, south side of the same gulch, opposite Sta. 68 and not more than 150 feet distant. *Oreohelix cooperi* (W. G. B.), live examples scarce, dead shells plentiful, under shrubbery on a limestone slope devoid of rock slides. Though separated from Sta. 69 only by the narrow bed of the gulch and with the more favorable north exposure, the snails here are much smaller, the shells varying from 13.5 mm. to 15.5 mm. in diameter. Lack of cover does not appear to be the cause of the difference in size, as the cover at Sta. 67 is about the same.

Sta. 70, canyon about two miles north of Montpelier. *Oreohelix cooperi* (W. G. B.), of fair size, but not plentiful, in edges of limestone slides.

Sta. 71, a short distance up Bennington Canyon, east of Bennington (north of Montpelier). *Oreohelix cooperi* (W. G. B.), large, robust, very abundant under shrubbery, especially wild roses, on steep banks of creek, active among the tiny patches of snow remaining from the late storm. None found in the big sandstone slides on the slope above the brush and trees of the narrow bottomland.

Sta. 72, sloughs on east side of Bear River, on both sides of the Montpelier-Ovid wagon road. We here obtained the following:

<i>Sphaerium</i> sp.	<i>Lymnaea utahensis</i> Call.
<i>Musculium</i> n. sp.	<i>Planorbis trivolvis</i> near <i>binneyi</i>
<i>Succinea rusticana</i> Gld.	Tryon.
<i>Valvata humeralis californica</i>	<i>Planorbis parvus</i> Say.
Pils.	<i>Planorbis exacuus</i> Say.
<i>Lymnaea stagnalis appressa</i> Say.	<i>Physa ampullacea</i> Gld.
<i>Lymnaea proxima</i> Lea.	<i>Aplexa hypnorum</i> (Linn.).

The *Planorbis trivolvis* at all stations in this valley reaches great size—up to 35 mm. in diameter in some instances. They have the strong transverse sculpture of the variety *binneyi*, but the whorls are not quite so conspicuously strap-like as those from Sta. 127 at Utah Lake. Caddis larvæ cases from one of the sloughs are composed almost wholly of *Planorbis parvus*, *P. exacuus* and other small shells and shell fragments. *Planorbis exacuus* was described by Say,⁶ in 1821, under this name as thus spelled, apparently a poorly formed adjective from *exacuo* or from *acu*, referring to the sharp periphery. It should have been spelled either *exacueus* or *exacutus*. Gould,⁷ in 1841, inserted the *t*, saying:

"I cannot but think that the name under which this shell appears in the 'Journal of the Academy,' is not exactly as it was intended by the author, as it is neither a Latin word nor a Latin termination. Supposing that by a typographical error, an *o* has taken the place of a *t*, we have a legitimate term, and one very expressive of the form of the shell."

In his synonymy he gives the original spelling. Haldeman, in his monograph, 1842, follows Gould, but in the synonymy he also cites the name as originally published. Unfortunately, Binney,⁸ in 1865, adopting Gould's form of the name, in his synonymy of the species cited Say's original description as though it had been spelled *exacutus*. As the latter is the work most generally accessible and used for reference, it has misled many subsequent writers. If the original name were clearly a misprint and we could ascertain just what was intended, the rules of nomenclature would justify its correction. It is conceivably, though not likely, a case of poor judgment in the formation of the word, and not a typographical error. If a printer's error, it seems more likely that the printer, well accustomed to the common English syllable *ous*, had carelessly inserted an *o* in *exacuus*,

⁶ JOURN. ACAD. NAT. SCI. PHILA., II, p. 165, 1821.

⁷ A Report on the Invertebrata of Massachusetts, pp. 208-209, 1841. See also Binney's edition of the same, pp. 495-496, 1870.

⁸ Land and Fresh Water Shells of North America, Part II, p. 126.

than that he had replaced the *t* in *exacutus* with an *o*. We have no way of ascertaining which form the author intended. Hence we believe the original spelling should be retained, bad as it is, and it is no worse in this respect than many other names in general use.

Sta. 74, southwest of Sta. 72, about two miles north of east from Ovid, Idaho, where the railroad track crosses Bear Lake outlet. Dead shells of the following species were found in the loose sand on the bank of the stream:

<i>Sphaerium</i> sp.	<i>Valvata humeralis californica</i> Pils.
<i>Pisidium compressum</i> Prime.	<i>Valvata utahensis</i> (Call).
<i>Pisidium</i> near <i>variabile</i> Prime.	<i>Carinifex newberryi</i> (Lea).
<i>Anodonta wahlametensis</i> Lea?	<i>Lymnaea proxima</i> Lea.
1 broken valve.	<i>Planorbis trivolvis</i> near <i>binneyi</i>
<i>Succinea haydeni</i> W. G. B. ?	Tryon.
2 broken shells.	<i>Planorbis parvus</i> Say.
<i>Fluminicola fusca</i> (Hald.).	

The *Sphaerium* is very large, but Sterki does not consider it *S. pilsbryanum* St., which would be expected in this vicinity. He does not venture to name these specimens.

Sta. 75, slough from Mill Creek drainage, beside the railroad track, a mile north of east from Ovid. *Musculium* n. sp. abundant, gravid.

Sta. 76, Mill Creek, where railroad crosses it south of Ovid.

<i>Anodonta nuttalliana</i> Lea, one alive.	<i>Lymnaea stagnalis appressa</i> Say.
<i>Sphaerium</i> sp., 3 fresh shells.	<i>Planorbis trivolvis</i> near <i>binneyi</i>
<i>Fluminicola fusca</i> (Hald.).	Tryon.
	<i>Physa ampullacea</i> Gld.

Sta. 73, three or four miles up Paris Canyon, west of Paris, Idaho. *Oreohelix cooperi* (W. G. B.) common under shrubbery on limestone slopes devoid of slides. A search for small snails in an aspen grove near by proved surprisingly fruitless.

Sta. 77, half a mile up St. Charles Canyon, west of St. Charles, Idaho. *Oreohelix haydeni hybrida* (Hemph.), with sculpture less pronounced than in the Logan colony, common under the radical leaves of *Balsamorhiza sagittata* and shrubs, on a limestone slope devoid of rock slides. A few *Vallonia cyclophorella* Ancy and quite a number of *Pupilla muscorum idahoensis* n. subsp. were found.

***Pupilla muscorum idahoensis* n. subsp.**

Differs uniformly from typical *P. muscorum* (L.) in its more slender form and thinner lip. Color light to dark brown. The

type, in the University of Colorado Museum, measures 3.1 mm. in altitude, 1.3 mm. in width. Whorls 6. Common at Sta. 77, west of St. Charles, Idaho, June 27, 1916.

Sta. 78, natural turnpike forming the northern barrier of Bear Lake and separating it from Mud Lake and Dingle Swamp. The sandy soil of this broad barrier is in places composed largely of fossil shells of the same species that abound along the beach, leading to the belief that the beach shells have mostly been washed from the sand by the waves and are fossil. Though we found no live mollusks in the lake, many of the shells, especially *Lymnaea* and *Planorbis*, were rather fresh, and all were of species that might be expected to now live in the region, though only two or three of the species were actually taken alive in the valley. As the lake is now used to regulate the flow of water in the streams and ditches, the water level fluctuates considerably, and at the time of our visit the water in the lake, as well as in the streams, was high. The beach material yielded the following:

<i>Spharium pilsbryanum</i> Sterki.	<i>Valvata utahensis</i> (Call).
<i>Pisidium compressum</i> Prime.	<i>Planorbis trivolvis</i> near <i>binneyi</i> Tryon.
<i>Pisidium</i> n. sp.	
<i>Pyramidula cronkhitei anthonyi</i> Pils.	<i>Planorbis parvus</i> Say.
	<i>Planorbis exacuus</i> Say.
<i>Vertigo ovata</i> (Say).	<i>Physa ampullacea</i> Gld.
<i>Fluminicola fusca</i> (Hald.).	<i>Ancylus</i> sp.
<i>Paludestrina longinqua</i> (Gld.).	<i>Lymnaea proxima</i> Lea.
<i>Carinifex newberryi</i> (Lea).	<i>Lymnaea stagnalis appressa</i> Say.
<i>Valvata humeralis californica</i> Pils.	<i>Lymnaea utahensis</i> Call.

Baker, in his *Lymnaeidae* of North America, records *L. proxima* also from the Utah end of the lake. *L. utahensis* at this station is on the average more elongate than those from the type locality at Utah Lake, but on the whole they cannot be separated. *Valvata h. californica* is here more highly polished and closely coiled than at Sta. 127, Utah Lake.

Sta. 79, roadside pools west of Sta. 78, near St. Charles. *Lymnaea proxima* Lea and *Aplexa hypnorum* (L.).

Sta. 80, bank of St. Charles Creek, at the north edge of the town:

<i>Agriolimax campestris montana</i> (Ing.).	<i>Pyramidula cronkhitei anthonyi</i> Pils.
<i>Succinea avara</i> Say.	<i>Euconulus fulvus alaskensis</i> Pils.
<i>Zonitoides arborea</i> (Say).	

Sta. 81, three miles up St. Charles Canyon, west of St. Charles, Idaho. *Oreohelix strigosa depressa* (Ckll.) found sparingly in sandstone slides and about limestone ledges. In the water-cress of a small seepage channel from the creek we found:

Paludestrina longinqua (Gld.) *Lymnaea obrussa* Say.
Physa ampullacea Gld. *Succinea rusticana* Gld.

Sta. 82, mouth of Garden City Canyon, west of Garden City, Utah, on south side of canyon. *Oreohelix haydeni hybrida* (Hemph.) typical, as at Logan, common under small shrubs, and especially under the matted radical leaves of *Balsamorhiza sagittata* (Nutt.), on limestone slopes devoid of rock slides. We also found a few *Pupilla blandi* (Morse). The slopes are now very barren, but we were informed by pioneers that forty-five years ago they were well covered with large mountain mahogany, up to a foot in diameter, as at Sta. 1 $\frac{1}{2}$, in the McCammon district. These trees furnished fuel for the early settlers, but wasteful cutting and fires have denuded the hills for some miles back, and overgrazing by stock has been disastrous to the smaller shrubs and herbs. It is difficult to believe that snails could obtain a foothold under present conditions, but having flourished here under more favorable conditions, they have been able thus far to survive the change in environment. Erosion is rapidly carrying the soil and vegetative debris from beneath the scant shrubbery and may soon destroy the colony, unless saved by a series of years of increased moisture favorable to plant growth.

Sta. 83, south side of next canyon south of Sta. 82 and about half a mile distant. *Oreohelix cooperi* (W. G. B.) abundant, but much smaller than at most localities where we have found this species (diameter 14 mm. to 15.5 mm.). These specimens agree with those from Eureka, Utah, in their small size and the absence of the color bands from below, many of them having no color bands at all.

Sta. 84, stagnant pool by the roadside, two miles south of Garden City, Utah. *Lymnaea obrussa* Say abundant, *L. humilis modicella* Say rare.

Sta. 85, along wagon road from Garden City to Logan, a mile east of the "Sink Holes," east of the crest of the divide. We picked up one large bleached shell of *Oreohelix cooperi* (W. G. B.), but, as we had a hard day's trip ahead, we did not stop to search for more.

PRESTON, IDAHO.

Sta. 97, bank of Bear River, south and southeast of the wagon bridge due west of Preston. A layer of sand in the bank, several feet in thickness, yielded the following fossils:

Margaritana margaritifera L. ?

Fluminicola fusca (Hald.).

Sphaerium sp.

Lymnaea traskii Tryon.

Succinea grosvenori Lea ?

Sta. 98, bottomland near Sta. 97. *Oreohelix cooperi* (W. G. B.) abundant under leaves in clumps of rose bushes, scrub willows, etc. This station, a flat soil area entirely free from rocks and some distance from ledges, is an unusual site for a fine colony of *Oreohelix*. The same species is common under similar conditions at Montrose, Colorado.

Sta. 99, slough west of Sta. 98, north of wagon road. *Lymnaea traskii* Lea (?), dead shells abundant, fairly fresh; live examples not found. *Physa ampullacea* Gould, one dead shell. A similar slough across the road yielded no mollusks at all.

Sta. 100, muddy bank of river due north of Sta. 99. *Succinea avara* Say common under overhanging willows.

WESTON, IDAHO.

Sta. 59, cliff of igneous rock about three miles northwest of Weston. Though the place from a distance looked like good snail territory, we succeeded in finding only a very few scorched shells which seem to be a small form of *Oreohelix strigosa depressa* (Ckll.). A year or two before, a fierce fire had swept the mountain, burning the leaves and sticks to the very bottom of the rock slides, but the scarcity of "bones" shows that the snails were not at all plentiful before the fire. We also visited a good-looking mountain southwest of Weston, in the northern edge of Utah, but found no snails there.

Sta. 60, irrigating ditch southeast of Sta. 59, about one-third of the way to town:

Succinea oregonensis Lea.

Lymnaea bulimoides cockerelli Pils.

Lymnaea humilis modicella Say.

and Ferr.

Physa crandalli Baker ?

So far as we know, this is the only record of *L. b. cockerelli* for Idaho, though the Montana, Colorado, New Mexico and Nevada records would lead one to expect it in Idaho, Utah and Wyoming.

Sta. 61, stagnant roadside pool southeast of Sta. 60, about a mile northwest of Weston. *Lymnaea traskii* Tryon (typical, according to Walker), common, young very abundant.

In 1915 Daniels obtained from the banks of the Bear River, east of Weston, *Succinea haydeni* W. G. B. and *Lymnaea proxima* Lea.

THE FRANKLIN DISTRICT, IDAHO AND UTAH.

Franklin is only a mile or two north of the southern boundary of Idaho, due east of Weston. We visited a good-looking hill about four miles northeast of town, where we found the vegetative cover poor and no snails.

Sta. 93, dry slope southeast of Franklin, about half way to the base of the mountain, due north of the type locality of *Oreohelix haydeni corrugata* H. & D. *Succinea oregonensis* Lea was very abundant among the quartzite and red sandstone boulders thickly strewn over the surface of the gentle slope, sheltered by very scant vegetation growing close to the rocks. Tracks of horses and cattle made when the ground is soft after rains hold a little water for a short time after storms, thus insuring periods of activity sufficient to sustain a very prosperous colony of these snails. They were clinging to the rocks and to the soil beneath by means of a glutinous substance which caused the snails to stick to our fingers and tweezers in removing them from the rocks. Dry, membranous "scars" adhering to the rocks showed former places of attachment during periods of inactivity, reminding one of *Sonorella* scars. We obtained over a thousand specimens alive in a very short time on the Idaho side of the boundary, then found dead shells all along the way across the line into Utah, to the edge of the mouth of High Creek Canyon; but not realizing at the time that we were crossing the line, we did not look for live examples.

Sta. 94, small reservoir in shallow ravine north of Sta. 93. *Physa ampullacea* Gld., scarce.

Sta. 95, north side of High Creek Canyon, southeast of Sta. 93, just within the mouth of the canyon and continuing some distance up the canyon on the same side. *Oreohelix strigosa fragilis* (Hemph.) in quartzite and red sandstone slides.

Sta. 96, similar slides a mile or so up the canyon on the south side, the same subspecies, scarce. Further up the canyon the walls are of limestone, but strange to say our brief search there did not yield snails. Hemphill states that the type locality of *fragilis* is "near Franklin, Idaho, among Red Sandstone." The topography suggests this canyon as a very likely one for him to have visited, the other likely one being two or three miles to the north, a little north of east from Franklin and hence in Idaho. Our stations for this subspecies, 39 (1915), 95 and 96 (1916), are all in Utah. If Hemphill's type locality is any of these three, then the only Idaho station known for *fragilis* is Franklin Butte, west of the town, our Sta. 38, 1915.

SMITHFIELD, UTAH.

Sta. 101, limestone butte about two miles northeast of Smithfield. *Oreohelix peripherica* (Ancey), almost devoid of color bands—the *binneyi* form. A few live snails were found by persistent search, but dead, bleached shells were very abundant on the slopes to the top of the butte, thence to the north slope of the entrance to the canyon to the southeast. The butte has been considerably denuded by overgrazing, and erosion has washed the soil and dead leaves from beneath the shrubs and *Balsamorhiza* that formerly afforded shelter for the snails. Bleached shells almost whitened the ground down the slopes from clumps of bushes where now there is no snail cover at all. It is difficult to see how the shrubbery can long continue to exist. As this butte is only six miles south of the *Oreohelix haydeni corrugata* butte, and the two buttes are of the same character, we expected to find that subspecies here, but failed to do so. Three buttes of similar character, placed at intervals of about six miles and almost in line, our stations 38, 40 and 101, yielded respectively *O. s. fragilis*, *O. h. corrugata* and *O. peripherica*.

We worked up the large canyon southeast of Sta. 101 for several miles, and were surprised to find no snails in it.

THE LOGAN, UTAH, DISTRICT.

This region is covered by the Logan Quadrangle topographic sheet of the United States Geological Survey, issued since our visit.

Sta. 86, north fork of Logan Canyon, about sixteen miles from Logan and three miles above "the forks." *Oreohelix strigosa depressa* (Ckll.) abundant under mountain maples at the edges of limestone slides, where the blanket of leaves was thick, but a few large rocks and roots provided clinging places for the snails. We also obtained the following species:

<i>Thysanophora ingersolli</i> (Bland).	<i>Zonitoides arborea</i> (Say).
<i>Pupilla blandi</i> (Morse) ? one broken shell.	<i>Pyramidula cronkhitei anthonyi</i> Pils.
<i>Vitrina alaskana</i> Dall.	<i>Succinea avara</i> Say.
<i>Euconulus fulvus alaskensis</i> Pils.	

Thysanophora ingersolli was described by Bland⁹ in 1875, under the name *Helix ingersollii*, from specimens obtained in Colorado. Ingersoll¹⁰ republished the description in 1876, under the name

⁹ *Ann. N. Y. Lyc. Nat. Hist.*, XI, p. 151, 1875.

¹⁰ 8th Ann. Rept. (Hayden's) U. S. Geol. and Geog. Surv. Terr., for 1874, pp. 397-398, 1876.

Microphysa ingersolli, with three outline figures which do not adequately represent the material he collected or any specimens we have seen from Colorado or elsewhere, and the lateral view is misleading. Binney,¹¹ in 1878, 1885, 1886 and 1890, again published misleading figures, perhaps based upon the original figures. These all represent a shell with apex so depressed that it does not show at all above the last whorl in lateral view. In 1887 Ancey,¹² relying upon the supposed accuracy of those misleading figures, as he plainly indicates, and finding that his specimens of *Thysanophora* collected by Hemphill in Logan Canyon, Utah, exhibited a spire elevated clearly above the last whorl, described it under the name *Microphysa ingersolli convexior*. Meanwhile Binney, in his second supplement, in presenting what he said was a better figure of *ingersolli*, recorded under that name material collected by Hemphill (doubtless part of the same lot of material from which Ancey's types came) at Logan Canyon and Mt. Nebo, Utah, and also Weston, Oregon. We have examined *Thysanophoras* from two stations in Logan Canyon, a number of other localities in Utah and Idaho and many localities in Colorado, some of them near the type locality of *ingersolli*, and can see no difference, none of them being accurately represented by the figures of *ingersolli*. Specimens from Logan Canyon were sent to Pilsbry, who compared them with Ingersoll's specimens of *ingersolli*. He agrees with us that the names are exact synonyms, *ingersolli*, of course, having priority. In 1890 Professor T. D. A. Cockerell was permitted to examine and copy portions of Ancey's manuscript notes, including notes on his *M. i. convexior*, with pen and ink figures. We have examined his copies of Ancey's figures, and the one labelled *ingersolli* represents Binney's misleading figure of the species, while the one labelled *convexior* is an excellent illustration of the shell found in Montana, Idaho, Utah, Colorado, New Mexico and doubtless Wyoming, and which must take the name *ingersolli*. It is interesting to note that though Binney recorded *ingersolli* from Weston, Oregon, collected by Hemphill, Pilsbry¹³ recorded and figured specimens from the same place under the name *convexior*, because they had the spire considerably higher than material from Colorado and elsewhere. This confirms our conclusion that Binney was really dealing with a form having a slightly raised spire, while

¹¹ Binney, Terr. Moll. U. S., vol. V, p. 173; 2d Suppl., p. 35, Pl. III, fig. 5; 3d Suppl., p. 215; Man. Amer. Land Shells, p. 170.

¹² *The Conchologist's Exchange*, vol. II, p. 64, 1887.

¹³ Proc. Acad. Nat. Sci. Phila., LXII, 117, 1910.

figuring one with the spire depressed out of sight in lateral view. If further material shows the Oregon form to be worthy a name, it should be given a new one and not called *convexior*.

Sta. 87, just within mouth of Logan Canyon, on south side. *Oreohelix strigosa depressa* (Ckll.) very abundant, rather small, nearly white, with two conspicuous, usually broad, dark brown bands, which almost invariably extend to the aperture. These are the most conspicuously banded snails we found during the two seasons' work, except *O. peripherica* form *albofasciata*. They were found scattered for a mile up the canyon, and were quite abundant in a small rock slide covered by *Clematis*. This station also yielded the following:

Vitrina alaskana Dall. *Thysanophora ingersolli* (Bland).
Pyramidula cronkhitei anthonyi *Euconulus fulvus alaskensis* Pils.
 Pils.

A spring choked with water-cress yielded *Paludestrina longinqua* (Gld.). Sterki¹⁴ doubtfully recorded *Vallonia gracilicosta* Reinh. from Logan Canyon.

Sta. 88, about a mile up, on the south side of next large canyon, about two miles to the north from Logan Canyon. *Oreohelix strigosa depressa* (Ckll.), a few alive under mountain maples in the edges of rock slides, dead shells common.

Sta. 89, between 87 and 88, along the west slope of the mountain. *Oreohelix haydeni hybrida* (Hemph.), dead shells scattered, but especially common where limestone ledges are exposed at the mouths of small ravines. About a dozen live snails were found under sagebrush in rock slides, but none under *Balsamorhiza*, which is usually excellent cover for *Oreohelix* where it droops over rocks. Here the plant was found in loose soil, not about the rocks. The evidence is abundant that the vegetative cover has here been greatly reduced by overgrazing, followed, as usual in such cases, by active erosion. The colony is likely near extinction. A few dead shells of *Vitrina alaskana* Dall were found.

Sta. 90, several steep, short ravines on the west slope of the mountains south of Logan Canyon and south of our Sta. 42, 1915. *Oreohelix haydeni hybrida* (Hemph.) found sparingly in all of these ravines. This form seems to be here confined to such situations and is not found in the larger canyons, which are the best places for *depressa* and *cooperi*.

¹⁴ PROC. ACAD. NAT. SCI. PHILA., 1893, p. 270; Man. Conch., 2d Ser., vol. VIII, p. 256.

Sta. 42, where in 1915 we collected *O. h. hybrida*, yielded in 1916 a single example of *Thysanophora ingersolli* (Bland), one *Euconulus fulvus alaskensis* Pils., and three *Vitrina alaskana* Dall.

Sta. 91, Providence Canyon, southeast of Providence and about four miles from Logan. *Oreohelix strigosa depressa* (Ckll.) and *O. cooperi* (W. G. B.), both rather small, dead shells plentiful, a few live examples found under mountain maples and various shrubs in rock slides.

Sta. 92, a small stream choked with water-cress, a mile south of Logan, yielded *Succinea rusticana* Gld., *Lymnaea proxima* Lea and *Physa ampullacea* Gld.

Baker, in his Lymnæidæ of North America, records *L. proxima* Lea and *L. stagnalis wasatchensis* Hemph. from "near Logan."

CLARKSTON, UTAH.

Sta. 57, Newton town reservoir, about half way between Trenton and Clarkston:

<i>Musculium</i> sp.	<i>Planorbis trivolvis hornii</i> Tryon.
<i>Musculium rykholti</i> Normand.	<i>Planorbis exaeuous</i> Say.
<i>Succinea avara</i> Say.	<i>Planorbis parvus</i> Say.
<i>Lymnaea proxima</i> Lea.	<i>Physa ampullacea</i> Gould.

Planorbis trivolvis hornii (so identified by Pilsbry) here varies from 19 mm. to 24 mm. in diameter. Our former record of *P. trivolvis* from Cache Junction should be referred to this form. Ingersoll¹⁵ recorded *hornii* from Utah.

Sta. 58, mountainside due west of the southern portion of Clarkston, half a mile south of Sta. 3, 1915. *Oreohelix rugosa* (Hemph.) abundant and very robust, under *Balsamorhiza sagittata* and small bushes, around limestone ledges. In places the ground is almost white with bleached shells, and we obtained a thousand live ones in a short time. In our former report we suggested (p. 334) the possibility that *O. hendersoni dakani* Hend. might be a synonym of *rugosa*, a suspicion then shared by Pilsbry.¹⁶ We have since visited the type locality of *dakani* at Newcastle, Colorado, and obtained a large quantity of live specimens. Dr. Pilsbry has examined the anatomy of both forms, and reports that they are distinct, the anatomy of *dakani* proving its relationship to *hendersoni*, as was

¹⁵ 5th Ann. Rept. (Hayden's), U. S. Geol. and Geog. Surv. Terr., for 1874, p. 404.

¹⁶ Proc. Acad. Nat. Sci. Phila., LXVIII, 353, 1916.

originally assumed from shell characters alone, while the anatomy of *rugosa* connects it with the *cooperi* group.

While in this district we discovered that our *O. peripherica* stations 4 and 36, 1915, are on opposite sides of the same small mountain. We were misled before by the fact that Daniels had approached his Sta. 4 from one direction, while we had together at a later date approached Sta. 36 from another direction.

DEWEYVILLE. UTAH.

Deweyville Postoffice is in Box Elder County, Utah, fifteen miles north of Brigham. Some confusion is likely to arise from the fact that the railroads, both steam and electric, passing through the town, have abbreviated the name to Dewey, though some maps and gazetteers locate a Dewey post village in Grand County. Specimens of *Oreohelix* collected and labelled by Hemphill, in the collection of Mr. Daniels, bear the locality label, "Dewey, Box Elder Co., Utah," and are designated as *utahensis*. Specimens in the Hemphill collection in the cabinet of Mrs. Ida S. Oldroyd, and others placed by her in the University of Colorado Museum, were labelled by Hemphill: "Smooth variety of *binneyi*, passing into *albida*. Dewey, Utah. Large." Another lot, designated by him as "var. *albida*," is from "Collinston, Utah," which is about five miles north of Deweyville, and three lots labelled *albida* by him are from Logan, according to the labels. A careful examination of this material under a lens convinces us that it is identical with the smooth form of *O. h. hybrida* from Sta. 102, which grades so completely into typical *hybrida* that we cannot consider it entitled to a separate name, even as a "form."

Sta. 102, mouth of first gulch northeast of Deweyville. *Oreohelix haydeni hybrida* (Hemph.), periphery quite rounded and spiral sculpture obscure in most examples, common under wild cherry and mountain maple overhanging limestone slides composed chiefly of small fragments. *Vitrina alaskana* Dall common.

Sta. 103, next gulch south of Sta. 102, southeast of Deweyville. *Oreohelix haydeni hybrida* (Hemph.) under same conditions as at Sta. 102, specimens more or less angled, but not on the average so much so as at Sta. 104, sculpture more pronounced than at Sta. 102 and less so than at Sta. 104.

Sta. 104, gulch about two miles south of Sta. 103, east of Madsen. *Oreohelix haydeni hybrida* (Hemph.) common under same conditions as at Sta. 102, strongly angled to slightly keeled, spiral sculpture

well developed as seen under a lens, but much less pronounced than in *gabbiana* from Oquirrh Mountains, though many specimens are more angular than typical *hybrida* from Logan.

The material of these three stations taken as a whole seems to be clearly *hybrida*, and the variation within such short distances is characteristic of the various subspecies of *haydeni* wherever we have found small colonies of them not far apart, as at Devil's Slide and Oquirrh Mountain, Utah, and at Glenwood Springs, Colorado.

OGDEN, UTAH.

Sta. 105, mouth of Ogden Canyon. *Oreohelix strigosa depressa* (Ckll.), dead shells about the granite and quartzite slides for a mile up the canyon on both sides. Live examples were found by a moment's search at several points, particularly abundant under a large mat of *Clematis* on one quartzite slide. Bleached shells also extend along the west slope of the mountains to a gulch about a mile to the north, as far as we went. Brush fires swept the mountains some years ago, so the vegetative cover is now very poor and erosion is rapidly stripping the steep slopes. Binney¹⁷ recorded *Pupilla blandi* (Morse) from Ogden and *Vertigo corpulenta* (Morse) from Ogden Canyon. Probably the latter record should be referred to *V. modesta parietalis* (Ancy),¹⁸ of which Ogden Canyon is the type locality. Binney's material recorded as *corpulenta* was collected by Hemphill, and the fact that other material described by Ancy at about this time was received by him from the same collector makes the supposition that his *parietalis* was obtained by Hemphill reasonable, and hence probably Binney's and Ancy's records are not only from the same canyon, but from the same lot of material.

Sta. 106, a small, sluggish stream on south side of valley, about a mile below the mouth of Ogden Canyon:

Fluminicola fusca (Hald.).
Lymnaea traskii Tryon.

Physa crandalli Baker ?

Oreohelix peripherica wasatchensis (Hemph.).

Sta. 108, base of river terrace, south and southeast of Sta. 106, alluvium, enclosing fragments of limestone. Dead shells abundant, about 25 live examples found in a scrub oak and mountain-maple thicket. At this station the shells vary greatly in form, many being not distinctly carinated and much flatter and smoother than typical *wasatchensis*, thus forming an intergrading series between typical

¹⁷ 2d Suppl. to 5th vol. Terr. Moll., p. 40.

¹⁸ *The Conchologists' Exchange*, vol. II, p. 80, 1887.

wasatchensis from the next station and *peripherica* from other localities. As we had expected, Pilsbry's report on the soft anatomy is that the genitalia of *wasatchensis* and *peripherica* agree. As usual, *Vitrina alaskana* Dall is common at this station.

Sta. 109. This station is east of, but continuous with, Sta. 108, the separation having been made only because of the greater variation at the lower end of the colony. Following up a draw toward the mountain, the smoother, depressed, non-angular form soon disappeared, but the typical, high-spined, strongly ribbed, carinated form was found plentifully under the leaves, often with very scant cover, a single small leaf being sometimes sufficient, though the weather was hot and dry. The colony continues up the mountain slope into a quartzite slide, where many of the large pieces of rock are well rounded. Some years ago brush fires burned the leaves to the bottom of the slides along this slope, so we were able to find no live snails above the brush in the ravine and along the side of the valley, which was not touched by fire. We had very carefully searched the region for several miles north and south and up the canyon for this species, but without success until we reached this place, which seemed to be the last chance. We are quite convinced that it is the exact type locality of the subspecies. It answers Hemphill's description, as no other place we found does, but he does not appear, from his notes, to have worked down into the gulch where the live snails are plentiful now. The topography and an old, abandoned road make it seem likely that he would have passed over this quartzite slide on his way to the mountain. In his description he says: "This pretty and interesting shell I found among quartzite boulders, in crevices sufficiently large to afford cool and moist retreats during the active summer season and safe places for hibernating during the cold months. This shell seems to be confined in its range to a very limited area, for I did not find a single specimen, either dead or alive, outside of a little plat containing an acre of ground." The last sentence quoted agrees with our experience, after collecting from 126 stations in Utah and southern Idaho. Hemphill's statement that almost the first shell he picked up at Ogden was *wasatchensis* indicates that he did not go first into the canyon, or he would have found there plenty of *depressa* and no *wasatchensis*.

PROMONTORY RANGE.

This range of mountains forms a narrow peninsula jutting into Great Salt Lake from the north. The southern portion formed an

island perhaps twenty-five miles in length during the maximum expansion of ancient Lake Bonneville. Hague's¹⁹ discussion is quoted at length by Butler and Heikes,²⁰ with additional information, in a recent bulletin. The isolation of the range and the presence of large bodies of limestone, brush and trees lead us to believe that systematic work there would produce interesting results, but our time was limited and the single day spent at the extreme southern end was disappointing. The only mollusks we saw were *Vallonia cyclophorella* Ancey and *Pupilla blandi* (Morse), under small bushes in rock slides at Sta. 107, an isolated limestone butte close to the railroad station of Saline. This butte was either covered by the waters of Lake Bonneville or formed only a tiny rocky island. The vegetative cover across the southern slope of the range is everywhere too scant for the larger snails.

MORGAN AND DEVIL'S SLIDE DISTRICT, UTAH.

Oreohelix haydeni (Gabb) was described from material said to have been obtained in "Webber" Canyon, Utah.²¹ We have not been able to learn of any canyon bearing that name, and are assured by men long and well acquainted with Utah that the well-known Weber Canyon is the one intended. Unfortunately, that name has been sometimes used to designate the whole valley of the Weber River and its larger tributaries. It is quite desirable to find this species alive in the type locality or elsewhere, in order to ascertain the anatomy. In 1915 we searched for it in what is more properly called Weber Canyon, below Gateway, without success. In 1916 we made two trips to the upper canyon, above Morgan, without success so far as typical *haydeni* is concerned, but found other interesting forms. Between Morgan and Gateway, a broad valley, with canyons entering from both sides, and the whole canyon south of Echo²² afford a large field as yet wholly untouched. Binney's²³ report of live *haydeni* received from Hemphill is incorrect, as Hemphill did not find true *haydeni*, though much of his material from the Oquirrh Mountains was sent out under that name.

Sta. 47, gulch on north side of valley, about half a mile north of Morgan depot. *Oreohelix peripherica* (Ancey), the *binneyi* (Hemph.) form, small, from 11 mm. to 16 mm. in diameter, mostly rather depressed, a very few showing one or two spiral color bands.

¹⁹ Hague, U. S. Geol. Explor. 40th Parallel, vol. 2, pp. 420-423.

²⁰ Butler and Heikes, U. S. Geol. Surv., Bull. No. 640-A, pp. 1-6.

²¹ Amer. Journ. Conch., V, p. 24, Pl. 8, fig. 1.

²² See Coalville Quadrangle topographic sheet, U. S. Geol. Surv.

²³ Terr. Moll. U. S., V., p. 159; Man. Amer. Land Shells, p. 167.

Sta. 114, south side of canyon, about a mile southeast of Morgan depot, close to a big warm spring and picnic ground, where the broad valley narrows into the canyon, east side of a limestone ledge at the base of a red sandstone hill. *Orcohelix strigosa depressa* (Ckll.) abundant beneath *Balsamorhiza sagittata*, sagebrush and other herbs and shrubs overhanging the rocks, but equally abundant deep in the red soil beneath such plants; an unusual habitat for this subspecies.

Sta. 115, west side of the same ledge, the same subspecies. Stations 114 and 115 constitute really a single colony, but we arbitrarily separated it and gave different numbers to our material, because many of the shells from one side of the ledge are more depressed than those from the other side, though the ledge is narrow and the colony actually extends across it.

Sta. 113, a short distance up the canyon from Sta. 114, on same side. *Orcohelix strigosa depressa* (Ckll.), dead shells very abundant on a limestone slope where the scrub oak and mountain maple thicket has recently been burned and all leaves and underbrush thus destroyed.

Sta. 112, big limestone slides not far above Sta. 113, on same side of canyon, concealed from the road by tall shrubbery. *Orcohelix strigosa depressa* (Ckll.), small (15 mm. to 18 mm. in diameter), white, strongly banded.

Sta. 111, next point of rocks, about 200 yards east of Sta. 112, at foot of canyon wall, beneath limestone ledge, perhaps two miles east of Morgan. *Orcohelix peripherica* (Ancy) common in leaves beneath scrub oaks and mountain maples, showing complete intergradation between Hemphill's *binneyi* and *albofasciata* forms, as at several stations in the Cache Junction district, discussed in our former report. This station is about 65 miles from Cache Junction in an air line. *O. peripherica* at all other stations where we have found it lacks the *albofasciata* form, so it is interesting to find the intergradation again at this most remote station for the species.

Sta. 110, some distance above Sta. 111, on same side of canyon, below the railroad tunnel, nearly opposite Sta. 53. *Orcohelix strigosa depressa* (Ckll.), dormant, deep in the rock slides and hard to find during the hot, dry season when we were there. Generally this subspecies has not been found by us very deep in the slides.

Sta. 48, both sides of and above the "slide," south side of canyon, Devil's Slide, Utah. *Orcohelix haydeni hybrida* (Hemph.) common beneath the heavy, drooping radical leaves of *Balsamorhiza*, on

steep limestone slopes, not in the rock slides. Dead shells plentiful. The vicinity is covered by a thick coat of lime dust from the cement plant. It is strange that any live examples were found under the circumstances.

Sta. 49, west slope of first gulch that enters the canyon from the north below the Devil's Slide depot. *Oreohelix haydeni* form *gabbiana* (Hemph.) under sagebrush, mountain maple, scrub oak, wild cherry and other shrubs at the edges of limestone slides, common alive, dead shells plentiful. The narrow-leaved cottonwood grove in the bottomland beneath the slides yielded:

Vitrina alaskana Dall.

Pyramidula cronkhitci anthonyi

Vallonia gracilicosta Reinh.

Pils.

Pupilla blandi (Morse).

Zonitoides arborea (Say).

Sta. 50, pools beside the railroad track half a mile below Sta. 49.

Succinea rusticana Gld.

Aplexa hypnorum (L.).

Lymnaea proxima Lea.

Paludetrina longinqua (Gld.).

Physa crandalli Baker ?

Sta. 51, below Sta. 50, opposite (north of) the railroad tunnel, just east of a dry gulch that comes in from the north. *Oreohelix haydeni* form *gabbiana* (Hemph.) plentiful in edges of rock slides. The following were also found:

Vitrina alaskana Dall.

Pyramidula cronkhitci anthonyi

Euconulus fulvus alaskensis Pils.

Pils.

Zonitoides arborea (Say).

Sta. 52, across the mouth of the gulch just mentioned, west of Sta. 51, thence along the base of the canyon wall for some distance around the curve. *Oreohelix haydeni* form *gabbiana* (Hemph.), less common than at Sta. 51.

Sta. 53, east-facing slope southwest of Sta. 52, west of the railroad tunnel, separated from Sta. 52 by a hundred yards or so of slope free from rock slides, where we found no snails. *Oreohelix haydeni* form *gabbiana* (Hemph.), a few found alive, dead shells plentiful.

Sta. 54, a mile down the canyon from Sta. 53, on an east-facing slope where the wagon road approaches the railroad. *Oreohelix haydeni hybrida* (Hemph.), plentiful under poison ivy in rock slides.

The *Oreohelices* from stations 48, 49, 51, 52, 53 and 54, all belong to the *haydeni* group. Hence the soft anatomy is the same and shell characters alone must be relied upon in their separation. Not a single example has as strong spiral sculpture as typical *haydeni* or

oquirrhensis, though a few approach it. *O. h. hybrida*, from its type locality at Logan, is readily distinguished from *O. h.* form *gabbiana* from its type locality in the Oquirrh Mountains, but at these stations we have a puzzling mixture and variation of characters, so that the determinations are made with some hesitation. The stations are not far apart and in the same canyon, so they may almost be considered one large colony. The form at the extremes of the colony so considered, stations 48 and 54, seems referable to *hybrida*, a considerable proportion of those from Sta. 48 being typical, others varying more or less in peripheral angulation and the altitude of the spire, but the spiral sculpture in those from Sta. 54 is obscure, much weaker than in the typical form. Both lots have the whorls well rounded from above and below to the more or less angled, but not keeled, periphery. The form at Sta. 49 (next to 48) and Sta. 53 (next to 54), we refer to *gabbiana*, not typical. It is really transitional from the *hybrida* of 48 and 54 to the *gabbiana* of 51 and 52. On the average the whorls are not so well rounded, the spire flatter and the angulation more pronounced, though they are somewhat variable in all these characters. On the whole, they seem more nearly related to the form at the nearest stations, 51 and 52, than to the form at the more remote stations, 48 and 54. Some examples are entirely indistinguishable from material labelled *utahensis* from Hemphill's collection. The form at stations 51 and 52, which we refer to *gabbiana*, has a depressed spire and the whorls slope rather flatly from above and below to a keeled periphery. The spiral sculpture is variable, the primary spirals in some examples being nearly as strong as those in typical *oquirrhensis*, though only indistinctly seen in others. These forms are further discussed in the sections on Deweyville and Oquirrh Mountains.

Sta. 55, a small stream by the roadside, perhaps a mile and a half above Morgan, below Sta. 54.

Lymnæa proxima Lea.

Aplexa hypnorum (L.).

Physa ampullacea Gld.

Sta. 56, pool by the roadside, about a mile above Morgan, just above where the wagon road crosses the railroad.

Pisidium near *huachucanum* Pils.

Lymnæa humilis modicella Say.

Paludestrina longinqua (Gld.).

Planorbis parvus Say.

Lymnæa proxima Lea.

Physa ampullacea Gld. ?

Sterki says of the *Pisidium*: "*P. huachucanum* Pils., or near. Somewhat different from the originals; somewhat smaller (all speci-

mens may not be full-grown); superior margin not so straight; beaks somewhat narrower."

Stations 47 and 49 to 56 are all on the north side of the canyon, while stations 48 and 110 to 115 are on the south side.

SALT LAKE CITY, UTAH.

We did not stop at Salt Lake City to do any collecting in 1916, but have recently received from Mr. L. A. Giddings, of that city, two small lots of *Oreohelix strigosa depressa* form *carnea* (Hemph.), one from his Sta. 1, upper slopes of Red Butte Canyon, the other from his Sta. 2, close to the creek in City Creek Canyon. In both lots the spires are much more elevated than usual, but otherwise they correspond with Hemphill's specimens of *carnea*, of which the type locality is "near Salt Lake, Utah," and which we found in Dry Canyon in 1915. Pilsbry writes that the anatomy is that of *depressa*. It may be well to say that this form, sent out by Hemphill, is to be found in many cabinets bearing a printed label on which, by a typographical error, an *o* has taken the place of an *a*, making the name *corneus*, which should be corrected. We also note another typographical error in Hemphill's printed labels, the *i* having been omitted from *gabbiana*.

Call²⁴ reported the following species from this locality:

<i>Pisidium abditum</i> Hald. (= <i>Pisidium</i> ?).	<i>Valvata utahensis</i> (Call).
<i>Margaritana margaritifera</i> (Linn.).	<i>Lymnaea stagnalis</i> Linn.
<i>Anodonta nuttalliana</i> Lea.	<i>Planorbis opercularis</i> Gld.
<i>Valvata sincera</i> (Say).	<i>Planorbis parvus</i> Say.
	<i>Planorbis trivolvis</i> Say.
	<i>Physa gyrina elliptica</i> Lea.

As he placed *A. wahlametensis* Lea and *A. californiensis* Lea in the synonymy of *A. nuttalliana* Lea, which of these forms he found "somewhat common in the fresh-water streams near Salt Lake City" is an open question. His *L. stagnalis* is either *appressa* or *wasatchensis*. Baker²⁵ reports *L. s. wasatchensis* and *L. proxima* Lea from near Salt Lake City. Yarrow²⁶ reports *L. stagnalis* and *Valvata sincera* from "near Salt Lake City." Ingersoll²⁷ also records *V. sincera* from here. Probably all these records of *V. sincera* should be referred

²⁴ U. S. Geol. Surv., Bull. 11, 1884.

²⁵ *Lymnaeidae* of North America, pp. 152, 359.

²⁶ (Wheeler's) U. S. Geog. Surv. W. of 100th Meridian, V, pp. 941, 948.

²⁷ 9th Ann. Rept. (Hayden's) U. S. Geol. and Geog. Surv. Terr., for 1874, p. 390.

to *V. humeralis californica* Pils. Ingersoll also (on the same page of his report) records *Fluminicola seminalis* Hinds and *F. hindsii* Stm. from "Salt Lake, Utah," and *F. nuttalliana* Stm. from "Warm Springs, near Salt Lake, Utah." The two last mentioned may well be doubted. He also, on p. 399, records *Succinea nuttalliana* Lea from the Warm Springs locality—a doubtful record. Binney²⁸ records *Succinea haydeni* W. G. B. from Salt Lake City.

UTAH LAKE, UTAH.

This district is covered by the Salt Lake topographic sheet of the United States Geological Survey. Utah Lake was included in Lake Bonneville during the "Lake Period." It now remains fresh because it has an outlet, the Jordan River, through which it drains into Great Salt Lake. However, the water is said to be not so free from salts as formerly, owing to the extensive use of water for irrigation. Cameron²⁹ reports that the mineral content, chiefly sodium chloride, of the lake water increased from 300 parts of total solids per million parts of solution in 1883, to 1,400 parts per million in 1903—a period of twenty years. It is not likely that the salinity will increase so much as to be fatal to fresh-water mollusks or even to seriously modify them. Call³⁰ and Stearns have discussed the influence of temperature and salinity in modifying the shells of this region, and the arid region farther west. In his bulletin Call records the following species from Utah Lake:

<i>Pisidium compressum</i> Prime.	<i>Lymnaea stagnalis</i> Linn.
<i>Sphaerium dentatum</i> (Hald.).	<i>Lymnaea utahensis</i> Call.
<i>Ancylus</i> sp.	<i>Physa ampullacea</i> Gld.
<i>Carinifex newberryi</i> (Lea), living.	<i>Physa gyrina elliptica</i> Lea.
<i>Fluminicola fusca</i> (Hald.).	

His assertion that *S. dentatum* here attains great size strongly suggests that he really found *P. pilsbryanum* Sterki, which was not then described, but has since been described from Bear Lake (fossil) and reported from Utah Lake (recent) by Sterki.³¹ Yarrow³² reports finding *Lymnaea stagnalis* [= *appressa*] and *Planorbis trivolvis* Say

²⁸ 2d Suppl. to 5th vol. Terr. Moll., p. 40.

²⁹ Cameron, "The Water of Utah Lake," *Science*, n. s., vol. XXI, p. 257, 1905.

³⁰ Call, U. S. Geol. Surv., Bull. No. 11, 1884. Stearns, *Proc. U. S. Nat. Mus.*, XXIV, 1901, 271-299; *N. Amer. Fauna*, No. 7, pp. 269-283.

³¹ Sterki, "Sphaerium pilsbryanum n. sp.," *The Nautilus*, XXII, pp. 141-142, 1909; "A preliminary catalog of the North American Sphaeriidae," *Annals of Carnegie Museum*, X, p. 437, 1916.

³² Yarrow, (Wheeler's) U. S. Geog. Surv. W. of 100th Meridian, V, pp. 941, 946-947, 1875.

at Utah Lake, but says he found the latter alive at only one locality in Utah, namely, near Salt Lake City. Ingersoll³³ reports *Fluminicola fusca* (Hald.) from Utah Lake, placing it in the family Amnicolidae and on the same page repeated the same record under the name *Leptoxis fusca* in the family Melaniidae. His Utah Lake record of *Lymnaea catascopium* Say cannot be accepted. Pilsbry³⁴ records *Paludestrina longinqua* (Gld.) from Utah Lake; *Fluminicola fusca* (Hald.) from Utah Lake, Bear Lake and Malad River, and *Amnicola limosa* (Say) from Utah Lake and Spring Lake.

Sta. 127, shore of Utah Lake and adjacent slough, two miles south of Lehi, Utah. Very few live mollusks were found except *Succinea*, but dead shells were abundant, as follows:

<i>Sphaerium pilsbryanum</i> Sterki.	<i>Valvata humeralis californica</i> Pils.
<i>Pisidium</i> near <i>variabile</i> Prime.	<i>Valvata utahensis</i> (Call), type locality.
<i>Pisidium</i> sp.	<i>Ancylus</i> sp.
<i>Anodon'a wahlamatensis</i> Lea.	<i>Lymnaea proxima</i> Lea.
<i>Succinea haydeni</i> W. G. B., living.	<i>Lymnaea stagnalis appressa</i> Say.
<i>Vitrea hammonis</i> Ström.	<i>Lymnaea utahensis</i> Call, type locality.
<i>Euconulus fulvus alaskensis</i> Pils.	<i>Lymnaea humilis modicella</i> Say.
<i>Zonitoides arborea</i> (Say).	<i>Lymnaea obrussa</i> Say.
<i>Carinifex newberryi</i> (Lea).	<i>Planorbis trivolvis binneyi</i> Tryon.
<i>Fluminicola seminalis</i> (Hinds).	<i>Planorbis parvus</i> Say.
<i>Fluminicola fusca</i> (Hald.).	<i>Physa lordi</i> Baird.
<i>Amnicola limosa</i> (Say).	
<i>Paludestrina longinqua</i> (Gld.).	

P. t. binneyi here attains large size, the largest one measured having a diameter of 36 mm., and all specimens collected have the characteristic strap-like whorls and strong sculpture of this form, but the aperture is considerably expanded and not quite typical. Judged by Baird's description and Binney's figures, the *Physa* from this station appears to be true *P. lordi*. Material from the Douglas Lake district, Michigan, referred by some conchologists to *lordi*, by others to *P. ancillaria parkeri*, differs markedly from the Utah Lake form and Binney's figures in its tabulate form, which is due to the decidedly flat upper surface of the last whorl and the much more acute angulation of the shoulder. The same is true of material from Chelsea, Quebec, though the difference in that case is not so

³³ 8th Ann. Rept. (Hayden's) U. S. Geol. and Geog. Surv. Terr., for 1874, pp. 391, 406.

³⁴ Pilsbry, "Catalogue of Amnicolidae of the Western United States," *The Nautilus*, XII, pp. 122-123, 1899.

marked or uniform. *Valvata h. californica* here is less highly polished and more loosely coiled than at Sta. 78, Bear Lake.

Sta. 125, creek and sloughs south of Provo, from one to two miles north of Springville.

Succinea haydeni W. G. B.

Lymnaea humilis modicella Say.

Paludestrina longinqua (Gld.).

Planorbis trivolvis near *binneyi*

Fluminicola fusca (Hald.).

Tryon.

Valvata humeralis californica Pils.

Planorbis parvus Say.

Lymnaea proxima Lea.

Physa crandalli Baker ?

Lymnaea stagnalis appressa Say.

The *Planorbis* cf. *binneyi* here is much smaller than at Sta. 127, the largest measuring only 20.5 mm. in diameter; some as strongly sculptured, but the whorls not so strap-like; some with the nearly circular aperture of *hornii* Tryon. Yarrow³⁵ records *Physa elliptica* Lea from Provo, Rush Lake and Virgin River, Utah. To what species his records should be referred we do not know. Crandall³⁶ confines *P. elliptica* to the region east of the Mississippi.

Sta. 126, gulch a mile and a half northeast of Springville. *Oreohelix strigosa depressa* (Ckll.), a few dead shells found, no live examples obtained.

OQUIRH MOUNTAINS, UTAH.

We spent one rainy day at Bingham. Such investigation as we were able to make in the rain led to the conclusion that it is not good snail territory, though doubtless more extensive and persistent search would result in some finds.

Sta. 116, rock slides and ledges, chiefly limestone, south and southeast of Garfield, on the ancient lake terraces at the northern end of the range. *Oreohelix cooperi* (W. G. B.) (?), plentiful in rock slides, but several hours of digging deep into the slides and under the new growth of shrubs failed to produce a single live snail. The dead shells were weathered and scorched, the periostracum and embryonic sculpture destroyed, so we do not feel confident of their identity.

Sta. 117, gravel pit on one of the lake terraces north of the west edge of Garfield. This pit yielded fossil fresh-water shells of species living now in the region, and added nothing to the fossils recorded from the region by Call.

Sta. 118, sloughs between the west end of Garfield and the main line of the railroad.

³⁵ (Wheeler's) U. S. Geog. Surv. W. of 100th Meridian, V, p. 937.

³⁶ *The Nautilus*, XV, pp. 54-55, 1901.

Lymnæa traskii Tryon.

Physa sp.

Planorbis parvus Say.

Call³⁷ records *Paludestrina longinqua* (Gld.) from Lake Point, a short distance west of Garfield, and Pilsbry³⁸ records *Ammicola* (*Cincinnatiata*) *cincinnatiensis* (Anth.) from the same place, as well as from Salt Lake and the Sevier Lake Valley.

Sta. 14, southeast of Black Rock, in a small ravine, above the lowest prominent limestone ledge and below the second one.

Sta. 119, down the slope from Sta. 14, below the lower ledge.

Sta. 15, gulch southeast of the railroad flag station of Morris, perhaps four or five miles south of Sta. 14.

Sta. 123, south side of a ravine about half a mile north of Sta. 15.

Sta. 122, next gulch north of Sta. 123.

Sta. 121, west slope of mountain and next gulch north of Sta. 122, almost connecting with Sta. 120.

Sta. 120, gulch and divide north of Sta. 121.

***Oreohelix haydeni oquirrhensis* (Hemph.).**

Patula strigosa var. *oquirrhensis*, Hemphill, Binney's 2d Suppl. to 5th vol. of Terr. Moll. U. S., pp. 30, 34, Pl. II, fig. 12.

Patula strigosa var. *gabbiana* Hemphill, Binney's 2d Suppl. to 5th vol. Terr. Moll., pp. 30, 34, Pl. II, fig. 9.

Patula strigosa var. *utahensis* Hemphill, Binney's 2d Suppl. to 5th vol. of Terr. Moll.

Further collections in the Oquirrh Mountains and a careful study of the material obtained by us, as well as a study of Hemphill's material, convinces us that the forms above mentioned cannot be considered distinct subspecies, though the names may be useful as descriptive terms by which to designate the different phases. Typical *oquirrhensis* is a robust shell, with strong revolving ribs. The form *gabbiana* is less robust, with less pronounced and sometimes almost obsolete ribs. The form *utahensis*, as distributed by Hemphill, is smoother than *gabbiana*, with a less pronounced keel. Though the extremes are so very different, complete intergradation is found within a short distance, and in each gulch there is a considerable difference in shape, size and sculpture. In our former report we referred a few shells obtained at Sta. 14 to *gabbiana*. We revisited this station and Sta. 119, a few rods below 14, and found dead shells rather common in small rock slides, but a thorough search of the slides and the scant shrubbery brought to light no live examples. This material seems referable to the form *utahensis*, of which these

³⁷ U. S. Geol. Surv., Bull. 11, p. 20.

³⁸ *The Nautilus*, XI, p. 122. 1889.

stations are possibly the type locality, described as a "detached pile of rocks," "at the foot of the mountain." It has seemed almost hopeless to recognize *utahensis*. Pilsbry³⁹ has discussed the confusion in which he found the descriptions and figures of this form. Hemphill's description (in a letter to Binney) was quite inadequate, as follows:

"This has the form of *hemphilli*, but is destitute of the revolving ridges of *haydeni*. The specimens were all constant in sculpturing, but varied very much in size and somewhat in form."

Binney published the letter, and on a subsequent page of the same publication says of *utahensis*:

"This is a rough, coarse, carinated *strigosa*, figured in *Terr. Moll.*, V, p. 158, fig. 66. The peristome is sometimes continuous by a heavy raised callus, connecting its terminations. It is sometimes smaller and more elevated."

As Pilsbry has pointed out, the figure referred to was based upon material from Big Horn Basin, Wyoming, and Binney added characters belonging to the Wyoming form, now known as *O. strigosa magnicornu* Pils. The connected terminations of the peristome is a common feature in a number of species of *Oreohelix*, including Hemphill's forms *oquirrhensis* and *gabbiana*, and hence is not of diagnostic significance. Material we have seen from the Hemphill collection, bearing the name *utahensis*, is mostly labelled "near Salt Lake," but one small lot is labelled "near Logan." We cannot know whether any of it came from Oquirrh Mountains, but it all agrees quite well with our stations 14 and 119 material. The exact type locality of *utahensis* is not known, except that it is on the west side of this range, and there is no more probable place than these two stations, which really form but one small colony, being each of small extent and but a few rods apart. We cannot ascertain from the descriptions and figures alone, with certainty, just what *utahensis* is. Material from Hemphill's collection does not settle it, because of the absence of designated types and cotypes, the uncertainty as to whether any we have seen are even topotypes, and the fact that he apparently used that name for more than one form. His *hemphilli*, with which he compared *utahensis*, is not true *hemphilli*, but is the material he collected in the Oquirrh Mountains and distributed under that name, which cannot be separated from his *oquirrhensis* from the same locality. By referring to the descriptions and figures,⁴⁰ we

³⁹ *Nautilus*, XXIX, pp. 139-141, 1916.

⁴⁰ Binney's 2d Suppl. to 5th vol. *Terr. Moll.*, pp. 30, 34, Pl. II, figs. 9, 12.

find that *oquirrhensis* has very strong ribs and is keeled, agreeing with specimens he distributed under that name and with our material from Sta. 120; while in his *gabbiana* the spirals are quite weak or nearly obsolete, with the periphery compressed into a distinct keel, the primary spirals being usually visible to the unaided eye, the secondaries visible under a lens, thus agreeing in all respects with the material from our Sta. 15. It has distinctly the two series of spirals characteristic of the *haydeni* group—a few ribs, with intercalated riblets. Our stations 14 and 119 specimens, which we consider of the *utahensis* form, are well angled, but the periphery is not pinched into a keel. There is perhaps a little greater variation in the altitude of the spire. The spiral sculpture is weaker, and in most examples the microscopic riblets are crowded and subequal, instead of a few stronger ribs with intercalated riblets. However, in a few examples the compound spiral sculpture is distinctly present, thus forming a series grading into the form *gabbiana*. Viewed in mass, material from stations 14 and 119 can be distinguished at once from that found at Sta. 15, and Sta. 15 material can be distinguished from that found at Sta. 120, but plenty of individuals are found to connect them all. If anyone insists upon considering these forms sufficiently distinct, in spite of complete intergradation, to merit separate names, then *utahensis* should be applied to the Sta. 14 form, as it is usually “destitute of the revolving ribs [not of the riblets] of *haydeni*,” a description not at all fitting other forms from this region. In selecting a name, it would seem most natural to select the one occurring first in the original publication, though all occur on the same page in Hemphill’s letter to Binney. That would be *utahensis*. The same thing would result if we select the first one in Binney’s notes, as *utahensis* precedes *oquirrhensis* and *gabbiana* by one page. We have seen the difficulty of recognizing *utahensis*, while *oquirrhensis* is well figured and sufficiently described. The confused description and figure do not satisfy the priority rule requiring a name to be accompanied by a description, in order to be accepted. Part of the description flatly contradicts the Hemphill specimens, which would otherwise perhaps enable us to definitely decide what the name applied to. The rules of nomenclature justify the selection of the name *oquirrhensis*, instead of *utahensis*, under the circumstances. Especially is this course justified by Art. 28 of the International Code of Zoological Nomenclature, which provides that “if the names are of the same date, that selected by the first reviser shall stand,” and recommendation *b*, that a specific name accom-

panied by both description and figure stands in preference to one accompanied only by a diagnosis or only by a figure, the figure of *utahensis* in the present case being either spurious or doubtful. The page precedence recommendation (*c*) only applies when "other things are equal." The name *utahensis* should be dropped and *gabbiana* used (if at all) only as a "form" name, not in a subspecific sense.

We revisited Sta. 15 and found one live example of the *gabbiana* form, so it is possible that the colony may survive the destructive fire of 1915, as a new growth of scrub oak is starting and will soon furnish fair cover.

Starting at Sta. 120, we found old, bleached shells of *Oreohelix haydeni oquirrhensis* (Hemph.), robust and strongly ribbed spirally, though the ribbing is somewhat variable. The ribs below the sharply keeled periphery vary from four to seven and are usually somewhat unequal in prominence or spacing or both. Above the keel there are usually four ribs, sometimes only three. These shells are very abundant among the charred stumps of scrub-oak thickets, which had been recently burned, but were not found in the rock slides. Persistent search up the gulch and across the low divide to the south, failed to reveal a single live snail, though everywhere "bones" were plentiful to the top of the divide. They are all much weathered. Our impression is that the colony may have been destroyed long ago, as this portion of the range has apparently been swept by fires before, and is now barren for many miles. Hemphill found this form abundant alive somewhere near here over thirty years ago. We found a number of bleached shells which we doubtfully assign to *Succinea oregonensis* Lea. They vary from grosvenori-like to avara-like shells. The absence of color enhances the difficulty of specific determination.

Probably the colony of Sta. 120 crosses the divide well up the mountain, and thus connects with Sta. 121, in the next ravine, where the same subspecies of *Oreohelix* was found, all dead shells, some nearly as coarsely ribbed as at Sta. 120, though the average examples have much less conspicuous ribs, usually seven or eight below, occasionally only four.

At Sta. 122, on the west slope of the mountain, not in the gulch, but only a short distance from 121, the few examples found, all dead shells, are smaller, slightly flatter and smoother than at Sta. 121, very near typical *O. h. gabbiana* (Hemph.), but exhibiting a tendency to grade into *oquirrhensis*.

This near-gabbiana form was found again at Sta. 123, but the shells here were somewhat larger.

Material reported from these mountains by Hemphill under the names *haydeni*, *hemphilli* and *oquirrhensis* is all *oquirrhensis*. Repeated careful examinations, by one of the present writers, of such material in several Hemphill collections, fail to discover any basis for or consistency in his separation of the material. Professor T. D. A. Cockerell and Dr. Paul Bartsch recently, at our request, compared examples of *oquirrhensis* from our Sta. 120 with three examples from the type lot of *haydeni*, from Weber Canyon, in the United States National Museum, and find them "quite distinct." Professor Cockerell writes: "The difference in the spiral keels is constant. In *haydeni* the whorls are rounded, the keels subequal, and the peripheral keel not distinct as in the Oquirrh Mountain specimens. *Haydeni* has a distinct channel below the suture, which is not present in the Oquirrh Mountain material."

EUREKA, UTAH.

Sta. 6, north side of Godiva Mountain, in the southeast edge of the town. In 1915, in collecting about 800 specimens of the small form of *Oreohelix cooperi* (W. G. B.) at this station, we obtained the type lot of *O. hemphilli eurekaensis* H. and D., only seven specimens, all dead shells. In 1916 we revisited the station, but found no more of the *eurekaensis* until we crossed a shallow ravine which marked the eastern boundary of our former work. There we found the small *cooperi* and *eurekaensis* about equally plentiful, and obtained about 600 of the latter, mostly alive. The anatomy of *eurekaensis*, according to Pilsbry, shows relationship to the southern *yavapai* group. The anatomy of *hemphilli* is as yet unknown, *eurekaensis* being designated a subspecies of it on shell characters only. We also found at this station *Pupilla blandi* (Morse), common; *Succinea avara* Say (?), a few worn specimens; *Vallonia cyclophorella* Ancy, rare.

Sta. 124, west slope of Pinyon Mountain, three miles northeast of Eureka. *Oreohelix strigosa depressa* (Ckll.), a few small, dead shells beneath *Kunzia tridentata* near limestone ledges. We found none alive and no dead shells in the rock slides, though we made a long search for them. A box containing the same form is in Mrs. Oldroyd's Hemphill collection, bearing the following label: "Var. *albida*, *corneus*, etc., Eureka, Utah, 1912. Oiled." The shells are a little larger than those we found.

MARCH 20.

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

Three hundred and two persons present.

The presentation of papers for publication under the following titles was reported by the Publication Committee:

"Notes on fishes from New Jersey, Pennsylvania, and Maryland," by Henry W. Fowler (February 21, 1917).

"A second collection of fishes from the Panama Canal Zone," by Henry W. Fowler (February 21, 1917).

"The Oligocene Mollusca of Santo Domingo," by H. A. Pilsbry (February 27, 1917).

DR. WILLIAM E. HUGHES made a beautifully illustrated communication on travel routes in Korea, Manchuria, and China. (No abstract.)

Eugene A. Rau was elected a member.

William Morris Davis, Ph.D., of Cambridge, Mass., was elected a correspondent.

The following were ordered to be printed:

**MOLLUSCA OF THE SOUTHWESTERN STATES, VIII: THE BLACK RANGE,
NEW MEXICO.**

BY H. A. PILSBRY AND J. H. FERRISS.

In the summer of 1915, beginning in the second week of August, we collected in the Black Range of New Mexico. Approaching from the west, by way of the Mimbres Valley and up Gallina Canyon, we reached the crest above the head of Silver Creek. Subsequent camps were made at intervals from Sawyer Peak, the southern end of the range, to Reed's ranch on Black Canyon, our route being along the crest trail, with numerous short trips down the slopes, and a two-day trip to Kingston, in the eastern foothills. After September 12th Ferriss continued the exploration alone, in Morgan and Diamond Creeks on the main range, then eastward to Chloride, the Cuchillo Mountains and the San Mateo Mountains, west of San Marcial, in the southern edge of Socorro County. Travel was by pack train. Throughout the trip we had the services of an excellent packer, Teodoro Solis, a native of Chihuahua.

The Black Range is on the boundary between Grant and Sierra Counties, about 40 miles north of Deming, New Mexico. In the north it forms part of the continental divide. The Mimbres River Valley on the west isolates the Black from the Mogollon Range and its outliers. The range is narrow and sharp, its flanks deeply furrowed, but without long spurs. Hillsboro Peak is 10,000 ft. high. Much of the crest trail is from 8,500 to slightly over 9,000 ft. elevation.

Fine forest extends down nearly to the 7,000-foot contour. It has been well protected against fire and its remoteness has deterred the lumberman. The yellow pine, spruce and quaking asp are large and the ground well covered with forest mold.

There seem to be limestone outcrops on all sides of Sawyer Peak. The scattered exposures of these ledges were traced from the south end of the range up the west side at between 7,000 and 8,000 feet, as far as Iron Creek at our Station 16. Limestone was not seen on that side of the range further north, on Black Canyon or Diamond Creek, where it was looked for down to about 6,000 feet. On the east side limestone appears in the foothills at intervals, as around Kingston and Hillsboro, at Hermosa, Chloride, and some distance further north. Otherwise the Black Range is of igneous or meta-

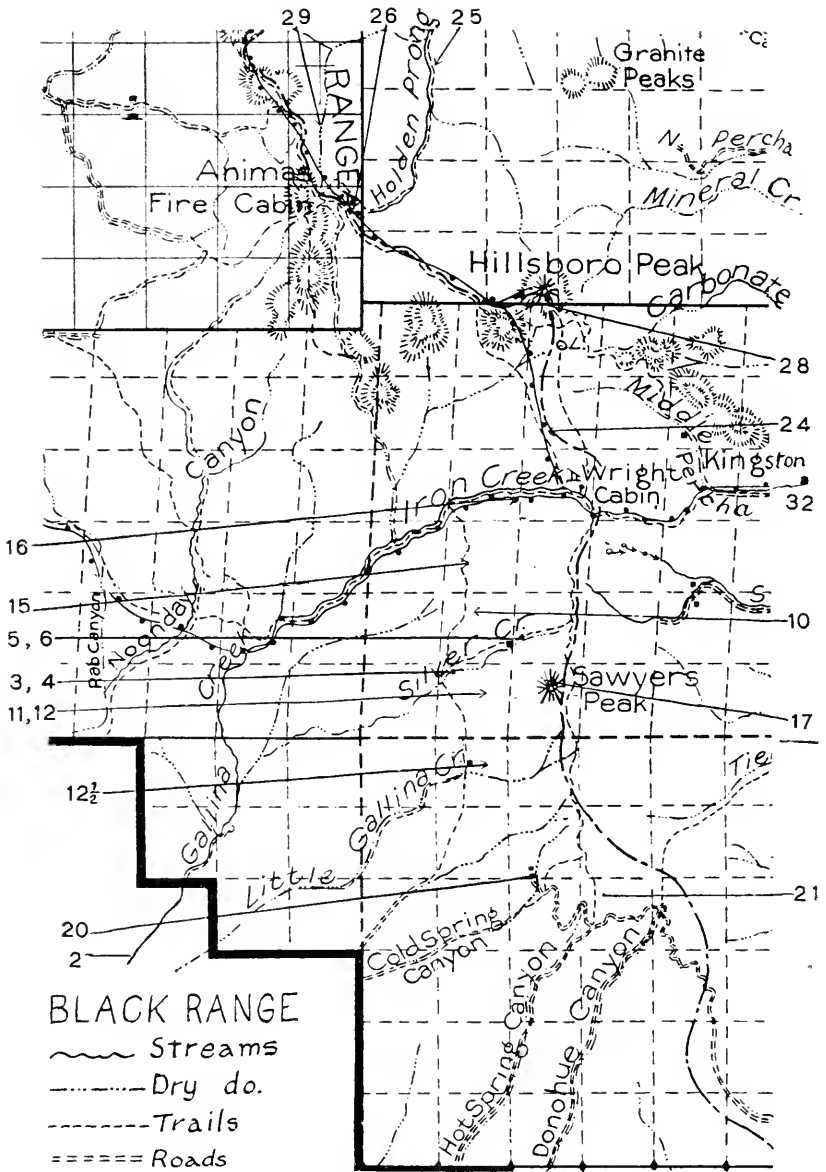


Fig. 1.—Collecting stations in the Black Range, southern section. The map is ruled into square miles.

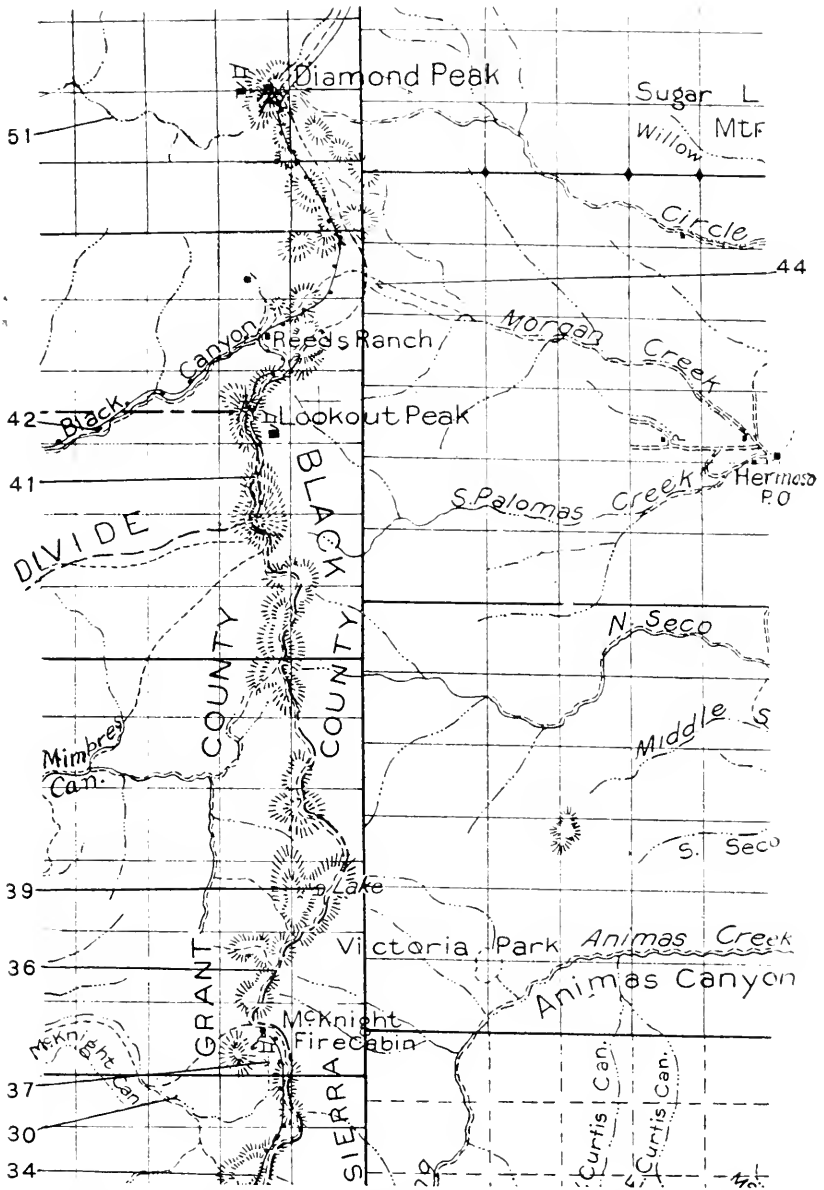


Fig. 2.—Collecting stations in the Black Range, northern section. The map is ruled into square miles.

morphic rock. Except at the southern end, there is no mining in the range at present.

A good crest trail is maintained by the Forestry Service, and several cabins along it are occupied by forest rangers during the dry season. At the time we were there, the range was uninhabited except for two men caring for mines in Silver Creek, and several at Reed's ranch on Black Canyon. Deer, bear and wild turkeys are abundant. There are no rattlesnakes in the forest zone, though occasionally seen up to about 6,000 feet.

Eastern Foothills of the Black Range.—Returning to Deming from Chloride, the limestone ridges about Chloride were found barren of shells, although they had been seen there by miners at an earlier day. At the Oliver Mine, on Mineral Creek, 4 miles above Chloride, *Oreohelix pilsbryi* was found. A few miles southward, on the north side of a limestone mountain at Sam's Canyon, *Holospira cockerelli* was abundant, and a few very old "bones" of *Oreohelix metcalfei* and *cooperi* were found. Again in a like situation on the Little Palomas Creek, *Holospira* was plentiful, and again at Hermosa. This is a small village on the Big Palomas Creek, all that remains of a settlement of over 2,000 miners in flush times. Teodoro had seen shells here years ago, when employed as superintendent at the Ocean Wave Mine, but not even "bones" remain. Across the stream, however, and down stream for a mile or more, *Oreohelix* and *Holospira* were abundant. Hard digging was required to get living shells, as the hillside of fine soil and limestone spawls had been completely plowed up by herds of goats. The snails found shelter under the roots of dead oaks and in undisturbed rock.

In the foothill region there was extensive mining years ago, with consequent destruction of the small wood which grew in favorable places.

Although a sharp lookout was kept, nothing further was found on the return trip except a colony of *Ashmunella* in a slide of igneous rock along the wagon road near the mouth of a small creek tributary to Las Animas River. All were dead except a few very young ones.

No topographic map has been published. Our collecting stations are therefore plotted (pp. 84 and 85) on the Forest Service Temporary Base Map of the Gila National Forest.¹ A list of the stations is given at the end of this article.

¹ Second edition, corrected to January 1, 1916.

THE CUCHILLO RANGE.

This range is about six miles east of Chloride, the post office of Fairview at the foot of the mountains. The peaks probably reach up to 7,500 feet.

On a brushy northern slope on the Thomas Seale trail, in the southern end of the range, *Oreohelix metcalfei cuchillensis* and *Holospira cockerelli* were found in abundance. The cover was scant, and cattle plentiful. Both species were found again a couple of miles further on, in Frank Calhoun's pasture. In both places they lived in groves of oak, under limestone spawls and dead timber.

At the north end of the range the peaks are higher, some having large outcrops of fossiliferous limestone, but the only evidences of living shells obtained were a few "bones" of *Helicodiscus*. In drift debris, however, were many small shells which apparently graze on the grassy slopes and meadows.

THE SAN MATEO RANGE.

The San Mateo Range probably reaches a height of 8,000 feet. The southern end is about 15 miles north of Monticello Post Office, a village on the Cañada Alamosa. The rock in this part of the range is a friable, crumbling granite. Nearly the entire southern end is a continuous slope of granitic fragments, many feet in depth. The mesa continues nearly to Monticello. Pinyon, juniper and low-growing shrubs cover the hillsides. Along Chippy Creek, walnut, quaking asp and yellow pine prevail.

Around the edges of the rocky slides, *Oreohelix cooperi* and *Ashmunella* were fairly abundant, but the smaller shells were scarce. A day given to the peaks overlooking San Marcial, a couple of miles farther, added only a few *O. cooperi* to the collection.

CHARACTERISTICS OF THE BLACK RANGE MOLLUSK FAUNA.

The snail fauna of the Black Range is like that of the Mogollon Range in the rich development of *Ashmunella*, the species being also related. Coarsely granulate species are a unique feature. It differs from the ranges southward and westward by the absence of *Sonorella*. A special feature of the range is the *Oreohelix metcalfei* group, wonderfully varied in shape and sculpture. No doubt further members of this group will be found in Sierra and Socorro Counties. *Oreohelix swopei* also is special to the northern end of the Black Range, so far as we know.

The crest of the range everywhere has an abundant Canadian

zone fauna of small shells, *Vertigo*, *Pupilla*, *Vitrina*, *Thysanophora ingersolli*, etc., in common with similar elevations as far west as the Santa Catalinas in Arizona. Also the Canadian *Oreohelix cooperi*.

LIST OF SPECIES.

The specimens have been studied by both authors. Types are in coll. A. N. S. Phila.; paratypes in coll. Ferriss.

HELICIDÆ.

ASHMUNELLA.

The Black Range Ashmunellas resemble those of the Mogollon and Chiricahua Ranges in the genitalia. The penis is more or less distinctly bipartite by a submedian constriction.

In *A. binneyi*, *A. tetrodon*, and in *A. mogollouensis* of the Mogollon Range, a retractor muscle of a few slender strands attaches to both segments of the penis and to the epiphallus further up, but there is no continuation attaching to the diaphragm.

In *A. mendax* and *A. cockerelli* with its subspecies there is, in addition to the incoherent penial retractor just described, a broad, very thin and extremely short band connecting the epiphallus with the diaphragm. This is similar to the condition in most other Ashmunellas except that the connection with the diaphragm is here very short.

All of the species have the usual short flagellum, about 1.5 mm. long. The constancy in *Ashmunella* of this minute, seemingly vestigial organ is remarkable.

Aside from the particulars noted above, the organs are much alike in the several species. For convenient comparison the measurements, in millimeters, are given in one table, *A. mogollouensis* being added for comparison.

Ashmunella tetrodon Pils. and Ferr.

Ashmunella tetrodon P. & F., Nautilus, XXIX, June, 1915, p. 15, Pl. 1, figs. 1-3*a*.

Southern slope of the San Mateo Mountains, Socorro County, New Mexico.

This species was described from the western slope of the Mogollon Mountains, and its occurrence in the San Mateo Range appears anomalous. The numerous specimens obtained are quite constant, showing none of the variations noted in the Mogollons.

The genitalia of one of these specimens are figured, Pl. X, fig. 6.

	Length of penis and epiphallus.	Length of penis (swol- len basal portion).	Length of vagina.	Length of spermatheca and duct.	Penial retractor in- serted on diaphragm.	diam. of shell.	Plate N.
<i>A. mogollonensis</i> .	53	3	7.5	42	None	Fig. 3
"	58	6		52	None		
<i>A. mendax</i> , Sta. 2	56	5	9	40	Short	16.5	Fig. 1
" Sta. 32	54	4.5	6.5	63	Short	19	
" Sta. 16	61	6.5	8.5	42	Short	20	
" Sta. 26	35	3.5			Short	17	
<i>A. binneyi</i> , Sta. 15	42			25	None		
" Sta. 13	35	4.5	6.5	22	None	15.5	
" Sta. 7	42	4.5		34.5	None	15-16	Fig. 5
<i>A. cockerelli</i> , Sta. 20	45	5.5	5	35	Short	17	Fig. 2
<i>A. c. perobtusata</i> , Sta. 21	40	5.5	5	23	Short	16.7	Fig. 4
<i>A. tetradon</i> , S. Mateo	28	4	5	23	None	13.5	Fig. 6
<i>A. t. animorum</i> , Sta. 26	37	4	6	31	None	14	

Ashmunella tetradon fragilis n. subsp. Pl. VII, figs. 1-16.

The shell is markedly thinner than *A. tetradon*, and subangular peripherally, the periphery situated high. Basal teeth small and well separated. Parietal tooth smaller than in *A. tetradon*. There is no denticle between its inner end and the upper termination of the lip.

Alt. 6.5, diam. 14 mm.: $5\frac{1}{2}$ whorls. No. 115,753, A. N. S. P.

One colony was found, Station 58, in slides on south side of Cave Creek, near its mouth, and an equal distance from where the wagon road starts up a long-grade hillside on the trail from Chloride to Hillsboro, in the eastern foothills of the Black Range.

Ashmunella tetradon animorum n. subsp. Pl. VII, figs. 2-26.

The shell resembles *A. tetradon*, but differs by having the basal teeth much closer together and united by a callus. The parietal tooth is simple; the outer lip-tooth is long. Color light buff, with a slightly brownish tinge above. Under a strong lens some imperfect granulation is produced by the interruption and irregularity of the growth strike on the penult whorl. There is also an extremely minute spiral striation on the later whorls.

Alt. 7, diam. 15 mm.: $5\frac{1}{4}$ whorls (type, No. 115,747).

" 5.4, " 12 " (Station 36).

Black Range, from Station 26, Holden's Spring (type loc.), north-

ward to Black Canyon (Reed's) and Morgan Creek. Taken at 15 stations.

This is a common shell at high elevations, in the mountains north of Hillsboro Peak. Especially in the labyrinth of canyons forming the heads of Las Animas Canyon, but also on the western slope of the range. Most of the stations are between 8,000 and 9,000 feet. It was found mainly under dead wood on shady and rather humid slopes.

Very often the inner of the two basal teeth is wanting, being reduced to a sloping callus against the other tooth.

Ashmunella cockerelli n. sp. Pl. VII, figs. 3, 4, 9.

The shell is umbilicate (umbilicus between one-fifth and one-sixth the total diameter, enlarging in the last half whorl, rather tubular further in); depressed; *carinate at the periphery*; the shape recalling *Polygyra carolinensis* and *obstricta*; wood-brown above, usually somewhat paler at the base, having a buff streak indicating a former resting stage about the middle of the last whorl. Surface lusterless except the earliest whorls. *Sculpture of close-set, irregular pebble-like granules* on the last whorl, finer on the whorl preceding, before which it is finely striate and slightly punctate, the first $1\frac{1}{2}$ whorls smooth and glossy. The inner whorls are convex, the penult whorl flattened, the last somewhat convex above, but excavated on both sides of the strong peripheral keel. It is rather swollen below the keel, particularly in the last half. It descends shortly in front, and is guttered behind the outer and basal margins of the lip. The aperture is very oblique, subcircular and toothless. Lip is reflected and somewhat thickened within.

Alt. 8.2, diam. 16.4 mm.; $5\frac{1}{3}$ whorls (type, figs. 3, 9).

“ 7.2, “ 17.8 “

South of Sawyer's Peak, on slopes of the ravine at Grand Central Mine (Station 20), and in the next two ravines on the trail to the peak (stations 19 and 22). Also further north at Station $12\frac{1}{2}$, a short distance above Spade's cabin.

This species, which it gives us pleasure to name for Professor T. D. A. Cockerell, is remarkable for its strong carina and roughly pebbly sculpture, which is coarsest on the latter part of the whorl. The upper surface is usually convex, but often nearly flat. The periphery of the penult whorl frequently projects a little above the suture in the individuals with flattened spire.

Ashmunella cockerelli perobtusa n. subsp. Pl. VII, figs. 7, 7a.

The shell is sharply angular in the young, and on the front of the last whorl, but *becomes rounded and rather swollen in the last third. The granulation is minute*, as in the following race, and in places the granules are linked into spiral lines.

Alt. 7.8, diam. 16 mm.; $5\frac{1}{3}$ whorls.

Locality, Station 21, a ravine about two miles to the left of the trail (going down) from the camp site on Sawyer Peak to the Grand Central Mine, and at a somewhat higher level than the mine.

Type No. 115,750, A. N. S. P.; paratypes in Ferriss coll.

As one of the authors was lost when he found this colony, its exact location cannot be made perfectly clear; yet by turning along a trail which branches to the left before the steep descent into the second ravine from the Grand Central Mine, the snail hunter must get into the vicinity of the *perobtusa* colony. It is in a ravine on the left side of said trail.

Ashmunella cockerelli argenticola n. subsp. Pl. VII, fig. 5.

This form differs from *A. cockerelli* by the far smoother surface; the granulation being very fine, and on the base the granules are connected into spiral threads, closely placed, and not visible over the whole base. The keel is strong, and continues to the lip, thereby differing from *A. c. perobtusa*.

Alt. 7.4, diam. 16 mm. (type).

Upper Silver Creek and its branches, above 7,500 feet, to the northern flank of Sawyer Peak, about 500 feet below the summit. It was taken at stations 3, $4\frac{1}{2}$, 6 and 9 on Silver Creek, 10 and $10\frac{1}{2}$ on a tributary from the north which enters at Mitchell Gray's cabin, 11, gulch south of Gray's cabin, and $17\frac{1}{2}$ near the summit of Sawyer Peak. The type locality is Silver Creek just below the box, where the trail makes a detour on the steep northern slope. This is probably between 8,000 and 8,500 feet, Gray's cabin being at 7,500 feet.

In the type locality, Station $4\frac{1}{2}$, the diameter is 15 to 16 mm., and the keel projects but little or not at all above the suture. Some lots vary more. At Station 11 the diameter is from 13.7 to 16 mm., and the keel of the penult whorl often projects. In some lots there are coarse, conspicuous wrinkles of growth, as at Station 10. The spire varies in convexity in all lots, and is often almost flat.

Ashmunella binneyi n. sp. Pl. VII, fig. 8.

The shell is depressed, with low but convex spire and angular periphery; isabella color above, paler below. Sculpture of very minute, interrupted, somewhat anastomosing striae along growth-lines; some weak traces of spiral lines on the base. Whorls slowly

widening, convex, the last angular or subangular in front, descending a little to the aperture. Umbilicus widening rapidly in the last whorl, one-fifth the total diameter. Aperture toothless, rounded, lunate, the peristome white, evenly and rather narrowly reflected throughout.

Alt. 7, diam. 15.5 mm.; 5 whorls. (Type, Station 8½.)

Diam. 13.5 to 16.7 mm. (Station 15).

Black Range at stations 7 and 8½, on Silver Creek above the "box"; 13, head of Bull Top Creek, and 15, Spring Creek, a tributary of Iron Creek. The type locality, Station 8½, is near the deserted cabin just above the box of Silver Creek, at an elevation of about 8,500 feet.

This species differs from *A. mendax* by the angularity and the microscopic sculpture of the last whorl. Also by the absence of any penial retractor muscle attached to the diaphragm. It is far smoother than any form of *A. cockerelli*, and not carinate.

It is certainly far less widely spread than *A. mendax*. We found it only in an area of a couple of miles along the western flank of the range, from Upper Silver Creek to Upper Spring Creek, well within the heavily forested zone. No doubt it will be found over a somewhat wider area; yet its absence in our many stations both north and south indicate that it is a relatively local species.

Ashmunella mendax n. sp. Pl. VII, figs. 6, 6a, 6b.

The shell resembles *A. mogollonensis*, but is less robust, with different microscopic sculpture, lighter colored, being between tawny-olive and saccardo amber, often with a lighter streak from a former resting period. The third and fourth whorls have minute growth-wrinkles interrupted to form oblong granules in places, and an excessively minute spiral striation. On the last whorl the growth-wrinkles are low, unequal and continuous, and there are many weakly impressed spiral lines. Last whorl descends slightly in front. The aperture is small, toothless; lip white, narrowly reflected. The umbilicus is cylindric within, but in the last whorl opens out to more than twice its former diameter.

Alt. 9.3, diam. 20, width of umbilicus 5.2 mm.; 5½ whorls.

Black Range, at the following stations: 2, Gallina Canyon, 4 miles above Pryor's upper cabin. Sawyer Peak at stations 18, northeast, and 23, east of camp on the saddle, about 20 minutes' walk down the mountain. Stations 16, Iron Creek above confluence of Spring Creek, and 16½, around Wright's cabin, near the head of the creek. Station 26, Holden's Spring, at one of the heads of Holden's Prong of Animas Canyon. Station 28, southwest side of Hillsboro

Peak. Station 27, west of Animas ranger cabin, and Station 30, about $3\frac{1}{2}$ miles west, down the mountain. Station 49, Black Canyon, above Diamond Bar ranch house, on the western slope of the range. Station 32, garden of Stephen Reay, west end of Kingston. Type locality, Station 16.

The shell, while superficially very like *A. mogollonensis*, is easily distinguished by the somewhat granose intermediate whorls and far less deeply engraved last whorl. In *A. mogollonensis* there is no granulation, and the last whorl is very deeply and closely engraved spirally (Pl. VII, fig. 10). In the genitalia, the presence of a very short, broad penial retractor attached to the diaphragm distinguishes *mendax* (Pl. X, fig. 1) from *mogollonensis* (Pl. X, fig. 3), in which there is none.

This snail has a remarkable range. The lowest colonies on both sides are far below the forest, especially on the west side, where it was found in great numbers in the arid Gallina Canyon. The examples here are rather small, diam. 16 to 17.3 mm. On the east side we took it under wood and rubbish in a garden of Kingston, where it was common. Most of the other localities are along the crest of the range, in the humid forest zone. The type locality is on the south side of Iron Creek some distance above the mouth of Spring Creek, at the entrance of a ravine from the south, where there has been rather extensive mine prospecting.

A figure of the genitalia of *A. mogollonensis* P. & F. is given for comparison, Pl. X, fig. 3.

OREOHELIX.

Three of the four species belong to the southern group of species having swollen penes. The fourth, *O. cooperi*, is here at the southern border of its vast range.

Most of the specimens taken between the middle of August and the middle of October contained embryos. A few collected in the latter part of October contained none.

Oreohelix swopei n. sp. Pl. IX, figs. 2, 3-3b.

The shell resembles *O. strigosa depressa*. It has an ample umbilicus, a low, conic spire, obtuse and rounded at the summit, and a slightly angular periphery. Color fawn or vinaceous fawn, with two chocolate or lighter bands in the usual positions, and finely, irregularly speckled and streaked with creamy markings, partly the result of wear. The surface is glossy where unworn, marked with irregular growth-lines and fine wrinkles, which form sharp little folds just above the suture on some of the intermediate whorls. No spiral striation. The embryonic shell, of $2\frac{1}{3}$ flat whorls, shows growth-

lines and faint traces of microscopic spirals, and on its last third there are usually several small spiral threads. The young stages have an acutely angular periphery, which becomes bluntly angular on the last whorl, which descends very little in front. The aperture is strongly oblique.

Alt. 12, diam. 21 mm. (type).

" 12, " 22 "

" 13.2, " 20 "

Black Range, at stations 44, 45 and 48, head of Morgan Creek; 42, Black Canyon, 4 miles below Reed's ranch; 50 and 51, on Diamond Creek, about 3 miles below the summit, and again about half way down.

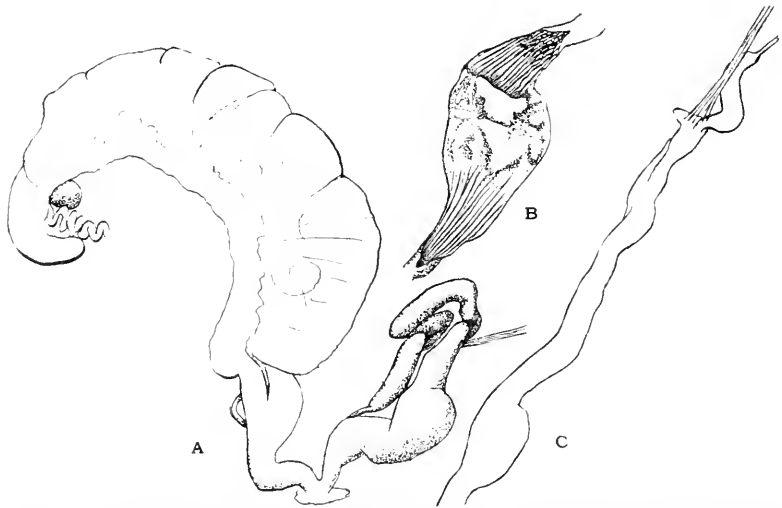


Fig. 3.—Reproductive organs of *Orcobelix swopei*. *b*, the penis opened, showing fleshy organs in the swollen portion. *c*, the penis and epiphallus stretched straight.

This snail is named in honor of Dr. S. D. Swope, of Deming, New Mexico, in acknowledgment of his interest in scientific matters and his kindly help in furthering our investigation. That we visited the Black Range at all was due to his alluring picture of its beauties.

In the field this shell was taken for *O. s. depressa*. It was found among rocks on the well-shaded slopes of ravines, usually with *O. cooperi* and *Ashmunella*. The absence of spiral striation on the last whorl aroused suspicion of the reference to *O. s. depressa*, and on closer study it was found to differ by the far smoother embryonic shell, and especially by the soft anatomy, the male organs being quite different in the two species. In *O. s. depressa* the lower part

of the penis is not swollen, and its cavity contains four or five subequal longitudinal ridges. These structures have been found constant in a great many specimens dissected, from Utah, Colorado, Arizona and New Mexico.² In *O. swopei* the lower part of the penis is conspicuously swollen, its cavity containing several large, irregular, fleshy processes (fig. 3*b*), below which there are many small longitudinal cords (fig. 3).

The organs measure:

Length of penis	22	mm.
“ swollen portion of penis	8.5	“
“ of epiphallus	4.5	“
“ of penial retractor	7	“
“ of vagina	6.5	“
“ of spermatheca and duct	21	“
Diameter of shell	21	“

O. concentrata differs by its far shorter penis.

In the specimen dissected, taken about September 15, there were eight embryos (Pl. IX, fig. 13), the largest 4.2 mm. diameter. The base shows many smooth spiral lines and bands cutting through densely crowded, erinkled radial striae. When these are worn off it appears almost smooth, the apparently strong spiral sculpture shown in the figures being cuticular.

A few beautiful albino shells were found in one rock pile in Station 45.

Oreohelix metcalfei Ckll. Pl. VIII, fig. 5.

Oreohelix strigosa metcalfei Ckll., Nautilus, XVIII, 1905, p. 113. Pilsbry, Proc. A. N. S. Phila., 1905, p. 278, Pl. 25, figs. 44, 48, 52.

This species was described from shells collected by Mr. O. B. Metcalfe “near Kingston,” the exact spot not designated. We hunted one day around Kingston, but did not find it. The country near the town is rather discouraging—steep stony hills with practically no shade, though there is abundant limestone. Probably we did not go far enough afield. We suspect that the colony was either nearer the mountains or northward, probably not in the immediate vicinity of the town.

Three very old “bones” were found by one of us in Sam’s Canyon, Station 53, some miles south of Chloride. These occurred with *Holospira*, like the original lot.

It appears that the *O. metcalfei* group, in Grant, Sierra and Socorro Counties, comprises a series of forms largely parallel to the *O. haydeni* series in Utah and Colorado, but even more remarkable in its extremes of form and sculpture.

²See these PROCEEDINGS for 1905, p. 272, Pl. 19, fig. 3; 1916, p. 345, Pl. 19, figs. 1-4, 6, 7; Pl. 20, fig. 8.

On the west slope of the Black Range there are two forms: (1) in the south, *O. m. concentrica*, broadly umbilicate, with low, wide spiral cords on the base, and (2) further north, *O. m. radiata*, with strong radial sculpture, remarkably like *O. elrodi*. On the eastern slope we have (3), southward, *O. m. acutidiscus*, broadly umbilicate, with fine spiral and coarser radial sculpture, and (4) further north, *O. hermosensis*, nearly smooth, angular only in front. Still further north a few "bones" of typical *metcalfei* were found, acutely keeled throughout and nearly smooth. Northeast of here was found *O. m. cuchillensis*, which is so weakly angular that we at first thought it a form of *O. strigosa depressa*. Further west *O. pilsbryi* was found. Further north, in Socorro County, there is *O. socorroensis*, an angular, roughly sculptured shell, as yet known only by perfectly bleached "bones."

The *metcalfei* group therefore comprises, besides the original type, forms resembling *O. haydeni*, *O. elrodi* and *O. strigosa depressa*; each being alone in its district. The distribution may be represented diagrammatically thus:

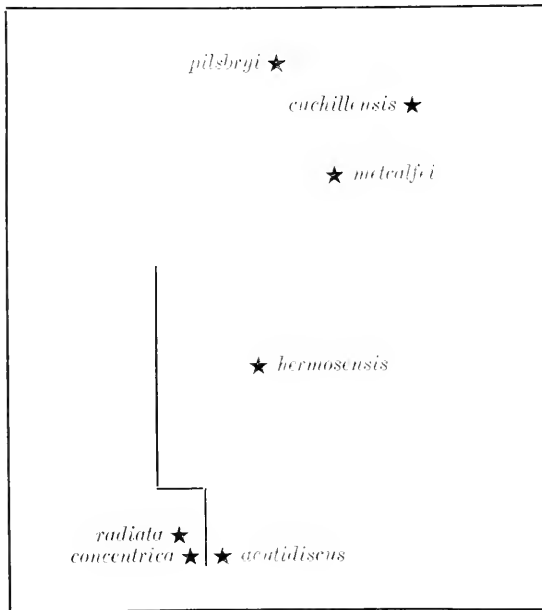


Diagram to show localities of the races of *Orchelimum metcalfei* relative to one another and to the crest of the Black Range from Sawyer to Diamond Peak. Scale about 16 miles to an inch.

Oreohelix metcalfei concentrica n. subsp. Pl. VIII, figs. 1-1d.

The shell is much more broadly and openly umbilicate than *O. metcalfei*; cartridge buff, inconspicuously mottled with gray or light drab, the embryonic whorls pinkish cinnamon, and the peripheral keel bordered below with a brown band. Sculpture of about five extremely low spiral cords on the base, and usually traces of two or three above, their intervals finely and sharply striate spirally, and there are very fine, irregular striæ along growth-lines, sharp where they pass over the keel and spiral cords, elsewhere weak. The last whorl does not descend in front.

Alt. 9.3, diam. 21.5 mm.; $4\frac{3}{4}$ whorls.

Silver Creek, above 7,500 feet, at stations 3, $4\frac{1}{2}$, 7, and 11, on limestone outcrops. Type No. 115,755, A. N. S. P. from Station 7, above the box of Silver Creek, on the north side.

In most specimens the intervals between the cords on the base are dull brown, or when concolored the spiral striæ make them appear darker, giving an appearance of relief to the cords. A few individuals from Station 11 (a branch ravine of Silver Creek south of Gray's cabin) have the base blackish chocolate.

Specimens with the spiral cords on the base less conspicuous and the color usually darker—clouded and banded with dull walnut brown in varying degree—were found at Station 20, at the Grand Central Mine; Station 19, the next gulch north of that where the mine is; also Station 22, the succeeding gulch north (Pl. VIII, fig. 1d). At Station $17\frac{1}{2}$, on the west side of Sawyer Peak about 500 feet below the summit, similar shells were found, varying from nearly typical color to broadly banded below with chocolate, the spiral cords therefore inconspicuous.

Genitalia as in *O. m. radiata*.

The embryonic shell (Pl. IX, fig. 10) is very beautiful. The first whorl is smooth, cuticular laminae along growth-lines then appearing gradually. From these triangular processes rise, forming 3 or 4 spiral series above, usually 4 below a peripheral series of larger processes.

The embryos of *radiata*, *acutidiscus* and *hermosensis* are identical with those of *concentrica*.

Oreohelix metcalfei radiata n. subsp. Pl. VIII, figs. 2, 2a, 3-3c, 6, 6a.

The shell is more openly umbilicate than *O. metcalfei*, with irregular sculpture of strong wrinkles in the direction of growth-lines, the lens showing fine spiral striæ between the wrinkles of the lower surface, very few on the upper surface. Faint traces of a few coarse spirals

on the base may be discerned in most examples. The last whorl usually does not descend in front (but in some exceptional specimens it descends). The typical color is cartridge-buff, with some cream-buff clouding above, the early whorls being light pinkish cinnamon; but it varies, some shells having a bister band below the periphery, or this may be widened, suffusing much of the base (figs. 6, 6a), with also a cinnamon line on the upper surface. In a few examples, all of the base except within the umbilicus is between chocolate and black, the upper surface being brownish.

Alt. 9, d am. 19.4 mm.

Limestone outcrops on Iron Creek, Station 16, some distance above the confluence of Spring Creek and on Spring Creek, Station 15 (type loc.).

The Iron Creek specimens are nearly all of the pale typical color.

The genitalia of a specimen from Station 15, the type locality, were figured, *sub nom. O. metcalfei*, in PROC. A. N. S. PHILA., 1916, p. 352, Pl. XXII, fig. 10. Embryonic shell (Pl. IX, fig. 11) as in *O. m. concentrica*.

Oreohelix metcalfei acutidiscus n. subsp. Pl. VIII, figs. 4, 4a.

Broadly umbilicate, like *O. m. concentrica*, from which this race differs by having stronger growth-wrinkles (though much less coarse than in *O. m. radiata*), and in place of the spiral cords of *concentrica* there are slightly enlarged striæ, the whole base being finely striate spirally between the riblets. It is mottled and clouded profusely, above and below, with walnut brown. The keel is very acute.

Alt. 10.4, diam. 22.4 mm.: $5\frac{1}{3}$ whorls.

Station 23, about 1,000 feet below the summit of Sawyer Peak, east of and below the camp site on the saddle, on a small outcrop of limestone.

In another place down the mountain southeast from camp, Station 18, we found a colony differing by being cartridge buff, a few with a band below the periphery. Both of the localities are on the opposite side of the mountain from the known localities of *O. m. radiata*. The embryonic shells are like those of *radiata* and *concentrica*.

Oreohelix metcalfei hermosensis n. subsp. Pl. IX, figs. 4, 4a, 4b.

The shell is solid, cartridge buff with a narrow chocolate band below the periphery, and some indistinct pinkish cinnamon mottling, especially above. The surface is nearly smooth, having light irregular growth-lines and no spiral striæ. The last whorl descends in front. It is strongly angular in front of the aperture, the angle becoming weak on the last half. The umbilicus about as in *metcalfei*.

Alt. 12.3, diam. 21.4 mm.; $5\frac{1}{3}$ whorls.

Stations 55 and 56, near Hermosa, Sierra County, New Mexico.

This subspecies resembles *O. metcalfei* in color and the smooth surface, but differs by wanting the strong keel of the last whorl.

Genitalia are substantially as in *O. m. radiata*. The penis is figured, fig. 4a, and opened, fig. 4b. The lower portion has several very irregular and unequal fleshy ridges within, upper portion papillose. Length of penis 13 mm., of its thickened lower part 5 mm.; length of epiphallus 3.5 mm.; of penial retractor 6 mm. Diameter of the shell 20.5 mm.

The embryonic shells (Pl. IX, fig. 12) are exactly as in the forms of *metcalfei* from the Black Range. In the adult shell the embryo photographs abnormally dark on account of its yellow hue.

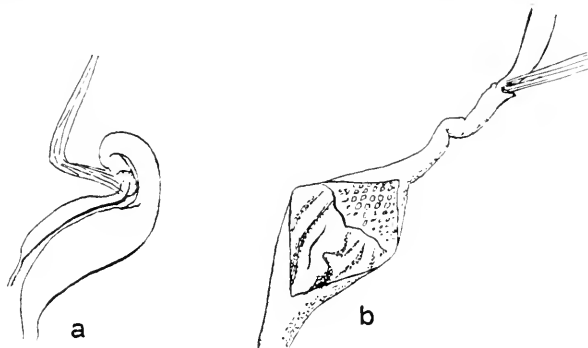


Fig. 4.—Penis of *Oreohelix metcalfei hermosensis*. a, exterior; b, the same opened.

Oreohelix metcalfei cuchillensis n. subsp. Pl. IX, figs. 1, 1a, 1b.

This form is smaller than *hermosensis*, and the peripheral angle in front of the aperture is weaker, scarcely noticeable. Typically there are very minute and superficial spiral striae, but on many specimens these cannot be made out. The last whorl descends little or not at all in front. There is about a half whorl less.

Alt. 9, diam. 18.2 mm.; $4\frac{3}{4}$ whorls.

Cuchillo Mountains, Sierra County, at two stations about two miles apart, at the southern end of the range.

We have hesitated between uniting this with *O. m. hermosensis* and giving it separate standing. The sizes intergrade in a small number of specimens, *cuchillensis* varying from 15.4 to 20 mm. diameter; yet where this is the case, the specimens are readily separable by other characters. Except for one specimen of 20 mm. diam., none of the lot of over 200 specimens exceeds 19 mm. diameter.

The genitalia are substantially similar to *O. m. hermosensis* except for the smaller size. Length of penis 7, of its internally thickened lower portion 4 mm.; of epiphallus 3 mm.; of penial retractor 6.5 mm.; diam. shell about 17.5 mm. (No. 112,917, A. N. S. P.)

No embryos were found in a few specimens preserved in spirit, taken in October.

Oreohelix pilsbryi Ferriss. Pl. VIII, figs. 7-7c.

Oreohelix pilsbryi Ferriss, Nautilus, XXX, January, 1917, p. 102.

While closely related to *O. metcalfei*, this form appears to be sufficiently distinct for specific rank. It is most like *O. m. concentrica*, but differs by the narrow, strongly raised spiral liræ and the smaller umbilicus. It is also relatively higher, resembling some forms of *O. haydeni* from the Oquirrh Range, in Utah. There are usually four spirals on the base, two on the upper surface. The embryonic whorls of adults and the genitalia (figured in PROC. A. N. S. PHILA., 1916, Pl. XXII, fig. 8) are substantially as in *O. metcalfei radiata* and the other forms of that species. Embryos were not found in the uterus in the few specimens preserved in spirit.

It was found only near the Oliver Mine, on Mineral Creek, about 6 miles from Chloride, Sierra County. Several hundred living examples were obtained. See *Nautilus*, XXX, p. 102.

Oreohelix cooperi (W. G. B.) Pl. IX, figs. 5-9.

This region, which forms the southern border of the vast area of *cooperi*, has a capacious form of the species. Many examples are typical in coloring (figs. 7, 9), but pale shells with faint bands or none are abundant, especially on Silver Creek (figs. 6, 8, 8a). Occasionally throughout the range, specimens were found with very broad, almost black bands (figs. 5, 5a). These color forms are to be found together, throughout the forest zone of the range. Thus, figs. 5-7 (Station 9) and 8, 8a (Station 4½) are from Silver Creek; fig. 9 from Holden's Spring (Station 26). The extremes of elevation of the spire may also be found in single colonies. The shape and color mutations or forms are spread throughout the range, though particular color-forms are often prevalent at one or another station.

The specimens figured measure as follows:

Figs. 5, 5a,	alt. 14,	diam. 20 mm.
Fig. 6,	" 13,	" 20 "
Fig. 7,	" 15.6,	" 20.6 "
Figs. 8, 8a,	" 16.7,	" 22 "
Fig. 9,	" 14.3,	" 20.5 "

Localities in the Black Range and environs are given below. It is not confined to limestone exposures, but is quite sparsely scattered on shaded hillsides throughout the forested zone of the range from Sawyer Peak northward.

Sawyer Peak. Station 17 $\frac{1}{2}$, west side of the north peak, near the summit.

Silver Creek, at stations 3, 4 $\frac{1}{2}$, 6, 7, 9; Bull Top Creek; Station 13.

Spring Creek, Station 15;

Iron Creek, stations 16 and 16 $\frac{1}{2}$ (Wright's cabin). Between Iron Creek and Hillsboro Peak.

Heads of Animas Canyon at Holden's Spring, Station 26, and at stations 29, 30, 32, 33, northward.

Near McKnight's cabin, Station 36; stations 38, 39 $\frac{1}{2}$, 40, the last 8 miles north.

Black Canyon region at stations 41, 42.

Morgan Canyon, stations 44, 45, 48.

Diamond Creek, Station 50, about halfway down the mountain on the west side.

East of the Black Range it was taken at—

Sam's Canyon, about 6 miles south of Chloride, dead only.

San Mateo Mountains, everywhere on the south side, abundant.

Specimens from Holden's Spring (Station 26) were dissected last year. See PROC. A. N. S. PHILA., 1916, p. 351. Two more have been opened, giving the following measurements of the genitalia:

	No. 115,156. Silver Creek. Station 4 $\frac{1}{2}$.	No. 112,920. San Mateo Mountains.
Length of penis	21 mm.	13.5 mm.
" " internally ribbed part	11 "	8 "
" " epiphallus	4.5 "	5 "
" " penial retractor muscle	10 "	7 "
Diameter of the shell	22 "	" "

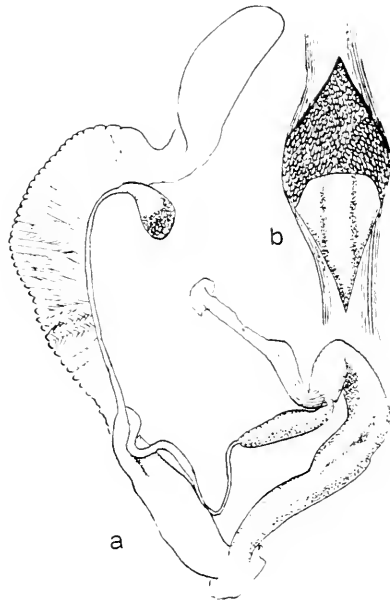


Fig. 5.—Reproductive organs of *Oreohelix cooperi* from Holden's Spring, Black Range, with detail of the penis, opened at upper end of the internally ribbed portion.

The lower part of the penis contains two or three fleshy ridges, the upper ends of which project a little into the cavity of the thin-walled portion.

Thysanophora ingersolli (Bld.).

Common throughout the humid forested zone, especially among aspens. Taken at 16 stations, from Sawyer Peak to Black Canyon.

Thysanophora hornii (Gabb).

Not found in the Black Range. A few were taken in the Cuchillo Mountains.

UROCOPTIDÆ.

Holospira cockerelli Dall.

Holospira cockerelli Dall, Nautilus, XI, October, 1897, p. 62. Pilsbry, Proc. A. N. S. P., 1905, p. 218, Pl. 26, fig. 6.

San's Canyon, about 4 miles south of Chloride. Cuchillo Mountains. Big Palomas Creek, near Hermosa, in a mountain across-stream, above the fork, at Ocean Wave Mine; also in the next peak below. Little Palomas Creek, in a limestone mountain 2 miles north of Black Bob's ranch.

The specimens from the Little Palomas are about typical in size:

Length 12.5 mm., 13½ whorls.

 " 10.5 " 12 "

The largest are from the Cuchillo Mountains on the south side of the peak, where some are 16.8 mm. long, with 16½ whorls. Specimens from the other localities are intermediate in size. All we have opened have a single short lamella low on the axis in the penult whorl.

The type was found in drift debris of the Rio Grande. Subsequently Mr. Metcalfe found one "near Kingston"—probably northward near the southern localities given above.

We did not find *Holospira regis* Pils. and Ckll., which was collected by Mr. Metcalfe somewhere in the Kingston district.

ENDODONTIDÆ.

Pyramidula cronkhitei (Newc.).

Found everywhere (18 stations) throughout the wooded zone. Also in the Middle Percha drift below Kingston, Mineral Creek near Chloride, and Little Palomas Creek; probably washed down from above.

Helicodiscus arizonensis P. and F.

Rather sparingly found at many stations throughout the Black Range, from the summit to the level of Kingston. Also San Mateo and Cuchillo Mountains.

VITRINIDÆ.

Vitrina alaskana Dall.

From the summit of the ascent north of Wright's cabin northward to Black Canyon; abundant, especially near McKnight's cabin, on bits of wood, etc. Not seen south of Iron Creek.

ZONITIDÆ.

Polita indentata umbilicata (Ckll.).

Black Range on Silver Creek; head of Iron Creek, Station 16½; Animas Creek above the box, Station 25; Bear Wallow, Reed's ranch, Station 43. It is rare at the higher levels. In dryer, lower country it was taken at Station 1, Gallina Creek, on Little and Big Palomas Creeks, near Chloride, and in the Cuchillo and San Mateo Mountains.

Zonitoides arborea (Say).

Found throughout the Black Range; taken at 17 stations.

Zonitoides minuscula alachuana (Dall).

Iron Creek, stations 16, 16½; Holden's Spring; drift of Percha below Kingston; Oliver Mine, near Chloride.

Striatura milium meridionalis P. and F.

Station 28, south side of Hillsboro Peak; Station 26, Holden's Spring.

Euconulus fulvus (Drap.).

Everywhere along the crest, from Sawyer Peak to Black Canyon. Also in drift at Station 1, Gallina Creek, and below Kingston; Oliver Mine near Chloride; San Mateo Mountains.

LIMACIDÆ.

Agriolimax campestris (Binn.).

Taken at 6 stations in the wooded zone of the Black Range.

PUPILLIDÆ.

Pupilla blandi pithodes n. subsp.

The shell is short, cylindric with rounded ends, chestnut brown, slightly shining. Whorls somewhat convex, the last slowly ascending a little in front, somewhat flattened and tapering to the rather narrow base, noticeably contracted behind the lip, having a quite low (or sometimes rather strong) crest, of the same color as the rest of the shell, behind the contraction. Parietal lamella deeply placed, about one-third of a whorl long. Lower palatal plica rather long. Columellar lamella well developed, short.

Length 3.2, diam. 1.8 mm.

Black Range, abundant in the forested zone, chiefly among aspens. Type locality, Station 39, around the cattle-trap and lake between McKnight's and Mimbres forester stations.

It was taken at stations 5, 9, 16½, 17, 26, 28, 30, 31, 33, 34, 37, 39, 42 and 47, well scattered over the ridge and upper slopes from Sawyer Peak to Black Canyon. Single bleached shells were taken in the drift debris of Gallina Creek at Station 1, and in the debris of Middle Percha Creek below Kingston. These were doubtless carried down from the forest zone by freshets.

This is relatively wider and shorter than *P. blandi*, with a far less developed crest behind the lip. Typical *P. blandi* is a decidedly smaller shell.

***Pupoides marginatus* (Say).**

A bleached shell was found in drift of the Middle Percha Creek below Kingston, therefore in the foothills rather than the Black Range itself.

***Gastrocopta pellucida hordeacella* (Pils.).**

Middle Percha Creek, below Kingston. Not found in the mountains.

***Gastrocopta pilsbryana* (Sterki).**

Not uncommon on top. It was taken at 8 stations between Silver Creek and McKnight's ranger cabin. Also on Mineral Creek, near the Oliver Mine, Station 52, and in the Cuchillo Mountains.

***Gastrocopta ashmuni* (Sterki).**

Stations 16, Iron Creek, and 54, Little Palomas Creek, a single shell at each. The former station, probably above 7,500 feet, is unexpected, and above its usual zone in this part of New Mexico.

***Gastrocopta quadridens* Pils.**

Stations 16½, Iron Creek near Wright's cabin, and 28, south side of Hillsboro Peak.

***Vertigo coloradensis arizonensis* P. and V.**

Taken at 10 stations along the range, above 7,500 feet, and doubtless to be found in the forest zone wherever minutiae are looked for, especially among aspens.

***Vertigo modesta* n. subsp.**

This new subspecies will be described in the next paper of this series. It was taken in the Black Range at stations 1, 9, 16½, 24, 26, 28, 30, 34, 39, 47.

VALLONIIDÆ.

Vallonia perspectiva Sterki.

Silver Creek, Station 9, elevation 8,000 feet, in the forest zone, and above its usual range. Much lower down it was taken at Station 42, Black Canyon, about 4 miles below the crest; in drift of the Middle Percha below Kingston; Station 54, on Little Palomas Creek, and in the Cuchillo Mountains.

Vallonia cyclophorella Cktl

On the crest at stations 16 $\frac{1}{2}$, 39, and 47.

FERUSSACIDÆ.

Cochlicopa lubrica (Müll.)

Found sparingly but generally spread throughout the Black Range, from Silver Creek to Black Canyon; also on lower levels at Station 1, Kingston, Little Palomas Creek, Cuchillo and San Mateo Mountains.

SUCCINEIDÆ.

Succinea avara Say.

Station 1, Gallina Canyon; Middle Percha below Kingston. Not in the forest zone.

PHYSIDÆ.

Physa sp. undet.

Middle Percha Creek, Kingston; Animas River near junction of Cherry Creek; both in the eastern foothills of the Black Range.

COLLECTING STATIONS IN THE BLACK RANGE.

Many of the stations are plotted on the maps, pp. 84 and 85; most of the others may be located by their relation to those plotted.

1. Middle branch of Gallina Creek about 2 miles above Pryor's upper cabin.
2. Same, 4 miles above cabin, at the fork.
- 3, 4. Limestone ledges on north and south sides of Silver Creek, a few hundred yards above Mitchell Gray's cabin (7,500 feet).
- 4 $\frac{1}{2}$. Silver Creek just below the "box," where the trail makes a detour.
5. Silver Creek above the box, on north side, near a deserted cabin.
6. Silver Creek, north side, a short distance above Station 5.
7. Silver Creek, north side, above the preceding.
8. Saddle above the head of Silver Creek.
9. South side of the "box" of Silver Creek.
10. Gulch tributary to Silver Creek on north side, near Strohm's "mine."
- 11, 12. Gulch tributary to Silver Creek, about a mile south of Gray's cabin, and not far from the same elevation.
- 12 $\frac{1}{2}$. About a half mile above Spade's cabin, on Little Gallina Creek.
13. Branch of the head of Spring Creek (Bull Top Creek?).
15. Outcrop of limestone on east side of Spring Creek, where a small ravine enters from the east.
16. Iron Creek, where a ravine with numerous prospect holes enters from the south, between confluence of Spring Creek and Wright's cabin.
- 16 $\frac{1}{2}$. Wright's cabin, near the head of Iron Creek.

17. Western side of the north summit of Sawyer Peak about 500 feet below the summit.
- 17½. Same vicinity, 3-500 feet below summit.
18. Northeastern flank of Sawyer Peak, a half mile below camp on saddle.
19. Ravine next up the trail to Sawyer Peak from Grand Central Mine.
20. Grand Central Mine, on the mine side of the ravine.
21. About 2 miles east of the trail from Sawyer Peak to Grand Central Mine, and not much higher than the mine.
22. Ravine north of Station 19.
23. A limestone ledge 20 minutes' walk down the mountain east from the camp on the saddle of Sawyer Peak.
- 23½. Hillside south of Wright's cabin near head of Iron Creek.
24. Top of the steep trail north of Wright's cabin.
25. Just above the box of Holden Prong of Animas Canyon, several miles below Holden's Spring.
26. Hillside southward above Holden's Spring.
27. A branch of Noonday Canyon, heading opposite Holden Spring, perhaps 2 miles down.
28. South side of Hillsboro Peak, among aspens.
29. Branch of Animas Canyon 1 mile west of Animas range: cabin.
30. Branch of McKnight Canyon, running westward, about 3½ miles west of Animas cabin and 2 miles from the summit trail.
31. Drift debris of Middle Pehcha Creek, near Kingston.
32. Garden of Mr. Stephen Reay, west end of Kingston.
33. Along summit trail, 2 or 3 miles north of Animas ranger cabin.
34. About half way between Animas and McKnight's ranger cabins, in aspens along the summit trail.
35. Rocky hillside about 2 miles north of McKnight's cabin, along the trail.
36. Rocky slide facing south about a mile north of McKnight's cabin.
37. Head of McKnight's Canyon.
38. McKnight's Canyon below the "box."
39. Around lake and cattle-trap, on the shoulder of Mimbres Peak.
40. Eight miles north of McKnight's cabin, on trail.
41. About 1½ miles south of Black Canyon ranger station.
42. Black Canyon about 3 to 4 miles below Reed's ranch.
43. Bear Wallow, Reed's ranch, among aspens.
44. Head of Morgan Creek, near the Hermoso trail. Stations 45, 47 and 48 are in the same vicinity.
45. North and west sides of the head of Morgan Creek.
46. Rock slides south of Reed's ranch.
47. Trail half a mile south of Reed's ranch.
48. Morgan Creek, ¼ mile below Station 44.
49. Black Canyon, 1 mile above Diamond Bar Ranch.
50. Diamond Creek, about 4 miles below crest of range.
51. Diamond Creek, about 3 miles below crest of range.
52. Mineral Creek at Oliver Mine, 4 miles above Chloride.
53. Sam's Canyon, 4 miles south of Chloride.
54. Limestone Mountain on Little Palomas Creek, 2 miles north of Bob's ranch.
55. First mountain across creek above forks at Ocean Wave Mine, Big Palomas Creek near Hermosa.
56. Next peak below 55.
57. Reservoir on the Animas near mouth of Cave Creek, ranch of Rue Panka.
58. Rock slides on south side of Cave Creek between its mouth and the trail to Hillsboro.

Cuchillo Range. Three stations at the south end of this small range, 6 miles east of Chloride.

San Mateo Range, in the south end, 6 miles from Monticello. Several rock slides, in the vicinity of Chippy Creek and on the southern slope, were investigated.

EXPLANATION OF PLATES VII, VIII, IX, X.

PLATE VII.—Figs. 1, 1a, 1b.—*Ashmunella tetradon fragilis* n. subsp. Type. Station 58. No. 115,753.

Figs. 2, 2a, 2b.—*Ashmunella tetradon unimorum* n. subsp. Type. Station 26. No. 115,747.

Figs. 3, 3a, 3b.—*Ashmunella cockerelli* n. sp. Type. Station 19. No. 115,748.

Fig. 4.—Depressed specimen of the same lot.

Fig. 5.—*Ashmunella cockerelli argenticola* n. subsp. Type. Station 4¹. No. 115,749.

Figs. 6, 6a, 6b.—*Ashmunella mendax* n. sp. Type. Station 16. No. 115,754.

Figs. 7, 7a.—*Ashmunella cockerelli proobtusata* n. subsp. Type. Station 21. No. 115,750.

Fig. 8.—*Ashmunella binneyi* n. sp. Type. Station 8¹. No. 115,751.

Fig. 9.—*Ashmunella cockerelli* n. sp. Enlarged view of type.

Fig. 10.—*Ashmunella mogollonensis* Pils. Enlarged view of specimen from the Mogollon Range.

PLATE VIII.—Figs. 1-1c.—*Orcohelix metcalfei concentrica* n. subsp. Type. Station 7. No. 115,755. 1d, dark specimen of same from Station 22.

Figs. 2, 2a.—*Orcohelix metcalfei radiata* n. subsp. Station 15.

Figs. 3-3c.—*Orcohelix metcalfei radiata* n. subsp. Type. Station 15. No. 112,899.

Figs. 4, 4a.—*Orcohelix metcalfei acutidiscus* n. subsp. Type. Station 23. No. 115,757.

Fig. 5.—*Orcohelix metcalfei* C'kll. Type. No. 10,941.

Figs. 6, 6a.—*Orcohelix metcalfei radiata* n. subsp. Station 16.

Figs. 7-7c.—*Orcohelix pilsbryi* Ferriss. Type. Station 52. No. 112,918a.

PLATE IX.—Figs. 1-1b.—*Orcohelix metcalfei cuchillensis* n. subsp. Type. No. 115,760.

Fig. 2.—*Orcohelix swopci* n. sp. Elevated example from Station 45.

Figs. 3-3b.—*Orcohelix swopci* n. sp. Type. Station 45. No. 112,896.

Figs. 4-4b.—*Orcohelix metcalfei hermosensis* n. subsp. Type. No. 115,759.

Figs. 5, 5a, 6, 7.—*Orcohelix cooperi* (W. G. B.). Station 9. No. 115,280.

Figs. 8, 8a.—*Orcohelix cooperi* (W. G. B.). Station 4¹. No. 115,156.

Fig. 9.—*Orcohelix cooperi* (W. G. B.). Station 26. No. 115,306.

Fig. 10.—*Orcohelix metcalfei concentrica*. Embryos. No. 115,315.

Fig. 11.—*Orcohelix metcalfei radiata*. Embryos. No. 115,319.

Fig. 12.—*Orcohelix metcalfei hermosensis*. Embryos. No. 112,922.

Fig. 13.—*Orcohelix swopci*. Embryos. Station 41.

PLATE X.—Fig. 1.—*Ashmunella mendax* n. sp. Station 16.

Fig. 2.—*Ashmunella cockerelli* n. sp. Station 20.

Fig. 3.—*Ashmunella mogollonensis* P. and F.

Fig. 4.—*Ashmunella cockerelli proobtusata* n. subsp. Station 21.

Fig. 5.—*Ashmunella binneyi* n. sp. Station 7.

Fig. 6.—*Ashmunella tetradon* P. and F. San Mateo Mountains. No. 112,921.

NOTES ON FISHES FROM NEW JERSEY, PENNSYLVANIA, AND MARYLAND.

BY HENRY W. FOWLER.

Within the past two years some local fishes have been obtained for the collections of the Academy. A number have recently been studied, and as there are large series of specimens in many cases, representing the fish-faunas of a number of streams heretofore not explored, a résumé is here given. Several species new to the region may also be noted, besides others rare or little known. Among those to whom I am indebted for assistance and many favors are Messrs. C. S. Abbott, Jr., and R. M. Abbott, Miss K. Bell, Messrs. H. H. Burton, Edwin Fowler, W. J. Fox, H. W. Hand, Philip Laurent, G. H. Lings, H. L. Mather, E. S. and W. I. Mattern, W. E. Meehan, Dr. F. Pennell, Mr. H. E. Thompson and Dr. R. O. Van Deusen.

NEW JERSEY.

During the past season collections were made in late April in the streams and bay-shore region of Cumberland County (Bivalve, Cedarville, Sheppard's Mill and Fortescue): July 31, the Assampink Creek in Mercer County (Quaker Bridge); August 8, streams in Warren County (Musconeteong River and Hihickihocki Creek near Stewartville, and the Pohatcong Creek near Washington and Port Colden); August 3, Hunterdon County (Wickecheoke Creek at Stockton and the Loekatong Creek below Raven Rock), and on September 27, near Frenchtown (Harihokake, Nishisakawick and Copper Creeks). I have also examined the records of material collected and such specimens as were brought to the Philadelphia Aquarium during the past summer from Atlantic City and Somers Point.

Carcharias taurus Rafinesque.

One 9 feet long at Atlantic City and several more about the same length from off shore brought to Somers Point in September.

Alopias vulpinus (Bonnaterre).

Mr. J. W. Tatum submitted a photograph of an adult about 15 feet long taken at Stone Harbor, in June, 1902.

Isurus tigris (Atwood).

An example about 8 feet long, captured at Seaside Heights, August 26, of which I have a photograph, appears to be this species. Another about 9 feet long, captured off Atlantic City in August and brought to Somers Point, is probably identical. These are the only recent records known to me.

Mustelus mustelus (Linné).

Atlantic City and Somers Point.

Eulamia milberti (Müller and Henle).

One adult at Seaside Heights during midsummer and examples in Delaware Bay at Fishing Creek; one example 8 feet long, caught September 17, examined.

Sphyrna zygaena (Linné).

Common off Atlantic City, all small.

Squalus acanthias Linné.

Atlantic City and Somers Point.

Raja eglanteria Lacépède.

Atlantic City.

Dasyatis say (Le Sueur).

Sea Isle City on June 10.

Myliobatis freminvillii Le Sueur.

Two at Somers Point in September.

Rhinoptera bonasus Mitchell.

On September 24 an adult, estimated at 40 pounds in weight, caught in the surf at Sea Isle City on a hook baited with clam. Mr. W. J. Fox has given me its caudal spine. In the same month three other examples were taken at Somers Point, weighing from 25 to 50 pounds.

Amiatus calvus (Linné).

Mr. W. H. Strang reports a male taken in Cresson Lake, Camden County, on July 5. This is the first record of this introduced species brought to my attention.

Pomolobus pseudoharengus (Wilson).

Bayside.

Alosa sapidissima (Wilson).

Bivalve and Bayside. About 70 pounds, reported taken off Sea Isle City in May.

Synodus foetens (Linné).

One secured in Great Egg Harbor Bay at Ocean City on September 14, and in the same month four more at Somers Point.

Ameiurus nebulosus (Le Sueur).

Bivalve and near Port Colden.

Schilbeodes insignis (Richardson).

Harihokake Creek.

Pimephales notatus (Rafinesque).

A single example was secured with the above in Harihokake Creek. This is of interest as the first record since its only previous capture by the late Prof. A. C. Apgar and Dr. C. C. Abbott in 1874.¹ They likewise obtained but a single example in the Delaware and Raritan Canal in Trenton. As the stream in which my example was taken is very clear and falls with moderate descent over red shale rocks, it was possible to examine many fishes as they swam about. Probably a dozen other examples were seen in the same locality. They usually kept together and did not appear to scatter much or associate with the dace or suckers.

Semotilus bullaris (Rafinesque).

Stockton, Raven Rock, Musconeteong and Hihickihocki Creeks.

Semotilus atromaculatus (Mitchill).

Stockton, near Port Colden and Harihokake Creek.

Abramis crysoleucas (Mitchill).

Washington and Copper Creek.

Notropis whipplii analostanus (Girard).

Stockton and Raven Rock.

Notropis cornutus (Mitchill).

Stockton, Raven Rock, Musconeteong Creek, Hihickihocki Creek, Port Colden, Harihokake, Nishisakawick and Copper Creeks.

Notropis chalybæus (Cope).

Quaker Bridge.

Rhinichthys cataractæ (Valenciennes).

Stockton, Raven Rock, Harihokake and Nishisakawick Creeks.

Rhinichthys atronasmus (Mitchill).

Stockton, Raven Rock, Musconeteong Creek, Port Colden, Hihickihocki, Harihokake, Nishisakawick and Copper Creeks.

Exoglossum maxillingua (Le Sueur).

Stockton.

¹ *Amer. Nat.*, VIII, 1874, p. 337.

Catostomus commersonnii (Lacépède).

Stockton, Raven Rock, Musconetcong Creek, Hibiickihocki Creek, Washington, Port Colden, Harihokake, Nishisakawick and Copper Creeks.

Anguilla rostrata Le Sueur.

Bivalve, Sheppard's Mill, Fortescue, Stockton, Raven Rock, Harihokake Creek, Somers Point and Atlantic City.

Leptocephalus conger (Linné).

Two at Atlantic City in October.

Umbra pygmaea (De Kay).

Cedarville and Sheppard's Mill. Mr. P. Laurent also secured it at Clementon on July 1, 1914.

Esox americanus (Gmelin).

Copper Creek.

Esox reticulatus Le Sueur.

Sheppard's Mill.

Fundulus majalis (Walbaum).

Somers Point.

Fundulus heteroclitus macrolepidotus (Walbaum).

Bivalve, Fortescue and Somers Point.

Fundulus diaphanus (Le Sueur).

Bivalve and Washington.

Fundulus luciae (Baird).

Bivalve and Fortescue.

Lucania parva (Baird).

Bivalve and Fortescue.

Cyprinodon variegatus Lacépède.

Fortescue.

Tylosurus marinus (Walbaum).

Somers Point.

Menidia beryllina (Cope).

Fortescue.

Mugil cephalus Linné.

This and the next from Somers Point.

Mugil curema Valenciennes.

Gasterosteus aculeatus Linné.

Fortescue.

Thunnus thynnus (Linné).

An adult taken off Seaside Heights, and another secured in September thirty miles off Anglesea was 6 feet 7 inches in length.

Sarda sarda (Bloch).

Few at Atlantic City.

Trachinotus carolinus (Linné).

One weighing about two pounds, at Atlantic City in September.

Poronotus triacanthus (Peck).

Plentiful at Atlantic City and Somers Point.

Acantharchus pomotis (Baird).

Several fine examples from Elmer, some quite mottled with darker.

Enneacanthus gloriosus (Holbrook).

Sheppard's Mill.

Mesogonistius chætodon (Baird).

Port Elizabeth, in October.

Lepomis auritus (Linné).

Stockton, Raven Rock, Harihokake and Nishisakawiek Creeks.

Pomotis gibbosus (Linné).

Cedarville, Washington and near Port Colden.

Micropterus dolomieu Lacépède.

Musconetcong Creek.

Boleosoma nigrum olmstedii (Storer).

Quaker Bridge, Stockton, Raven Rock, Musconetcong and Hihiekihocki Creeks, Washington, near Port Colden, Harihokake, Nishisakawiek and Copper Creeks.

Boleichthys fusiformis (Girard).

Elmer.

Roccus lineatus (Bloch).

Bayside, Atlantic City and Somers Point. These examples 2 to 10 pounds in weight.

Morone americana (Gmelin).

Scarce at Atlantic City.

Centropristis striatus (Linné).

Abundant at Atlantic City and Somers Point.

Orthopristis chrysopterus (Linné).

Sea Isle City and Atlantic City.

Stenotomus chrysops (Linné).

Common at Atlantic City and Somers Point.

Cynoscion regalis (Schneider).

Less abundant than usual at Atlantic City and Somers Point.

Cynoscion nebulosus (Cuvier).

Four reported from Somers Point in September.

Bairdiella chrysura (Lacépède).

Frequent at Atlantic City and Somers Point.

Leiostomus xanthurus Lacépède.

Abundant with the last.

Micropogon undulatus (Linné).

Bayside. Very abundant and of large size at Somers Point. Atlantic City.

Sciænops ocellatus (Linné).

Large example from Ocean City examined, and abundant up to 40 pounds weight at Atlantic City and Somers Point.

Menticirrhus saxatilis (Schneider).

Very abundant at Atlantic City and Somers Point.

Pogonias cromis (Linné).

Adult examined taken at Ocean City in September. Abundant at Somers Point and Atlantic City to 40 pounds weight.

Tautoga onitis (Linné).

Examples 1 to 2 pounds plentiful at Atlantic City and Somers Point.

Chætodipterus faber (Broussonet).

Six examples from 5 to 7 pounds taken at Atlantic City, where scarce.

Balistes carolinensis Gmelin.

About a dozen at Atlantic City in July and August.

Alutera punctata Agassiz.

A fine example, 290 mm. long, was caught in a crab net at Corson's Inlet, on September 9, by Mr. R. C. Williams, Jr., who very kindly presented it to the Academy. Mr. Williams informs me that the fish was not active, swimming with its body slightly inclined upwards in about six feet of water in the shadow of the boat. Its color when fresh was gray-mauve generally, flanks and lower side of head with large areas of slightly silvery. Back above, between dorsal spine and dorsal fin, and head above eye, with small gilded-gamboge spots, each about half size of pupil, well and evenly spaced. Obscure, dull or very pale bluish spots appear on lower surface, flanks and hind portion of trunk. The spots in life more brilliant or conspicuous.

Iris pearl-white, with gray tint. Lips neutral dusky. Spinous dorsal bright orange, soft dorsal and anal rays pale brownish, membranes transparent. Caudal black, with several dull orange lengthwise streaks. Caudal rays tinted basally with dull orange. Pectoral transparent.

This very interesting fish ranges from the tropical Atlantic in Brazil and the West Indies north to North Carolina. No previous record has ever been given of its occurrence so far to the northward as New Jersey.

Lagocephalus lævigatus (Linné).

Adult in Barnegat Bay during the summer, and another example, about 6 inches long, taken at Atlantic City in August.

Spheroides maculatus (Schneider).

Abundant at Somers Point and Atlantic City.

Diodon hystrix Linné

A dried skin was found in the collection labelled Atlantic City, September 22, 1860, obtained from G. C. Roney. As no fresh specimen has ever come to my notice, the record above is offered for what it may be worth. It is 125 mm. in length. The species is known to range from the tropical Atlantic and Florida to New England, but its presence in New Jersey has not previously been definitely noted.

It appears reasonably certain that *Diodon pilosus* Mitchell is simply the young of the present species, and therefore *Trichodiodon* Bleeker simply a synonym of *Diodon*. I have examined similar young specimens, evidently in the *Trichodiodon* stage, with the flexible hair-like bristles, and conclude they are undeveloped. Among many large examples of *Diodon*, none were found with other than long, stiff, rigid and strong spines.

Chilomyeterus schoepfi (Walbaum).

Associated with the preceding specimen of *Diodon hystrix* is one of the present species, with same data. The label further states "found on the sea-beach in large numbers."

Wildwood (Jesse Donaldson in October), Cape May (Edward Wilson on October 20), and common at Somers Point and Atlantic City.

I have re-examined the specimens of *Lyosphaera globosa* Evermann and Kendall, from Anglesea and Florida, and feel convinced they are simply the young of the present species. No characters of distinction other than those due to change with growth are apparent

to me. It seems that the soft or papery plates of *Lyosphara* are simply the early stages of the short, blunt, rigid spines of the adult *Chilomycterus*. For these reasons *Lyosphara globosa* may be merged in the synonymy of the present species.

Cottus gracilis Heckel.

Musconetcong Creek.

Prionotus evolans strigatus (Cuvier).

Abundant at Atlantic City and Somers Point.

Leptecheneis neucrates (Linné).

One at Somers Point and two at Atlantic City.

Lophopsetta maculata (Mitchill).

Atlantic City and Somers Point; also next species.

Paralichthys dentatus (Linné).

Pseudopleuronectes americanus (Walbaum).

Bayside.

Achirus fasciatus Lacépède.

Atlantic City and Somers Point.

Astroscopus guttatus Abbott.

One at Cape May on May 2.

Opsanus tau (Linné).

Abundant at Atlantic City and Somers Point.

Lophius piscatorius Linné.

One at Stone Harbor on June 1.

PENNSYLVANIA.

In the drainage area of the Delaware a number of collections were made chiefly from points reached by automobile within a thirty-mile radius of Allentown, by Messrs. E. S. and W. I. Mattern, during August, September and October. Several thousand specimens were collected and all desiderata forwarded to the Academy. They were from Carbon County (Lizard Creek), Lehigh County (Jordan Creek throughout its entire basin, Saucon Creek near Lanark, Little Lehigh River and Trout Run at Allentown, Indian Creek in the Hosensack drainage near Corning, Coplay Creek, Fell Creek, Lehigh River south of Rittersville and Ontelany Creek near New Tripoli, the last a tributary of the Schuylkill), Montgomery County (Swamp Creek, Skippack Creek and Souderton, all in the Perkiomen drainage), and Northampton County (Martin's Creek near Bangor). Concerning most interesting conditions in the Jordan, Mr. E. S. Mattern writes:

"We mentioned that the Jordan dries up during the summer. We found it dry September 2 in the afternoon, with the exception of three or four pools. Most of the pools had fish in them. One in particular, about ten feet long by three feet wide and its depth but a few inches, was full of fish. In fact, it was filled so that the backs of the catfish projected from the water. We lifted about fifty pounds of fish out of this hole and transplanted them to a larger body of water, taking all we thought necessary. It may be of interest to state that this was the farthest up stream we took or saw trout-perch. Having forgotten the camera, we concluded to return next day and take photographs of the pool and some of the fish in the net. Imagine our surprise when visiting the place the next morning to find the bed of the stream covered with three to five feet depth of water. We secured photographs further down stream, showing some of the holes in the river bottom, through which the water evidently disappears. Previous to arriving at this place we caught some long-nosed dace, taken in swift water below a large spring. When we say large spring we mean one that discharges thousands of gallons of water per minute.

"On September 22 we collected more trout-perch in the Jordan at the original station, then went up stream to see if any more pools formed. In the pool or depression where we took so many fish during the last visit, the water evidently had just left, for some catfish and killifish were still alive. Raccoons or minks had eaten most of the larger fish, as fish heads and tails were still strewn about. Another depression, at higher level, was still filled with water. Altogether it is a remarkable stream, at one place dry, at another the water runs eighteen inches deep, and so swift we could hardly keep on our feet while crossing. We fished Lyon Valley also in the Jordan and caught several fishes. It is about six miles up stream from the first station at Helfrich's Springs."

Other collections were made by the writer during the past season, with the assistance of several gentlemen mentioned above, in Berks County (Hay Creek and its tributary, as Beaver Creek at White Bear, and tributaries at Geigertown and Cold Run, also tributary of the Perkiomen at Hereford, and the Perkiomen at Pennsburg), Lehigh County (tributary of the Little Lehigh River at Emaus, North Branch of the Saucon Creek at Vera Cruz, Saucon Creek and tributary near Lanark, and Hosensack Creek at Hosensack).

In the Susquehanna River basin during the past season collections were made in August in Berks County (Conestoga Creek at Joanna and tributary of Conestoga near Joanna Heights), and in Cumberland County in September, 1914 (Simmon's Run and its North Branch, Conodoguinet Creek and tributary from Lamb's Gap), and also Perry County (Fox Hollow, Fishing Creek, Cove Creek, and Susquehanna River at Wister Island). In 1914 Dr. Witmer Stone

secured a small collection in Sullivan County (Loyalsock Creek at Shady Nook). August 4, 1916, Dr. Pennell and the writer visited Chester County (East Branch of Big Elk Creek near Elk View, West Branch of Big Elk Creek, and Little Elk Creek near Hickory Hill).

Salvelinus fontinalis (Mitchill).

Trout Run and Cold Run.

Ameiurus nebulosus (Le Sueur).

Pennsburg, Hosensaek, Jordan Creek near Helfrich's Springs, Indian and Swamp Creeks.

Schilbeodes gyrinus (Mitchill).

Saucon Creek and Lanark.

Schilbeodes insignis (Richardson).

New Tripoli, Lanark, Skippack Creek, Martin's Creek and Elk View.

Pimephales notatus (Rafinesque).

Souderton, Swamp Creek, and Lehigh River south of Rittersville.

Semotilus bullaris (Rafinesque).

Jordan Creek near Helfrich's Springs and Lyon Valley, Indian Creek, New Tripoli, Lizard Creek and Lehigh River.

Semotilus atromaculatus (Mitchill).

New Tripoli, Swamp Creek, Vera Cruz, Lanark, Jordan Creek, Lehigh River, Coplay, Fell, Lizard and Indian Creeks, Hay and Beaver Creeks near White Bear with tributary above, Fishing Creek tributary near Miller's Gap, Keystone and above in Fishing Creek, Cove Creek, Wister Island, Simmon's Run and North Branch, tributary Conodoguinet near Lamb's Gap and below Simon's Run, Joanna, Joanna Heights, and Shady Nook.

Leuciscus vandoisulus Valenciennes.

West Branch of Big Elk Creek and Little Elk Creek.

Abramis crysoleucas (Mitchill).

Pennsburg, Hosensaek, Lanark, Jordan Creek, Souderton, Lehigh River, Skippack, Indian and Swamp Creeks, Joanna.

Notropis bifrenatus (Cope).

Lanark, Lehigh River, Souderton and Bangor.

Notropis proce (Cope).

Swamp Creek, Elk View, West Branch of Big Elk and Little Elk Creeks, Wister Island.

Notropis hudsonius amarus (Girard).

Jordan Creek, Little Lehigh, Souderton, New Tripoli, Swamp Creek.

Notropis whipplii analostanus (Girard).

Jordan Creek, Lehigh River, Lizard Creek, Souderton, New Tripoli, Swamp Creek, Elk View, Cove Creek and Wister Island.

Notropis cornutus (Mitchill).

Swamp Creek, Hosensack, Lanark, Indian Creek, Little Lehigh River, Jordan, Coplay, Fell and Lizard Creeks, Lehigh River, Souderton, West Branch Big Elk and Little Elk Creeks, Elk View, Shady Nook, tributary of Conodoguinet near Lamb's Gap, Cove Creek, Wister Island, Keystone and Fishing Creek.

Notropis photogenis amœnus (Abbott).

Wister Island and Souderton. At the latter locality Messrs. Mattern secured two adult examples, one showing the extreme development of small predorsal scales. These scales number about 30, several more than in any count I have made of dozens of adult examples from various streams in the Middle States. This variant is still more remarkable, as the predorsal scales are more or less uniformly small. In several adult examples small scales anteriorly in the predorsal region may be noticed, though no example has yet been seen with the appearance of the Souderton specimen.

Notropis chalybæus (Cope).

Abundant at Bangor. This is the first record for Northampton County, and as far up the Delaware basin as it is known to occur.

Rhinichthys cataractæ (Valenciennes).

Lizard and Indian Creeks, Hereford, Lanark, Helfrich's Springs, Jordan Creek, Elk View, West Branch of Big Elk and Little Elk Creeks. Many specimens from the Jordan, Indian and Durham Creeks are interesting, as being in brilliant spawning dress. All such were secured in the autumn, and this indicates an exceptionally protracted spawning season.

Rhinichthys atronasus (Mitchill).

New Tripoli, Swamp and Skippack Creeks, Souderton, Lizard, Coplay, Fell, Jordan and Indian Creeks, Lehigh River, Emaus, Vera Cruz, Hereford, Hosensack, Lanark, Little Lehigh River, Elk View, Little Elk and West Branch Big Elk Creeks, Shady Nook, White Bear and tributary above, Geigertown, Cold Run, Joanna Heights and Joanna, Fox Hollow, tributary of Fishing Creek near Miller's Gap, Cove Creek, Keystone and Fishing Creek above,

Wister Island, Simmon's Run and North Branch, tributary of Conodoguinet near Lamb's Gap and below Simmon's Run. A number of males are in brilliant color, like those from Indian Creek in late fall.

Hybopsis kentuckiensis (Rafinesque).

Cove Creek, Wister Island and Elk View.

Exoglossum maxillingua (Le Sueur).

Same localities as preceding, also West Branch, Big Elk Creek, Little Elk Creek, Joanna and Souderton.

Cyprinus carpio Linné.

Silver Spring in Cumberland County.

Catostomus commersonii (Lacépède).

Bangor, Swamp Creek, New Tripoli, Souderton, Lizard Creek, Lehigh River, Fell, Coplay and Jordan Creeks, Vera Cruz, Hereford, Pennsburg, Hosensack, Lanark, Helfrich's Springs, Indian Creek, Trout Run, Little Lehigh, tributary of Conodoguinet near Lamb's Gap, Cove Creek, Wister Island and Fishing Creek.

Catostomus nigricans Le Sueur.

Wister Island, Elk View and Lanark.

Erimyzon sucetta oblongus (Mitchill).

Saucon Creek and tributary near Lanark, Jordan and Indian Creeks, New Tripoli, Swamp Creek, Bangor and Shady Nook.

Anguilla rostrata Le Sueur.

Pennsburg and Hosensack.

Esox americanus (Gmelin).

Pennsburg, Jordan and Swamp Creeks, New Tripoli and Bangor.

Esox reticulatus Le Sueur.

Lizard Creek.

Fundulus diaphanus Le Sueur.

Swamp Creek, Souderton, New Tripoli, Coplay Creek, Lehigh River, Hereford, Jordan and Indian Creeks.

Percopsis omiscomaycus (Walbaum).

This interesting fish was first ascribed to Pennsylvania by Cope.² He reports it from the Great Lakes, Ohio and Potomac Rivers, also the "Delaware River (Abbott)," as "a rare species in Pennsylvania." Dr. T. H. Bean later³ states "it has been collected in the Delaware River by Dr. C. C. Abbott, in the Potomac by Professor

² Rep. Comm. Fisher. Pa., 1879-80 (1881), p. 100.

³ *L.c.*, 1889-91 (1892), p. 84.

Baird." Later⁴ I stated, "*Percopsis guttatus* Agassiz has been credited to the Delaware River by writers with reference to its capture by Dr. Charles C. Abbott. However, Dr. Abbott tells me that he has never taken this fish in the Delaware, and also that he has never seen a specimen from any part of the same river system. The confusion he attributes to the remark which he made that Baird had reported it from Easton, Pa." Its occurrence in the Delaware was previously admitted by Jordan and Evermann,⁵ and copied recently by Kendall,⁶ in his paper on the identity of *Percopsis guttatus* Agassiz with the earlier *Salmo omiscomaycus* Walbaum. Uhler and Lugg⁷ first record it from the lower Potomac and also state, "Prof. Baird has seen specimens from the Susquehanna River." Subsequently Smith and Bean mention it⁸ from the Potomac basin in Rock Creek and Cabin John Run, where "it is not abundant, so far as known."

That Prof. Baird's Delaware River record was correct is quite likely, as Messrs. Mattern have recently presented the Academy with a number of examples, taken in the Jordan Creek near Allentown, or about three miles above the mouth where it debouches into the Lehigh River. These little fish were captured August 26, 1916. They were quite active, dwelling in the clear waters of the stream, and associated with shiners, black-nosed dace, suckers and darters. They are free swimmers, and travel in schools composed entirely of their own species, and none were secured in water less than a foot in depth. Their capture is of interest as serving to record with certainty the trout-perch in the Delaware River basin.

The allied western *Columbia* differs chiefly in the more robust dorsal and anal spines, the latter two in number. In my examples of the trout-perch the dorsal and anal spines are slender. As the species is somewhat variable, the following variations are from 15 examples. Head $2\frac{7}{5}$ to $3\frac{2}{5}$; depth $3\frac{4}{5}$ to $4\frac{1}{4}$; D. III, rarely IV, 9 or 10, rarely 8; A. I, 7, frequently 6, rarely 9; V. I, 7; scales in lateral line variable, usually 44 to 52, rarely 40, to caudal base, and usually 2 on latter, often 3; 6 scales above l. l., often 7, rarely 5; 8 scales below l. l. to anal origin, sometimes 7; snout $2\frac{3}{5}$ to 3 in head; eye 3 to $3\frac{5}{8}$; maxillary 3 to $3\frac{1}{2}$; interorbital $3\frac{1}{4}$ to $4\frac{1}{4}$; length 45 to 77 mm. In the smaller examples dark spots on the back are larger and few.

⁴ Rep. N. J. State Mus., 1905 (1906), p. 274.

⁵ Bull. U. S. Nat. Mus., No. 47, I, 1896, p. 784.

⁶ Proc. Biol. Soc. Wash., XXIV, 1911, pp. 45-52.

⁷ Rep. Com. F. Md., 1876, p. 129.

⁸ Bull. U. S. F. Com., XVIII, 1898 (1899), p. 185.

All show a dark streak obliquely over the opercle. The maxillary is always shorter than in the figure by Jordan and Evermann,⁹ usually reaching two-thirds to eye. Other examples in the Academy from: Sparrow Lake, Ontario; Lake Superior; Cherokee, Iowa; La Pointe, Wisconsin, and tributary of Lake Ontario.

Apeltes quadracus (Mitchill).

Little Lehigh River.

Ambloplites rupestris (Rafinesque).

Wister Island.

Lepomis auritus (Linné).

Bangor, Souderton, Swamp Creek, Emaus, Lanark, Helfrich's Springs, Elk View, West Branch of Elk Creek and Shady Nook.

Pomotis gibbosus (Linné).

Swamp, Indian and Jordan Creeks, Pennsburg, Hosensack, Lanark and Joanna.

Micropterus dolomieu Lacépède.

Silver Spring, Hosensack and New Tripoli.

Micropterus salmoides (Lacépède).

Jordan Creek, Hosensack and Souderton.

Perca flavescens (Mitchill).

Hosensack.

Hadropterus peltatus (Cope).

Messrs. Mattern visited Skippack Creek on October 1, at the locality I obtained this species previously.¹⁰ They write: "We went up the creek and after about three-quarters of a mile we caught the darter. We supposed it to be the shielded darter, as it has the plates or scales on the belly and a slightly forked tail. We caught two of them and think we saw four more. In fact, we were able to identify them in the water. They are very swift swimmers. How you were able to catch your example with a hand net is a mystery. As we stepped into the swift water they would immediately dart up stream and hide under stones. Occasionally one would rest in an unprotected position on top of a stone, and as soon as we made any movement it would dart off six or eight feet. Likely as we did not know how to fish for it, we may have overlooked it in Lehigh County streams."

⁹ Bull. U. S. Nat. Mus., No. 47, IV, 1900, Pl. 121.

¹⁰ *Science*, XL, December 25, 1914, p. 939.

***Boleosoma nigrum olmstedii* (Storer).**

Emaus, Vera Cruz, Hereford, Hosensack, Saucon and tributary at Lanark, Jordan and Indian Creeks, Trout Run, Little Lehigh River, Lizard, Coplay and Fell Creeks, Lehigh River, New Tripoli, Swamp Creek, Bangor, Hay Creek and Beaver Creek at White Bear, Joanna, Simmon's Run and North Branch, tributary of Conodoguinet near Lamb's Gap, Cove Creek, Wister Island, Fishing Creek and near Keystone, Elk View, West Branch Big Elk and Little Elk Creeks.

***Cottus gracilis* Heckel.**

Elk View, Trout Run and Little Lehigh River.

MARYLAND.

A few collections were made in Anne Arundel County in May of 1916 (in the fish market at Annapolis of specimens secured near by in the Severn River, and the South River basin, at Rhodes River, Barrow, Muddy and Scaffold Creeks), in Cecil County (during late May, 1914, at Bohemia Bridge, Dike, Scotchman, Pool and Cove Creeks, and in late August, 1916, in the Northeast River at Charlestown, Principio Creek near Principio Furnace, and the Northeast Creek near Leslie), in Kent County (Swan Creek on May 20, 1914), and Kent County (Rock Hall in August, 1915).

***Petromyzon marinus* Linné.**

Bohemia Bridge. Small ones reported from Rhodes River and Charlestown.

***Eulamia milberti* (Müller and Hentle).**

Only known in the Northeast River from reports of occasional sharks seen in the lower waters during recent years. In the spring they were captured in shad seines, and in 1911? five, 6 to 10 or more feet in length, were landed within two or three days at Carpenter's Point.

***Acipenser sturio* Linné.**

Formerly common about Charlestown, now rare, and only small ones seen. Young also reported from the Rhodes River.

***Pomolobus pseudoharengus* (Wilson).**

Bohemia Bridge, Annapolis, Rhodes River and Charlestown, also the next.

Alosa sapidissima* (Wilson).**Breevoortia tyrannus* (Latrobe).**

Bohemia Bridge, Rockhall, Rhodes River and oyster bar at mouth of South River.

Dorosoma cepedianum (Le Sueur).

Bohemia Bridge and South River.

Anchovia mitchilli (Valenciennes).

Rhodes River, Barrow, Muddy and Scaffold Creeks.

Ameiurus catus (Linné).

Bohemia Bridge.

Ameiurus nebulosus (Le Sueur).

Bohemia Bridge and Annapolis.

Hybognathus nuchalis regius (Girard).

Muddy Creek.

Semotilus atromaculatus (Mitchill).

Swan Creek.

Leuciscus vandoisulus Valenciennes.

Swan Creek, Principio Furnace and Leslie.

Abramis crysoleucas (Mittelhäll).

Bohemia Bridge, Scotchman, Cove and Muddy Creeks.

Notropis bifrenatus (Cope).

Muddy Creek.

Notropis procne (Cope).

Swan Creek.

Notropis hudsonius amarus (Girard).

Bohemia Bridge, Scotchman Creek and Charlestown.

Notropis cornutus (Mitchill).

Swan Creek, Principio Furnace and Leslie.

Notropis photogenis amœnus (Abbott).

Leslie.

Rhinichthys atronasmus (Mittelhäll).

Principio Furnace and Leslie.

Hybopsis kentuckiensis (Rafinesque).

Principio Furnace and Leslie.

Exoglossum maxillingua (Le Sueur).

Swan Creek, Principio Furnace and Leslie.

Cyprinus carpio Linné.

Bohemia Bridge, Scotchman Creek, Rhodes River and Muddy Creek. In the Rhodes River two large ones were found thickly parasitized with *Egathoa oculata* (Say).

Catostomus commersonnii (Lacépède).

Swan Creek, Bohemia Bridge, Cove Creek, Principio Furnace and Leslie.

Catostomus nigricans Le Sueur.

Swan Creek, Principio Furnace and Leslie.

Erimyzon sucetta oblongus (Mitchill).

Bohemia Bridge.

Anguilla rostrata Le Sueur.

Bohemia Bridge, Scotchman Creek, Annapolis, South River and Rhodes River.

Esox americanus Gmelin.

Bohemia Bridge and Muddy Creek.

Esox reticulatus Le Sueur.

South River and Muddy Creek.

Umbra pygmæa (De Kay).

Dike Creek.

Fundulus majalis (Walbaum).

Rockhall, South River, Scaffold, Muddy and Barrow Creeks, Rhodes River.

Fundulus heteroclitus macrolepidotus (Walbaum).

Barrow, Muddy and Scaffold Creeks, Rhodes River.

Fundulus diaphanus Le Sueur.

Bohemia Bridge, Scotchman, Pool and Cove Creeks, Charlestown, Rhodes River, Barrow and Muddy Creeks.

Fundulus luciae (Baird).

Barrow Creek.

Lucania parva (Baird).

Barrow, Muddy and Scaffold Creeks.

Cyprinodon variegatus Lacépède.

Same as last.

Tylosurus marinus (Walbaum).

Bohemia Bridge, Scotchman Creek, Charlestown, Rockhall, South River.

Kirtlandia vagrans (Goode and Bean).

Rhodes River.

Menidia beryllina (Cope).

Bohemia Bridge, Charlestown, Barrow, Muddy and Scaffold Creeks.

Menidia menidia notata (Mitchill).

Rockhall, Rhodes River, South River, Scaffold and Barrow Creeks.

Apeltes quadracus (Mitchill).

Pool Creek, Rhodes River, Barrow and Muddy Creeks.

Syngnathus fuscus Storer.

Rhodes River and Barrow Creek.

Pomatomus saltatrix (Linné).

Rhodes River. One reported in the fresh tidal of the Elk River about two miles below Elkton, October 15, 1916, by Dr. P. N. Longnecker.

Poronotus triacanthus (Peck).

Rhodes River.

Enneacanthus gloriosus (Holbrook).

Pool Creek, Charlestown, Rhodes River and Muddy Creek.

Lepomis auritus (Linné).

Swan Creek, Bohemia Bridge, Scotchman and Cove Creeks, Charlestown, Principio Furnace and Leslie.

Pomotis gibbosus (Linné).

Bohemia Bridge, Scotchman and Cove Creeks, Charlestown, Principio Furnace, Leslie, South River, Muddy Creek, Rhodes River.

Micropterus salmoides (Lacépède).

Bohemia Bridge, Scotchman's Creek and Charlestown.

Perca flavescens (Mitchill).

Bohemia Bridge, Scotchman and Cove Creeks, Charlestown, South River.

Boleosoma nigrum olmstedii (Storer).

Swan Creek, Bohemia Bridge, Pool Creek, Leslie.

Roccus lineatus (Bloch).

Bohemia Bridge, Annapolis, Charlestown and Rhodes River.

Morone americana (Gmelin).

Bohemia Bridge, Scotchman Creek, Charlestown, Annapolis, South River, Barrow Creek and Rhodes River.

Cynoscion regalis (Schneider).

Annapolis, South and Rhodes Rivers.

Bairdiella chrysura (Lacépède).

Annapolis, Rhodes River and oyster bar at mouth of South River.

Leiostomus xanthurus Lacépède.

Annapolis, Barrow Creek and Rhodes River.

Micropogon undulatus (Linné).

Annapolis, South and Rhodes Rivers.

Spheroides maculatus (Schneider).

Rhodes River.

Gobiesox strumosus Cope.

Proc. Acad. Nat. Sci. Phila., 1870, p. 121. Hilton Head, South Carolina.

This species was described from examples (now 14 in number) in the Academy, obtained from T. J. Craven at Hilton Head, South Carolina. As these examples are still in fair preservation, they have been examined and compared with the accounts of other writers published subsequently. Cope gives D. 11 and A. 10. His series shows D. usually 11 and occasionally 12, A. usually 9, occasionally 10 and rarely 8. He says, "Color in spirits bluish-lead color; fins blackish." In this respect the body is now nearly uniform, though the fins show dark cross-bars or blotches. Evermann and Bean record four examples from Indian River at Titusville, Florida.¹¹ They give D. 11 and A. 8. More recently, Evermann and Hildebrand record an example $1\frac{1}{4}$ inches long from St. Georges Island, Maryland, and another 2 inches long from Gloucester Point, Virginia.¹² They give D. 10, A. 8.

On December 15, 1915, Mr. R. M. Abbott secured an example 45 mm. long at South River. It has D. 11 and A. 9. When captured it was clinging to an oyster, dredged up in the river, and was received in fresh condition. Its coloration was so much in agreement with that given for *G. virgatulus* Jordan and Gilbert,¹³ described from Pensacola, and later recorded by Jordan¹⁴ from Egmont, Florida, that a careful comparison convinces me they are identical, and that *G. virgatulus* Jordan and Gilbert must be merged in the synonymy. There is absolutely nothing in their description not applicable to my specimens. The known range of *G. strumosus* will then extend from the upper Chesapeake Bay and Maryland to Pensacola, Florida. My entire series range from 30 to 77 mm., including additional material, also from South River, recently received.

Gobiosoma bosc Lacépède.

Rhodes River and oyster bar at mouth of South River.

Pseudopleuronectes americanus (Walbaum).

Rockhall, Annapolis and Rhodes River.

Achirus fasciatus Lacépède.

Bohemia Bridge, South and Rhodes Rivers.

Chasmodes bosquianus (Lacépède).

Chesapeake Bay near mouth of West River, and both sexes from oyster bar at mouth of South River.

Opsanus tau (Linné).

Rhodes River.

¹¹ Rep. U. S. F. Com., 1896 (1898), p. 248.

¹² Proc. Biol. Soc. Wash., XXIII, 1910, p. 163.

¹³ Proc. U. S. Nat. Mus., 1882, p. 293.

¹⁴ *L.c.*, 1884, p. 149.

A SECOND COLLECTION OF FISHES FROM THE PANAMA CANAL ZONE.

BY HENRY W. FOWLER.

Mr. David E. Harrower again visited the Canal zone in the summer of 1916, and made a collection of marine fishes at Colon. These have been purchased by the Academy. Two species appear to be new and several others are interesting records.

Sphyrna tiburo (Linné).

Three heads, 128 to 162 mm. wide. Also seven young, 160 to 245 mm. long.

Sphyrna zygæna (Linné).

Two heads preserved, 167 to 198 mm. wide.

Eulamia commersonii (Blainville).

A head of a slightly larger example than any identified as *Eulamia porosus*, shows several characters not in agreement. The nostril as seen in profile begins nearly midway in the length of the snout and nasal valves with only very obtuse wide point at hind angles, whereas in *E. porosus* the point is distinct and projecting. Each mouth corner with a conspicuous though very short fold. Teeth all very finely serrate. No pores on lower internasal space as in *E. porosus*, those above rictus and in postorbital region inconspicuous, whereas in *E. porosus* the reverse obtains.

Miller and Henle state¹ "Maul schwach konvex." Their figure of the lower view of the head does not show any distinct point to the ends of the nasal lobes, and there is no indication of a fold at the mouth corner. It also shows the space between the snout tip and mouth about an eye-diameter greater than the space between the outer nasal corners, which is not in agreement with my specimen. The short labial groove at each mouth angle and the width of the orbit half of space to nostril are points in agreement with my material.

Eulamia porosus (Ranzani).

One example, 432 mm. long, and three heads. The first smallest, and shows the nostrils in the last third of the snout, though in the largest head only slightly more forward. The smallest shows the mouth length $\frac{2}{3}$ its width, while in the largest but little over half its

¹ Besch. Plagiost., 1839, p. 37, Pl. 12.

width. In the smallest example space between front tip of lower jaw and snout tip slightly less than snout measured from its tip to eye. All have a distinct projecting point to the nasal valve. Very slight outer fold at mouth corner.

Ranzani's lateral figure² shows the nostril near the last fourth of the snout as seen in profile. His lower view of the head shows it slightly behind middle in snout length, as measured from snout tip to eye. Also the mouth length is shown greater than its width and without any trace of a short groove at the outer corners. His specimen was about 1.171 mm. long.

Scoliodon lalandi (Müller and Henle).

One example, 425 mm. long. Width of snout at outer nostril edges shorter than space between snout tip and front tip of lower jaw by nearly length of nasal aperture. Nostrils about last $\frac{2}{7}$ in snout length.

Compared with *Scoliodon terræ-novæ* from Holly Beach, New Jersey, the width of snout, as measured above, of nearly equal length with space between snout tip and front tip of lower jaw. This species also shows the nostril about last $\frac{2}{5}$ in snout.

Albula vulpes (Linné).

Eight examples, largest 324 mm. long.

Sardinella humeralis (Valenciennes).

Nine, largest 152 mm.

Opisthonema oglinum (Le Sueur).

Three, 105 to 162 mm.

Hlisha harroweri sp. nov. Fig. 1

Head $3\frac{1}{5}$; depth $2\frac{2}{3}$; D. III, 13; A. IV, 36, 1; P. II, 12; V. I, 5; scales about 34? (according to pockets) in lateral series to caudal base; about 14? scales (squamation injured) between dorsal and anal origins; head width $2\frac{2}{3}$ its length; head depth $1\frac{1}{4}$; dorsal base $2\frac{1}{4}$; mandible 2; least depth of caudal peduncle $3\frac{1}{5}$; lower caudal lobe $1\frac{1}{6}$; pectoral $1\frac{2}{5}$; first branched anal ray $2\frac{2}{5}$; snout 4 in head measured from upper jaw tip; eye $2\frac{3}{4}$; maxillary $1\frac{7}{8}$; interorbital $5\frac{1}{8}$.

Body strongly compressed, thin, deepest at ventral origin, edges slightly trenchant, abdominal edge with 20+6 serræ forming trenchant keel, profiles similarly convex. Caudal peduncle compressed, length about equals its least depth.

Head compressed, sides moderately flattened, strongly convergent below, upper profile moderately inclined and lower more so. Snout

² Nov. Com. Ac. S. I. Benon., IV, 1840, p. 71, Pl. 9.

surface convex, wide as long. Eye large, rounded, nearly midway in head. No adipose eyelid. Maxillary greatly inclined, reaches slightly beyond front pupil edge till about opposite first $\frac{2}{3}$ in eye, its lower edge minutely dentate and greatest expansion about $\frac{1}{2}$ of eye. Mouth rather small, superior. Upper jaw with slight median emargination as viewed from above. Mandible well protruded, rami well elevated inside mouth. Each premaxillary with a row of fine, slender, small teeth, median largest, others graduated smaller forward and backward. Few weak mandibular teeth. Each palatine with lengthwise patch of minute teeth. Tongue narrow, depressed, few asperities above posteriorly, free in front and end rounded. Nostrils together, hind one slit-like, about midway in

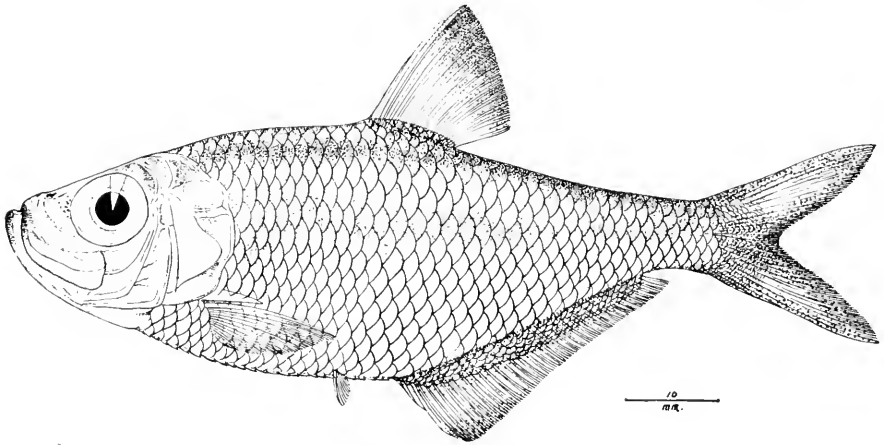


Fig. 1.—*Ilisha harroweri* sp. nov.

snout. Interorbital constricted, but slightly elevated, depressed or with rather deep concave depression extending backward. Pre-orbital width slightly less than $\frac{2}{5}$ of eye, slips over greater portion of upper maxillary edge. Postero-infraorbital about $\frac{2}{3}$ of pupil. Pre-opercle ridge oblique and hind edge only slightly inclined forward. Opercles and cheeks smooth, latter with few traces of obsolete striae.

Gill-opening forward about opposite front eye edge. Rakers $12 + 24$, lanceolate, about 3 in eye. Filaments about $\frac{2}{3}$ of rakers. Pseudobranchiae $2\frac{1}{2}$ in eye, much larger than filaments. Isthmus slender, compressed, little swollen behind. Shoulder-girdle without depression, though flexible fleshy keel before pectoral base.

Scales large, eeloid, with 3 to 5 vertical striae on each, edges entire, arranged in lengthwise series, largest along middle of side

and very caducous. Caudal and anal bases largely scaly, though scales now largely fallen. Pectoral with free, pointed axillary scale slightly less than half length of fin. Ventral with small, pointed axillary scale.

Dorsal inserted slightly nearer caudal base than lower jaw tip, graduated down from first branched ray which longest (now damaged), depressed fin $2\frac{2}{3}$ to caudal base. Anal inserted about opposite first third of dorsal base, first branched ray longest, and base of fin straight. Caudal forked, pointed lobes about equal. Pectoral rather broad, reaches back but slightly beyond ventral base. Ventral about long as pupil, inserted slightly before dorsal origin, and reaches half way to anal. Vent close before anal.

Color in alcohol pale brownish on back, sides and lower surface whitish, evidently bright silvery-white in life. Same also of head. Lips tinted with brownish. Iris whitish. Fins all pale brownish, dorsal and caudal tinged slightly with dusky about borders.

Length, 96 mm.

Type No. 46,959, A. N. S. P. One example from Colon. 1916. D. E. Harrower.

Related to *Pellona castelnaeana* Valenciennes,³ which differs according to the description in the numerous ramified striae in the preopercle and opercle, D. 19, A. 36 to 38, and lower caudal lobe marked by a large black spot. *Pellona bleekariana* Poey⁴ is also related, evidently more closely. It is described, however, with the eye $3\frac{1}{2}$ in the head, depth $5\frac{2}{3}$ in total (in my example $3\frac{2}{3}$), A. 43, anal placed behind dorsal, length of anal equal to its distance from hind border of eye (anal length shorter in my example), and maxillary to hind pupil edge. As Poey's example was 104 mm. long, it hardly appears likely these differences are due to age.

(Named for Mr. David E. Harrower, who collected the type.)

Anchovia macrolepidota (Kner and Steindachner).

Three examples, 197 to 202 mm. long.

Ophichthus gomesii (Castelnau).

Head 3 to vent; head and trunk $2\frac{1}{10}$ in tail; snout 6 in head; mouth $2\frac{2}{3}$; pectoral $2\frac{2}{3}$; eye $1\frac{3}{4}$ in snout and $1\frac{3}{5}$ in interorbital. Teeth biserial in lower jaw and on vomer. Nasal tubes short, pointed. Gill-opening long as snout. Pores on muzzle and head conspicuous. Dorsal inserted just behind end of depressed pectoral. Color in

³ Hist. Nat. Poiss., XX, 1844, p. 222. Mouth of the Amazon.

⁴ Repertor. H. N. Cuba, II, 1867, p. 242. Matanzas.

alcohol largely uniform olive-brown above, pale yellowish below (later turning whitish). Lower jaw grayish. Dorsal and anal pale or translucent, edged blackish, this most distinct posteriorly. End of tail whitish. Pectoral grayish. Iris white. Length, 400 mm.

Gymnothorax funebris *Rauzani*.

Head of large example. It shows eye 2 in snout, mouth completely closing and vomer with two rows of teeth in its median extent.

Gymnothorax ocellatus *Agassiz*.

Four examples, 350 to 395 mm.

Felichthys marinus (*Mitchill*).

Three examples, 315 to 324 mm. long, which agree with my New Jersey series. The specimen recently listed⁵ from Wounta Haulover, Nicaragua, is found on further comparison to be *Felichthys filamentosus* Swainson, differing chiefly in its longer pectoral spine, which is very little shorter than the head.

Tylosurus timucu (*Walbaum*).

Two examples, 483 to 490 mm.

Sphyræna guachancho *Cuvier*.

Five, 180 to 228 mm.

Holocentrus adscensionis (*Osbeck*).

Three, 146 to 180 mm.

Scomberomorus cavalla (*Cuvier*).

Three examples, 191 to 228 mm. All with isopod parasites in the gill-cavities.

I previously listed young examples from Port Limon, Costa Rica⁶ and Colon.⁷ A re-examination and comparison of this material shows that three larger examples of those obtained at Colon are *Scomberomorus maculatus* (length 127 to 148 mm.) The one representing the present species is 147 mm. long.

Caranx bartholomæi *Valenciennes*.

One, 173 mm. long.

Caranx hippos (*Linné*).

Three, 127 to 142 mm.

Caranx orysos (*Mitchill*).

Two, 140 and 148 mm.

⁵ PROC. ACAD. NAT. SCI. PHILA., 1915, p. 203.

⁶ PROC. ACAD. NAT. SCI. PHILA., 1916, p. 398.

⁷ *L.c.*, p. 401.

Caranx latus Agassiz.

Two examples, 122 and 136 mm. Scutes 40.

Vomer setapinnis (Mitchill).

Six, 98 to 170 mm.

Chloroscombrus chrysurus (Linné).

Five, 68 to 186 mm.

Trachinotus glaucus (Bloch).

Two, 132 and 148 mm.

Trachinotus falcatus (Linné).

One, 117 mm.

Epinephelus mystacinus (Poey).

One, 148 mm.

Epinephelus striatus (Bloch).

One, 150 mm.

Lutianus analis (Cuvier).

Four, 137 to 154 mm.

Lutianus synagris (Linné).

Six, 103 to 142 mm.

Ooyurus chrysurus (Bloch).

One, 177 mm.

Rhomboplites aurorubens (Cuvier).

Five, 128 to 155 mm.

Hæmulon parra (Desmarest).

Four, 137 to 153 mm.

Hæmulon flavolineatum (Desmarest).

Three, 118 to 126 mm.

Anisotremus virginicus (Linné).

Four, 110 to 144 mm.

Conodon nobilis (Linné).

Two, 110 and 135 mm.

Brahydeuterus corvinæformis (Steindachner).

Seven, 88 to 123 mm.

Archosargus unimaoulatus (Bloch).

Five, 117 to 130 mm.

Cynoscion acoupa (Lacépède).

One, 188 mm.

Larimus breviceps Cuvier.

Four, 117 to 162 mm.

Bairdiella ronchus (Cuvier).

Three, 132 to 152 mm.

Umbrina coroides (Valenciennes).

Three, 110 to 154 mm.

Eucinostomus pseudogula Poey.

Four examples, 93 to 137 mm. *Eucinostomus harengulus* Goode and Bean, as previously reported from Port Limon, Costa Rica,⁸ and Colon,⁹ in the slightly more slender body (depth $2\frac{7}{8}$ to 3) and slightly longer second anal spine. The present examples show the depth $2\frac{4}{5}$ to $2\frac{7}{8}$.

Eucinostomus gula (Valenciennes).

Eight, 88 to 117 mm. Depth $3\frac{1}{3}$.

Gerres rhombeus Cuvier.

Eight, 95 to 135 mm.

Upeneus maculatus (Bloch).

Five, 118 to 180 mm.

Polydactylus virginicus (Linné).

Four, 98 to 226 mm.

Abudefduf mauritii (Bloch).

Six, 78 to 98 mm.

Lachnolaimus maximus (Walbaum).

One, 128 mm.

Callyodon margarita sp. nov. Fig. 2.

Head 3; depth $3\frac{1}{3}$; D. IX, 10; A. II, 10; P. I, 12; V. I, 5; scales 23 in l. l. to caudal base, and 2 more on latter; 2 scales above l. l. to spinous dorsal origin; 7 scales below l. l. to spinous anal origin; 6 median predorsal scales; 5 median scales on breast before ventral origins; head width $1\frac{4}{7}$ in its length; head depth at occiput, $1\frac{1}{3}$; snout about 3 in head; eye $5\frac{1}{2}$; maxillary $4\frac{4}{5}$; interorbital 3; first dorsal spine $2\frac{2}{5}$; first dorsal ray $2\frac{1}{2}$; first anal ray 4; least depth of caudal peduncle $2\frac{1}{2}$; pectoral $1\frac{4}{7}$; ventral $1\frac{7}{8}$.

Body elongate, moderately compressed, deepest about opposite middle of pectoral, edges all rounded convexly. Caudal peduncle compressed, about long as deep.

Head compressed, moderately deep, profiles little convex and alike, sides flattened. Snout convex over surface, slightly so in profile, and length about $\frac{4}{5}$ its width. Eye rounded, rather high,

⁸ PROC. ACAD. NAT. SCI. PHILA., 1916, p. 399.

⁹ L.c., p. 404.

and hind edge anterior to midway in head length. Mouth terminal, commissure not quite extending half way to eye and inclined slightly down in front. Maxillary largely concealed. Lips thin, scarcely free. Teeth with nearly even cutting-edges, especially lower, and all form narrow trenchant margins. Upper dental area with slight notch near middle of each side, and behind this four small, erect external canines each side. No lower canines. Both inner buccal folds broad. Tongue large, thick, fleshy, not free. Nostrils pore-like, level with upper part of eye, anterior about last third in snout length. Inter-orbital slightly convex. Preopercle ridge little distinct, with number of short radiating tubes.

Gill-opening extends forward about opposite middle of eye. Gill-

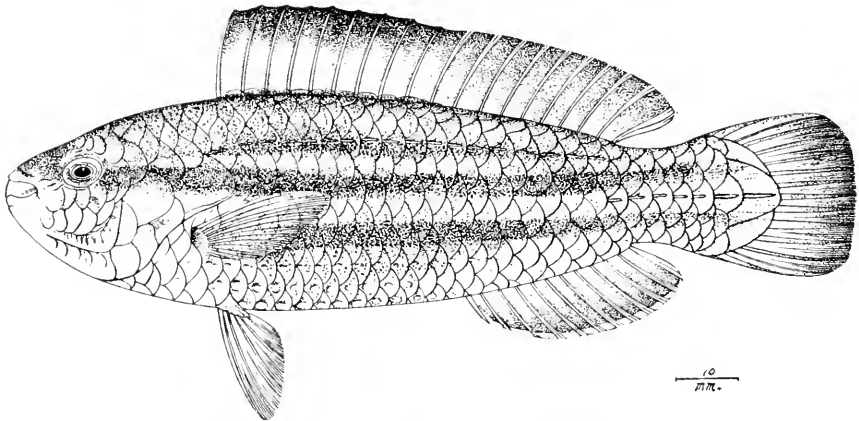


Fig. 2.—*Callyodon margarita* sp. nov.

rakers 12+19, slender, fine, flexible, about 3 in filaments, and latter about equal eye. Pseudobranchiæ little smaller than filaments. Branchiostegals moderate. Isthmus convex.

Scales large, cycloid, in even lengthwise series, more or less equal in size, though largest on middle of sides and breast. Ventral with free, pointed axillary scale about $\frac{1}{3}$ length of fin. Fins naked, except large scales covering caudal base. Largely two rows of scales on cheek. L. 1. complete, high, mostly concurrent with dorsal profile, and falls midway along side of caudal peduncle. Scales in l. 1. slightly smaller than those adjoining. Tubes largely simple, or with only very short branch basally.

Dorsal origin slightly before first third in space between snout tip and caudal base, spines largely pungent though tips somewhat flexible, and edge of fin entire. Anal spines small, somewhat flexible,

fin otherwise like dorsal. Caudal with hind edge rounded. Pectoral small, first rudimentary ray short and as concealed thorn, fin extending $1\frac{1}{2}$ to anal. Ventral inserted slightly behind pectoral origin, fin reaching half way to vent.

Color in alcohol largely dull brownish, lower sides and under surfaces paler to whitish. Upper surface of head with slaty tints. Teeth whitish. Iris pale yellowish. An obscure dark brownish lengthwise band from eye to upper caudal base. Below a similar shorter band, parallel, from pectoral axil back to lower caudal base. Vertical fins all pale dusky, lower anal edge whitish. Outer pectoral base dusky above, fin pale. Ventral whitish. Scales below lower dark lateral band on each side of median ventral row, each with white median spot, and those of lowermost row largest.

Length, 138 mm.

Type, 46,960, A. N. S. P. Colon, Panama Canal Zone. 1916. David E. Harrower.

Only the above known, and evidently allied with *Callyodon trispinosus* (Valenciennes), but that species has been described as uniform reddish-brown. Another allied species is *Callyodon aracanga* (Günther) which is uniform dark violet-purple and with the median fins very dark. The present species differs from these, as well as the others in the genus by its dark lengthwise bands and pearly-white abdominal spots.

(*Margarita*, a pearl, with reference to the white spots on the abdomen.)

Chætodipterus faber (Broussonet).

Four, 95 to 135 mm.

Chætodon ocellatus Bloch.

One, 98 mm.

Chætodon capistratus Linné.

Two, 75 and 80 mm.

Angelichthys ciliaris (Linné).

One, 145 mm.

Hepatus hepatus (Linné).

Two, 105 and 128 mm.

Hepatus bahianus (Castelnaud).

One, 132 mm.

Alutera punctata Agassiz.

One, 195 mm.

Lactophrys trigonus (Linné).

Four, 100 to 255 mm.

Lactophrys tricornis (Linné).

One, 205 mm.

Lagocephalus pachycephalus (Ranzani).

One, 285 mm.

Spheroides testudineus (Linné).

Four, 130 to 175 mm.

Chilomycterus antennatus (Cuvier).

Three, 100 to 160 mm.

Dactylopterus volitans (Linné).

One, 180 mm.

Batrachoides surinamensis (Schneider).

One, 300 mm.

Citharichthys arenaceus Everman and Marsh.

Three, 80 to 103 mm.

Achirus lineatus (Linné).

Three, 122 to 180 mm. On pale side caudal peduncle and adjacent region of trunk dusky.

Symphurus plagusia (Schneider).

One, 118 mm.

THE ANATOMY OF AN EOLID, *CHIORÆRA DALLI*.

BY HAROLD HEATH.

In 1852 Gould¹ described a species of nudibranch, dredged in three fathoms of water at Fort Discovery, Puget Sound, establishing for it a new genus, *Chioræra*, whose translated diagnosis is as follows: Body limaciform, head very large, pedunculate, semiglobose; oral face ventral, discoidal; mouth longitudinal, surrounded by a double series of cirri; cephalic tentacles foliate, retractile; branchial folds fan-shaped, arranged in a series on each side; genital opening removed from the almost dorsal anus." The species is further characterized by a pearly and whitish-colored body finely reticulated with orange. The cirri likewise are orange colored, and the cephalic tentacles are capable of retraction within a special sheath. The total length of the body is five and one-fourth inches.

On the 26th of July, 1913, I collected a number of specimens of what appear to be a new species of this genus in Rose Inlet on the eastern shore of Dall Island in southeastern Alaska. Two days later a few other individuals were taken in Hecate Strait near Hetta on the western coast of Prince of Wales Island. To Mr. W. F. Thompson I am indebted for additional material collected at Echo Harbor and Sewell Inlet on the eastern coast of the Queen Charlotte Islands.

The present species appears to be largely confined to the littoral zone, as the larger number of specimens were collected on algæ in shallow water. Nevertheless, a considerable number were found swimming near the surface, in some instances fully three hundred yards from shore. As they crawl about the great head is frequently contracted with considerable violence, possibly for the purpose of dislodging small organisms which serve as food. Sections of the alimentary canal, however, show it to be entirely empty, in all of the individuals critically examined, with the exception of one containing a few diatoms, so that we have little information indeed concerning the usual bill of fare. In the act of swimming the head is contracted as much as possible and the body is strongly flexed from side to side. Large numbers of eggs were found attached to "eel grass" and imbedded in gelatinous, spirally wound folds after the fashion of many nudibranchs.

¹ U. S. Exploring Expedition, vol. 12, pp. 309-311.

The following are the measurements of the largest specimen: total length three inches, diameter of head one and one-half inches, greatest width of body one-half inch, greatest width of foot one-fourth inch, greatest height of body three-fourths inch. No pigment is visible in the skin of living animals, though the body wall has a milky appearance and is sufficiently transparent to show the light blue and reddish viscera within.

External Features.—The body (Pl. XI, fig. 1) comprises two distinct divisions, the head and body proper. The head presents the appearance of a low vault or cowl provided with two dorsal tentacles, two sets of marginal tentacles and on its under surface bears the mouth. Unlike *Chiorara leonina*, the dorsal tentacles are not retractile, and in preserved material are plain, muscular, foliaceous outgrowths. Gould states that the tentacles of *C. leonina* bear on their anterior margins “an opaque, whitish papilla, presenting something of a spiral or lamellar structure.” Nothing of the kind has been found to exist in the present species.

The marginal head tentacles form two series, an outer set comprising from fifty to seventy-five large, slender processes, and an inner fringe formed of much smaller outgrowths of approximately double the number. Each of these cirri is provided with a nerve (Pl. XI, fig. 2) and gives evidence of being a tactile organ, though observations along this line were very incomplete.

The mouth presents the appearance of a longitudinal slit (Pl. XI, fig. 1) placed near the posterior margin of the head, and therefore in close proximity to the anterior margin of the foot. Its posterior border may be said to be formed by the free border of the head, which here forms a deep angle usually devoid of the larger type of tentacle. Laterally and anteriorly the oral opening is surrounded by prominent, swollen lips. In living and in certain preserved specimens, the head region for some distance beyond the lips forms a prominent swollen area, occasionally thrown into temporary ridges. Sections show this area to be highly vascular. Unfortunately, more pressing duties made it impossible to make careful observations on living animals, and an exact description of the normal appearance of this area is now impossible. It may be added that in Gould's figure of *C. leonina* the mouth occupies a central position beneath the cephalic vault or cowl, whose tentaculate margin encompasses it at a considerable distance.

The body, separated from the head by a distinct cleft forming a neck, is roughly conical in form, and ventrally is traversed throughout

its entire extent by a slender foot. Dorsally it carries a number of lappets in two longitudinal series attached along the junction of the dorsal and lateral surfaces of the body. All of the specimens in hand were preserved in formaldehyde, and while this served admirably to preserve the general appearance and proportion of parts, practically all of the lappets were found to be detached when the material was unpacked for study. It is certain, however, that each lappet is attached to the body by a slender stalk, and is leaf-like in form. The only doubtful point concerns their exact number. Judging by the slight circular scars where they were attached to the body, there appear to be five on the left side and four on the right, the place of the second largest one on the right being occupied by the anal opening. In a few large specimens there are traces of an additional, very small pair near the posterior end of the body. Each is penetrated by ramifications of the liver branches and by a system of blood sinuses.

The genital openings are on the right side of the body in the neck region, while the anal opening is far removed on the dorsal side of the animal.

Internal Anatomy.—In this species no distinct visceral cavity or spacious primary body cavity exists, the various systems of organs being surrounded by a loose meshwork of connective tissue and muscle fibers with the intercommunicating spaces serving as blood sinuses. Dissection accordingly is a comparatively simple matter, and the different systems of organs, especially the nervous, have been traced out in considerable detail. A description of each of these will now be given.

Considering first the digestive system, we find that the posterior border of the snout is deeply cleft along the midline, and, lacking the larger tentacles at this point, forms the ventral border of the mouth opening. The remaining margin is fashioned into thick, swollen, glandular lips united anteriorly, and of such length that the mouth appears as a longitudinal slit three or four millimeters in length.

The esophagus or pharynx (Pl. XI, fig. 4) is a comparatively short tube, and owing to the ventral position of the mouth the dorsal wall is considerably longer than the ventral. Immediately beyond the mouth opening the walls are relatively thick and without folds, but as the brain region is approached the inner lining becomes thinner and is thrown into numerous longitudinal folds. Probably not less than a dozen digestive tracts were either sectioned or opened care-

fully, but in no instance was there a trace of jaws, radula or distinct salivary glands.

Posterior to the central nervous system the lining of the pharynx becomes smoothed out before uniting with the smooth-walled stomach. Externally there are no noteworthy features to be noted in this section of the gut. It may be said, however, that the stomach is somewhat shorter than the pharynx and of considerably greater diameter. On the left side of the stomach are two sac-like dilations and one on the left, all of which are in communication with ducts from the digestive gland. In sections the lining epithelium of each of these sacs is seen to be thrown into a few high folds that are more or less continuous with lower longitudinal ridges extending throughout the main hepato-pancreatic duct.

As noted previously, the ventral gastric surface is longer in an antero-posterior direction than the dorsal, and the intestine is thus inclined dorsally, forming a distinct dorsal cleft between the stomach and intestine. Beyond this point the gut proceeds posteriorly, sinking slightly toward the ventral surface of the body, and also curving to the right until it reaches a point on the right side of the animal near the middle of the body. Here it curves dorsally, and expanding considerably opens to the surface. The intestinal epithelium is fashioned into several folds, visible externally through the thin wall, of which one, the dorsal, is highly developed and continues like a typhlosole throughout the entire length of the gut.

In preserved material the yellowish digestive gland is seen through the translucent body wall in the form of a dense mat generally distributed throughout the body, penetrating the lappets and extending into the snout as far forward as the tentacles. As can be seen in the figures, the follicles are united by an extensive system of ducts, which finally communicate with the stomach by means of one of the three openings noted previously.

The circulatory system can be disposed of in a few words, as the sinuses are unusually delicate and difficult to follow. The pericardium (Pl. XIII, fig. 13), situated anterior to the rectum, is a spacious thin-walled sac, with the ventral and posterior surfaces largely concealed by a mass of excretory tubules. The heart comprises an auricle and ventricle with their longitudinal axes directed in a dorso-ventral direction. The aorta, leaving the dorsal margin of the pericardial cavity, extends forward and soon disappears. On the other hand, the sinuses entering the auricle have been traced into the kidney and to a much less degree into the reproductive system and liver.

The kidney (Pl. XIII, fig. 13) lies on the dorsal side of the body, immediately above the anterior half of the hermaphroditic gland. In two specimens it was relatively thin and sheetlike, while in half a dozen other cases it occupied practically all of the space between the ovotestis and the body wall. As may be seen in fig. 13, the most conspicuous feature of the excretory system is a long and slender, thin-walled reservoir, somewhat crescent-shaped in lateral view. The form, however, is more or less irregular, owing to great numbers of diverticula springing from its surface. Each diverticulum divides several times, the number of divisions corresponding roughly to its diameter, until it finally breaks up into a number of thin-walled, transparent, blind-ended tubes [comprising the major portion of the kidney.

From the central and most elevated portion of the main reservoir a wide cylindrical duct arises, which, narrowing as it pursues a course dorsally, opens upon the surface of the body on the left side of the anal opening. For a portion of the distance this canal is in contact with the rectum, and the excretory and anal openings are accordingly very close together. As indicated by the drawing (fig. 13), the ureter bears several excretory diverticula, and becomes muscular and non-glandular only in the neighborhood of the external opening. The reno-pericardial canal likewise is borne on the dorsally directed ureter in the form of a short, inconspicuous tube, terminating in much folded, ciliated nephrostome.

The reproductive system forms a conspicuous and compact mass in the posterior half of the body (Pl. XII, figs. 6, 8, 9). Of the various component elements, the gonad, occupying the posterior half of the visceral cavity, is the largest and presents the appearance of a slender conical organ comprising vast numbers of lobules. In section each of these is seen to be composed of several short acini communicating near the excurrent duct with a common chamber. Spermatozoa are developed in the more central acini, while those more externally placed contain ova only.

From each lobule of the gonad a slender duct arises, unites with a corresponding duct from some other lobule, and these unite with other and larger tubes, until finally the resulting main duct, the hermaphroditic canal, is formed that courses along the entire ventral face of the gonad. At the anterior border of the gonad it expands perceptibly, and in the form of a yellowish, smooth-walled structure undergoes a few twists, and upon decreasing its diameter divides into two branches, the oviduct and vas deferens, respectively.

The oviduct (Ov), the more dorsal of the two branches, comprises three main divisions, of which the first is relatively the most slender and forms a highly convoluted mass at the anterior end of the gonad at a somewhat higher level than the remaining elements of the accessory reproductive apparatus. This first section passes abruptly into the second, which is characterized by a greater diameter, much more highly developed muscular walls, and a more open arrangement of the coils. Near its union with the third division, comprising the albumen and mucous glands, it communicates with a slender seminal receptacle (Sr), empty in all of the dozen specimens examined. The mucous gland (Mu) is considerably larger than the albumen, with relatively smooth, thin walls thrown into gentle folds internally. The albumen gland (Al), on the other hand, is externally folded to a conspicuous degree, especially in its distal half. It communicates at its base with the mucous gland, and the secretory products from both make their way by a common canal which unites with the main section of the oviduct close to the external reproductive opening.

The vas deferens (Vd) enters almost immediately a compact gland, possibly functioning as a prostate, by means of several slender ducts which communicate in turn with numerous blind, finger-shaped hollow processes (Pa). Sections show these follicles to be composed of large, highly glandular cells, from many of which the secretion is in the act of escaping in the form of a finely granular colorless product. In some instances the hermaphroditic duct and the adjacent section of the vas deferens contain multitudes of spermatozoa; none occur in the supposed prostate. Beyond the prostate gland the vas deferens proceeds as a uniformly slender, much convoluted tube located immediately in front of the prostate. Distally it opens into the penis, a thick-walled, twisted structure communicating with the exterior by means of a pore immediately anterior to that of the female reproductive opening. A retractor muscle attaches to the base of the penis, and extending posteriorly divides, each half becoming inserted in the body wall about opposite the lateral border of the foot.

The central nervous system, presenting the highly compact appearance of the æolids in general, rests upon the dorsal surface of the esophagus or pharynx a short distance in front of the anterior border of the stomach. The cerebral ganglia are in close contact along the mid line, and posteriorly are closely united with the pleural ganglia. The lateral portions of the cerebral moiety are prolonged into short horns. On each side of the mid line a short connective leads from the posterior border of the cerebral ganglion and unites

with a corresponding tentacular ganglion. Each of these last-named bodies is relatively small and rests in a depression between the cerebral ganglia, and in every specimen carefully examined the left is grooved and is considerably larger than the right. The pleural ganglia are more or less spherical bodies separated by a shallow depression from the cerebral and by a much deeper constriction from the pedal, which are therefore more clearly defined. The cerebral ganglia give rise to two or three pairs of nerves whose lettering in the following paragraphs is the same as in the figures.

C1, a nerve to the snout. In some instances this nerve has an independent origin; in other cases (as in Pl. XI, fig. 2, on the right side) it arises as a branch of C2. In any event, it soon divides repeatedly, and, so far as traced, forms a plexus, with ganglia at the nodes, that extends over the base of the snout in the middle area.

C2 is a heavy nerve extending through the loose tissue of the snout in the direction of the tentacle. About the middle of its length it divides, each half with its branches passing to the inside or the outside of the tentacle. The inner branch, after developing a few fibers, supplying the more median portion of the head, extends forward to the margin of the cowl. The outer branch, after dividing once or twice, likewise pursues a course to the margin. At the border of the cowl all of these nerves unite with an irregular nerve lying at the base of and supplying both sets of marginal tentacles.

C3 extends from each cerebral ganglion into the lateral portions of the cowl. After branching three times the resultant nerves unite with the marginal nerve. A short distance beyond its point of origin a connective unites C3 with C2.

Cx, a nerve springing from the ventral surface of each cerebral ganglion close to the cerebro-buccal connective (Pl. XIII, fig. 10). Extending anteriorly and ventrally, it enters the inferior wall of the esophagus. There are indications that it anastomoses with some of the nerves developed from the anterior surface of the buccal ganglion, but this has not been conclusively established.

C4, the tentacular nerve, which pursues a direct course from each tentacular ganglion into the tentacle, where it rapidly disappears from view among the dense mass of muscle fibers.

Each otcyst rests upon the dorsal surface of the central nervous system at the junction of the cerebral and pedal ganglion. In preserved material in surface view it appears as a yellowish, spherical body resting in a shallow cup of black pigmented cells. No sections of it were made.

Two pairs of nerves, in addition to the two commissures (Pc), arise from the pedal ganglia. The first of these is—

P1, a fairly heavy bundle springing from the side of the ganglion. Coursing through the dense mat of muscle and connective tissue composing the body wall, it extends posteriorly and ventrally, and divides at the junction of the body and head (Pl. XIII, fig. 11). The anterior branch supplies the body wall adjacent to the head, and sends a ventrally directed division to join the extensive plexus located in the foot. The posterior branch is distributed over the antero-lateral body wall, and in some instances also appears to be connected with the pedal plexus, though this has not been established with complete certainty.

P2 is a nerve likewise originating from the lateral surface of the pedal ganglion, but posterior to the foregoing nerve. Extending laterally and posteriorly, it divides opposite to the stomach into an anterior and posterior branch. The anterior division supplies the body wall posterior to the area adjacent to the external reproductive opening, and, extending to the foot, unites with the pedal plexus. The posterior branch continues posteriorly to a point about opposite to the level of the vas deferens, where it divides. The ventral division pursues a fairly direct course to the foot, where it unites with the pedal plexus. The dorsal branch continues its way along the side of the body to the posterior end of the animal. Throughout its course it develops at least four connectives which unite with the pedal plexus. Approximately one-third of its length beyond the point of origin, P2 gives rise to two dorsally directed branches. The anterior one passes forward and appears to anastomose with nerves from offshoots of x and y (fig. 12) arising from the pleural ganglion. The posterior branch, a slender nerve, pursues a course posteriorly and dorsally, and more or less parallel with P2 extends to the hinder end of the body. Throughout its extent it develops four branches, which pass into the dorsal lappets and about the anal opening, since this normally replaces one of the lappets on the right side.

The pedal ganglia are united by two commissures (Pc), the heavier one being anterior.

Four pairs of nerves usually pass out from the pleural ganglia. In certain cases this may become obscured on one or both sides through fusion or the presence of heavy connectives. In addition to these paired nerves, a single one—

G, appears on the right side (Pl. XIII, figs. 11, 12), emerging at a point close to the union of the pedal and pleural ganglia. Coursing

ventrally and posteriorly, it finally reaches the region of the accessory reproductive apparatus, where it breaks up into several distinct branches. One of these disappears from view among the coils of the vas deferens, two or three minute twigs enter the penis, and in two specimens nerves have been traced into the seminal receptacle and into the oviduct adjacent to its external opening.

P11 arises from the antero-ventral border of the pleural ganglion. In one case it was represented by two nerves, but whether single or paired, it directs its course dorsally, and branching repeatedly is distributed to the dorsal body wall in the neck region.

P12, a somewhat stronger nerve than P11, near which it originates, extends in a postero-dorsal direction and after giving off one or two small nerves enters the most anterior and largest lappet.

P13 arises close to P12, at times fused with it basally, and likewise courses dorsally and posteriorly as far backward as the anal opening. Throughout its extent it gives off branches to the first lappet, which is also innervated by a branch from P12, and also to the second and third lappets. As the third lappet has no counterpart on the right side of the body, the corresponding nerve is distributed to the region about the anus. Attention has been called to the fact that the third lappet and anal region are likewise innervated by branches of P2.

P14 courses ventrally and after dividing becomes lost in the connective tissue and muscle fibers of the body wall close to the anterior margin of the foot.

Buccal System.—From the postero-ventral face of the cerebral ganglia the cerebro-buccal connectives arise, and coursing around the sides of the pharynx or esophagus unite with the buccal ganglia (Pl. XIII, fig. 10, B) at the sides of the digestive tract. The buccal ganglia are more or less globular bodies, and in addition to the cerebro-buccal connectives each is attached to three other nerves, of which one is the commissure extending beneath the pharynx to join its fellow of the opposite side. Of the remaining two nerves one is comparatively short, and extending anteriorly unites almost immediately with a nerve originating more dorsally from the cerebro-buccal connective. Beyond this point of union the combined bundle extends anteriorly and ventrally, and after forming a plexus becomes lost among the muscles of the pharynx. The last buccal nerve to be considered pursues a posteriorly directed course from the buccal ganglion, and very soon unites with the smaller of the two pedal commissures. Posterior to this point it continues along the sides of

the pharynx to a point about midway between the level of the central nervous system and the first liver pouch. Here it divides, one branch extending dorsally to enter the pleural ganglion or the base of P13, while the ventral branch is directed to the ventral wall of the pharynx where it breaks up into several branches. Both of these last-named nerves give rise to a single offshoot, each of which continues backward to the anterior border of the first liver pouch where they enter a strong, ganglionated commissure, passing over the dorsal wall of the pharynx. The lower of the two nerves just mentioned develops a nerve, before entering the dorsal commissure, which is directed posteriorly beneath the first liver pouch and branches over the ventral wall of the stomach. Another nerve, having a similar course, arises from the ganglion, and curving around the ventral margin of the pouch becomes lost on its walls after branching two or three times.

As noted previously, the dorsal buccal commissure is ganglionated at the point of union with the two nerves connected more anteriorly with the buccal ganglion, and posteriorly this ganglionated section extends along the sides of the stomach to the posterior border of the first liver pouch. From it a clearly defined nerve arises, and extending dorsally follows the bile duct into the liver proper, where it breaks up and can be seen extending along some of the larger follicles. At the posterior end of the liver pouch the buccal nerve divides, the ventral branch supplying the liver pouch and the ventral wall of the stomach. The dorsal branch extends posteriorly along the sides of the stomach, and upon reaching the second liver pouch forms several branches, all but one of which enter the liver pouch. The exception is a distinct nerve (Bi) which continues along the sides of the intestine, where it soon forms with its fellow a plexus that has been followed to the anal opening. There are indications that in the anal region this plexus becomes continuous with branches from P13 or P2, which, as noted previously, are distributed to the body wall about the anus.

From the foregoing paragraphs it will be seen that the head, tentacles and otocysts are innervated solely by nerves from the cerebral ganglia. The neck region is supplied with branches (P11, P14) from the pleural ganglia. The entire ventral half of the body proper and the posterior dorsal half is provided with nerves (P1, P2) from the pedal ganglia. The remaining dorsal half is furnished with offshoots from pleural ganglion nerves (P12, P13). The ventral surface of the esophagus is innervated by nerves (Cx) from the

ventral face of the cerebral ganglia. The stomach is supplied with at least three pairs of nerves having their origin in the buccal system. The liver pouches and gland itself likewise derive their nerve supply from the buccal nerve complex. From the same source a nerve on each side of the intestine forms a plexus throughout the length of the gut, and may connect with branches (P2c) from the pedal ganglia or with others (P13) from the pleural. The reproductive apparatus is abundantly supplied with branches of the nerve G having its origin in the right pleural ganglion. In two specimens there were faint indications that delicate twigs from this same source enter the heart and renal organ, but this was not definitely determined.

A brief diagnosis of the present species is herewith appended.

Genus **CHIORÆRA** Gould.

A description of the genus is given in the opening paragraph of the present paper. Type of the genus *C. leonina*.

Chioræra dalli new species.

Body limaciform, smooth and of a pearly color without definite signs of pigmentation. Head enormously developed, with the mouth near the posterior margin. Dorsal tentacles simple leaf-like expansions without special sheath. Jaws, radula and salivary glands wanting. Total length three inches. Off the coast of British Columbia, in shallow water.

It is with great pleasure that I associate the name of this species with that of the renowned student of west-coast conchology, Dr. W. H. Dall.

ABBREVIATIONS USED IN FIGURES.

Al.	albumen gland.	Ov	oviduct.
B.	buccal ganglion.	P	pedal ganglion.
Bi.	intestinal nerve.	P1, P2, P3, P4	pedal nerves.
C	* cerebral gan. lion.	Pa	prostate gland.
C1, C2, C3, C4	cerebral nerves.	Pe	pedal commissures.
Cx	cerebro-esophageal nerve.	Pe	pericardium.
G	visceral nerve.	P	pleural ganglion.
Lp	liver pouch.	P11, P12, P13, P 4	pleural nerves.
Mu	mucous gland.	Sr	seminal receptacle.
Ot	ovotestis.	Vd	vas deferens.

EXPLANATION OF PLATES XI, XII, AND XIII.

PLATE XI.—Fig. 1.—*Chioræra dalli*, ventral view.

Fig. 2.—Dorsal view of head, showing its innervation.

Fig. 3.—Side view of entire animal. Anal opening, near which is excretory pore, replaces lappet; left one shown in stippled outline.

Fig. 4.—Side view of alimentary canal and digestive gland.

Fig. 5.—Left side of body, showing distribution of pedal nerves.

PLATE XII.—Fig. 6.—Dorsal view of alimentary canal and reproductive system.

Fig. 7.—Dorsal view of alimentary canal and digestive gland.

Fig. 8.—View of right side of reproductive system.

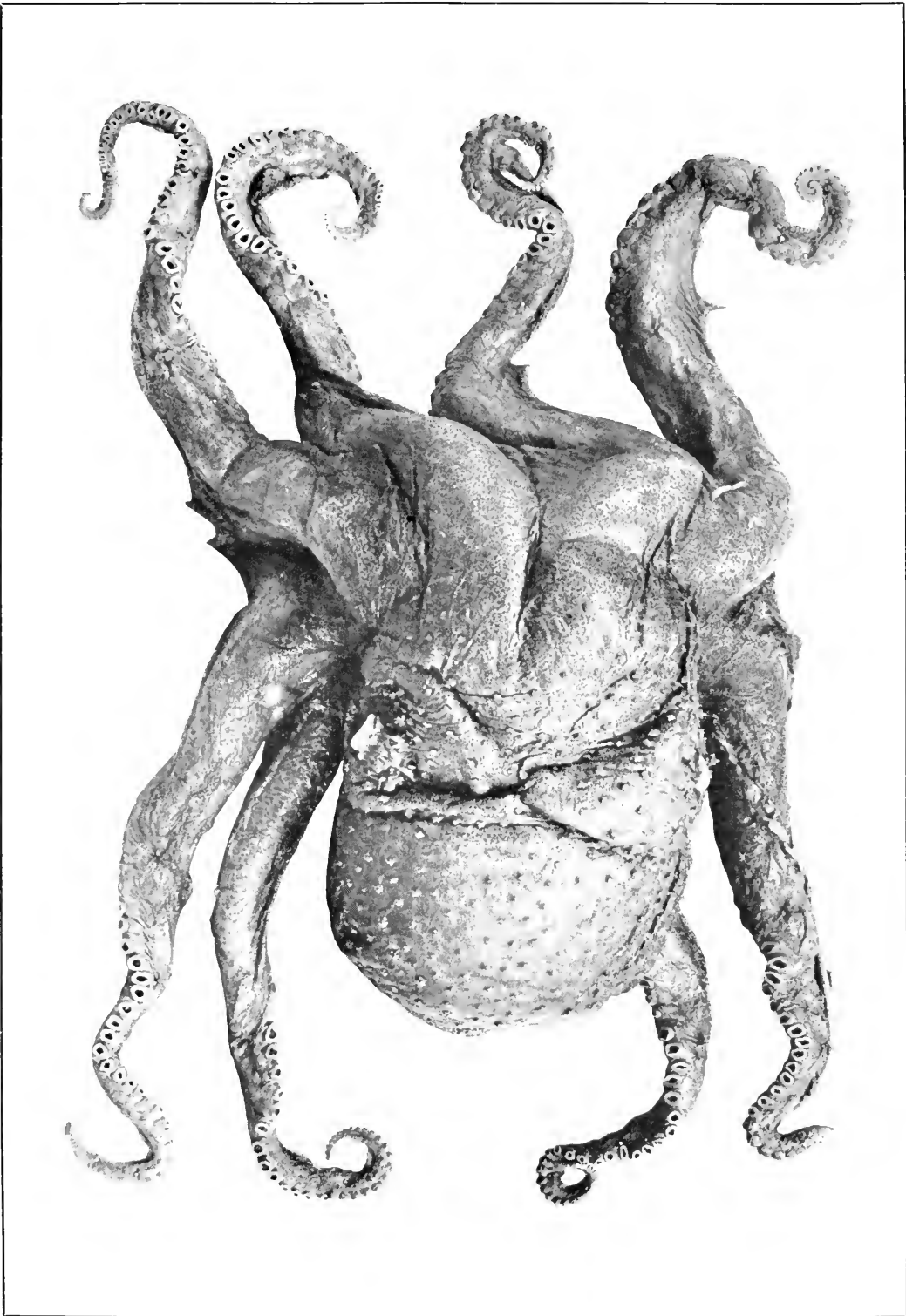
Fig. 9.—Diagram of reproductive system.

PLATE XIII.—Fig. 10.—Central nervous system and adjacent nerves.

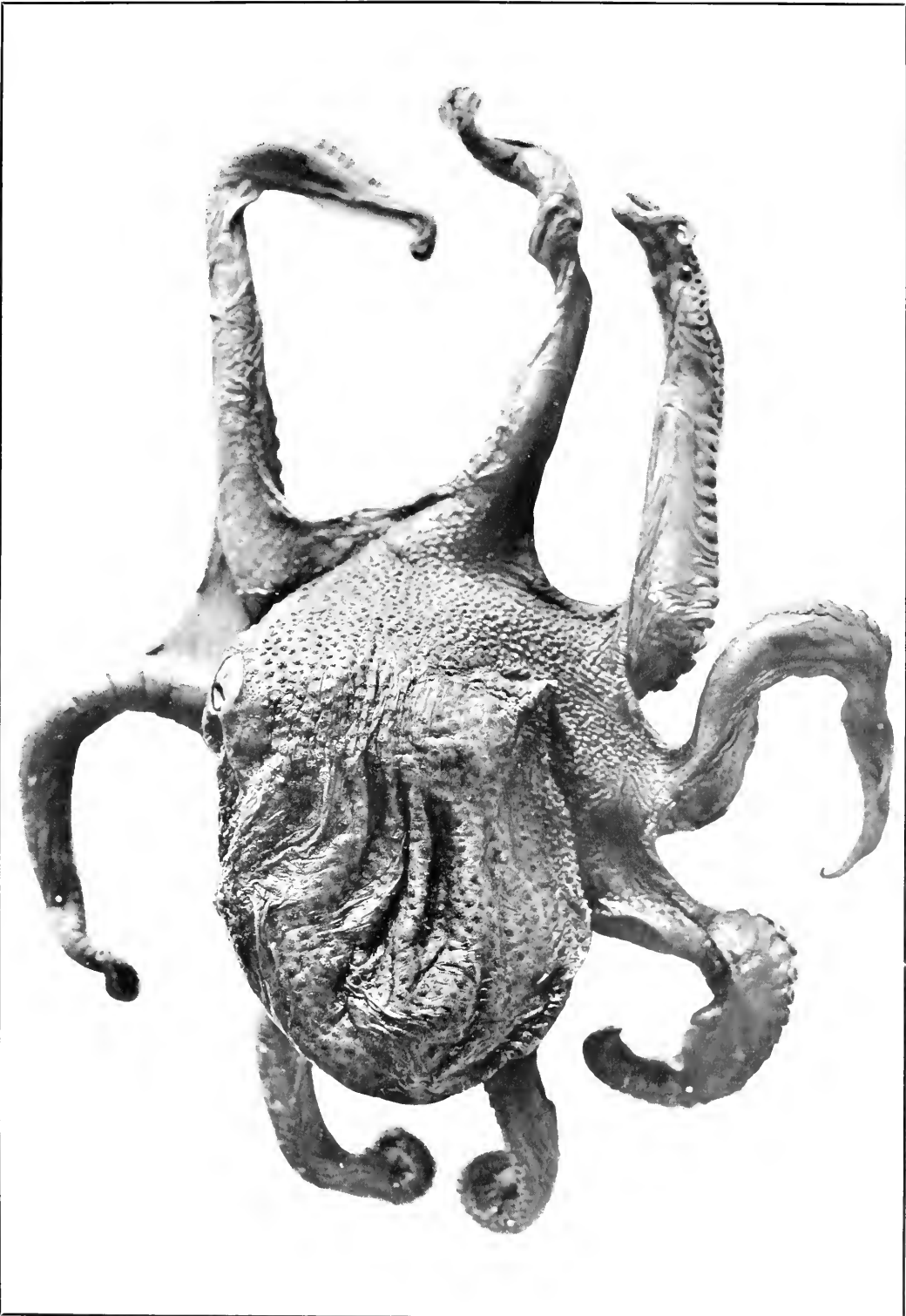
Fig. 11.—Right side of body, showing distribution of principal nerves.

Fig. 12.—Dorsal view of central nervous system and origin of principal nerves.

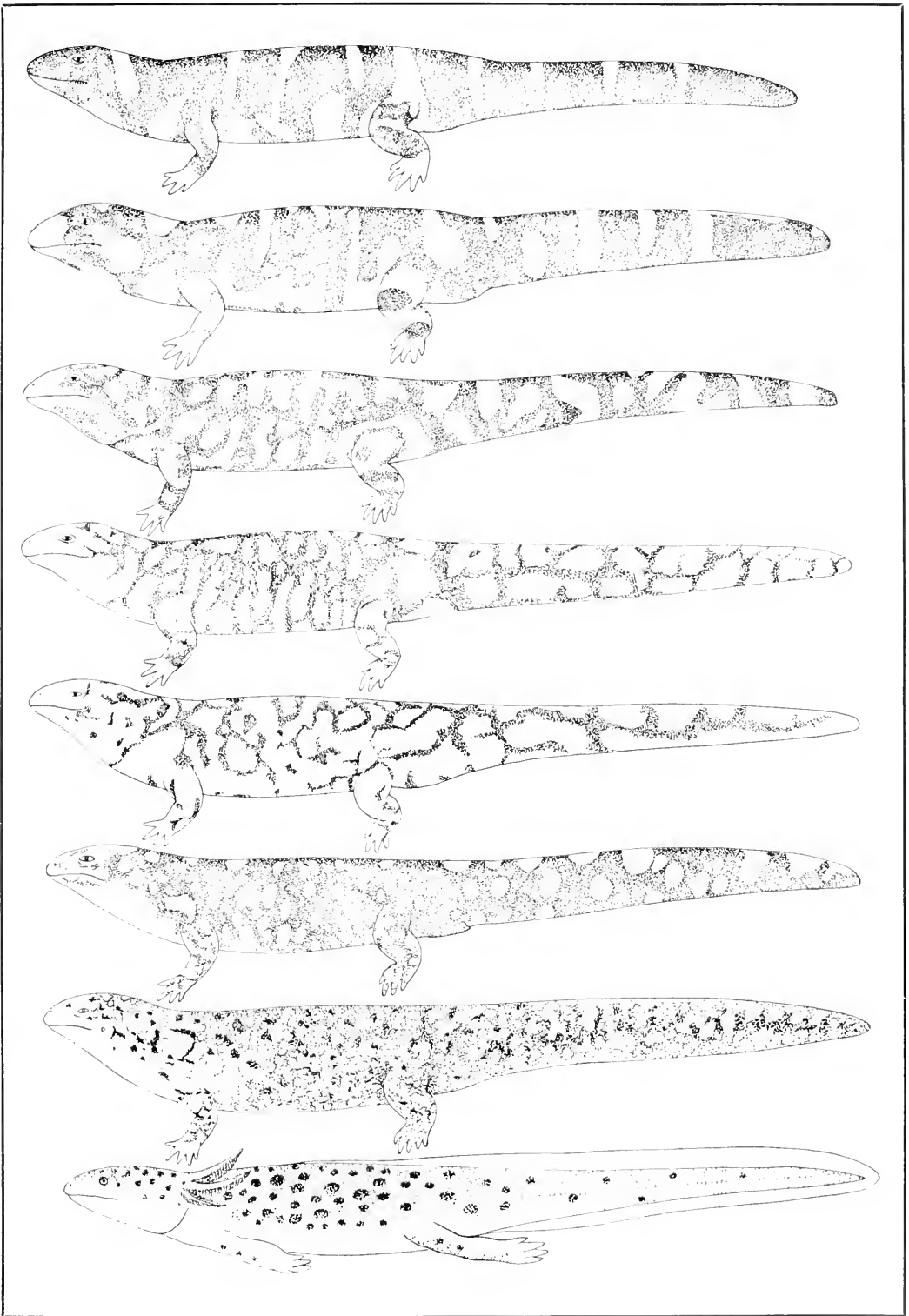
Fig. 13.—Lateral view of pericardium, heart and the excretory system with main reservoir, nephrostome, ureter and external opening.



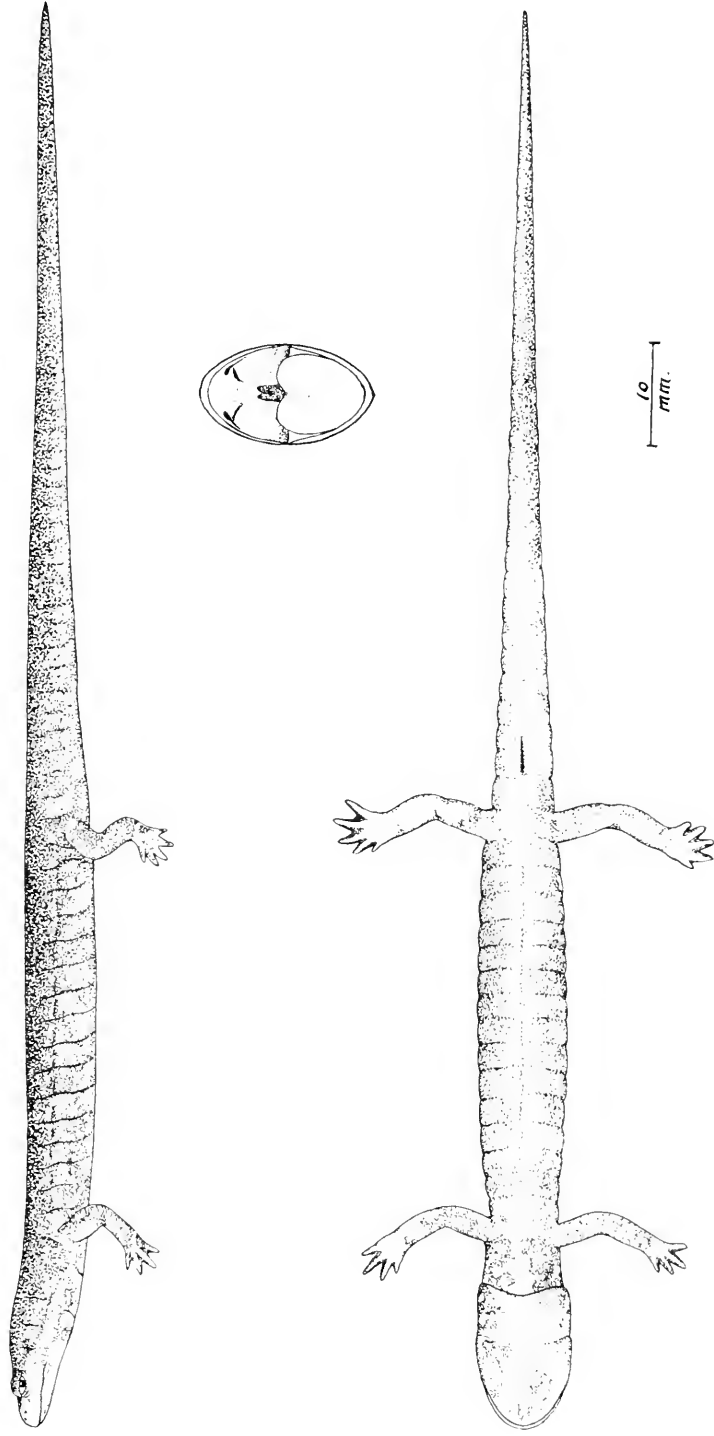
BERRY: MOSCHITES VERRUCOSA VER.

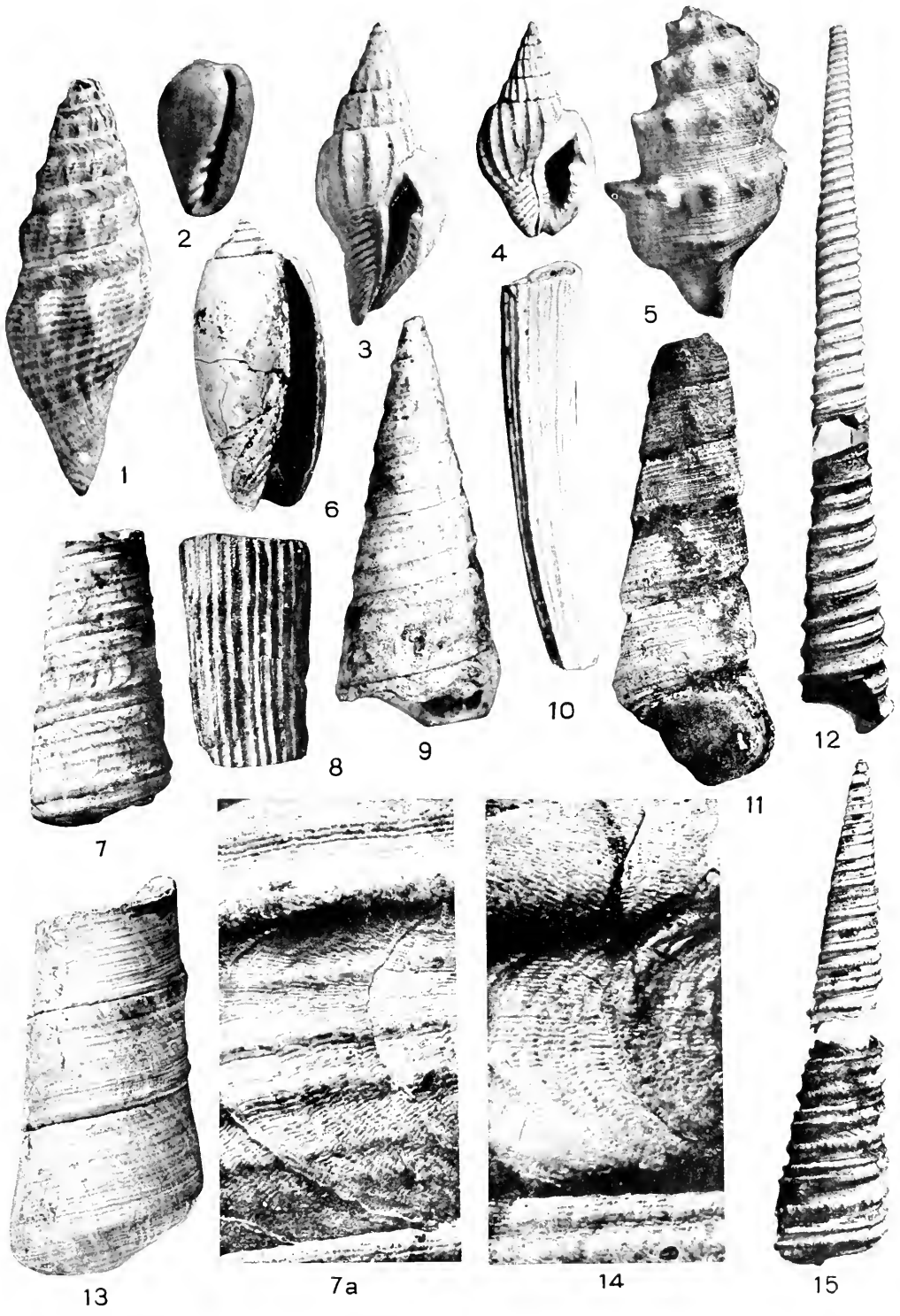


BERRY: MOSCHITES CHALLENGERI BERRY.



FOWLER AND DUNN: SALAMANDERS.





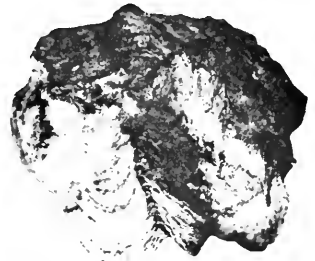
PILSBRY AND BROWN: OLIGOCENE FOSSILS.



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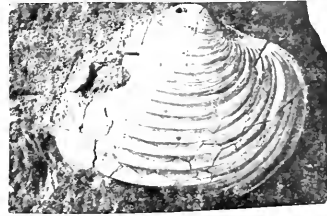
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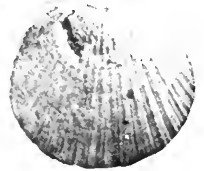
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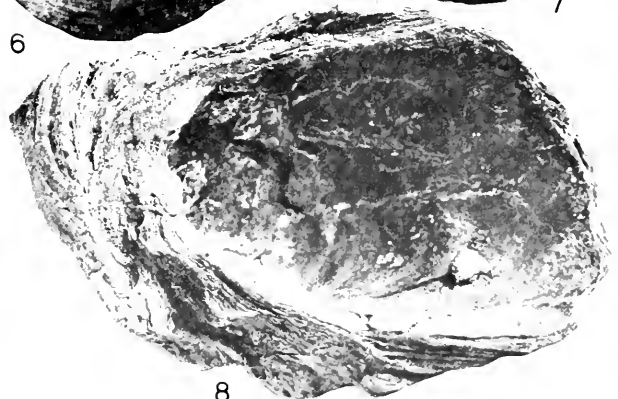
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7



8



1



1a



1b



2



2a



2b



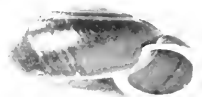
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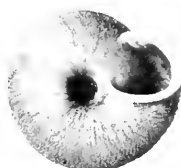
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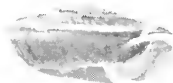
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6a



7



8



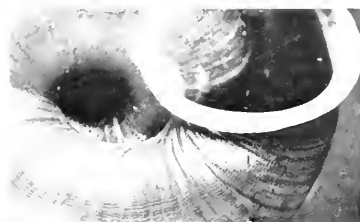
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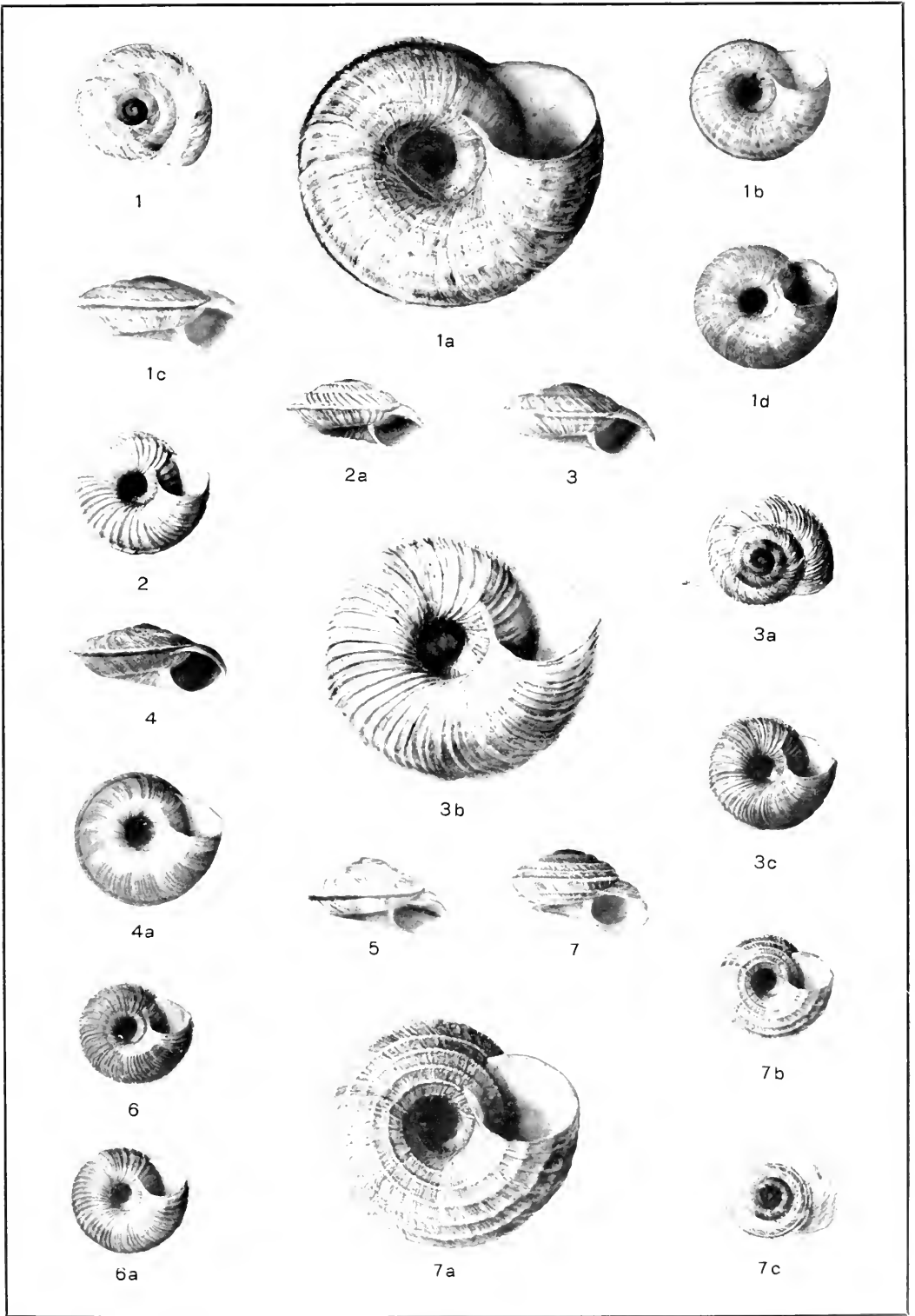
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9



10





1



1a



1b



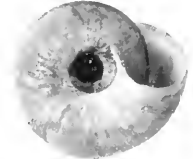
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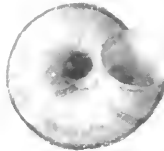
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6



7



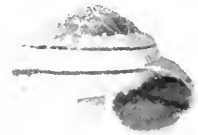
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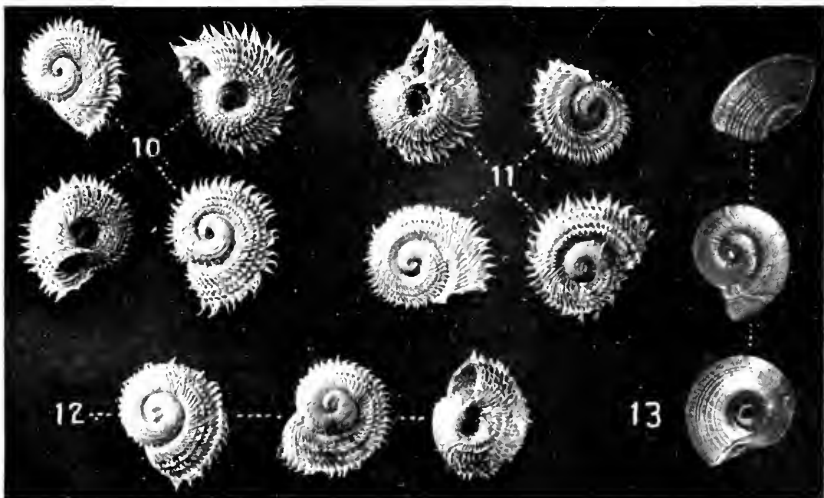
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8a

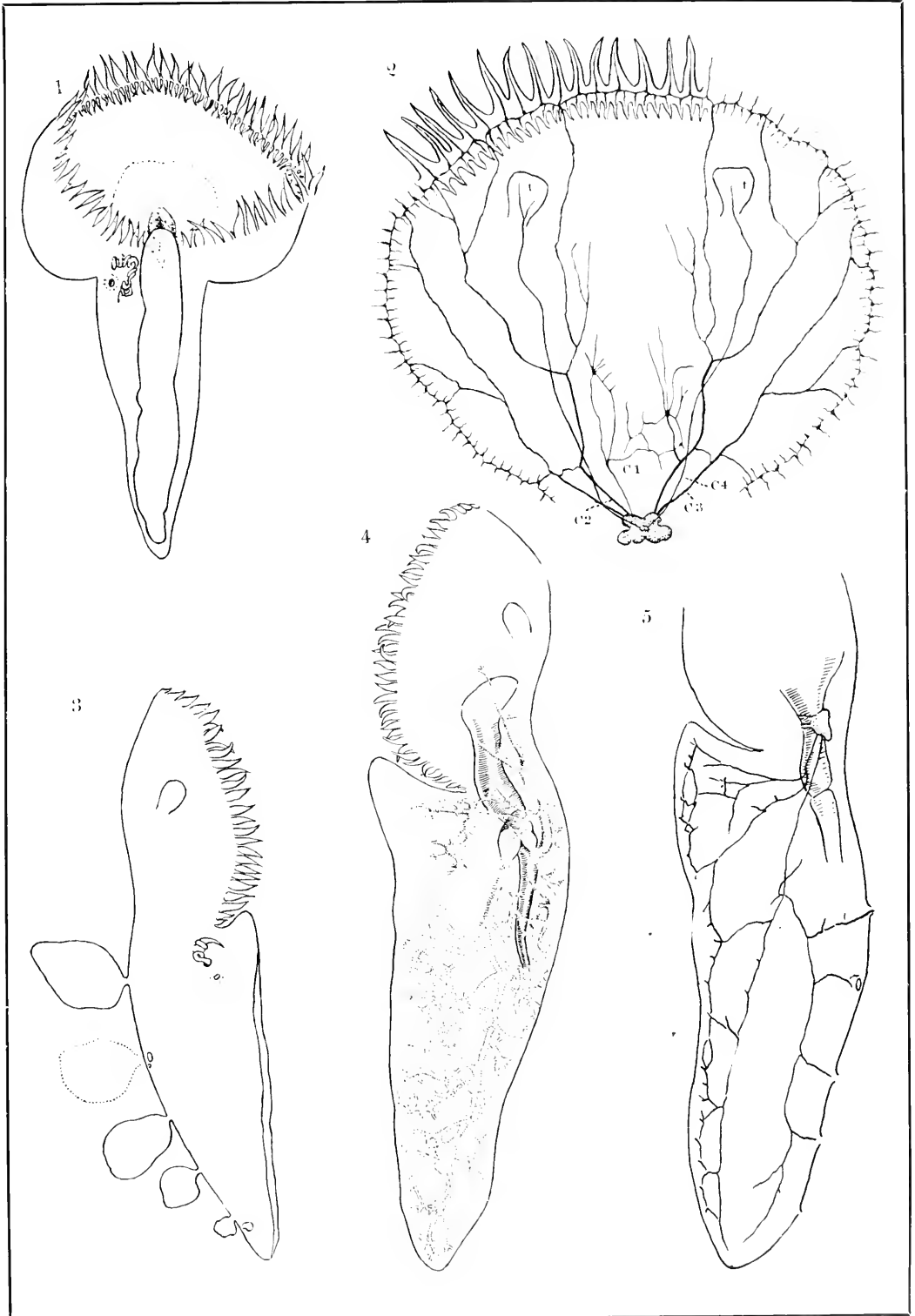


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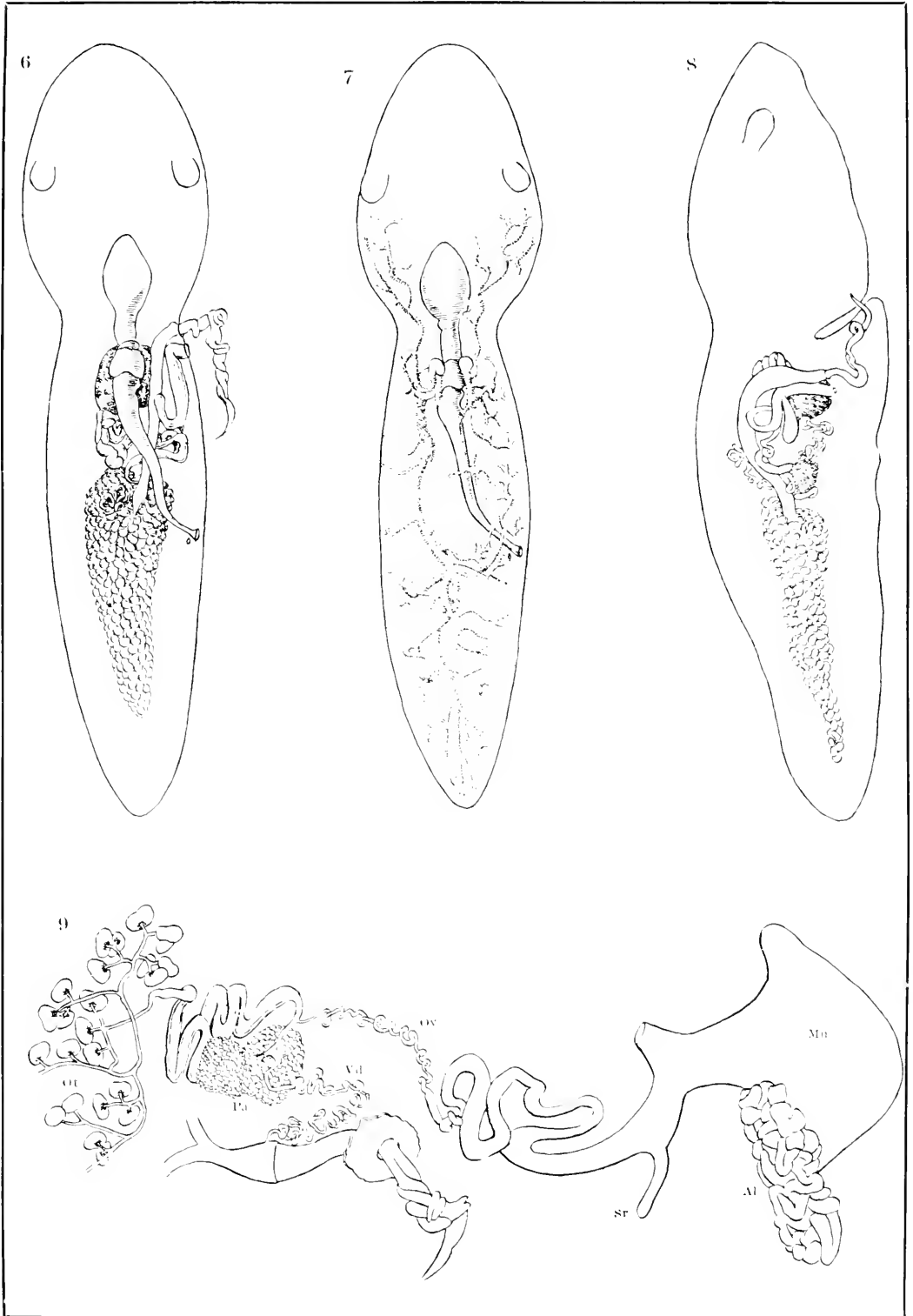




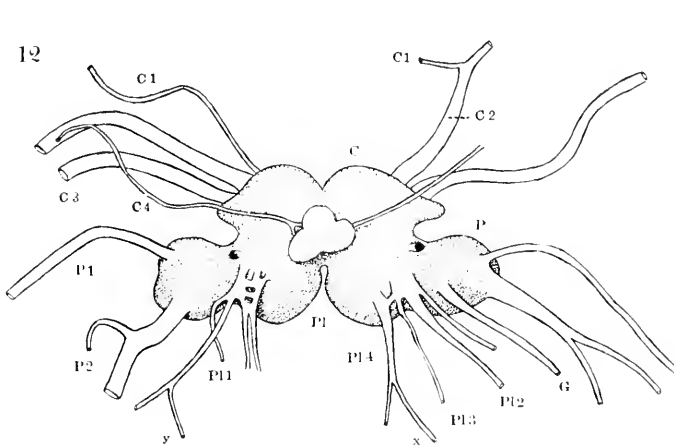
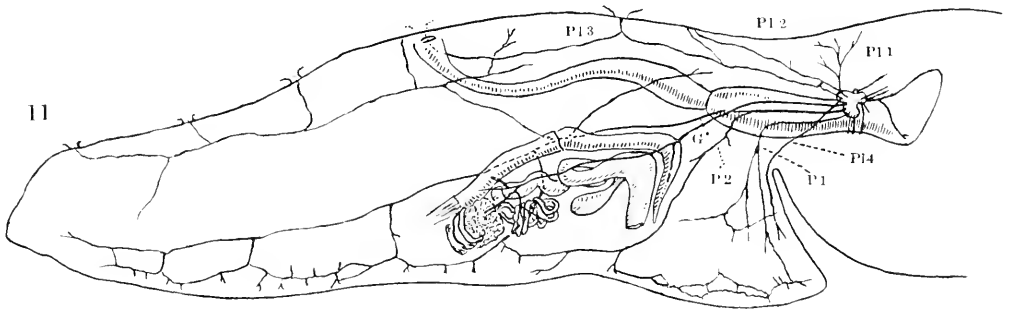
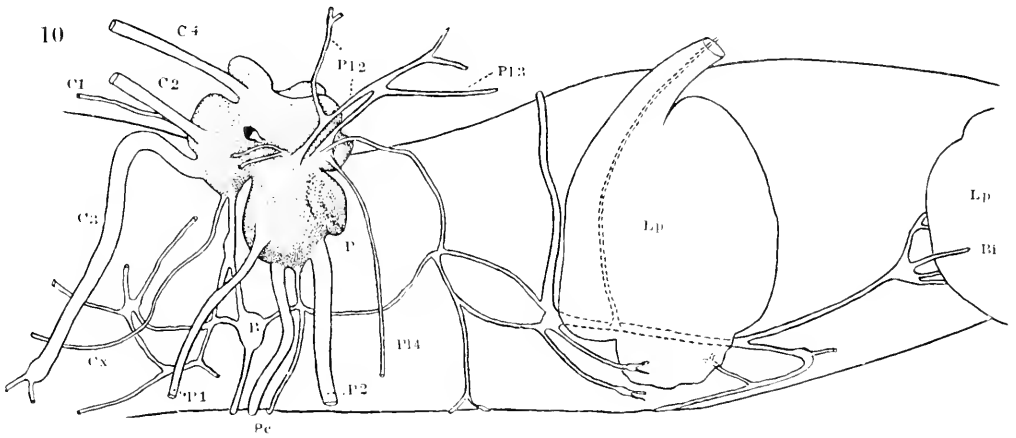
PILSBRY AND FERRISS: MOLLUSKS OF THE BLACK RANGE, NEW MEXICO.



HEATH: CHIORERA DALLI.



HEATH: CHLORERA DALLI.



APRIL 17.

MR. CHARLES MORRIS in the Chair.

Fifty persons present.

The deaths of the following members were announced: Dr. William H. Forwood, U. S. N., May 11, 1915, and Simon J. Martin, March 24, 1917.

MR. JOHN ROTHERMEL made an illustrated communication on the petrified forest and painted desert of Arizona. (No abstract.)

The following were elected members:

Charles W. Frost,
George L. Harrison, Jr.,
Charles J. Rhoads,
J. Parker Norris,
Howard Fuguet.

The following was ordered to be printed:

NEW MOLLUSCA OF THE SANTO DOMINGAN OLIGOCENE.

BY H. A. PILSBRY AND C. W. JOHNSON.

The authors have had a revision of the fossils of Santo Domingo and Haiti, chiefly contained in the William M. Gabb collection, in preparation for some years. The work is now completed; but as some months must elapse before the illustrations can be published, advance descriptions are here given of most of the new forms.

The age of the Santo Domingan beds covered by the collections of Heneken and Gabb has been the subject of some uncertainty; but it appears that the lower bed or beds, containing *Orthaulax*, are nearly or quite equivalent to the *Orthaulax pugnax* zone of the Oligocene of Tampa Bay, while the upper beds, furnishing most of the fossils, are uppermost Oligocene, synchronous with the upper beds (Gatum formation) of the Canal Zone. We have found no evidence of Pliocene or other beds between the Upper Oligocene and the Pleistocene.

Illustrations of the species here described will appear in the complete report, now awaiting publication.

ACTEONIDÆ.

Acteon subtoratilis n. sp.

Actæon toratilis Linn., Gabb, Trans. Amer. Philos. Soc., XV, p. 245.

Shell similar to *A. toratilis* of Europe in size and form, but as coarsely sculptured over the whole body-whorl as that species is on the base. There are about 35 subequal spiral grooves on the last whorl, cut into square or oblong pits by narrow vertical lamellæ, the grooves separated by flat-topped ridges which are wider than the intervals except on the base, where they become narrow, no longer flat-topped, and about equal in width to the intervening grooves. Length 17, diam. 8.4, length of aperture 12 mm.

This form was referred to *A. toratilis* by Gabb, but it differs in having the sculpture coarser and equally developed over the whole body-whorl, not finer and fainter in the middle as in the well-known European species.

Type No. 3183.

Acteocina subbullata n. sp.

This species is almost identical with *A. bullata* (Kilner) in form

and size, but the aperture is slightly narrower above, and except close to the base there is *no spiral striation*.

Length 10, diam. 4.6 mm.

Type No. 3193.

Retusa biforis n. sp.

The shell is perforate at both ends, cylindric, smooth. Above it tapers to an angle around the concave summit, which has a small perforation. Aperture is about twice as wide in the lower as in the upper part. The lip recedes strongly at both ends. Columella straight, the columellar margin somewhat reflected, the whorl narrowly excavated below the perforation.

Length 3, diam. 1.4 mm.

Type No. 3192, A. N. S. P.

Volvula ornata n. sp.

The shell is moderately obese, tapering downward, with sculpture of small axial folds near the summit, spiral impressed lines around the base. Spine is moderately long, obtuse.

Length 3.75, diam. 1.7 mm.

Type and 7 other specimens are No. 3178, A. N. S. P.

Volvula parallela n. sp.

The shell is extremely fragile, slender, cylindric, showing extremely faint and fine spiral striation in the lower half. The spine rises well above the lip, is rather short and acute. The columella is a little convex.

Length 2.2, diam. 0.75 mm. (type).

Length 3 mm. (largest specimen).

All of the three specimens are somewhat broken. It is the most fragile and slenderest *Volvula* we have seen.

Type No. 3188.

Volvula cylichnoides n. sp.

The shell is rimate, oblong, the right side less convex than the left, the surface smooth so far as can be seen. The lip rises high above the vertex, which shows no trace of a spine, and is narrowly rounded above. Columella nearly straight.

Length 4.4, diam. 2 mm.

Type No. 3177, A. N. S. P.

This species appears to be closely related to the unfigured recent *V. aspinosa*, but there is no trace of the rudimentary spine described for that species.

Atys cinctorii n. sp.

The shell is perforate, very shortly fusiform, swollen and smooth in the middle, rapidly tapering and encircled with impressed lines towards the two ends. The vertex is narrowly concave, plain. Columella prominent in the middle.

Length 2.6, diam. 1.35 mm.

Type No. 3185, A. N. S. P.

The lip is somewhat broken. It resembles the Chipolan *A ademata* Dall, but has not the ornamentation of the vertex seen in that species; and the columella is rather strongly prominent in the middle. In *ademata* it is figured as straight.

Atys sulcutorum n. sp.

Shell imperforate, short, swollen, with sculpture of about 15 encircling grooves, which are widely spaced in the middle; low and rather close vertical folds are seen in the upper part. They pass over the vertex and converge to the axis. Summit concave. The columella is rather thick, terminating in a prominent plait.

Length 2.3, diam. 1.35 mm.

Type No. 3317, A. N. S. P.

Terebra baculiformis n. sp.

The shell is very slender, of nearly flat whorls. These have axial sculpture of narrow, continuous, retractive, arcuate riblets, and spiral sculpture of unequal cords and threads, which are weak where they pass over the riblets. A narrow, convex posterior fasciole has about 6 fine, unequal spiral threads, and is defined by a rather deep sulcus, also striate. Below the sulcus there are about 7 unequal cords, followed below by a group of finer threads. On the last whorl the axial riblets are sigmoid and extend to the siphonal fasciole the uneven spiral striation covering the same portion. The anterior channel is rather long for this genus, narrow. The columella is smooth and very weakly sigmoid, being less bent than in most *Terebras*.

Length 30, diam. 5 mm.; $10\frac{1}{2}$ whorls remaining.

The type is No. 2906, A. N. S. P.

Terebra hitia n. sp.

The shell is very slender, with slightly convex whorls. Sculpture of many narrow axial riblets, narrower than their intervals, retractive above, vertical in the lower two-thirds. Below the suture there are two spiral cords under the ribs, followed by a deeper sulcus and then a prominent spiral, below which there are about 6 spiral

cords, unequally spaced, with some small spiral striae in the widest space. The last whorl is largely broken away. The columella shows one very low, rounded plait.

Length 24, diam. 5 mm.; $11\frac{1}{2}$ whorls remaining.

Type No. 2905, A. N. S. P.

Drillia sororcula n. sp.

A shell with much the appearance of *D. ischnacta*, but differing by the much shorter aperture, less produced anterior canal, and the absence of spiral striae in the intervals of the spiral cords. The latter are quite low and rounded, equal to their intervals. On the last whorl there are 13 between the anal and siphonal fascioles, on the whorls of the spire 5, with another following the suture. The anal fasciole is excavated, without distinct spiral striation.

Length 40.5, diam. 12 mm.; length of aperture 19 mm. 9 whorls remaining, the apical ones broken off.

Type No. 2929, A. N. S. P.

Drillia subgibbosa n. sp.

Turris (Drillia) gibbosa Chemn., Gabb, Tr. Am. Philos. Soc., XV, p. 208. Not of Born.

The penult whorl is crossed by about thirteen rather sharp axial ribs which weaken abruptly where they cross the concave anal fasciole. Some short ribs are intercalated on the last whorl. The back is humped by a broad, prominent varix. The anal fasciole is without spiral sculpture; below it there are six spiral grooves between the ribs on the whorls of the spire, and on the last whorl about fourteen, here passing over both valleys and ribs. The anal sinus is deep, separated from the preceding whorl by a heavy callous pad. Siphonal fasciole is prominent.

Length 53.3, diam. 19 mm.; about 10 whorls.

Though resembling the recent *D. gibbosa*, this form is at once distinguishable by the less regular axial ribs, which do not end abruptly at the shoulder, but continue weakly to the suture; also by the less contracted anterior canal.

Type and a smaller specimen are No. 2920, A. N. S. P.

Drillia elocata n. sp.

Drillia henckeni Sow., Cossmann, Jour. de Conchyl., LXI, 1913, p. 25, Pl. 3, figs. 10, 11. Not of Sowerby.

This shell resembles *D. fusiformis* Gabb in sculpture, but differs by the far shorter anterior canal. The whorls are strongly convex, with sculpture of large, rounded, slightly protractive ribs, 6 on the penult, 7 on the last whorl. These ribs distinctly undulate the anal

fasciole. Between sutures there is a strongly undulating presutural spiral followed by several very small spiral striæ on the anal fasciole, which is not excavated or concave, and three strong cords, a fourth barely appearing above the suture. Between these cords some very fine and weak spiral striation is visible. On the last whorl there are 17 spiral cords in addition to the presutural cord. There is a strong varix a short distance behind the lip. Anal sinus deep and rounded.

Length 25.5, of last whorl 14, diam. 9.7 mm.

Type No. 3296, A. N. S. P. Seventeen other examples are No. 3295.

Some specimens are more slender, the most lengthened being 26.5 mm. long, 8.3 wide.

It appears to stand close to *D. severina* Dall, but that species has a wider, "distinctly excavated" anal fasciole, and a relatively longer last whorl.

***Drillia callistura* n. sp.**

The spire is straightly turritid, sculptured with regular, acute, slightly protractive axial ribs, of which there are 18 on the penult whorl. The ribs terminate abruptly above, leaving a narrow, deeply concave anal fasciole which is bounded above by a spiral cord a little distance below the suture. In the posterior fasciole and between the axial ribs there are close, fine spiral threads, and weakly marked growth-lines, more obliquely protractive than the ribs. On the last whorl the ribs gradually diminish downward, and are wanting on the narrow anterior end, and the lower half has rather coarse spirals. A rather strong varix stands close behind the lip. There are about 9 acute liræ within the outer lip.

Length 22, diam. 8, length of aperture 9 mm.; 8 whorls remaining in the type, which has lost the apical whorls.

Type is No. 2907, A. N. S. P. One specimen.

This species is closely related to *D. jamaicensis* Guppy (*D. ebenina* Dall), from which it differs by having the anal fasciole evenly and distinctly striated spirally, with no trace of the close, arcuate growth-ridges, which predominate in *jamaicensis*. The anal sinus is not nearly so deep and not contracted in front. The throat is lirate. The spire has straight outlines. Finally, it attains a somewhat larger size.

***Drillia ischnatracta* n. sp.**

The shell is fusiform, the two apical whorls smooth, following

whorls of the spire with about nine slightly protractive axial ribs, which do not cross the concave anal fasciole. There are numerous, acute, spiral threads alternating with smaller ones. On the penult whorl there are seven of the larger threads below and two or three above the anal fasciole. Between the alternating threads are still finer spiral striae. On the last whorl, where the axial ribs become irregular, partly obsolete, the spiral sculpture remains the same; there being about 28 larger spirals below the shoulder. The anal fasciole is minutely striate spirally.

Length 51.4, diam. 13.5 mm.

Length 53.4, diam. 13.5 mm., length of aperture 25.5 mm.; 11 postnepionic whorls.

Type No. 2904.

This differs from *D. henekeni* by the more slender shape, with much lower ribs, which become weak and irregular on the last whorl. The inter-liral spaces are densely, finely striate, while in *D. henekeni* they are smooth.

In many specimens the spirals do not alternate in size as described above, the intervals having fine, unequal or subequal spiral striae.

***Drillia scala* n. sp.**

The shell is fusiform, whorls strongly convex, concave just below the suture. Penult whorl with sixteen acute axial ribs, nearly vertical except for a short backward curvature below the suture, where the ribs diminish abruptly in size. In the intervals there are fine, rounded, spiral threads, scarcely as wide as their interstices; between them much more minute growth-lines may be seen. There is a strong, latero-dorsal varix. The aperture is somewhat broken.

Length 45.5, diam. 17 mm.

This species resembles *D. squamosa* in form but the *acute* not *nodose* longitudinal ribs, the *regular* revolving sculpture at once separate it from that species. On the other hand it is related to *D. venusta* but is at once distinguished by its long anterior canal, fewer longitudinal ribs and more numerous spirals. The fine lines of growth between the spiral lines are wanting in *D. venusta*.

Type and a broken specimen are No. 2932.

***Drillia hexapleura* n. sp.**

A small species with nearly straight sided spire upon which the limits of the whorls are difficult to make out. Sculpture of 6 very broad, low, rounded axial ribs, continuous from whorl to whorl. These are crossed by strong spiral cords, which are a little narrower

in the intervals. Each whorl of the spire has two of these cords below and one above the concave anal fasciole, in which a few weak spiral striæ may be seen. On the last whorl there are 11 spirals below the fasciole, the intervals somewhat distinctly marked with growth-striæ. There is a stout varix behind the outer lip. The aperture is rather narrow.

Length 8, diam. 3.5 mm.; about 6 whorls remaining.

The small number of spiral cords and very wide axial ribs distinguish this species. It is closely related to the Pliocene *D. acucincta* Dall, 1890, a very much larger species. The strong varix behind the lip of *D. hexapleura* shows that it is adult.

***Drillia mimula* n. sp.**

The shell closely resembles *D. parkeri* in ribbing, except that the ribs do not extend so far down on the last whorl. The whorls and the whole shell are shorter, the last much more abruptly contracted below. The smooth embryonic shell has only $1\frac{1}{2}$ bulbous whorls, the ribs beginning strongly in the middle of the second whorl. There is a microscopic sculpture of crowded spiral striæ. Aperture broken.

Length 16.5 mm. (broken anteriorly), diam. 5.8 mm.; nearly 10 whorls.

Type No. 2925.

***Drillia esculenta* n. sp.**

The shell is fusiform, of 10 whorls, the first $2\frac{1}{2}$ forming the embryonic shell are smooth and convex. Subsequent whorls are concave in the upper third, then convex, with sculpture of rounded, slightly protractive axial ribs, which become lower and arched backward as they cross the concave zone. There are 15 ribs on the penult whorl; last whorl having a stout dorsal varix. A few ripples along growth-lines may be seen, more obliquely protractive than the ribs. In the intervals and more weakly over the ribs there are crowded, very fine spiral threads. The aperture is broken, but the inner lip is continuous, rather heavy, and built forward.

Length 13.3, diam. 5 mm.

Three specimens are in the lot, the figured type having been bored by a predaceous gastropod. The minute sculpture differentiates it from other species of the same horizon.

Type No. 2922.

***Drillia orthopleura* n. sp.**

The shell is slender, fusiform, with sculpture of strong longitudinal ribs, continuous from whorl to whorl, and smooth except for fine

growth-wrinkles. The ribs are lower on the anal fasciole, which is limited below by an inconspicuous cord. The ribs disappear on the anterior canal. The siphonal fasciole is banded above by an acute cord. Columella is nearly straight. Outer lip broken.

Length 14, diam. (estimated) 5 mm.; 8 whorls, several at the apex lost.

Type No. 3198, A. N. S. P.

Drillia callistopleura n. sp.

Shell fusiform, of $11\frac{1}{2}$ whorls. Embryonic $1\frac{1}{2}$ whorls smooth, the first one inflated; three following whorls are angular above the suture, after which the whorls become convex, having slightly protracting axial ribs and spirally striated intervals. On the penult whorl there are nineteen axial ribs, which are slightly lower and a little arcuate below the suture. Between the axial ribs, on the spire, there are rounded spiral cords, about as wide as their intervals, twelve on the penult whorl; on the last whorl they number about thirty-six. Anteriorly the ribs weaken and the spirals pass over them. There is a prominent dorsal varix. Aperture imperfect.

Length 22.4, diam. 7 mm.

The smooth axial ribs, and uniform, close, revolving cords distinguish this species. It is nearly related to the following.

The type and 4 specimens are No. 2921, A. N. S. P.

Drillia lissotropis dorsuosa n. subsp.

Cf. Drillia lissotropis Dall, Bull. Mus. Comp. Zool. IX, 1881, p. 58: XVIII, 1889, p. 91, Pl. 11, figs. 3, 4, and *D. lissotropis* var. *perpolita* Dall

This form has eight or nine smooth ribs on each whorl. They extend from suture to suture, not being interrupted below the suture. Suture bordered below with an uneven ridge, the intercostal valleys slightly pitted below the ridge. There is a rather prominent varix about one-fourth whorl behind the aperture. The outer lip is broken away. A callous nodule on the body borders the posterior sinus.

Length 8.8, diam. 3 mm.; 9 whorls.

Drillia foveolata n. sp.

There are twelve rounded, slightly protracting ribs on the penult whorls, the intervals having sharply impressed spiral lines, seven on the penult whorl. There is a low, rounded ridge below the suture, the intercostal valleys somewhat pitted below it. There is a prominent varix about one-fourth whorl behind the aperture. The outer lip is broken.

Length 14.3 diam. 5 mm.; $11\frac{1}{2}$ whorls.

The type and two other specimens are No. 2958, A. N. S. P. The type is somewhat smaller than the others, both of which have been bored by predaceous snails.

Clathurella amica n. sp.

Resembles *C. gracilis*. It is less slender and the whorls are shorter and revolve less obliquely. It has the same number of axial ribs and spiral threads, but, as they are relatively larger, they are much more crowded than in *C. gracilis*. The fine spiral lines between the prominent raised threads are very minute. The lip varix is noticeably larger, and the mouth is wider; the callous nodule on the body next to the sinus is much larger than in *C. gracilis*.

Length 16.3, diam. 5.25 mm.; aperture 7.5 mm.

It is allied to *C. vendryesiana* Dall,¹ but the prominent axial ribs over the whole shell differentiate it.

Type is No. 2913, A. N. S. P.

Scobinella tristis n. sp.

The shell is fusiform with turrated spire. The whorls are strongly angular at the shoulder, rather deeply concave between the shoulder and a strong, beaded ridge below the suture. There are four spiral cords in the concavity. At and below the shoulder there are about 24, deeply beaded spiral cords, the beads arranged in protractive curves. On the penult whorl there are four spirals below the shoulder, which has a bifid spiral. The aperture is very narrow. The outer lip of the type has been broken during the life of the animal, and is thicker than normal, lirate within. The long, straight columella bears two strong, mitriform plaits, and there is the faint trace of a third one.

Length 45.8, diam. 13, length of aperture 26 mm.; 6 + whorls remain, the upper ones being lost.

Type No. 2927, A. N. S. P.

This is a shorter, less graceful shell than *S. magnifica*, with the whorls more strongly shouldered, more concave above the shoulder, and with a stronger presutural cord. *Scobinella morierei* (Cossm.) has a shorter anterior canal. *S. celata* Conrad is smaller and less fusiform.

Conus furvoides brachys n. subsp.

The shell is shorter than *furvoides*. The last 4 whorls are concave and weakly striate spirally. It stands close to *C. concavitectum* B. & P., of Gatun, but that species has more copious and granulous

¹ *Proc. U. S. Nat. Mus.*, XIX, 1896, p. 306, Pl. 27, fig. 1.

spiral striæ in the lower half, and the spiral striation of the spire is distinct.

Length 33.5, diam. 17.3 mm. (type).

“ 38, “ 20.5 “

Conus xenicus n. sp.

The shell is broad above, the diameter about two-thirds of the length; spire low, its outline strongly concave, rising to an acute apex; periphery carinate, the slopes below it nearly straight. The early whorls have a smooth keel, projecting above the suture, but the last five are flat, with very weak traces of spiral striæ, and separated by a plain, narrowly impressed suture. The last whorl has coarse, well separated spiral cords on the anterior end, but under suitably oblique light very faint spirals may be seen throughout. The faint growth-striæ retract rather strongly near the shoulder. The aperture is very narrow.

Length 29, diam. 19 mm. (type).

“ 27, “ 17 “

Besides the type, No. 2575, A. N. S. P., there are three other specimens in the lot. It was labeled “*Conus* sp. ?, monstrosity” by Gabb, but none of the specimens shows any trace of injury, and we have every reason to believe that they are entirely normal.

Conus perlepidus n. sp.

Conus planiliratus Sby., Gabb. Trans. Amer. Philos. Soc., XV, 1873, p. 230.
Not of Sowerby.

The shell is rather slender, with somewhat concavely conic spire of about 12 whorls, which are flat, marked with raised, areuate striæ, and have an angle projecting very little above the suture. Last whorl is rather actually angular, the sides nearly straight below the angle, with sculpture of about 22 spiral furrows half as wide as the flat intervals; the furrows being cancellated by raised axial threads. The posterior sinus of the aperture is deep. Aperture of about equal width throughout.

Length 44, diam. 18, length of aperture 38 mm.

Gabb referred the specimens of this species to *C. planiliratus*, but Sowerby's phrase “*Testa turbinata, crassa*” could hardly have been applied to such “a long, narrow species” as this. Gabb refers, also, to Guppy's figure in Quarterly Journal of the Geological Society, XXII, Pl. 16, fig. 7, which agrees well with Sowerby's brief diagnosis of *C. planiliratus*, but not with the present species.

The type and five other specimens are No. 2569, A. N. S. P. In

small specimens, 22 mm. long, the spiral grooves are equal in width to the flat intervals.

Conus trisculptus n. sp.

The shell is biconic, the spire composed of slightly concave whorls, with a low carina projecting above the suture. On the last $2\frac{1}{2}$ whorls this carina bears low nodes (about 20 on the last whorl), but on the earlier whorls the keel is smooth. The upper slope of each whorl has prominent, arcuate radial striae but no spirals. Below the shoulder the surface is slightly convex, contracted a little above the base. The lower half has about 13 spiral grooves, widely separated except close to the base; and except on the anterior fourth there are spiral series of small pustules which are slightly lengthened in the axial direction, and are arranged in vertical rows, but somewhat irregular in places.

Length 34.5, diam. 16.5 mm.; length of aperture 27 mm.

Costa Rica, Pliocene. W. M. Gabb. Type No. 2567, A. N. S. P.

This cone was with the lot of *C. consobrinus ultimus*, from which it is at once separable by the smooth keel of the upper whorls.

Conus consobrinus ultimus n. subsp.

Conus consobrinus Sby., Gabb, Journ. A. N. S. Phila. 2 Ser., VIII, p. 359.

Shell more squarely shouldered than *C. consobrinus*, and with tubercles extending upon the angle of the last whorl.

Length 52, diam. 24.3 mm.

Costa Rica, Pliocene. Collected by W. M. Gabb. Type and five other specimens are No. 3322, A. N. S. P.

Conus longitudinalis n. sp.

The shell is about twice as long as wide, with nearly straightly conic, elevated spire of about 10 whorls. These are flat, with an angle projecting above the suture and on the last whorl. There are slightly arcuate, protractive striae above. The last whorl, below the shoulder is coarsely corrugated vertically, the wrinkles somewhat irregular. The anterior third has narrow, spiral grooves, the upper three widely spaced, the rest in pairs, and all crossed by axial threads.

Length 35, diam. 17.5 mm.

This species is remarkable for its coarsely wrinkled surface. It is known by one specimen with the outer lip extensively broken, and the spire and part of the last whorl of another.

Type No. 2574, A. N. S. P.

Conus simplicioissimus n. sp.

Conus berghausii Mich., Gabb, Trans. Amer. Philos. Soc., XV, 1872, p. 232.
Not of Michelotti.

The shell is thick, stout, the diameter more than half the length, smooth except for delicate growth-lines. Spire conic with concave outlines, the whorls nearly flat, the upper ones angular above the suture. Shoulder rounded, the lateral slope below it somewhat convex, showing very faint traces of five spiral series of rather large reddish spots. Above the shoulder there are some oblique reddish flames. No spirals near the base or elsewhere. Aperture is somewhat widened in the lower third.

Length 68, diam. 42 mm.

“ 63, “ 33.5 “ ; whorls 11 (type).

“ 41, “ 25.5 “ .

A cone of very simple form, differing from others of somewhat similar contour by the absence of spiral sculpture. *C. recognitus* is much more contracted anteriorly, and has weak spiral striae.

The smallest specimen of the three is that which Gabb referred to *C. berghausii* Mich., an Italian Tertiary species. Dr. Dall has included *C. berghausii* Gabb in the synonymy of *C. proteus*, but it differs from that by the swollen shape, and is certainly distinct.

Type No. 2549.

Conus porcellus n. sp.

Conus cedo-nulli Brug., Gabb, Trans. Amer. Philos. Soc., XV, 1872, p. 232.

The shell is broad, the diameter about two-thirds of the length. The spire is low-conic with slightly concave outlines, composed of about 10 whorls, the later two or three concave above, earlier ones flat, a few showing a slightly projecting angle above the suture; lightly sculptured with arcuate growth-lines. The shoulder of the last whorl is well rounded; lateral slope convex in the upper part, then straight. A siphonal fasciole is defined by an oblique, spiral ridge, below which there are four spiral cords. Above the ridge there are about 10 narrow, widely spaced spiral cords, each bordered above by a slight gutter which is striated vertically. The upper third of the last whorl is nearly smooth, but under a lens it shows faint, widely spaced spirals, either slightly raised or indicated by gray lines.

Length 29.3, diam. 19 mm.; length of aperture 25 mm. (type).

“ 38, “ 24 “ (largest specimen).

Type No. 2546.

A series of several hundred specimens is in the collection, the type

being contained in No. 2556, A. N. S. P. We are utterly at a loss to account for Gabb's reference of the shell to *C. cedo-nulli*, which is entirely different.

The sculpture is rather variable, as usual in *Conus* some individuals showing raised spirals nearly up to the shoulder, while in other the upper half may be smooth.

Conus pernodosus n. sp.

The shell is rather slender, the diameter not quite half the length; spire produced, slightly concave in the upper part, of about 9 whorls, which are slightly concave and spirally striated above, with a projecting periphery which is set with somewhat pointed tubercles on the last $3\frac{1}{2}$ whorls. On the angle of the last whorl there are 11 tubercles. Below the angle the outline is very slightly convex. Surface closely sculptured with flat-topped spiral cords about twice as wide as the intervals (37 below the angle of last whorl); intervals are sharply sculptured with axial threads.

Length 23.3 (imperfect at base); diam. 12.3 mm.

With the type, No. 2552, A. N. S. P., there are two young shells about 15 mm. long, which show tubercles on the last whorl only. The upper whorls, in this species, have a smooth, projecting periphery.

Conus gabbi n. sp.

The shell is rather slender, stoutly fusiform, with a concavely conic spire of about 11 whorls; all post-embryonic whorls have a tubercular keel projecting above the suture. Upper surface of each whorl is slightly concave, with about 5 unequal spiral threads crossed by prominent, arched, unequal striae. Below the shoulder of the last whorl the slope is at first convex, becoming slightly concave in the lower part. It is sculptured with about 37 smooth, rounded spiral ribs narrower than their intervals, which are elegantly cancellated by close raised axial threads. The aperture is rather narrow throughout.

Length 43, diam. 17.5 mm.; length of aperture 35 mm.

The number and spacing of the spiral ribs is somewhat variable. In one specimen 35 mm. long there are only 24 spiral ribs. *Conus tortuosostriatus* Toula (1911), from the Panama Canal, resembles this species somewhat, but it has fewer and flattened spirals, and there are some fine spiral threads in the furrows. It seems also to be more contracted in the lower part.

The type and four other specimens are No. 2553, A. N. S. P.

Conus larvatus n. sp.

The shell is extremely slender, the length about $3\frac{1}{2}$ times the diameter, fusiform. Spire produced, composed of flat whorls, the beaded periphery projecting above the suture; apical whorls lost. The last whorl is angular, the angle set with 25 bead-like tubercles, which are a little lengthened in the spiral direction; elsewhere, above and below the angle, it has close, even fine spiral cords with very sharp axial striation in the intervals. Upward, towards the shoulder, the striae slowly retract. The aperture is extremely narrow. The inner lip is excavated in its lower fourth.

Length (truncated) 33, diam. 9.5 mm.; $5\frac{1}{2}$ whorls remaining.

Type No. 2550, A. N. S. P.

This species, *C. gabbi* and *C. pernodosus*, were lumped by Gabb under *C. orbigny* Audouin, a recent species inhabiting the Eastern Seas. *C. gracilissimus* Guppy, from the Oligocene of Jamaica, is closely allied, but it is a distinct species, with wide, flat, revolving costae.

C. larvatus is narrower than *C. tortuosostriatus* Toula, and differs conspicuously in contour. Toula's species has more resemblance to *C. gracilissimus* Guppy.

Cancellaria gabbiana n. sp.

The shell is short, turbinate solid, of about 7 whorls. The bulbous embryonic shell consists of $1\frac{3}{4}$ convex, smooth whorls. Following whorls have slightly retractive axial ribs much narrower than their intervals, about 18 on the last whorl. At intervals of about a half whorl there are rather broad varices. There are 18 spiral cords hardly half as wide as their intervals and passing over ribs and varices. Siphonal fasciole is prominent, surrounding a small umbilicus. The aperture is large, oval; outer lip is somewhat effuse at the outer-basal part, but not retracted; sculptured within with 14 sharp lirae. Columellar plaits are not very strong, the upper one thin, middle one somewhat blunt. A broadly spreading but thin parietal callous coats the face in front of the aperture.

Length 24.5, diam. 19.4 mm.; length of aperture 17 mm.

The type and another specimen were among unsorted material. No. 3288, A. N. S. P.

Cancellaria (Trigonostoma) insularis n. sp.

Cancellaria brevis Sby., Gabb, Tr. Am. Philos. Soc., XV, 1873, p. 236. Not of Sowerby.

? *Cancellaria (Trigonostoma) aff. C. bullata* Sow., Toula, Jahrb. k.k. Geol. Reichsanstalt, LXI, p. 504, Pl. 30, fig. 10.

The shell is short and broad, openly umbilicate, solid. There are

1½ smooth, strongly convex embryonic whorls, 4½ subsequent whorls, which are separated by a very deep y channelled suture; the last whorl therefore being bluntly carinate above and at the base. Sculpture of strong, narrow, retractive axial ribs, 14 on the last whorl, passing over the carinae at summit and base; crossed by numerous, unequal, low spiral cords. The aperture has two strong liræ within the straight upper margin, eleven within the outer. The inner lip has many entering wrinkles, and three columellar plaits, the anterior one low and obtuse.

Length 24.5, diam. 21 mm.

Type is No. 2989, A. N. S. P.

This species is not at all like the recent *C. brevis* Sowb. It closely resembles *C. perspectiva* Conr., of the Chesapeake Miocene, but differs in its more rugose aperture and narrow, irregular ribs, which in *C. perspectiva* are wide and regularly alternating. The aperture and umbilicus are larger than in *C. depressa* Dall, of the Tampa silex beds. It differs conspicuously from *C. moorei* Guppy in the basal region.

A *Trigonostoma* figured by Toulou, referred to above, appears to be close to *C. insularis*, perhaps specifically identical.

***Oliva proavia* n. sp.**

Oliva cylindrica Sby., Gabb. Tr. Amer. Philos. Soc., XV, 1873, p. 215 (*pars secunda*).

The shell is somewhat fusiform, the upper fourth of the last whorl and the spire tapering, forming a straightly conic spire. In its even surface the suture appears as an engraved groove, the individual whorls being flat. The first two whorls form a minute, mammillate apex. Whorls 9. The aperture occupies almost exactly ¾ of the total length. Columella is rather heavily calloused, and bears about 21 very oblique plaits, of which all but about 10 in the median part are quite small. There are faint traces of a color pattern resembling that of *O. sayana* Rav.

Length 81.5, diam. 27, aperture 62 mm. (type).

“ 101, “ 37, “ 86.5 “

The type and a larger specimen are No. 2992, A. N. S. P.

Comparing the two large specimens with *O. sayana* Rav. (*O. litterata* Lam., *O. carolinensis* Conr.) we note the more slender contour and much more oblique columellar folds of *O. proavia*. A further important distinction is that the lateral contours of the spire are continuous across the suture in *proavia*, while in the other species the posterior edge of each whorl projects beyond the preceding.

The type specimen is quite perfect except that the lip is somewhat crushed in above, making the aperture appear shorter and narrower above than it really is.

Oliva dimidiata n. sp.

The shell is small, cylindrical, with conic spire and mamillate apex. The last three to four whorls are flat, covered with callous, and separated by channelled suture. The last whorl is encircled a little above the middle by a narrow groove. The basal fasciole has 6 strong ledges. There are 14 short folds on the columellar margin.

Length 12.2, diam. 5.3 mm.; length of aperture 9 mm.; $6\frac{3}{4}$ whorls. Others measure 11.5 and 13 mm. long.

This was at first suspected to be a young stage of *O. gradata*; but that species is longer when it has the same number of whorls. Moreover, the narrow ledge of *gradata* is unlike the groove of this species. It is closely related to the recent *O. undatella* Lam. of the west Mexican coast but is less inflated, and to judge by the three examples in the typical lot, it does not become so large.

Type No. 2804.

Marginella nugax n. sp.

The shell is very small, biconic, of four slightly convex whorls; apex obtuse. The suture ascends strongly in front. Aperture narrow. Outer lip broad, thickened, the inner margin having 8 teeth, the upper fourth without teeth. Columella with four plaits.

Length 3.7, diam 2 mm.

Type No. 2802, A. N. S. P.

Though very small, the lip has a conspicuous external varix.

Mitra tortuosella n. sp.

The shell is fusiform, slender, with sculpture of acute axial ribs (about 14 on each whorl), the concave intervals between them having spiral impressed lines which do not pass over the smooth summits of the ribs. There are 7 or 8 such impressions in each interval on the penult whorl. On the narrow anterior half of the last whorl there are well separated spiral cords. The outer lip is sculptured within with five slender liræ. There are four columellar plaits.

Length 18.5, diam. 6 mm.; 8 whorls, the embryonic being lost.

Type No. 3285, A. N. S. P.

This is closely related by its sculpture to *M. tortuosa* but it differs by the very slender form. A young *M. tortuosa* 16.3 mm. long has a diameter of 7 mm.

In some of the intercostal intervals there is a median longitudinal groove.

Mitra tortuosella frater n. subsp.

This form is closely related to the preceding, but differs by having deeply cut spiral grooves about as wide as the raised cords, in the intercostal intervals. There are 7 or 8 grooves on the penult whorl, which has 15 slightly arched axial ribs. The anterior canal is shorter than in *M. tortuosella*.

Length 14.7, diam. 5 mm.; 8 whorls, the apical ones lost. Further series are needed to determine the value of the differences between this form and the preceding.

Type No. 3286.

Mitra mesolia n. sp.

The shell is short and stout. Sculpture of a few impressed spiral lines on the upper part of the last whorl and the spire, 6 on the penult whorl, the anterior end having about 9 low spiral ridges, with faint traces of spirals above them, the middle part of the last whorl being smooth. Lip thickened within in the lower three-fourths, smooth; 4 columellar plaits.

Length 20 (apical whorls wanting), diam., 9.5 mm.

This species is shorter than the Californian *M. maura* which it resembles. In a younger specimen only a small part of the last whorl is unsculptured.

Type No. 3275.

Plochelaea gabbi n. sp.

The shell is smaller than *P. crassilabrum*. Spire concavely conic, of $7\frac{1}{3}$ flat whorls. First 2 whorls form a nipple-like apex; the next 2 or 3 are very delicately striate spirally; subsequent whorls showing faint growth-lines only. Suture not impressed, suddenly ascending to or very nearly to the summit of the last whorl, in front. Last whorl has more convex outlines than *P. crassilabrum*, and terminates in a very low, wide varix. The outer lip is subacute in the upper part, but a little blunt and slightly reflected in the lower half. It is not inflected. The upper third of the aperture is narrow, lower two-thirds dilated, widest just above the basal channel, which is deep and recurved. There are 4 narrow, nearly horizontal columellar plaits, and above them 3 distinct and one or two vestigial, smaller, slightly ascending plaits in one specimen, but in the type only two short plaits above the four strong ones.

Length 25, diam. 12.7, length aperture 22.3 mm.

“ 27.4, “ 12.7, “ “ 24.2 “ (type).

The shorter spire, strongly ascending anterior end of the suture, and the straightened but not inflected outer lip, amply distinguish

this species from the larger *P. crassilabrum*, with which it was lumped by Gabb.

Type and one paratype are No. 3290, A. N. S. P.

Xancus rex n. sp.

Turbinella valida Sby., Gabb. Tr. Am. Philos. Soc., XV, 1873, p. 218. Not *Turbinellus validus* Sowerby.

The shell is biconic, large and ponderous, the periphery about median. First whorl distorted, bulbous, smooth, next whorl contracted and narrow. Succeeding whorls have massive axial folds, 6 or 7 on a whorl, traversed by about 7 spiral cords. After the mid-zeanic stage the spiral sculpture weakens, and the folds gradually give place to strong tubercles at the shoulder. On the last whorl of the type there are 12 such tubercles. Above the shoulder there is a steep, slightly concave slope to the suture, the surface being conspicuously, finely plicate and having a few spiral cords, which are indistinct in the adult stage. The whorl is appressed at the suture, the axial wrinkles becoming strongly retractive laminae there. The basal half of the last whorl has many spiral cords. The inner lip is heavily calloused, columella with 3 strong plaits.

Length (as broken) 212, diam. 117 mm. (type).

“ 155, diam. 62 mm.

This species differs from the recent *X. scolymus* by the shorter spire, coarser sculpture above the shoulder, smaller and more numerous tubercles at the shoulder, etc. The whorl slopes much more steeply above the shoulder than in *X. wilsoni* or *X. polygonatus*.

The type, No. 2628, A. N. S. P., and a series of 35 specimens of various ages are in the collection.

The description of the embryonic whorls is from a paratype.

Vasum pugnus n. sp.

The shell is biconic; spire elevated, the whorls having rounded peripheral nodes, about 8 on a whorl, and spiral threads, about 12 with a few minor ones, on the penult whorl. On the last whorl there are short, thick axial folds extending a short distance downward from the shoulder, and an inferior row of blunt tubercles. From the shoulder down there are low, well-spaced spiral cords, with about 3 smaller spirals in their intervals.

Length 80, diam. 50 mm.

The spire is higher and more straightly conic and the last whorl not so wide as in *V. muricatum*, the spiral threads on the spire are much smaller.

Type No. 2626, A. N. S. P.

Melongena orthacantha n. sp.

The shell has a shortly conic spire, angular periphery, below which it tapers rapidly. At the periphery there are short radiating spines rising from short folds, which corrugate the upper surface. The last whorl has 12 spines. There is an inferior ridge armed with spines, and a prominent siphonal fasciole. Below the suture there is a convex nodulose or scaly fasciole. The surface has also numerous spiral cords, ten between the peripheral and inferior series of spines. The aperture is smooth within.

Length 29.7, diam. 25.5 mm.: $5\frac{1}{2}$ whorls (type).

“ 36.2, “ 31.2 “ (worn adult).

The type and two paratypes are No. 2956, A. N. S. P. The type is a perfect but not quite adult specimen. A fully adult but worn (beach rolled) shell has 10 peripheral tubercles on the last whorl; the fold-like character is scarcely noticeable in this stage. The sutural fasciole is more prominent.

In a somewhat broken specimen 35.5 mm. long there are smaller spirals in part of the intervals, increasing the number mentioned above by about one-half. This specimen has ten spines on the last whorl.

Anachis gracilicostata n. sp.

The type specimen has 7 whorls, the first three smooth, the rest with about 27 straight, axial riblets at least as wide as their intervals; no spiral sculpture above the periphery; below it there are fine spiral lines between the riblets, and on the anterior third about 8 spiral cords. The aperture is about half the total length of the shell.

Length 4.7, diam. 2 mm.

Two specimens were found in the lot of *A. exilis*. As both are immature, the aperture cannot be described; but the characteristic sculpture, unlike any other shell of these beds, will insure recognition of the species. Type and another are No. 2803, A. N. S. P.

Another species of Columbelloid is represented by specimens too imperfect for diagnosis.

Strombina politissima n. sp.

The spire tapers regularly, and is composed of 7 convex whorls, separated by an impressed suture, which does not ascend in front. A prominent, rounded varix strengthens the lip, which has a small tubercle within near the posterior insertion, another at the beginning of the anterior canal. There is a small entering callus on the parietal wall posteriorly. Surface smooth and highly polished except at the base, where there are about 14 obliquely spiral cords.

Length 7.1, diam. 3.4 mm.

Type No. 2801, A. N. S. P.

One specimen was found with the large lot of *S. haitensis*. It resembles that species in shape but not in sculpture.

Metulella dominicensis n. sp.

The long spire has very slightly concave outlines. The embryonic shell is glossy and smooth, of $1\frac{3}{4}$ convex whorls, the first one rather large. Following whorls are very slightly convex, angular a short distance above the suture, which is in a channel. Sculpture of close, fine axial ribs, at first smooth, but at the third a few weak spiral cords appear, stronger in the intercostal spaces. On the penult whorl there are 3 or 4 such cords; on the last whorl about 5 from the periphery up; just below the periphery there is a zone without spirals, then about 20 stronger spirals on the lower part. There are about 7 teeth within the outer lip, and 5 or 6 on the columella.

Length 16.4, diam. 5.2 mm.; $8\frac{1}{2}$ whorls.

Type No. 3217, A. N. S. P.

Closely related to *M. fusiformis*, but the whorls are less convex, the spiral sculpture far weaker and the shell is more slender.

Thais santodomingensis n. sp.

The shell is somewhat biconic, with short, straightly conic spire and weakly angular periphery. Suture bordered below with an irregular, somewhat scabrous rounded ridge or welt; a somewhat nodose low rounded ridge runs in the anterior concavity. Sculpture of numerous vertical ribs on the upper and middle part of the whorls, strongest at the periphery, ten on the last whorl, and many spiral cords in strong relief. Siphonal fasciole prominent, umbilical crevice open. The aperture has a shallow posterior channel and the usual deep anterior notch. Columella is heavy rounded and straight.

Length 45, diam. 30 mm.; $5\frac{1}{2}$ whorls.

Type No. 3187, A. N. S. P.

This species may be compared with the recent Caribbean *Thais coronata* (Lam.). It differs in sculpture, having rounded ribs in the peripheral region, where it is indistinctly angular. In *T. coronata* the later whorls are distinctly shouldered. There is a spiral ridge in the concavity below, which is wanting in *T. coronata*.

Malea elliptica n. sp.

The shell is narrower than *M. camura*, with a longer spire. Sculpture of flattened, very slightly raised, strap-like spirals, which are

much wider than the intervals. Three spirals below the suture are narrow. On the penult whorl there are five subequal wide spirals besides three subsutural narrow ones, the intervals traversed by fine threads. The last whorl has twenty wide and three narrow spirals. The aperture is narrow. Lip having about the same structure as in *M. camura*. There is a large parietal tooth, with smaller ones above and below it, and a prominent, double, columellar tooth; the columella and the upper part of the parietal wall strongly rugose.

Length 53.5, diam. 34.7 mm.; $5\frac{3}{4}$ whorls remaining, the tip wanting.

Type No. 2590.

The very much less raised and more numerous spirals, as well as the general shape of the shell, separate this from *M. camura*.

Malea goliath n. sp.

Large and globose, thin, with sculpture of broad, flat spirals parted by furrows from one-fourth to one-third as wide, 19 spirals on the last whorl, five on the penult and next earlier, where the median one is larger and prominent. Parietal tooth composed of four plaits. Columellar prominence with about six plaits, the upper three larger. Outer lip broken, but fragments indicate structure similar to *M. camura*.

Length 129, diam. 107 mm.

Type No. 2592.

Strombus galliformis n. sp.

Strombus bituberculatus Lam., in part, Gabb, Tr. Am. Philos. Soc., XV, 1873, p. 233. Not of Lamarck.

Related to *S. gallus* L. The spire is high, with sculpture of axial riblets and inconspicuous varices on the earlier whorls, changing to short tubercles on the last four, the penult whorl having two low, massive varices. Whorls of the spire having unequal spiral striæ. The last whorl has a smooth shoulder in front, three high tubercles on the back, the central one largest; the whole surface having widely spaced spiral ridges and fine, very weak, spiral striæ. Lip produced upward in an angle, smooth within; no entering wrinkles on the posterior end of columellar lip.

Length 100, diam. 66 mm.; $9\frac{1}{2}$ whorls.

In the recent *S. gallus* the lip is far more produced upward and it spreads on the left side above the shoulder; the spiral ridges on the back are coarser, and the tubercles at the shoulder more numerous. The new form is more like *S. peruvianus* in form of the lip, but that species has the throat conspicuously rugose.

Type is No. 2582, A. N. S. P.

Strombus dominator n. sp.

Strombus gigas Linn., Gabb, Tr. Am. Philos. Soc., XV, p. 234.

A species related to *S. costatus* (*accipitrinus*). Spire not very high, the whorls having rounded tubercles on the periphery, and spiral striae. The last whorl has a strong, rounded keel at the shoulder, a stout, triangular tubercle in the middle of the back, preceded by another on the side. There is an inferior series of small tubercles, and on the latter part of the whorl, some low, coarse spiral ridges. The lip spreads broadly and is much thickened within. *Posteriorly it extends above the apex.* The throat is smooth.

Length 88, diam. 75 mm. Length of aperture (measured from end of canal to upper end of the lip) 97 mm.

The type is an almost perfect but dwarf specimen. Several fragmentary specimens are much larger, the best one about 15 cm. long. The outer lip of another indicates a length of perhaps 20 cm. It was apparently the mere size, rather than any close correspondence of form or sculpture, which determined Gabb's reference of the form to *S. gigas*.

It is related to *S. costatus* and *S. goliath*, the spire being much like the latter, which however, has the outer lip far more broadly expanding, and the upper margin quite different. In *S. costatus* the lip falls short of the height of the spire, but in *S. dominator* it rises above the apex.

Type No. 2579.

Potamides gastrodon n. sp.

The shell is rather short, conic, the whorls closely and regularly sculptured with axial riblets crossed by three spiral cords, forming small tubercles at the intersections. There are a few inconspicuous varices. Last whorl rises at the aperture, and has a prominent, rounded varix on the left side; the cavity of the whorl at this place having three well developed and a minute fourth tooth within the outer wall, a fold on the parietal wall near the posterior angle, and a plait on the columella. Last half of the last whorl is broken away. As broken, the type measures:

Length 22.5, diam. 11 mm.

The type and three other broken specimens are No. 2599, A. N. S. P.

Turritella sulcigrata n. sp.

Turritella planigrata Guppy, Gabb, Tr. Am. Philos. Soc., XV, 1873, p. 240.
Not of Guppy.

This species is closely related to *T. gatunensis* Conrad, but differs by being constantly less excavated along the suture, though there is a

rather deep sutural channel. This leaves a broad median band in strong relief on the whorls, which have spiral sculpture of spiral cords and threads. The inconspicuous growth-lines arch backward.

Length 54, diam. 13.8 mm.; 14 whorls. The specimen has lost the last whorl.

Type No. 3203, A. N. S. P.

We have not been able to compare the type of Guppy's *T. p anigyrate*, but his description and figure certainly do not support Gabb's identification. Guppy has remarked, however, that his figure of *T. planigyrate* "shows only the general shape."

T. sulcigyrate is an abundant species.

Turritella arata Guppy, in Proc. U. S. Nat. Mus., XIX, p. 319, Pl. 28, fig. 3 from the Oligocene of Haiti, is not contained in the collections studied.

Cæcum anellifer n. n.

Cæcum annulatum Gabb, Trans. Am. Philos. Soc., XV, p. 241; Journ. A. N. S. Phila., VIII, p. 363, Pl. 46, fig. 59. Not of Brown.

The single specimen is not mature, but it may be recognized by the sculpture. There are about 25 convex rings, more emphatic posteriorly, lower anteriorly, their intervals much narrower than the ribs, crossed and cut into pits by numerous low axial ribs, which appear very weakly on the rings. Septum rises in a point near the convex side.

Length 1.95, diam. 0.6 mm.

The rings of *C. crassicostum* Gabb are very much stronger, the intervals wider, so that, with a single example of each at hand, it does not seem prudent to unite them as one species.

Rissoa epulata n. sp.

The shell is globose-conic and has a relatively large circular umbilicus; spire short, straightly conic, of moderately convex whorls, the last whorl inflated. Sculpture of rounded vertical ribs about equal to their intervals, 17 on the last whorl, diminishing and soon disappearing after passing over the periphery. In the intercostal intervals there are very low spiral cords, six above the periphery, and the base has four much stronger and more separated cords. A broad and thick varix strengthens the outer lip. The aperture is roundly ovate; peristome continuous.

Length 1.25, diam. 0.9 mm.; $4\frac{3}{4}$ whorls.

Type No. 3167, A. N. S. P.

The short form and large umbilicus are the chief characteristics

of this species. Belongs to the section *Apicularia* of Tryon's arrangement.

Rissoa (Alvania) proavia n. sp.

The shell is imperforate, rather plump, conic; first $2\frac{1}{3}$ whorls are smooth, convex, and form a somewhat acuminate summit. Following whorls have latticed sculpture of rather narrow vertical ribs, which pass over the periphery but are obsolete over most of the base, crossed by spiral cords a little narrower than the ribs, and forming small nodes at the intersections. On the penult whorl there are three spiral cords, the upper one at the shoulder. On the last whorl there are six spiral cords, the second from above forming the periphery, the lower two smooth, the others passing over ribs. Some very minute spiral striae are visible in the intercostal spaces. The aperture is nearly circular, the lip strengthened by a strong varix.

Length 1.35, diam. 0.9 mm.; 5 whorls.

Type No. 3169, A. N. S. P.

This species stands close to *Rissoa lipeus* Dall,² but it differs by the acute apex and details of sculpture.

Hipponix otiosa n. sp.

The shell is oval, obliquely conic, with the apex curving backward nearly over the posterior margin. The apical portion sits cap-like at the summit, and is probably smooth, though somewhat worn, the original surface being mostly removed. The later growth is rudely ribbed radially with 14 ribs in a young specimen 5 mm. long, 18 in the largest specimen, about 9.3 mm. long. The ribs are wide, sculptured with rather rough growth-lines, and near the periphery with coarse radial striae. The border is scalloped by the ribs.

Length about 9.3, width 8, height 5.5 mm.

Type and two other specimens are No. 2887, A. N. S. P.

Natica finitima n. sp.

The shell resembles *N. canrena* in shape. The narrow and short spire is rather acute, of 5 convex whorls. The suture is very narrowly channelled; last whorl very convex throughout. Umbilicus is formed as in *canrena* except that the spiral pillar is decidedly smaller and terminates in a much smaller columellar callus. Parietal callus is heavy. The surface shows light growth-lines, some of which are slightly stronger below the suture, but far less so than in *N. canrena*.

Alt. 23.5, diam. 24 mm. (type).

" 23.5, " 26.2 " (largest specimen).

² *Trans. Wagn. Inst.*, III, p. 339, Pl. 20, fig. 5b. Pliocene of the Caloosahatchie, also recent, Watling Island, Bahamas.

This species is easily to be distinguished from *N. canrena* by the noticeably channelled suture, absence of subsutural plication, and the characters of the umbilicus. Gabb grouped them with the specimens of *N. canrena*.

The type and seven other specimens are No. 2875, A. N. S. P.

Aclis (Amblyspira) bartschiana n. sp.

The shell is long and slender, smooth. Nuclear whorls lost; the following whorls are slightly concave, the suture prominent as a sharp, low ridge; the penult whorl has an angle projecting inconspicuously just above the suture, last whorl is sharply angular in front, the angle entirely disappearing on its last half. The aperture is small, ovate, diagonal. Peristome continuous across the parietal wall, the columella somewhat thickened, simple.

Length 3.6, diam. 0.95, length of aperture 0.75 mm.; 10 post-nuclear whorls.

Type No. 3016, A. N. S. P.

A characteristic little shell, named for Dr. Paul Bartch, whose industry and acumen in the classification of *Pyramidellidae* are bringing order into this once chaotic group.

Pyramidella forulata famelica n. subsp.

The shell closely resembles *P. canaliculata*, but differs by its narrower contour, smaller sutural channel and by having faint traces of spiral striation. Last whorl has a small peripheral carina, but only the weak trace of a furrow below it. There is fine erenulation below the suture and a narrow umbilicus bounded by a cord-like fasciole.

Length 10.5, diam. 3 mm.; 13 whorls (apex entire).

The shell is somewhat narrower than the Bowden form which we take to be the adult stage of *P. forulata* Guppy,³ yet a thorough comparison of good series may show that there are transitions. The type of *forulata* is, we believe, a quite young shell.

Turbonilla (Pyrgiscus) beatula n. sp.

Shell rather rapidly tapering, the whorls slightly prominent and convex below the suture, elsewhere nearly flat, with sculpture of vertical, rounded ribs about equal to the intervals, and extending from suture to suture. Intervals minutely striate vertically, the striae cut by incised spiral lines, of which there are eight on the penult whorl. A few similar spirals may be seen on the otherwise

³ *Pyramidella forulata* Guppy, in Dall, *Proc. U. S. N. Mus.*, XIX, p. 315, Pl. 28, fig. 13.

smooth base. There are nineteen ribs on the penult whorl. Aperture somewhat trapezoidal, the columella slightly sinuous, thickened.

Length 3.8, diam. 1, length of aperture 0.75 mm.; 8 post-embryonic whorls.

Type No. 3026, A. N. S. P.

Turbonilla (Pyrgiscus) santodomingensis n. sp.

The shell tapers very slowly. Nuclear and early neanic whorls wanting. The rest have rather strong, rounded, straight vertical ribs, which become slightly retractive on the last two whorls, and part of them continue very weakly over the base. There are 17 ribs on the penult whorl. There are five (5) spiral impressed lines between sutures, not crossing the summits of the ribs. On the base there are about 6 spiral impressed lines, the lower three continuous. The aperture is especially short; columella very strongly folded and thickened.

Length 6.4, diam. 1.35 mm.; $10\frac{1}{2}$ whorls remaining.

Type No. 3034, A. N. S. P.

Longer, more slender than *T. dominicensis*, with fewer ribs and fewer spirals which are more deeply impressed. It differs more fundamentally by the very strong columellar fold.

Turbonilla (Chemnitzia) galeata n. sp.

The shell is very slender, with a large helicoid nucleus; next whorl sculptured with numerous ribs, subsequent whorls with fewer vertical rounded ribs running from suture to suture, nearly as wide as the concave intervals, which under a high power show a faint woven texture. Sixteen ribs are on the penult whorl. On the last whorl there is an inconspicuous spiral depression at the anterior termination of the ribs. The base has some faint spiral impressed lines. The aperture is ovate; columella somewhat thickened, distinctly folded above.

Length 2.9, diam. 0.55, length of aperture 0.4 mm.; $7\frac{1}{2}$ post-nuclear whorls.

Type No. 3028, A. N. S. P.

Turbonilla (Chemnitzia) peraequa n. sp.

Embryonic whorls helicoid. Subsequent whorls with sculpture of numerous rounded vertical ribs equal to the concave intervals, both ribs becoming weaker and terminating a little distance short of the lower suture; the concave intervals also terminating there, but rather abruptly. There are 22 ribs on the penult whorl. Base smooth.

The aperture is ovate, columella very little thickened, somewhat sinuous.

Length 2.6, diam. 0.65, length of aperture 0.6 mm.; $6\frac{2}{3}$ post-embryonic whorls.

Type No. 3027, A. N. S. P.

The spire of the nuclear shell is rather high for a snail of this section.

Turbonilla (Nisiturris) ? angustula n. n.

Turbonilla angusta Gabb, Trans. Am. Philos. Soc., XV, 1873, p. 225. Not *Chrysallida angusta* Cpr. 1864.

The embryonic whorls are lost, with one or more of the neanic. Subsequent whorls have straight, rounded, slightly protractive ribs, which do not reach to the lower suture, the lower ends of the concave intervals abruptly limited but rounded, and showing very faint traces of spiral striae, in part obsolete. On the penult whorl there are 18 ribs. The rounded base has growth-lines and faint spiral lines. The upper whorls are convex, later ones flattened, the suture rather deeply impressed. The columella is very feebly sinuous, somewhat thickened.

Length 5.7, diam. 1.35 mm.; 10 whorls remaining.

Type No. 3025, A. N. S. P.

Gabb's name has been previously used in the subgenus *Pyrgiscus*. His statement that the shell is "without any trace of spiral lines" is inexact, since faint spirals may be seen under the compound microscope, though not visible with an ordinary hand lens.

Turbonilla (Nisiturris) aratibacillum n. sp.

The shell is smaller and more slender than *T. angustula*, with sculpture of rounded, vertical ribs extending barely to the lower suture of each whorl and the periphery of the last, the lower ends of the smooth intervals not sharply defined. There are 13 ribs on the penult whorl. Base smooth. Columella straight, with dilated edge.

Length 3.3, diam. 0.75 mm.; 9 post-embryonic whorls.

Type No. 3036, A. N. S. P.

The embryonic shell is not perfect, but seems to have been of the bulimoid form. The shell is less slender than *T. pertenuis*.

Turbonilla (Nisiturris) insititia n. sp.

The shell is extremely slender, with embryonic shell of bulimoid shape; subsequent whorls at first convex, becoming flattened in the lower part, sculptured with strong, rounded vertical ribs not quite

as wide as the smooth concave interval which do not quite extend to the suture below, and terminate abruptly at the periphery. There are ten ribs on the penult whorl. Base smooth. The aperture is trapezoidal; columella very slightly sinuous.

Length 2.8, diam. 0.5, length of aperture 0.4 mm.; $9\frac{1}{2}$ post-nuclear whorls.

Type No. 3024, A. N. S. P.

This is the most slender of the known Santo Domingan species, further distinguished by its few coarse ribs.

Turbonilla (Nisiturris) undecimcostata n. sp.

The shell is slender with bulimoid nucleus; subsequent whorls convex, sculptured with narrow, straight vertical ribs separated by concave intervals about twice as wide as the ribs, and under strong magnification showing extremely fine and faint vertical and spiral striae. The concave intervals terminate rather abruptly just above the suture and at the periphery. On the penult whorl there are eleven ribs. The aperture is subtrapezoidal. Columella thick and very slightly sinuous.

Length 3.3, diam. 0.7, length of aperture 0.5 mm.; $9\frac{1}{2}$ post-nuclear whorls.

Type No. 3023, A. N. S. P.

Turbonilla (Nisiturris) pertenuis Gabb.

Turbonilla pertenuis Gabb, Trans. Am. Philos. Soc., XV, 1873, p. 226.

An extremely slender species. Nuclear shell bulimoid; subsequent whorls at first rather strongly convex gradually becoming less convex, the lower ones somewhat flattened laterally, with sculpture of strong, rounded vertical ribs parted by slightly wider, smooth, concave intervals, the rounded lower ends of which are a little above the lower suture, leaving a very narrow smooth band on each whorl. There are twelve ribs on the penult whorl. Base smooth, convex, the columella is thin and slightly sinuous.

Length 4, diam. 0.7, length of aperture 0.6 mm.; 11 post-nuclear whorls.

Type No. 3030, A. N. S. P.

Turbonilla (Nisiturris) contexta n. sp.

The shell is very slender with bulimoid embryo; subsequent whorls convex at first, the later ones distinctly flattened, sculptured with vertical rounded ribs, 15 on the penult whorl, slightly narrower than the concave intervals, and extending from suture to suture. Under the compound microscope the intervals are seen to have a minute

sculpture of vertical striæ cut into beads by close spiral-lines. On the last whorl the ribs and intervals do not end abruptly. The base has weak spiral impressed lines. The aperture is rhombic; columella thin and very slightly sinuous.

Length 3.7, diam. 0.75, length of aperture 0.6 mm.; 9 post-nuclear whorls.

Type No. 3035, A. N. S. P.

The microscopic sculpture is a distinctive feature of this species.

Turbonilla (Tragula) egressa n. sp.

The shell is slender, with a depressed-helicoid nuclear shell, fully half immersed. Following whorls are subangular and overhang the suture, and are flattened above the angle. Sculpture of rounded vertical riblets as wide as their intervals on the first two whorls, but gradually becoming more spaced, so that on the last 3 whorls the intervals are wider. First three post-nuclear whorls have in the intercostal intervals a single rounded cord on the angle, another very weak one below the upper suture. On the next two whorls there is an additional cord above the angle, another just above the suture, and the subsutural cord is obsolete. Last whorl has the vertical ribs extending nearly to the axis, the intervals crossed by a spiral cord at, another above the periphery, and two strong cords on the base, followed by about four faint ones, very low and difficult to see. The aperture is ovate; columella thin, straight above, but showing a small, sharp, oblique plait in an obliquely basal view.

Length 2.5, diam. 0.75, length of aperture 0.65 mm.; $6\frac{1}{2}$ post-nuclear whorls.

Type No. 3095.

Odostomia (Odostomia) ingloria n. sp.

Shell oblong-conic with obtuse summit, the first whorl convex, turned down at the tip; following whorls flat, with the suture rather deeply impressed. Last whorl rounded peripherally, narrowly rimate. Aperture ovate; columella a little thickened, bearing a small oblique plait. Surface plain.

Length 2.05, diam. 1 mm.; 5 whorls.

Type No. 3087, A. N. S. P.

An allied form, which may be called *O. ingloria calvata* differs by its shorter whorls, the last one noticeably subangular in front. Length 2.5, diam. 1.05 mm.; slightly over 6 whorls.

Type No. 3088, A. N. S. P.

Odostomia santodomingensis n. n.

Aclis polita Gabb, Trans. Amer. Philos. Soc., XV, 1873, p. 226. Not *Odostomia polita* of Bivona or of Pease.

The form is somewhat cylindrical. The surface is marked with very fine growth-lines only. Whorls are weakly convex except the first which is rather strongly so. The suture is channelled, the whorl being excavated above it, narrowly horizontal and carinate close below. There is a very slight median prominence of the columella, hardly noticeable. The tip of the spire is turned in, nucleus immersed. The aperture is rather oblique.

Length 2.6, diam. 0.9 mm.; 6 whorls.

Type No. 3084, A. N. S. P.

This species and the following one scarcely agree with the characters of *Spiroclimax*, and the channelled suture appears to remove them from typical *Odostomia*. They seem to form a new subgenus of *Odostomia*. As Doctor Bartsch has a general work on east American *Pyramidellidae* under way, we prefer to leave the final classification in his able hands.

A second specimen is more solid than the figured type but otherwise similar.

Odostomia myrmecoon n. sp.

The shell is structurally very similar to *O. santodomingensis*, from which it differs by the shorter, more obese outline and the slightly sinuous columella.

Length 2.25, diam. 1 mm.; $5\frac{1}{2}$ whorls.

Type No. 3085, A. N. S. P.

Odostomia (Eulimastoma) pyrgulopsis n. sp.

The shell is openly perforate, long-conic, solid, marked with faint growth-lines only. (Nuclear whorls presumably immersed), the first rounded above, turned in at the tip; following whorls flat, separated by a narrowly channelled suture, caused by the revolution of the suture just below a peripheral angle; on the last two whorls the suture descends more, leaving the peripheral angle, projecting prominently. It weakens on the latter part of the last whorl. The margin of the umbilical opening is rounded. Aperture is ovate. Columella thin, concave, having a small, obliquely receding plait above.

Length 1.8, diam. 0.7 mm.; $6\frac{1}{2}$ whorls.

Type No. 3092, A. N. S. P.

There is considerable variation in the degree of descent of the last two whorls, and the point where the more rapid descent begins.

In some shells the penult whorl does not descend more rapidly than those preceding it. This gives the shell a contour somewhat different.

This little shell resembles *Pyrgulopsis* in shape. It also has much in common with *Aclis* (*Amblyspira*) *prominens* Guppy of the Bowden bed, but we can find no columellar plait in that species, which moreover is decidedly larger.

Odostomia (**Eulimastoma**) **bathyraphe** n. sp.

The shell resembles *O. pyrgulopsis* in umbilicus, surface and general appearance, but differs as follows: The last whorl is more strongly carinate; the whole shell is wider, summit more obtuse, whorls less numerous. The tip of the first whorl is turned in, nuclear whorls being presumably wholly immersed. The suture is deeply channelled from its beginning.

Length 1.5, diam. 0.8 mm.; $4\frac{1}{2}$ whorls.

Type No. 3091, A. N. S. P.

As in *O. pyrgulopsis*, the columellar plait appears much larger in an oblique view than in the face view drawn in the figures.

Odostomia (**Evalea?**) **vexator** n. sp.

The shell is somewhat cylindrical but tapers slowly upwards to a very obtuse summit, which turns in at the tip, the nuclear whorls being immersed. Subsequent whorls are flattened, excavated above the suture, very narrowly shouldered below it, with sculpture of fine lines of growth and numerous (about 15 on the penult whorl) unequally spaced, very low and relatively coarse spiral striae. The aperture is somewhat rhombic; columella thin, with a strong, short plait.

Length 1.9, diam. 0.6 mm.; $5\frac{1}{2}$ whorls.

Type No. 3086, A. N. S. P.

By Doctor Bartsch's key we bring this species into the subgenus *Evalca*. The deeply excavated suture and somewhat coarser spiral sculpture are differential characters, the suture, summit and general shape of the shell agreeing with *O. santodomingensis*. We are therefore in doubt as to its subgeneric place. The columellar plait shows fully only in a somewhat oblique view, as it recedes somewhat.

Besides the type and a broken specimen, there is a larger shell, length 2.2, diam. 0.75 mm., otherwise similar.

Odostomia (**Goniodostomia**) **superans** n. sp.

The shell is imperforate, oblong-conic, terminating in a very obtuse summit. Embryonic whorls immersed. First visible whorl is strongly convex, its initial part ascending. Following whorls are

flat, separated by a channelled suture, angular above and below it, the lower angle becoming more prominent on the penult whorl, forming a keel which continues at the periphery of the last whorl, which is rather strongly concave above it, and slightly so below. The surface is marked with faint growth-lines and many unequal spiral striæ. The aperture is ovate, somewhat oblique; columella thick, bearing a stout oblique plait above.

Length 1.85, diam. 0.9, length of aperture 0.6 mm.; very nearly 5 whorls.

Type No. 3096, A. N. S. P.

This species is related to *O. circumvineta*, but is wider, with a stronger peripheral carina, a stronger columellar plait, and not so many whorls.

The spiral sculpture is indicated rather than drawn in the figures of this species and the next. The spiral striæ are very low, rounded, unequal and unevenly spaced, but somewhat coarse and barely visible with a good hand lens.

As it cannot readily be fitted into any of the sections of *Odostomia*, we propose the new section *Goniodostomia*, for *Odostomias* without axial ribs, having a peripheral keel and spiral striation, the columellar plait emerging, nucleus wholly immersed. Type *O. superans*.

***Odostomia (Goniodostomia) circumvineta* n. sp.**

The shell is rimate, slowly tapering to the obtuse summit, the embryonic whorls immersed, first visible whorl convex, turned in at the tip; subsequent whorls flat, narrowly excavated above and narrowly shouldered below the suture, which is therefore deeply channelled; last whorl angular or subcarinate at the periphery. Sculpture of faint growth-lines and rather sparse unequal, low, spiral striæ. Aperture ovate; columella thin, bearing a short fold above.

Length 1.75, diam. 0.65, aperture 0.5 mm.; $5\frac{3}{4}$ whorls.

Type No. 3097, A. N. S. P.

Somewhat like *O. vexator*, but the suture is decidedly more channelled and the last whorl is carinate. In shape but not in sculpture it resembles the subgenus *Eulimastoma*. It is more slender than *O. superans*.

***Odostomia (Parthenina?) cyclocephala* n. sp.**

Shell lanceolate, thin, with a large helicoid nucleus of $1\frac{1}{2}$ whorls; subsequent whorls sculptured with small vertical ribs narrower than their intervals, becoming obsolete at the periphery; over ribs and intervals there are delicately engraved spiral lines, of which 17 may

be counted on the penult whorl. The whole base is closely, finely striate spirally. Aperture is long-ovate, acute above, the columella with a small but distinct fold.

Length 2.6, diam. 0.6 mm.; $5\frac{1}{2}$ post-nuclear whorls.

Type No. 3033, A. N. S. P.

This species has a spirally striate base, as in the subgenus *Besla* of Dall & Bartsch, but it has not the special sculpture above the periphery described for the species of that group.

Odostomia (Odostomidea) bartschiana n. sp.

The shell is oblong, with a rounded nucleus more than half immersed. Subsequent whorls have few strong ribs, about 13 on the first post-nuclear whorl, not so many on the next, where they are slightly protractive; eight vertical ribs on the last whorl. Intercostal spaces very wide, concave, showing most minute spiral striae in some places. Suture somewhat sinuated by the ribs. The ovate aperture has a continuous peristome, the columella bearing a strong central plait.

Length 2, diam. 0.7 mm.; $4\frac{1}{2}$ post-nuclear whorls.

Type No. 3032, A. N. S. P.

The very small number of ribs with wide intervals appears to indicate a section of subgenus distinct from *Odostomella* B. D. & D., which may be called *Odostomidea*.

Odostomia (Chrysallida) duleis n. sp.

Menestho clathrata Gabb, Trans. Amer. Philos. Soc., XV, 1873, p. 226. Not *Odostomia clathrata* Jeffreys, Ann. Mag. N. H. II, 1848, p. 345.

The nucleus is more than half immersed. Subsequent whorls are convex, with a deeply impressed suture. Sculpture of numerous rounded vertical ribs equal to their intervals, gradually fading out at the periphery of the last whorl. These ribs are crossed by six slightly smaller spiral cords between sutures; the intersections are not noticeably nodose. On the base there are seven cords, and there they are broader and more crowded their intervals narrow. The aperture is long-ovate. Columella concave and a little thickened below, passing into a moderate fold above.

Length 2.9, diam. 1, length of aperture 1 mm.; 5 post-nuclear whorls.

Melanella astuta n. n.

Eulina robusta Gabb, Trans. Am. Philos. Soc., XV, 1873, p. 227. Not of A. Adams, 1861.

The shell is very slightly curved, smooth and glossy, the whorls nearly flat, rather short, showing a bluish-gray band above the

middle; suture distinct, but slightly oblique. Aperture short, piriform, the columella strongly thickened.

Length 4.2, diam. 1.2, length of aperture 1.1 mm.; 12 whorls.

Type No. 3009, A. N. S. P.

Melanella gabbiana n. sp.

The shell is straight, smooth and glossy, of barely convex whorls, the suture rather indistinct. There is an impressed protractive groove on the penult whorl, left by a former peristome. Aperture narrowly ovate. Outer lip sinuous, protractive. Columella strongly thickened.

Length 4.2, diam. 1.25, length of aperture 1.2 mm.; 11 whorls.

Type No. 3012, A. N. S. P.

Though of nearly the same dimensions as *M. astuta*, this species differs in shape.

Strombiformis sarissiformis n. n.

Eulima acicularis Gabb, Trans. Amer. Philos. Soc., XV, 1873, p. 227. Not of A. Adams, 1861.

The shell is slender, the diameter contained about 5 times in the length. Whorls of the spire nearly flat, smooth except for several unequally spaced growth-arrest marks on each. Aperture very narrow, lanceolate. Columella thickened. The tip of the spire and the outer lip are broken.

Length 12, diam. 2.2, length of aperture 3.3 mm.; 12 whorls.

Type No. 3010, A. N. S. P.

Strombiformis praelubrica n. sp.

Very slender, the diameter contained about $4\frac{2}{3}$ times in the length, whorls hardly convex, very smooth, but showing faintly a few marks of growth-arrest. Aperture narrow, lanceolate, acuminate above. Outer lip receding slightly downward. Columella rather strongly thickened.

Length 5.1, diam. 1.1, length of aperture 1.4 mm.; 11 whorls.

Type No. 3011, A. N. S. P.

Strombiformis ischnon n. sp.

The shell is very similar to *M. praelubrica*, but differs by its more slender shape, the diameter contained five times in the length. The aperture is narrower, and the columella more thickened.

Length 4.1, diam. 0.8, length of aperture 1.1 mm.; 10 whorls.

Type No. 3013, A. N. S. P.

Strombiformis (Subularia) stimulus n. sp.

The shell is minute, acuminate, showing very delicate, forwardly

arched growth-lines and several slightly impressed lines of growth-arrest. Whorls moderately convex. Suture distinctly impressed, oblique. Aperture lanceolate, the columella a little thickened and straightened.

Length 1.6, diam. 0.6, length of aperture 0.6 mm.; 7 whorls.

Type No. 3093, A. N. S. P.

The shell is pale gray with a rather wide opaque white band below the suture. Probably belongs to the genus or subgenus *Subularia*. The lines of growth-arrest are all sublateral.

***Astræa domingensis* n. sp.**

Astralium longispinum Lam., Gabb, Tr. Amer. Philos. Soc., XV, p. 242.

A species resembling *A. americana* in shape. The flat whorls have sculpture of numerous (about 9) low spiral cords, and extremely numerous, fine and low, protractive riblets. At the periphery there are slender, straight spines projecting above the suture, about 10 on the last whorl. Height and diameter about 16 mm. as preserved.

Type No. 2827, A. N. S. P.

The specimen is an external mould of the spire, or part of it, in a hard rock. It differs so conspicuously from *A. longispina* that we are surprised at Gabb's identification. The spines, on the next to the last whorl preserved, are slightly over 2 mm. long. It appears to be somewhat related to *Astralium chipolanum* Dall.

***Circulus domingensis* n. n.**

Cyclostrema striata Gabb, Tr. Amer. Philos. Soc., XV, 1873, p. 242. Not *Circulus striatus* Phil.

Eight spiral threads may be counted on the penult whorl just behind the aperture, seven on the next earlier whorl. On the last whorl the cords become widely separated by flat intervals on the upper surface, are weak and inconspicuous at and a short distance above the periphery, but remain strong and regular on the base.

Alt. 2.25, diam. 4.8 mm.

Though larger than the recent species of *Circulus*, with the spire a little more raised, we can find no differences of generic importance.

Type No. 2835.

***Discopsis* (?) *naso* n. n.**

Adeorbis carinata Gabb, Tr. Amer. Philos. Soc., XV, 1873, p. 243. Not *A. carinata* A. Ad., 1863.

The first two whorls are convex above; the third is flattened below the suture, the flat area bounded by an angle, and a second, less conspicuous spiral angulation runs above the periphery. The penult whorl is rounded, but shows the top of the peripheral carina

in the suture. Last whorl is convex above and below the acutely carinate periphery, and a carina also bounds the umbilicus. The peripheral carina has numerous little prominences, inconspicuous and regularly spaced. On the base there are unequal radial wrinkles around the umbilicus. The aperture is somewhat oblique and the peristome projects forward in a point at the periphery.

Alt. 2.7, diam. 4.5 mm.; diam. of umbilicus 0.9 mm.; 5 whorls.

The generic place of this species is doubtful.

Type No. 2832.

Dentalium sagittarii n. sp.

The shell is smooth, almost circular in section, but slightly flattened between concave and convex sides, rather strongly and evenly bent, very slowly increasing in size, the greatest diameter contained about twelve times in the length. Not sculptured, but very oblique growth-lines are discernable.

Length 13, greatest (lateral) diameter 1.1, antero-posterior diameter 1 mm.

This species is more arched than *D. macilentum*, which is compressed from side to side. *D. shumoi* differs by its close annulation.

Leda extricata n. n.

Leda acuta Gabb, Trans. Amer. Philos. Soc., XV, 1873, p. 255. Not of Conrad, 1832.

The shell is rather plump with nearly median beaks and acuminate posterior end, polished, strongly and closely sculptured with even, blunt-edged concentric riblets, equal to their smooth intervals. On the rather large escutcheon, which is indistinctly defined by a slight furrow, the riblets are a little sinuous, slightly emphasized at the sinuation, close and straight near the hinge-line. The lanceolate lunule has a series of short, oblique folds, stronger and more spaced than the adjacent riblets. Rostrum acute, slightly recurved.

Hinge with long and acute V-shaped teeth, 15 in the anterior, about 20 in the posterior series.

Length 8.7, alt. 5, diam. 4 mm.

Type No. 2655, A. N. S. P.

This abundant species is longer than *L. peltella* Dall,⁴ with a longer rostrum and quite different lunule and escutcheon.

Leda peltella was based upon (1) the figure of a specimen from Bowden, and (2) *L. acuta* Gabb not Conrad. As the figure is a more concrete indication than the second reference, we restrict *L. peltella*

⁴ Trans. Wagn. Inst., III, p. 579, Pl. 32, fig. 5.

to the Bowden shell. Gabb's *L. acuta* is certainly a distinct species, as we have ascertained by the examination of over a hundred examples of each.

It is related to *L. dodona* Dall, which differs in several details of form and sculpture.

Arca (Scapharca) sobrina n. n.

Arca consobrina Sowerby, Q. Jour. Geol. Soc., VI, 1849, p. 52, Pl. X, fig. 12. Not *A. consobrina* Orbigny, 1843, or of Guppy.

A. (Anadara) consobrina Sby., Gabb, Trans. Amer. Philos. Soc., XV, p. 253.

The shell is nearly equivalve, oblong, strongly inflated, tapering posteriorly, the anterior end somewhat oblique. Beaks moderate, mesially impressed, situated at about the anterior fourth of the length. The cardinal area is rather narrow, marked by several concentric grooves. The left valve is slightly larger, with sculpture of 33 rather high ribs with abrupt sides. Except on the posterior dorsal slope the ribs are closely sculptured with transverse granules, which are continued as thin raised striæ over the intervals. The anterior and posterior ribs are divided by a groove along the summits. The right valve is similar, but the granules on the ribs are almost obsolete. The hinge has 29 teeth in front, 40 behind, the row being continuous except for a small irregularity. Border very deeply crenated.

Length 50, alt. 30, diam. 29 mm.

“ 48, “ 30, “ of right valve, 14 mm.

Cotypes No. 2737, A. N. S. P.

Arca actinophora Dall has more ribs, is narrower posteriorly, and differs in proportions. *A. sobrina* is not very closely related to *A. halidonata* Dall of the Jamaican (Bowden) Oligocene, which we have not found in the Santo Domingan collection. It is very much like *A. dariensis* Brn. & Pils., but the valves are more convex and the details of rib sculpture differ. It also is a larger species.

Arca (Scapharca) copiosa n. sp.

The shell is oblong, somewhat trapezoidal, strongly inflated. Left valve slightly larger. Beaks impressed in the middle, in front of the anterior fourth. Cardinal area moderately wide, marked with about 4 grooves on the anterior, 5 or 6 on the posterior part. Sculpture of 30 ribs in the left valve about equal to the deep intervals; at the anterior end the ribs have flat, or somewhat concave summits. Both ribs and interstices are crossed by fine, close concentric threads, which give place to mere growth-lines on the posterior area, where the ribs weaken. The right valve is like the left except that the

concentric threads are not quite so well developed. Tooth-row continuous, but an enlarged tooth separates the anterior series of 30 teeth from the posterior series of 36; the length of the two being as 3 : 4, or as 2 : 3. Margins are deeply fluted, as usual.

Length 60, alt. 37, diam. 36.5 mm.

Type No. 2731, A. N. S. P.

This shell is related to *A. halidonata*, but it is much narrower, the ribs are not grooved and not so numerous, the beaks are smaller, the cardinal area has more grooves, etc. In *A. antiquata* L. the beaks are turned forward less, the anterior angle is more produced, and the cardinal area has fewer grooves. Both *A. halidonata* and *A. antiquata* have impressed lines or grooves along the posterior ribs, in large examples, which are wanting in *A. copiosa*.

Area (Scapharca) devexa n. sp.

The shell is somewhat trapezoidal, much inflated, with wide, moderately prominent beaks which are widely separated by a rather wide, flat cardinal area. Anterior and posterior ends oblique, roughly parallel, the anterior convex, posterior somewhat straightened; basal margin strongly convex. Sculpture of 26 square ribs somewhat narrower than their intervals, unevenly granose, the granules transverse, subobsolete in places, and on the posterior ribs weaker on the right valve, some of the anterior ribs are bifid in the left valve. Intervals sharply striated transversely. The cardinal area has many regular grooves over the whole posterior part, but anteriorly only the central part is grooved, the sides being smooth. The anterior end of the hinge line is strongly angular. Tooth-row continuous.

Length 42, alt. 30, diam. 31 mm.

Type No. 2727, A. N. S. P. Valves of 5 other individuals.

This species has a characteristic form. The close, regular grooves of the cardinal area, which has smooth sides anteriorly, is also notable.

Area (Scapharca) intumulata n. sp.

The shell is somewhat trapezoidal, inflated, with mesially impressed, beaks slightly before the anterior fourth. Cardinal area rather narrow, with a few grooves, bounded by a narrow ridge. Sculpture, in left valve, of 35 ribs about as wide as their intervals, crossed by concentric threads which are slender in the intervals, widened on the ribs. The right valve is like the left except that the concentric sculpture is slightly weaker. A few of the anterior ribs have a central sulcus. Hinge rather narrow, the tooth-row continuous, of 23 and 29 teeth.

Length 32, alt. 19, diam. of left valve 9 mm. (type).

" 33.5, " 20, " " " " 11.25 "

Type No. 2859, A. N. S. P.

Besides a number of valves agreeing with the above description, there are two entirely similar except that they have 32 ribs.

Arca (Scapharca) proletaria n. sp.

Shell oblong-trapezoidal, wider posteriorly, inflated, with rather large umbones, beaks at the anterior fourth. Cardinal area very narrow and bounded by a narrow ridge posterior of the beaks, wider and triangular in front of them. Ends of the hinge line angular. Anterior end rounded, posterior oblique. Sculpture of 35 ribs about equal to the furrows, in the left valve closely granose except on the posterior slope; interstices sharply but irregularly striate transversely. Right valve with some of the anterior ribs partly granose. Hinge with a continuous row of 15 + 31 teeth. Margin fluted.

Length of left valve 30, alt. 21, diam. 10 mm.

Type No. 2965, A. N. S. P.

There are 4 right and 4 left valves of this species, not paired. It is a decidedly broader shell than the preceding species but otherwise related.

Arca dolaticosta n. sp.

The shell is extremely plump, almost equilateral, and equivalve. The ends of the hinge are slightly produced; posterior margin somewhat straightened, anterior and basal margins rounded. Beaks very prominent and full. Cardinal area broad (almost wholly concealed by hard shale). Sculpture of 25 high ribs bearing rather large, irregular nodes lengthened in the direction of the ribs. It is similar in right and left valves.

Length 65, alt. 63, diam. 66 mm.

Type No. 2738, A. N. S. P., from the shale of Chiriqui collected by Dr. John Evans.

Two specimens of this very distinct ark were found with the lot of *A. chiriquiensis*. The shape and sculpture are characteristic.

The shale bed at Chiriqui may perhaps be equivalent to the lower or lignitic bed at Tower N on the Canal and therefore Oligocene.

Arca chiriquiensis, Gabb, is probably *A. patrica*, Sowb. *A. grandis* also occurs in Santo Domingo.

Arca (Scapharca) oocopleura n. sp.

A small, very obese nearly equivalve species with the postbasal angle somewhat produced, a rounded angle running to it, the beaks

full and prominent, curving well forward, at about the anterior fourth of the hinge line. Sculpture of 25 ribs, those of the left valve all closely granose, the grains rounded on the convexity, transverse towards the lower margin. Intervals sharply and finely striate transversely. On the anterior end the ribs are wider and more spaced. The right valve is similar except that it is very slightly smaller, and the granulation is weaker on and near the posterior ridge. Cardinal area is rather wide, with several concentric angulated grooves. Hinge line is rather short, with about 44 teeth.

Length 20.5, alt. 19.5, diam. 19 mm.

“ 23.5, “ 22, “ of left valve 12 mm.

Type No. 2734, A. N. S. P.

This prettily sculptured species, known from numerous specimens, stands near *A. santarosana* Dall, but it differs by the smaller number of ribs, the anterior ones not being mesially grooved. *Arca alcina* Dall of the Pliocene has more ribs. In *A. rhombica* Hanley, *A. chemnitzii* Phil. and *A. pittieri* Dall, of the Pleistocene and recent faunas, the beaks turn forward less than in *A. coccopleura*.

***Arca tolepia saxea* n. subsp.**

The shell is decidedly narrower than *A. tolepia*, but with substantially the same sculpture; 33 ribs.

Length 31, alt. 24, diam. 23.3 mm.

Type No. 2742, A. N. S. P.

It is less abundant in the collection than *A. tolepia*.

***Arca tolepia scapularis* n. subsp.**

The posterior end is straightened, angular and somewhat produced above, subangular below, 33 ribs.

Length 29, alt. 22.5, diam. 21 mm.

Type No. 2739, A. N. S. P.

***Arca tolepia crassicardinis* n. subsp.**

Similar to the typical form except that the hinge is very thick, 32 ribs.

Length 30, alt. 27, diam. 26 mm.

Type No. 2747, A. N. S. P.

***Arca cyclica* n. sp.**

Shell subcircular, plump, very thick, equivalve, with rather prominent nearly contiguous beaks at the anterior third of the length. Cardinal area extremely narrow behind the beaks, short but broader and triangular in front, with about two grooves. Posterior end broader than the anterior, an angle at its junction with the hinge

line. Rib- 35. about as wide as the intervals. granose in the left valve, the granulation obsolete in the posterior half of the right valve. Teeth 13 and 34, an irregularity where the anterior and posterior series meet. Edge fluted as usual.

Length 19.5, alt. 17.5, diam. 16.5 mm.: 35 ribs- type.

Length 22.3, alt. 22, diam. of right valve 9.5 mm.: 33 ribs- largest valve.

Type No. 2964, A. N. S. P.

This species is much less oblique than *A. tolepis*, and approaches more to a circular shape. It is known by 5 valves and one pair. The valves are remarkably thick.

Arca perfaceta n. sp.

The shell is nearly equivalve, inequilateral with large, inflated beaks at the anterior fourth; extremely globose. Lower-basal angle a little produced. Sculpture, in the left valve of 24 ribs about as wide as their intervals, and everywhere closely granose. Right valve having the ribs much narrower than their intervals, smooth in the median part, granose at the ends. Hinge rather short, with 13 teeth before, 25 behind an irregularity below the beaks. Margins deeply fluted.

Length 20.5, alt. 21.5, diam. of left valve 11.3 mm.

Type No. 2726, A. N. S. P.

A much smaller, more obese *Argina* than *A. tolepis*. The nine valves in the collection belonged to as many individuals. The sculpture is particularly pleasing.

Arca pomponiana n. sp.

The shell is rather thin, inflated, very inequilateral, the beaks inflated, curving strongly forward, between the anterior fifth and sixth of the length. Cardinal area narrow and tapering behind the beaks, very short and wider in front, marked with one or two angulated grooves. Posterior end sloping, produced below. Sculpture of the left valve, 28 ribs wider than their intervals, and everywhere closely set with transverse granules. Right valve with the ribs narrower, about equal to the intervals, flat-topped and rather low and smooth except at the ends, where they are granose. Hinge slender, with many fine teeth.

Length 16, alt. 14.25, diam. of left valve 7.3 mm.

" 19, " 15, " " right " 9 "

Cotype, No. 2725, A. N. S. P.

Thinner, more oblique than the preceding species, and differing in details of sculpture. Five valves belong to as many individuals.

Arca cuneolus n. sp.

The shell is thin, wedge-shaped, the anterior end short and very narrow, the posterior end very wide; beaks small, very convex, the convexity narrow; situated at the anterior two-fifths, turning somewhat backward. Cardinal area small, not distinctly defined. Sculpture of the convex and posterior parts of the shell of radial flattened, partly bifid ribs alternating with narrow riblets, all roughened by transverse granules; the anterior part of the shell having fine riblets and minute concentric threads. Hinge narrow, the tooth-row continuous, of about 27 teeth, a group of very small ones under the beaks.

Length 8.8, greatest width 6.25, diam. of left valve 3 mm.

This peculiar species has a general resemblance in shape to *Macrondon asperula* Dall, *Arca (Cucullaria) endemica* Dall, and *Arca culebrensis* Smith. It differs widely from them in sculpture. We know of no nearly related species.

Arca idiodon n. sp.

The cast is oblong, slightly wider posteriorly, with the beaks very close to the anterior end, full and prominent, and so near together that the beaks of the shell must be closely contiguous. Hinge-line, as indicated by a narrow ridge in the cast, is gently arcuate from the posterior end nearly to the beaks. Just below and anterior to the beaks it bends rather deeply downwards and the teeth, as indicated in the cast, are comparatively large. There seems to be about seven of these enlarged teeth in the short, downwardly-curved anterior arc. Immediately behind this arc there is a space where the teeth seem to have been very small and irregular. The rest of the hinge seems to have had moderately small, regular teeth, indicated by crenulations in the cast. The lateral surfaces of the cast has low, irregular concentric waves and numerous very shallow radial impressions. The anterior border is distinctly crenulated, but elsewhere the internal borders of the valves would appear to have been smooth.

Length 69.6, alt. 48, diam. 38 mm.

Quarry near Wilmington, North Carolina. Type No. 12475. A. N. S. P., collected by Mr. Joseph Willecox.

This peculiar ark differs widely from all Tertiary species known to us. The double curve of the tooth-row, with enlarged teeth on its short anterior arc, is a more specialized structure than we have found in the species compared. The recent *A. campechensis* Dillw. *americana* Gray, approaches nearer to *A. idiodon* than any other known to us.

Besides the peculiar hinge, this species is notable for its strongly

anterior, contiguous beaks, the absence or weakness of crenulation along the basal margin, and the concentric waves of the surface of the cast. The shell when found will probably prove to be thin for an *Arca*. Its strong individuality will permit ready recognition of this species, which we know from a single quite perfect cast.

***Glycymeris santodomingensis* n. sp.**

Axinea sericata Reeve, Gabb, Trans. Amer. Philos. Soc., XV, 1873, p. 255.

The orbicular shell is rather convex, solid; anterior end broadly rounded, the posterior end more narrowly so. Sculpture of 22 convex ribs, widest in the middle and anteriorly, much narrower on the posterior third. Hinge broad, with 10 anterior and 13 posterior teeth; median teeth subobsolete; sulci of the lower margin extremely shallow, almost obsolete. Posterior adductor scar bounded by an acute ridge anteriorly.

Length and alt. 37, semidiameter 11 mm.

Type No. 2654, A. N. S. P.

Gabb identified this species with a little known recent form, which differs in number of ribs, etc. In *G. lloydsmithi* P. & B. the ribs are much flatter, the hinge more curved, and the internal margin has strong v-shaped teeth.

***Glycymeris diffidentiae* n. sp.**

Axinea pennacea Lam., Gabb, Trans. Amer. Philos. Soc., XV, 1873, p. 255.

The shell is slightly inequilateral, rather convex, the posterior end more narrowly rounded and more produced than the anterior. Sculpture of low but distinct radial ribs in the median part, obsolete at the ends; over all are fine radial striæ, about six striæ (five to seven) between crests of the ribs; these are crossed by regular but extremely minute concentric striæ, which pit the grooves between the radial striæ, when the surface is unworn. Hinge is little curved, with tooth-row of 14, 15 teeth. The margin has rather strong, short teeth.

Length 20, alt. 16.7, semidiameter 7 mm. (type).

“ 21, “ 18.7, “ 7 “ (largest valve).

Type No. 2653, A. N. S. P., with 11 other valves.

The Bowden *G. jamaicensis* has a decidedly different sculpture, and fewer much larger teeth in specimens of the same size. The recent *G. lineatus* (Reeve) has much the same sculpture, but it differs in the teeth and in outline.

***Ostrea bolus* n. sp.**

The shell is small, usually subtriangular, the deep valve having the beak strongly curved as in some *Gryphæas*, exterior with a few

irregular ribs which do not affect the margin (and are sometimes wanting). Cardinal area oblique; no crenulation of the margins near the hinge or elsewhere. Upper valve with the beak oblique, cardinal area rather long.

Greatest length (alt.) 33, width 27 mm.

Type No. 2633, A. N. S. P., from between Las Caobas and Thomonde, Haiti, collected by Mr. Lloyd B. Smith, 1914.

Anomia gabbi n. sp.

Anomia ephippium Linn., Gabb.

Very similar to the European *A. ephippium*. Externally the convex valve has a coarse sculpture of radial ribs, with radial riblets and striae in the intervals. The byssal impressions are distinctly but not deeply impressed, but sufficiently to be readily seen or felt. Major impression somewhat square; minor impression close below it and not greatly smaller. Adductor impression alongside the minor byssal scar, not lower down. The shell is orbicular, and somewhat stronger than *A. ephippium* or *A. simplex*. Alt. 48 mm.

Type No. 2642, A. N. S. P.

There is the fragment of another valve, having the external sculpture less uneven though equally coarse.

Pecten plurinominis n. sp.

Pecten oxygonum Sby., Gabb, Trans. Amer. Philos. Soc., XV, 1873, p. 256. Not of Sowerby.

Pecten thetidis Sowerby, Dall, Trans. Wagn. Inst., III, p. 714. Not of Sowerby.

In this scallop there are 19 rounded ribs a little wider than their intervals, over ribs and intervals there are weak radial cords bearing thin scales, near the edge of the left valve there are three of these scaly cords upon each rib and three in each interval. Submargins and ears with numerous small ribs. Ctenolium is rather long. The right valve is slightly more convex than the left.

Length and alt. 31 mm.

Type No. 3236, A. N. S. P.

This species resembles the recent *P. fuscopurpurea* Conrad in sculpture, but the ribs are not so strong and the ears are much smaller. In our opinion it cannot be either *P. oxygonum* or *P. thetidis* of Sowerby. Whether it is specifically separable from several forms found in the Canal Zone and Costa Rica is uncertain, but there are various differences which indicate at least racial distinction. Typical specimens occur in some abundance in the Bowden bed also.

Pecten uselmæ n. sp.

Pecten inæqualis Sowerby, Guppy, Q. J. Geol. Soc., XXII, 1866, p. 294, Pl. 18, fig. 6. Not of Sowerby.

The shell is inequilateral, inequivalve, the left valve is larger, conspicuously surpassing the right throughout the lower margin and ends. It is strongly convex; the right valve weakly so. Sculpture of 17 rounded ribs. In the left valve these are wider than the intervals, which are deeply cut, with concave bottoms, which are closely sculptured with delicate transverse threads. In the right valve the ribs are lower, and not quite as wide as the intervals, in which the transverse striation is often weak. The submargins are smooth. Ears with several ribs. Ctenolium is very short, of three teeth, which are small in adult shells. Cardinal crura strong, vertically striate.

Length of left valve 28, alt. 27.3, diam. 8.25 mm.

Type No. 11124, A. N. S. P., from Bowden, Jamaica, collected by Mr. Uselma C. Smith.

This species is noticed here because it has been identified as *P. inæqualis* Sowb. of Santo Domingo. It differs from that by having fewer, stronger ribs in the left valve and more strongly ribbed ears. The left valve is more convex, and the form more inequilateral. Having seen large series of both, we find these differences constant. It is not represented in our Santo Domingan collections.

Pecten (Amusium?) correctus n. sp.

Pecten opercularis Gabb, Trans. Amer. Philos. Soc., XV, 1873, p. 256.

The shell is orbicular, weakly convex, with sculpture of 21 extremely low, weakly convex ribs, over which growth-lines are visible. Ears plain, subequal, separated from the rest of the valve by undercut grooves.

Alt. 52, semidiameter about 6.5 mm.

Type No. 2781, A. N. S. P.

Pecten ischnon n. sp.

The shell is delicate, very thin, much compressed, inequilateral, the right valve slightly more convex. Sculpture of 19 very low rounded ribs, and extremely delicate, fine and close concentric striation, strongest between the ribs. Ears rather large, with a few delicate riblets in the right valve. The left valve has 5 strong, crenulated ribs on the posterior ear. Ctenolium well developed. Both valves are strongly furrowed radially inside, the edges of the intervening elevations a little raised, thickened.

Length of right valve 23, alt. 23, diam. 3.5 mm.

Type No. 2780, A. N. S. P.

The collection contains five left and six right valves.

Crenella diuturna n. sp.

Crenella divaricata d'Orb., Gabb, Trans. Amer. Philos. Soc., XV, 1873, p. 252.

The shell is small, rounded-oval, resembling *C. duplinensis* Dall, but differing by the somewhat greater inflation, and by having regularly spaced, concentric threads over the rather fine divaricate ribbing. Hinge much more delicate than in *C. divaricata* (Orb.); crenulation of the valve-margins short and very weak.

Length 1.85, alt. 2.3, diam. 1.5 mm.

The line of divarication is well out of the median line. Several valves agree in characters of form and sculpture.

Crenella rota n. sp.

The shell is rather convex, almost circular, having rather fine low ribs divaricating at a small angle from the median line, and crossed by numerous weak concentric threads. Valve margins very strongly crenulated.

Length 1.8, alt. 1.95, diam. 1.4 mm.

Type No. 2753, A. N. S. P.

Distinguished by its subcircular outline.

Cuspidaria ornator n. sp.

Neæra ornatissima d'Orb., Gabb, Trans. Amer. Philos. Soc., XV, p. 248.

The shell resembles *C. ornatissima* (Orb.), but has much more numerous radial ribs, 22 in the type; on the anterior half they are subequal, evenly spaced and blunt. Concentric wrinkles along growth-lines are rather well developed in places.

Length 4.75, alt. 2.7 mm.

Type No. 2790, A. N. S. P. There are broken valves indicating a considerably larger size.

Cuspidaria gabbi n. sp.

Neæra alternata d'Orb., Gabb, Trans. Amer. Philos. Soc., XV, p. 248.

The shell is plump, with elevated, nearly central beaks, much attenuated behind, rostrate, the upper margin sloping and nearly straight before, very deeply concave behind the beaks. Basal margin is incurved posteriorly. There are about 30 radial ribs, the posterior one largest and a little more widely separated from its neighbor; following 4 or 5 ribs of intermediate size, the rest smaller, subequal, and not reaching nearly to the beaks.

Length 8, alt. 5.4, semidiameter 2.5 mm.

Type No. 2791, A. N. S. P.

Near *Sphena alternata* Orb., but the dorsal border is much more concave behind the beaks.

Crassatellites (Crassinella) microdelta n. sp.

Gouldia martinicensis d'Orb., Gabb, Trans. Amer. Philos. Soc., XV, p. 252.

The shell is subtriangular, the anterior and posterior slopes forming a right angle, basal margin strongly curved; lunule and escutcheon narrow, flattened, smooth; sculpture of strong, regular, rounded concentric ribs, about 19 visible in a lateral view of the valve, seven in 1 mm. measured upward from the basal margin.

Length 2.6, alt. 2.5, semidiameter 0.6 mm.

Type No. 3229, A. N. S. P.

According to the figures, Orbigny's *Crassatella martinicensis* has coarser, more widely spaced ribs. There is, however, a recent Antillean species which resembles this Oligocene form closely in sculpture.

Crassatellites (Crassinella) dolatus n. sp.

The shell is rather convex, the anterior slope straight, posterior convex; lunule is somewhat sunken and large; escutcheon narrow. Sculpture of coarse rounded concentric ribs much wider than their intervals, 15 being visible on a valve, five in 1 mm., measured upward from the basal margin. In the valleys very minute crowded radial striae are seen.

Length 3, alt. 3, semidiameter 1 mm.

Type No. 3230, A. N. S. P.

This species differs from the preceding by its much coarser sculpture, larger, more distinctly defined lunule, and greater convexity.

Venericardia aversa n. sp.

The shell is small, extremely plump, higher than long, with very large, strongly prosogyrate beaks, and no lunule. Sculpture of 18 strong tuberculiferous ribs equal to the interstices. Cardinal tooth very high and thin, the socket correspondingly of unusual depth, narrow. The inner margin is very strongly fluted, and there is a pit under the end of each rib.

Length 12, alt. 12.5, semidiameter 6.3 mm.

Type No. 3215, A. N. S. P.

This small species is well characterized by the inflated form (the diameter being about equal to the length), by the long cardinal tooth and deep socket, and the large beaks. Valves of two individuals, right and left, are in the collection.

Venericardia santodomingensis n. sp.

Cardita scabricostata Guppy, Gabb, Trans. Amer. Philos. Soc., XV, 1873, p. 252. Not of Guppy.

The shell is rounded-oval, the length very slightly exceeding the altitude, beaks very near the anterior end; lunule moderately sunken and rather large. Sculpture of 22 or 23 subacute ribs bearing small, somewhat transverse granules, the intervals between the ribs broad, concave, irregularly striated transversely. Hinge and basal margin as in *V. scabricostata* (Guppy).

Length 21.7, alt. 21.3, semidiameter 9 mm.

Type No. 3214, A. N. S. P.

This species is closely related to *V. scabricostata*, but differs by having more ribs, which are narrower with wider intervals; it is rounder, and higher relative to the length. We find these differences constant in large series of both examined. It has some resemblance to the young of *V. hadra* Dall, but that seems to be a heavier, far more coarsely sculptured shell, when specimens of equal size are compared. The Chipolan species reaches a far greater size than *V. santodomingensis*.

Echinochama trachyderma n. sp.

Chama arcinella Linn., Gabb, Trans. Amer. Philos. Soc., XV, 1873, p. 251.

Shell resembling *E. antiquata* Dall in shape, but differing by having fewer radial ribs (8 to 12), which are only sparsely spinose; surface very closely and strongly tuberculate, the tubercles sometimes anastomosing into a netted pattern in places.

Length 55.5, alt. 61.5, diam. 43.5 mm.

Type No. 2766, A. N. S. P.

The comparison of long series of excellently preserved shells from Bowden and Santo Domingo shows no intergradation between *E. antiquata* and this species.

Phacoides perplexus n. sp.

Lucina antillarum Reeve, Gabb, Trans. Amer. Philos. Soc., XV, p. 251.

The shell is small, orbicular, not very inequilateral, with sculpture of numerous (about ten) rounded radial ribs, which gradually diminish and partly disappear on the lower third of the disk, crossed by many close, fine, obtuse and slightly waved concentric threads. Lunule distinct, somewhat sunken. Hinge with two cardinal teeth but no laterals in the left valve. Anterior muscle scar long. Internal margin crenulated.

Length 7, alt. 6.7, diam. left valve 2.3 mm.

With a hinge like *Lucinoma*, this species has external sculpture

resembling *Codakia (Jagouia) antillarum* (Rve.) Gabb's specimen, No. 3324 A. N. S. P., a single valve, is not identical with *Codakia vandyesi*, as Dr. Dall supposed.

Phacoides (Parvilucina) pupulus n. sp.

Lucina crenulata Conr., Gabb, Trans. Amer. Philos. Soc., XV, p. 251.

This is a species of the *crenulata* group, differing from the type of *crenulata* Conr. (No. 2718, A. N. S. P.) by its far smaller size, thinner concentric lamellæ and the relatively coarser, low and rounded radial sculpture, which appears much more prominent when the concentric lamellæ are worn off. The lunule is relatively larger, very deep; finally the teeth are heavier and the marginal crenulation coarser for the size.

Length 2.8, alt. 2.7, diam. of one valve 1.05 mm.

Type No. 3323, A. N. S. P., with five other valves.

Divaricella proletaria n. sp.

Lucina dentata Wood, Gabb, Trans. Amer. Philos. Soc., XV, p. 251.

The shell is thin, plump, subcircular, equilateral, with sculpture of the usual *Divaricella* pattern, the grooves widely spaced for so small a shell. There are several strongly marked grooves of growth-arrest in large specimens. The inner margin is finely crenulated, the hinge-line strongly arched, and not angular at the ends.

Length 8.75, alt. 8.25, diam. of one valve 3 mm.

Type No. 2754, A. N. S. P.

This species is represented by over 20 valves. It is related to *D. quadrisulcata* (Orb.), but differs by the much smaller size, plumper form, far more curved hinge-line, and the relatively coarser sculpture.

Lucina mauryae n. sp.

The shell is compressed, the diameter about half the length, orbicular, with the small beaks near the anterior third of the length. In front of the beaks the shell is produced in a thin wing. There is a small lunule defined by a groove in the right valve, none in the left. The dorsal area is defined by a slight furrow in both valves; surface delicately striate concentrically.

Length 36.5, alt. 33.5, diam. 19 mm.

The valves are a few millimeters apart at the lower edge; if in contact the diameter would be at least 1 mm. less. The compressed shape is characteristic.

Diplodonta dedecoris n. sp.

The shell is thin, with rather small, pointed beaks, and inconspicuous sculpture of fine, irregularly developed concentric striae,

over which there is a most minute granulation. Posterior end very short, broadly rounded. Anterior end produced, also broadly rounded, both cardinal teeth bifid.

Length 1.5, alt. 1.35, semidiameter 0.35 mm.

Type No. 2758, A. N. S. P.

Similar to *D. minor* Dall, but of less oblique, more rounded outline.

***Chione santodomingensis* n. sp.**

The shell resembles *C. chipolana*, but differs as follows. It is shorter and higher, the dorsal and anterior slopes forming a smaller angle. The concentric laminae are widely spaced, and continue over the lunule. The radial sculpture produced by splitting of the ribs is less even. There are fewer concentric ribs than in *C. chipolana* of the same size.

Length 17.4, alt. 16.4, semidiameter 5.7 mm.

Type No. 2777, A. N. S. P.

We have compared this with a long series of *C. chipolana* from the type locality, and have no doubt of its distinctness, though there is a general similarity.

***Chione socia* n. sp.**

The shell resembles *C. woodwardi* Guppy in size and shape, as well as in the lunule, over which the concentric lamellae run. It differs by the radial sculpture. In *C. woodwardi* the radial ribs run to the basal border, gradually enlarging. In *C. socia* these ribs, at first similar, soon become smaller, low and slender, and towards the margin they split, so that there are very many more, and smaller ribs. Crenulations of the internal basal margin are smaller and twinned.

Length 21, alt. 19, diam. 14 mm.

Type No. 2778, A. N. S. P.

This form shows a particular sculpture not found in the common *C. woodwardi* of the Bowden bed, which appears not to occur in Santo Domingo. In *C. santodomingensis* the concentric lamellae are much more widely spaced.

***Chione primigenia* n. sp.**

Related to *C. cancellata* and *C. chipolana*. The radial sculpture is coarser than in *chipolana*, the beaks are nearer the anterior end, and the tooth-plate is decidedly broader. The posterior end is more prolonged and cuneate than in *C. cancellata*, the concentric ribs are more delicate, the lunule far wider than *cancellata* of equal size and the beaks more anterior.

Length 26, alt. 21.6, semidiameter 8.2 mm.

Type a right valve, No. 2782, A. N. S. P.

Cyclinella cyclica domingensis n. subsp.

Cyclina cyclica Guppy, Gabb, Trans. Amer. Philos. Soc., XV, p. 250.

? *Dosinia cyclica* Guppy, Q. J. Geol. Soc., XXII, 1866, p. 582, Pl. 26, figs. 15a, b.

According to Guppy, the lunule is entirely wanting in his species, but Dall, who has examined the types, states that it is large and lanceolate, and there is "a close concentric sculpture of fine, sharp, somewhat elevated lines" (Wagn. Trans. III, 1285). In the Santo Domingo specimen (No. 2755), an excessively faint impressed line defines the lunule, which is about 7 mm. long, 3 wide. The sculpture consists of unequal, unevenly developed flat growth-ripples, which on the posterior dorsal slope become fine but not much elevated threads.

Length 28.7, alt. 26.5, diam. 14 mm.

As the single specimen seems to differ somewhat from the account of Guppy's species, we prefer to treat it as a variety.

Dall stated that the type of *D. cyclica* Guppy was a *Lucinopsis* (*Proc. U. S. N. Mus.*, XIX, 329), but later (*Trans. Wagn. Inst.*, III, 1285) he placed it in *Cyclinella*.

Type No. 2755.

Dosinia azuana n. sp.

The shell resembles *D. elegans*, but is somewhat plumper, with the concentric grooves more widely spaced, strong throughout. The sculpture is not laminar at the ends. Lunule as in *D. elegans*.

Length 39, alt. 38, diam. 20 mm.

West of Azua, collected by Mr. L. B. Smith.

Type No. 2685, A. N. S. P.

Semele delimata n. sp.

The shell is compressed with small, inconspicuous beaks near the middle, lunule rather deep. Anterior end broadly rounded, posterior end more produced and narrower. There are rather sharp growth-striae near the lower margin, elsewhere smooth.

Length 47, alt. 38.5, diam. 20.5 mm.

It is related to *S. silicata* Dall, a smaller, more sharply sculptured species.

Semele firma n. sp.

Closely related to *S. sardonica* Dall, but of a less wide, ovate outline; lunule deep and narrow; escutcheon narrow, about equally

developed in both valves. Sculpture of sharp, low, thread-like concentric lamellæ without interstitial striae.

Length 31, alt. 22.5, diam. about 11 mm.

Both of these species of *Semle* are apparently from the *Orthaulax* bed, having the same hard matrix. They stand close to Ballast Point species, yet are evidently distinct.

Tellina (*Merisca*) *errati* n. sp.

Tellidora crystallina Chemn., Gabb, Trans. Amer. Philos. Soc., XV, 1873, p. 249.

The shell is compressed, with nearly median beaks, the dorsal slopes on either side straight. Anterior end broadly rounded, posterior end acute; lower margin strongly arched, a little incurved near the posterior end. The right valve has an angular ridge below the posterior upper margin, followed by a radial concavity. Left valve with a slight concavity below the same margin. The surface is matt, with sculpture of delicate, regularly and rather widely spaced laminar concentric ribs. In the intervals there is very fine radial crinkling, the wrinkles partly converging upwards into many little groups. The pallial sinus extends nearly to the anterior adductor scar, and is concretescent below with the pallial line. Lateral teeth well developed in the right, wanting in the left valve.

Length 13, alt. 9, diam. of left valve 2 mm.

Type No. 2666, A. N. S. P.

Gabb's identification of this species was really remarkable. There are two left valves and a broken right valve, the latter larger, indicating a length of 17 or 18 mm.

***Metis efferta* n. sp.**

The beaks are nearly central, left valve more convex, being plump throughout, right valve plump anteriorly, then broadly concave, strongly angular posteriorly. Surface very lightly striate with periodic marks of growth-arrest, and on the anterior and posterior areas there are fine laminae like those of *M. chipolana*. Radial striation is fine and superficial.

Length 36, alt. 30.7, diam. 17 mm.

Type No. 2665, A. N. S. P.

Related to *M. chipolana*, but readily distinguishable by the much plumper form, broader and deeper concavity of the right valve, and presence of little laminae only on the ends. The valves are slightly skewed. If evenly placed the diameter would be about 18 mm.

Metis postrema n. sp.

This species is closely related to *M. chipolana* and *M. efferta*, but differs from both by its relatively greater length.

Length 36, alt. 28.7, diam. about 14 mm.

Type No. 2760, A. N. S. P. Two other specimens.

Whether further series will show that these three supposed species intergrade we cannot tell. With the material before us, they seem sufficiently distinct. All were labelled *Macoma constricta* Brg. by Gabb. It was a wild shot, even for him.

Labiosa (Raeta) gabbi n. sp.

Reta canaliculata Say, Gabb, Trans. Amer. Philos. Soc., XV, 1873, p. 248.

The shell is oval-subtriangular, the beaks nearer the anterior end; sculptured with small concentric ribs which are weaker in the middle, where there is a slightly depressed, quite inconspicuous, wedge-shaped area radiating from the beaks. Beaks small, turned forward a little, smooth. Posterior end rounded, somewhat compressed, the contour in dorsal view being somewhat wedge-shaped. Hinge not exposed.

Length 28, alt. 23, diam. 13.8 mm.

Type No. 2675, A. N. S. P.

As the shape, sculpture and size differ conspicuously from *L. canaliculata*, it is not easy to account for Gabb's identification. It is also obviously unlike *L. alta* (Conr.). Besides the specimen mentioned by Gabb, five others were found in unassorted material.

A NEW HUMMINGBIRD FROM COLOMBIA.

BY WITMER STONE.

In a collection of birds from the Santa Marta region of Colombia, recently received by the Academy from Mr. M. A. Carriker, there are two specimens of a hummingbird which seem to belong to an undescribed form. They are related to *Lepidopygia cæruleigularis* Gould, but differ in having the whole under parts, except the under tail coverts, glittering blue, while in that species the abdomen is green, in sharp contrast to the blue of the throat and breast.

Of the two described species which are usually synonymized with *L. cæruleigularis*, *Trochilus Duchassaingii* Bourcier (*Compt. Rend.*, XXXII, p. 187) from "bois entre la Gorgone et Panama," is undoubtedly identical with that species. The other one, *Thalycrania calina* Bourcier (*Rev. Zool.*, 1856, p. 552), is described from the "environs de Santa Marthe," and one would suppose from the locality that it was likely to be the same form as that obtained by Mr. Carriker. The description, however, seems to apply to a bird much closer to *Lepidopygia cæruleigularis* Gould, as it says: "Gorge, devant du cou, thorax d'un beau bleu brillant, verdissant sur les côtés du cou. Abdomen vert bronzé."

In distinguishing it from *Trochilus Duchassaingii* [= *L. cæruleigularis*], the describer says: "elle en diffère par le dessus de la tête et du corps, terne bronzé chez ce dernier, ainsi que par les formes des rectrices et la coloration des mediaires, qui sont entièrement cuivrées."

Brabourne and Chubb, in their "List of the Birds of South America," recognize both *L. cæruleigularis* and *L. calina*, and if they are really distinct and if the type of *L. calina* really came from Santa Marta, it would seem that it was the representative of *L. cæruleigularis* in the coast region of the Santa Marta district. In this case the blue-bellied bird obtained by Mr. Carriker at Punto Caiman in the same general region must be specifically distinct. If, on the other hand, the type of *L. calina*, shipped from Santa Marta, was collected at some point more or less remote, in the mountains, as is quite possible since the exact locality at which many of these old types were obtained was not known, then both of them may be better regarded as races of *L. cæruleigularis*. Whether the latter

really occurs south of Panama is another question that remains to be settled by the acquisition of additional material.

Meanwhile it is desirable to provide a name for the blue-bellied bird, and until the distribution of the green-bellied forms is more accurately worked out it had better be regarded as specifically distinct.

The description follows:

Lepidopyga lilliae sp. nov.

Chars. Spec.—Similar to *Lepidopyga caruliigularis*, but lower breast and abdomen glittering blue instead of green and upper surface darker green with much less bronze iridescence.

Description.—Type, adult male, No. 62793, Collection Academy of Natural Sciences of Philadelphia; Punto Caiman, Santa Marta, Colombia, M. A. Carriker, September 29, 1913. Above dark glossy green with bronze tints showing only on the upper tail coverts and median rectrices; general tone of upper parts bluish green as contrasted with the yellow-bronze iridescence of *L. caruliigularis*. Below entirely glittering metallic blue excepting the under tail coverts which are metallic green edged with dull white. The center of the throat is purplish, as in *L. caruliigularis*, and some of the posterior feathers of the abdomen, especially the lateral ones, have green reflections in certain lights. Feet black and bill black above and flesh-colored with black tip below.

Measurements.—Wing, 48 mm.; tail, 35; culmen, 18; length in the flesh, 105. Named in honor of Mrs. Witmer Stone.

The second specimen obtained by Mr. Carriker (No. 62794, Coll. Acad. Nat. Sci. Phila.) is also an adult male and is exactly like the type in coloration. It measures: Wing, 49 mm.; tail, 34; culmen, 19. It was taken at the same time and place as the type.

JUNE 12.

ADJOURNED MEETING.

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

Eighteen members present.

The reception of papers under the following titles was reported by the Publication Committee:

"New species of North American bees of the genus *Andrena*," by Henry L. Viereck (May 23). Referred to the American Entomological Society, (Entomological Section of the Academy.)

"A new humming bird from the Santa Marta region of Colombia," by Witmer Stone (May 25).

"Marine mollusks of Hawaii, I-III," by Henry A. Pilsbry (May 26, June 11).

"Dermapterological notes" by Morgan Hebard (June 25).

The deaths of the following members were announced:

Robert J. Hess, M.D., June 20, 1909.

Henry A. Green, 1913.

Eugene I. Santee, M.D., June 16, 1915.

Frederick Gutekunst, April, 27, 1917.

William H. Newbold, May 25, 1917.

On Hagenius brevistylus.—DR. PHILIP P. CALVERT exhibited two larval exuviae of the large dragon fly, *Hagenius brevistylus*, from Darby Creek above Heyville, June 18, 1916, and a female imago of the same species from Crum Creek, near Castle Rock, June 23, 1916, both localities in Pennsylvania within nine miles from Philadelphia. He remarked that only one previous record (a larva, Fairmount Park, 1893, by the late C. Few Seiss, of this Academy) of this species within the Philadelphia area existed and called the attention of those present to the desirability of noting additional specimens in the present month. The peculiar shape of the larva was commented on.

Beltian Bodies on Acacia.—DR. CALVERT also exhibited specimens of a Bull's Horn Thorn (*Acacia costaricensis* Schenck) from Costa Rica, showing the paired thorns and the "Beltian bodies" at the tips of the pinnules, and specimens of ants (*Pseudomyrma nigrocincta*) from one of these thorns, all collected by himself. He stated the

views of Belt and others as to the relation existing between the plant and the insect and the arguments recently urged by Wheeler against the symbiosis side of Belt's view.

The following were elected members:

Samuel Bell, Jr.,	Walter Lippincott,
M. Georgina Biddle,	Percy C. Madeira,
W. Lyman Biddle,	Julia Hebard Marsden,
Kenneth M. Blakiston,	Hon. J. Willis Martin,
Henry H. Bonnell,	J. Hartley Merrick,
B. Preston Clark,	Robert Thomas Moore,
Walton Clark,	F. Corlies Morgan,
William M. Coates,	Marriott C. Morris,
Thomas De Witt Cuyler,	Frank J. Myers,
Herman Dercum,	Carroll B. Nichols,
Andrew J. Ennis,	William A. Patton,
Clayton D. Fretz, M.D.,	Edmund B. Piper, M.D.,
W. H. Gartley,	J. Sergeant Price, Jr.,
Hon. John Marshall Gest,	William K. Ramborger,
William P. Gest,	George D. Rosengarten, Ph.D.,
S. H. Gilliland,	Boyd P. Rothrock,
Alfred Gordon, M.D.,	B. Franklin Royer, M.D.,
Henry S. Grove,	Coleman Sellers, Jr.,
C. H. Guilbert,	Howard Sellers,
D. L. Hebard,	Robert P. Sharples,
Hannah M. Hebard,	Henry W. Shoemaker,
Mary Euphemia Hebard,	I. P. Strittmatter, M.D.,
S. Charlton Henry,	Sydney Thayer,
Benjamin R. Hoffman,	William Henry Trotter,
Alba B. Johnson,	Robert Orr Van Deusen,
Charles J. Jones, M.D.,	Bryant Walker, A.M., Sc.D.,
Theodore Justice,	Joseph Wayne, Jr.,
J. L. Ketterlinus,	S. P. Wetherill,
Charles H. La Wall,	Robert Whitaker,
Morris E. Leeds,	George Woodward, M.D.,
James E. Lennon,	Rev. Harrison B. Wright.

The following were ordered to be printed:

MARINE MOLLUSKS OF HAWAII, I-III.

BY HENRY A. PILSBRY.

In the identification of mollusks obtained by the writer in 1913, and those subsequently received from Mr. D. Thaanum, of Hilo, it was found necessary to review all the Hawaiian species of some families. That the studies may be of use to others interested in the Hawaiian fauna, it is proposed to publish the results in a series of articles with illustrations of new forms and those not previously figured.

It is a pleasure to acknowledge the liberality of Mr. Samuel Henshaw, Director of the Museum of Comparative Zoölogy, who allowed the author to study and figure specimens from the Pease collection, contained in that museum. Without these, definite conclusions would be unattainable in many cases.

I. THE PHASIANELLIDÆ.

The Hawaiian Phasianellæ are all very small, but of exquisite beauty. Probably all but *P. thaanumi* belong to the section *Tricoliella* Monts., type *P. pulla*, if this is separable from *Tricolia*. For *P. thaanumi* a new section, *Hiloo*, may be formed, characterized as in the following:

Key to Hawaiian Phasianellæ.

- a.* Peristome projecting forward at junction of columellar and basal margins; shell short, of rapidly enlarging whorls. *P. thaanumi*, n. sp.
- a*¹. No projection of the peristome in unbroken specimens.
- b.* Axis narrowly, deeply umbilicate; thin *P. molokaiensis*, n. sp.
- b*¹. Axis perforate.
- c.* Shell ovate, with moderately long spire.
- d.* Rather solid; 2.7 x 2 mm. *P. variabilis* (Psc.).
- d*¹. Thin, about 1.8 mm. long *P. v. kahoolawensis*, n. subsp.
- c*¹. Shell broad, with short spire *P. bryani*, n. sp.

Phasianella variabilis (Pease).1860. *Collonia variabilis* Psc., Proc. Zool. Soc. Lond., p. 436.1888. *Phasianella variabilis* Psc., Pilsbry, Man. of Conch., X, p. 176, Pl. 39a, figs. 21, 22.

This species is sometimes common on the beaches east of Honolulu (which may be taken as type locality), and I have taken it at Haleiwa,

on the west coast. In both places it was found associated with *Acyra rubra*. It has not been reported from any island but Oahu. It differs from other Hawaiian species of the genus by its longer, ovate contour. The patterns vary widely. An average specimen measures:

Length 2.7, diam. 2, longest axis of aperture 1.5 mm.; 4 whorls.

Phasianella variabilis kahoolawensis n. subsp. Pl. XV, fig. 11.

The shell is perforate, pinkish-buff with pink lineolation, the first whorl opaque white; thin.

Length 1.8, diam. 1.45, longest axis of aperture 1 mm.; $3\frac{1}{2}$ whorls.

Kahoolawe, the type, No. 116188, from the north shore; another specimen from Smuggler's Bay on the southern shore; collected by Pilsbry, 1913.

This is probably a distinct species. It is thinner, with a thinner columella than young *P. variabilis* of the same size. I did not find *variabilis* on the island of Kahoolawe.

Phasianella bryani n. sp. Pl. XV, fig. 13.

The shell is narrowly perforate, short and broad, rather solid, smooth, nearly white, closely, obliquely lineolate with pale rose. Spire short. Whorls well rounded, rapidly increasing. Aperture oblique, nearly round. Columella rather thin, not prominent at its junction with the basal margin.

Length 2.4, diam. 2.1, longest axis of aperture 1.54 mm.; $3\frac{1}{2}$ whorls.

Haleiwa, west coast of Oahu. Type and paratypes No. 116320, A. N. S. P., collected by Pilsbry, 1913.

This species occurred with *P. variabilis*, from which it is readily separable by the shorter spire and relatively broader last whorl. The groove behind the columella is much narrower than in *P. molokaiensis*, and the shell is thicker. Some examples have opaque white spots below the suture. It is named for the author of *Natural History of Hawaii*, who was my companion and guide on several collecting trips to the reefs of Oahu.

Phasianella molokaiensis n. sp. Pl. XV, fig. 10.

The shell is thin, narrowly umbilicate, globosely ovate, smooth and glossy, the type having old rose spots below the suture, irregular spots below the periphery, and a lineolate band between, on a whitish ground. The aperture is nearly round, oblique, showing the color through; outer lip thin; columella thin, a deep and wide groove behind it.

Length 2, diam. 1.7, longest axis of aperture 1.27 mm.; $3\frac{1}{2}$ whorls.

Moomomi, on the north coast of western Molokai, type and many other specimens No. 117054, A. N. S. P., collected by Pilsbry, 1913.

The umbilicus and the groove below it are larger than in other Hawaiian species. The shell is thinner than that of *P. variabilis* or *P. bryani*.

The specimens vary in pattern, but nearly all were bleached.

Phasianella thaanumi n. sp. Pl. XV, figs. 12, 14.

The shell is very thin, perforate, short, obliquely conic, the spire short, somewhat attenuate, last whorl very rapidly enlarging. Surface smooth, pale olive buff, translucent, with four indistinct, narrow whitish bands on the latter part of the last whorl, where there are also some very faint brownish flecks.

The very large and decidedly oblique aperture is subrotund, but a little longer than wide. The outer lip is well expanded. Columella is narrowly expanded, thin, regularly arched, and there is a forwardly salient angle where it joins the basal lip. The operculum is olive-buff, strongly convex and smooth externally.

Length 2.1, diam. 1.8, longest axis of aperture 1.35 mm.

Hilo, Hawaii, D. Thaanum. Type and paratype No. 117053, A. N. S. P., from No. 8393 of Mr. Thaanum's collection.

This species is very distinct by the projection of the peristome at the foot of the columella. The rapidly enlarging whorls and marked expansion of the lip are also characteristic. The surface has a thin calcareous incrustation, unlike the clean, glossy appearance of most *Phasianellas*.

ALCYNA.

Alcyona contains shells similar to *Phasianella* except that the columella has a strong tooth. The operculum is not yet known. So far as we know, the greatest development of *Alcyona* is on the Hawaiian shores, where six species have been found. Four of these were described by W. H. Pease, 1860-'69. As none of them has been fully characterized, and only one figured, I am giving new figures of all but one, *A. striata* Pease,¹ the specimens of which could not be found in the Pease collection, being either lost or misplaced.

Mr. Kuhns dredged *A. kuhnsi* in 25 to 50 fathoms. Four species collected by the writer were found in strand debris, on the shores of Oahu, Molokai and Kahoolawe.

¹ *Alcyona striata* Pease, *Amer. Jour. of Conch.*, V, p. 70; *Man. of Conch.*, X, p. 182, reprint of original description.

Key to Species of Alcyona.

- a. Shell very minutely or scarcely perforate; whorls rounded, without raised striae.
- b. Base and spire having fine, engraved spiral lines; of uniform color, longitudinally lineolate or spotted..... *A. rubra* Pse.
- b¹. No engraved lines, smooth; spirally banded with red,
A. kapiolaniae, n. sp.
- a¹. Shell openly perforate.
- b. Having raised spiral striae or small ridges.
- c. Marked with red spiral lines or narrow bands; varix behind the lip low *A. lineata* Pse.
- c¹. Marked with flammules or longitudinal stripes (or uniform white?); varix behind lip well developed
A. subangulata Pse.
- b¹. Whorls not ridged or striate, with minute engraved lines at and below middle of the last whorl *A. kuhnsi*, n. sp.

A. striata Pse., which I have not seen, is described as having impressed lines, whorls angular below suture, speckled and mottled with black and gray, whitish below the suture.

Alcyona rubra Pease. Pl. XV, figs. 1, 2.

1860. *Alcyona rubra* Pease, P. Z. S., p. 436.

1862. *Phasianella rubra* Pease, Reeve, Conchologia Iconica XIII, Pl. 6, fig. 18a, b.

1888. *Alcyona rubra* Pse., Pilsbry, Man. of Conch., X, p. 182.

Type in British Mus.; metatypes No. 31720, M. C. Z., and No. 37834, A. N. S. P.

Pease's description was reproduced in *Manual of Conchology*. He overlooked the fine, engraved spirals, of which there are six on the penult whorl, more on the next earlier. On the last whorl they are more or less weakened or even wanting in the peripheral region and above, but distinct on the base. There is a vertical groove at the axis, but not a perforation. As in other species, the columellar tooth appears stronger in an oblique view, but the degree of emergence varies individually. The whorl has a very low, broad swelling behind the lip in adults, but it is often scarcely noticeable.

The color, as seen in the mass, is old rose, but the shade varies noticeably in different specimens. There is a white area around the columella, and the apical whorl is slightly paler. Otherwise the color may be nearly uniform (fig. 2) or marked with darker oblique lines on a paler ground on the spire, blotched with buff or white below the suture of the last whorl, with scattered whitish dots over the rest of the surface (as in Reeve's fig. 18a, and our fig. 1), or exceptionally there may be oblique red lines also on the last whorl. The blunt lip-edge is touched with rose color in adult shells.

These notes apply to the typical lot in the Pease collection M. C. Z., which is labelled "Hawaii." There is also a numerous, wholly similar, series in A. N. S. received from Pease, No. 37834.

The shape varies somewhat, fig. 1 being of the prevalent form.

Length 2.55, diam. 1.9 mm.; $4\frac{2}{3}$ whorls (typical specimen, fig. 1).

" 2.35, " 1.8 " (wide specimen, fig. 2).

" 2.7, " 1.7 " (narrow specimen).

In a small series from Waikiki beach, near Honolulu, the same patterns occur.

At Haleiwa I found the typical pattern, also similar with a pale peripheral line, and a form with lineolation throughout, in isabella color.

One specimen from the north shore of Kahoolawe is isabella colored, in typical pattern.

Aleyna kuhnsi n. sp. Pl. XV, fig. 9.

The shell is openly perforate, globosely ovate, solid, varying in color from coral pink to eugenia red, spotted with white in varying patterns (the type specimen coral pink, having a series of white blotches below the suture on the last whorl, a series of spots above a pale peripheral line, and scattered spots in the intervals; other shells being darker with very few spots, olive-buff with irregular longitudinal lineolation of red and the typical white spots, etc.); the apical whorl white, the next white or olivaceous. Sculpture of encircling impressed lines at and below the periphery. Columellar area broad, white. Tooth conical, median on the columella. Lip thickened but beveled to an edge, the whorl noticeably swollen behind it.

Length 1.65, diam. 1.3 mm.; 4 whorls.

Off Waikiki (between Honolulu and Diamond Head), in 25 to 50 fathoms, D. B. Kuhns, 1917. Type No. 117055, A. N. S. P., from No. 8395, Thaanum Coll.

This species was taken in some numbers. It differs from *A. rubra* by the small size, short contour, open perforation and different shape of the columellar tooth.

Aleyna kuhnsi humerosa n. sub-sp. Pl. XV, fig. 8.

The shell is openly perforate, globular-conic, the last whorl obtusely angular at the shoulder, flattened below the angle; smooth and glossy, but engraved at and below the middle with spiral impressed lines, of which there are about 14. Color pale pinkish cinnamon, irregularly lineolate longitudinally with old rose, the lines not reaching

to the suture; the first two whorls white. Peristome somewhat thickened within. Columella deeply grooved, bearing a stout tooth.

Length 1.75, diam. 1.4 mm.

Waikiki beach, Pilsbry, 1913. Type No. 117049, A. N. S. P. This differs from *A. kuhnsi* by the distinctly angular shoulder, but as only one example has been examined the constancy of the character is uncertain.

Alcyona kapiolaniae n. sp. Pl. XV, fig. 3.

The shell is imperforate, though grooved at and below the umbilical situation, ovate, rather solid, smooth throughout, glossy; flesh-pink, encircled with narrow bands of old rose or jasper red, 7 to 12 on the last whorl, the first two whorls whitish. Lip thickened, bevelled. Columellar area broad, white, with a vertical groove; the tooth stout, directed somewhat downwards.

Length 2.4, diam. 1.74 mm.

Waikiki beach, near Honolulu, type No. 117052, A. N. S. P., and Haleiwa, on the west coast of Oahu; Pilsbry, 1913.

This charming little shell was found in beach debris in both localities. It has about the shape of *A. rubra*, but differs by lacking spiral impressed lines, the surface being smooth; also by the color-pattern, to which there is no approach whatever in the large series of *A. rubra* examined. It is colored like *A. lineata*, but that species is spirally ridged and somewhat shorter.

Alcyona lineata Pease. Pl. XV, fig. 4.

1869. *Alcyona lineata* Pease, Amer. Jour. of Conch., V, p. 69.

1888. *Alcyona lineata* Pease, Pilsbry, Man. of Conch. p. 182.

Pease's description was reprinted in *Manual of Conchology*, but the species has not been figured before. It is openly perforate, about as figured for *A. subangulata*, and, as Pease says, transversely ridged, the ridges jasper red, intervals coral pink. There is a distinct though low swelling behind the outer lip. The holotype measures:

Length 2.15, diam. 1.65 mm.; 4 whorls.

Type No. 31724, M. C. Z. Puuloa.

This species differs from *A. kapiolaniae*, which is similarly colored, by the well-developed spiral ridges, the open perforation and the shorter contour.

The type is figured. Besides this, I have seen a single specimen, found at Waikiki, which appears referable to this species. It differs by being a little more slender, with the columellar tooth more receding and only part of the spiral ridges are colored, there being five colored lines on the last whorl, instead of ten which the type shows.

Aleyna subangulata Pease. Pl. XV, figs. 5-7 (varieties).

1860. *Aleyna subangulata* Pease, P. Z. S., p. 436.

1888. *Aleyna subangulata* Pease, Pilsbry, Man. Conch. X, p. 182, reprint of original description.

This species was described from a specimen sent to H. Cuming, and the type is presumably in the British Museum. A specimen in the Pease collection, Museum of Comparative Zoölogy, No. 31723, is drawn in figs. 5 and 6. This shell agrees well with Pease's description except in color. It is pale pinkish buff with small, pale brownish flames radiating from the suture. The last whorl is obtusely biangular with about 4 low spiral cords above the upper angle, two and a very weak third between the angles, base with numerous spirals. There is a rounded swelling or varix behind the lip, stronger than in the other species. The umbilicus is rather large (fig. 5, an obliquely basal view). The tooth appears larger in a more oblique view than that drawn. It is a "dead" shell.

Length 2.2, diam. 1.7 mm.

A specimen from Haleiwa, on the west coast of Oahu (Pilsbry, 1913) is similar, but with only two cords between the angles, in front, and the color is uniform cartridge buff, probably bleached. Of two from Honolulu, collected by F. Stearns, No. 93890, A. S. N. P., one is bleached white, the other is fresh, whitish with flames of pale flesh color radiating from the suture, wider and more distinct than in the Pease example figured. As this coloration is quite unlike that described by Pease for *A. subangulata*, the specimens described above may be called *A. s. flammulata*; No. 93890 being the type.

Typical *A. subangulata* was described as "deep red with oblique light red lines."

Aleyna subangulata virgata, Pl. XV, fig. 7, is a somewhat narrower form with three carinæ in the middle, two small cords above the upper one, the color flesh pink, becoming old rose at the summit, and elegantly striped with claret brown. As in the other forms, there is a prominent rounded varix behind the outer lip.

Length 2.1, diam. 1.5 mm.

Haleiwa, west coast of Oahu, on the beach. Type No. 116297, A. S. N. P., collected by Pilsbry, 1913.

The tooth recedes, and in an oblique view it is seen to be much longer than shown in the figure. The value of the characters given for these forms of *A. subangulata* remains to be tested by the comparison of series of individuals.

A. subangulata resembles *A. lineata*, but differs by the much stronger varix behind the outer lip and the coloration.

II. THE TECTIBRANCHIATA.

Besides the species discussed below, the following Tectibranchs of the Cephalaspidian group have been reported from the Hawaiian Islands.² Species marked with a * were originally described from the Hawaiian Islands.

<i>Pupa nitidula</i> (Lam.). ³	* <i>Haminea pusilla</i> Pse.
<i>Bullina scabra</i> (Gmel.).	* <i>Haminea sandwicensis</i> Sowb.
* <i>Bullina vitrea</i> (Pse.).	* <i>Volvatella fragilis</i> Pse.
* <i>Scaphander alatus</i> Dall.	<i>Hydatina physis</i> (L.).
* <i>Scaphander pustulosus</i> Dall.	<i>Hydatina amplustre</i> (L.).
<i>Smaragdinella viridis</i> (Q. & G.).	<i>Micromelo guamensis</i> (Q. & G.).
* <i>Bullaria peaseana</i> (Pils.). ⁴	* <i>Aglaja nuttalli</i> Pils.
* <i>Haminea crocata</i> Pse.	* <i>Philinopsis speciosa</i> Pse.
* <i>Haminea galba</i> Pse.	* <i>Philinopsis nigra</i> Pse.

Bullaria peaseana has been found abundantly at Hilo by Mr. Tha anum. The writer took *Hydatina amplustre* on the north coast of Kahoolawe.

Umbraculum sinicum aurantiaeum (Pse.) which Mr. Tha anum has taken at Hilo, appears to be sufficiently distinct from *U. sinicum* by characters of the shell to merit a subspecific name.

***Pupa thaanumi* n. sp.** Fig. 1.

The shell is oblong with acutely conic spire, solid, somewhat shining, whitish, unevenly tessellated with flesh pink, the spotting interrupted by pale bands on the sixth and twelfth spaces between spiral grooves; an apricot buff area at the base. Sculpture of 17 spiral grooves on the last, four on the penult whorl; they are closely punctate; the upper two grooves and the lower seven are close, the rest being nearly twice as far apart. Columellar fold heavy, its wide crest grooved. A small spiral fold is above it on the parietal wall.

Length 9, diam. 4 mm.; $6\frac{1}{2}$ whorls.

Off Honolulu in 6 to 8 fathoms. Type No. 117069, A. N. S. P., from No. 1193a of Mr. Tha anum's collection, taken by D. B. Kuhns, 1916.

This species resembles *P. suturalis* (Ad.), *P. strigosa* (Gld.) and

² The list is quoted from a MS. catalogue of recorded Hawaiian mollusks compiled by Mr. D. Tha anum.

³ *Solidula nitidula* auct., *Tornatella nitidula* Lam.

⁴ *Bulla peaseana* Pils. Man. Conch. XV, 348.

P. alveola (Souverbie), more especially the last, which differs in details of sculpture and somewhat in coloration.

The substitution of *Pupa* for *Solidula* is one of the unfortunate consequences of adopting Bolten's nomenclature.

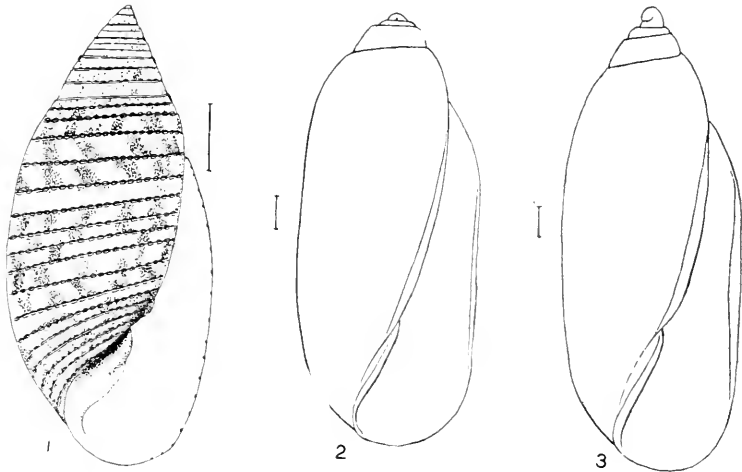


Fig. 1.—*Pupa thaanumi*.

Fig. 3.—*Acteocina honoluluensis*.

Fig. 2.—*Acteocina sandwichensis*.

***Acteocina sandwichensis* (Pease). Fig. 2.**

1860. *Tornatina sandwichensis* Pse., P. Z. S., p. 19; description reprinted in *Man. Conch.* XV, 190.

Pease's set of this species, No. 31712, M. C. Z., consists of five somewhat beach worn specimens, all of them having lost the nuclear whorls. There are, I think, two species in the lot, both of which have been dredged together by Mr. Kuhms, off Honolulu in 6 to 8 fathoms. As these specimens are perfect, the figure is drawn from one of them, No. 117071, A. N. S. P.

The form which may be taken as typical *A. sandwichensis* is cylindrical, white, glossy, with minute sculpture of close, superficial spiral striae, not extending upon the shoulder or spire. The spire is convexly conic. The nuclear whorl is *more than half immersed*. There are $3\frac{1}{2}$ subsequent whorls. The columellar is rather straight, with a very small fold above, and in an oblique view in the aperture a low prominence may be seen near the base. The inner lip has a rather heavy callus. Outer lip is strongly arched forward, as usual.

Length 4.05, diam. 1.7 mm.

Acteocina honoluluensis n. sp. Fig. 3.

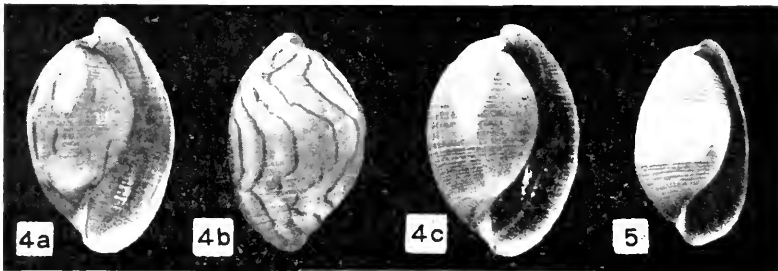
This species is similar to *A. sandwicensis* in size and sculpture. It differs by the noticeably longer spire and the *projecting nucleus*, the uptilted whorl being wholly exposed. The columellar fold is slightly more prominent.

Length 4.3, diam. 1.65 mm.

Off Honolulu in 6 to 8 fathoms, with *A. sandwicensis*. Type No. 117070, A. N. S. P., from Mr. Thaanum, collected by D. B. Kuhns.

Atys kuhnsi n. sp. Figs. 4 a, b, c.

The shell is narrowly umbilicate, oval, the diameter about two-thirds of the length; widest slightly above the middle; thin, semi-transparent, white, opaque white at base and vertex, marked with narrow, irregularly waved (sometimes branching) tawny or cinnamon-brown streaks. The surface is glossy, with sculpture of engraved encircling grooves; the intervals being closely sculptured with circular striae near the ends, but smooth towards the middle, where the grooves are wider apart (and, except in the largest individuals, there is a smooth zone in the middle, which narrows progressively with age). The vertex has a very small and shallow concavity about the posterior axis. The axis posteriorly has a moderate, oblique fold. The columella is narrow, nearly straight, but there is a small prominence below the middle. The aperture is narrowly rounded anteriorly.



Figs. 4a, b.—*Atys kuhnsi*. 4c white variety of same.
Fig. 5.—*Atys semistriata*.

Length 15.8, diam, 10 mm. (type, fig. 4a).

Off Waikiki, Oahu, in 25 to 50 fathoms, D. B. Kuhns, 1917; type and paratype No. 117074, A. N. S. P.

Two specimens, out of eight received from Mr. Thaanum, are pure white, without markings. It is an exquisite shell, which may appropriately be dedicated to Mr. Kuhns, who has dredged successfully over very difficult bottom on the kona shore of Oahu.

By the coloration it resembles *Bulla ferruginosa* Chemn., A. Adams, in Sowerby's *Thesaurus Conchyliorum* II, p. 585, Pl. 124, fig. 110, but differs by the decidedly less globose contour of *A. kuhnsi*.

Bulla ferruginosa Gmelin (*Syst. Nat.* 13, p. 3432) is a young *Cypraea*, so that A. Adams' form requires a new name. It may be called *Atys naucum strigata*. The habitat is unknown.

Atys semistriata Pease. Fig. 5.

1860. *Atys semistriata* Pse., P. Z. S., p. 20; description reprinted in Man. Conch. XV, p. 267.

The shell is narrowly umbilicate, truncate-ovate, widest below the middle, thin, bluish-white in the middle, opaque white at both ends. The rounded vertex is closely striate spirally, not deeply sunken in the center. Upper part sculptured with about 12 spiral impressed lines, the base with about 16; the middle third smooth. The axial fold above the vertex is rather low and rounded. Columella deeply concave, thin.

Length 14, diam. 8 mm.

The largest individual in Pease's lot, No. 31716, Mus. Comp. Zool., is described and figured. I found specimens on the north shore of Kahoolawe.

The apex is not perforate, as Pease described it, but the spiral curvature of the axis there gives the impression of perforation, in a superficial view.

Atys debilis Pease. Fig. 7.

1860. *Atys debilis* Pse., P. Z. S., p. 20; description reprinted in Man. Conch. XV, 266.

The type of the species was said by Pease to be in the Cuming collection, so it is likely that that Sowerby's figures (*Conch. Icon.* XVII, *Atys*, Pl. 5, fig. 28*a, b*) were drawn from it. I am giving an enlarged photographic copy of one of these figures for comparison with the following species, from which *A. debilis* differs by being "narrowed posteriorly." Sowerby's figure is 14.8 mm. long. The figures in Man. Conch. were copied from *Donum Bismarkianum*. It is curious that Pease did not mention the projecting point of the fold at the summit, which shows in Sowerby's figure.

Atys cornuta n. sp. Fig. 8.

The shell is thin, cylindric-oblong, tapering to both ends, nearly white. Sculpture of spiral grooves at both ends, about 6 deep and two or three minute ones, more spaced, at the upper end, numerous unequal grooves on the lower third. The vertex is narrow, deeply impressed around the axis, a spiral furrow or concavity within.

The ascending axis is broad, very obliquely spiral, terminating in a posteriorly projecting point. Anteriorly the axis is very minutely perforate; columella broad, concave, appressed above, obliquely truncate below.

Length 10.6, diam. 4.8 mm.

Off Honolulu in 6 to 8 fathoms, D. B. Kuhns. Type No. 117075, A. N. S. P., from No. 397a Thaanum coll. Also Hilo, Hawaii.

This form agrees with the account and figures of *A. debilis* except in shape; it is wider in the upper part, though not at the vertex. As no specimen of *A. debilis* is in the Pease collection at Cambridge, and comparison with the supposed type in London is impracticable at this time, the present form is described subject to further investigation.

The summit is more pinched up into a narrow ridge than in *A. cylindrica* (Helbling) or *A. parallela* Gld. *A. hyalina* Watson is less slender.

The species reaches a size considerably greater than the specimen serving as type. One from Hilo, sent by Mr. Thaanum (No. 117076) measures length 15, diam. 6.7 mm. There are about 11 spiral grooves on the upper fourth, followed by 4 or 5 slightly elevated spirals, the basal third, below the smooth space, having many spiral grooves, as usual.

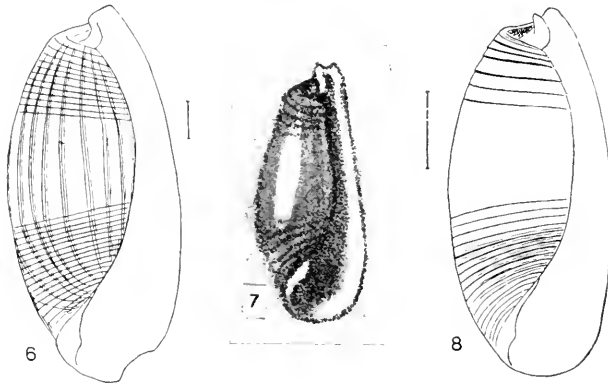


Fig. 6.—*Atys costulosa*. Fig. 7.—*Atys debilis*. Fig. 8.—*Atys cornuta*.

Atys costulosa Pease. Fig. 6.

1869. *Atys costulosa* Pse., Amer. Journ. Conch. V, p. 73.

1893. *Atys costulosa* Pse., Pilsbry, Man. Conch. XV, p. 267.

Waimalu, Oahu; Type No. 31714 Mus. Comp. Zool., Pease coll.
This species is quite distinct by the well developed longitudinal

folds. There are deep spirals at both ends, about 10 above, columella is slightly concave, widely reflected, bounded by a groove as usual, and indistinctly truncate basally. White. It appears to be closely related to *A. debilis* and *A. cornuta*, which have no longitudinal plication.

Length 5, diam. 2.3 mm.

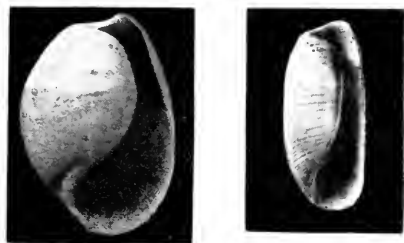


Fig. 9.—*H. a. oahuensis*. Fig. 10.—*H. c. tomaculum*.

Haminea aperta oahuensis n. subsp. Fig. 9.

Compared with *H. aperta* Pse. of Tahiti, this shell differs by being more swollen in the middle, and malleate (like some *Lymnaeas*) in the peripheral region. It is white, and without engraved spirals.

Length 14.5, diam. 10 mm.

On the shore of Oahu, $1\frac{1}{2}$ miles east of Kahuku. Type No. 117072, A. N. S. P., collected by Pilsbry, 1913.

The type of *H. aperta* originally illustrated by Pease, No. 57575 A. N. S. P., has been compared.

Haminea curta tomaculum n. subsp. Fig. 10.

Resembling *H. curta* A. Ad., but narrower, strictly cylindrical; narrowly perforate at both ends. Columella very narrow, hardly reflected; sculpture of minute, unequal, close spiral striae, with about 30 distinctly deeper spirals, close towards the base, elsewhere rather widely and unequally spaced.

Length 12.4, diam. 5.5 mm.

Off Honolulu, 6 to 8 fathoms. D. B. Kuhus, 1916. Type No. 117073 A. N. S. P., from No. 1181a Thaanum coll. The original figure of *H. curta*, as well as the specimens before me, is distinctly shorter and wider than this Hawaiian form, with the sides more convex and the lip ascending less at the posterior end. *H. cuticulifera* Smith and *H. cairnsiana* Melv. are related forms.

III. THE MELANELLIDÆ (*Eulimidæ*).

The absence of sculpture and the rarity of color, together with the simplicity of form, reduce the number of available specific characters in this family, rendering determination of species difficult. The arrangement of varices, whether in one or two longitudinal straight or spiral series, or sparsely scattered, is a valuable feature, also the width of the gray border below the suture, and the curvature of the outer lip; but these have often been overlooked in published descriptions. The size of the apex is often useful, also the degree of curvature, which, however, is individually rather variable.

All of the known Hawaiian species are mentioned below, but there are certainly many more. At least half a dozen species, beach material, are represented in our collection by specimens somewhat worn, or by single shells which may not be adult, though obviously distinct.

Melanella thaanumi n. sp. Pl. XIV, figs. 5 to 6 a.

The shell is white, slightly transparent, rather solid, with strongly developed curvature in two directions. Whorls very slightly convex, each with one varix. The varices are opaque white, the series ascending the spire spirally on the right side and back, making between a fourth and a half turn. The aperture is ovate. Outer lip arches very strongly forward. Length 25, diam. 7 mm.; length of aperture 6 mm.; 13 whorls, the apical ones lost (type, figs. 5, 5a). An immature specimen 19 mm. long has 16 whorls, the apex perfect.

Hilo, Hawaii, D. Thaanum. Type and paratypes No. 108471 A. N. S. P. Also No. 19764, from Dr. Newcomb, from "Sandwich Islands."

This species is probably *Eulima arcuata* Sowerby, *Conch. Icon.*, Pl. 2, fig. 14, 1865, not *E. arcuata* C. B. Ad., 1849.

None of the series before me is so much curved as Sowerby's figure, yet the individuals vary considerably in curvature.

There is an allied species from Mauritius (Pl. XIV, figs. 2, 2a) which differs from *thaanumi* by the somewhat larger size and wider form. It differs from *Eulima major* by the much more strongly arched outer lip. Length 28.5, diam. 9, length of aperture 8 mm.; 15 whorls, some at the apex lost. This form may be called *Melanella robillardiana*. Type No. 19763 A. N. S. P., figs. 2, 2a; two other specimens; collected by V. Robillard.

Melanella major (Sowb.),⁵ from Tahiti, is a larger, less curved

⁵ *Eulima major* Sowerby, *Proc. Zool. Soc.*, 1834, p. 7; Conchological Illustrations, *Eulima* fig. 1 (not fig. 1*, and probably not fig. 1**). Locality, Tahiti.

species in which the outer lip is far less strongly arched, and the shell more opaque. The row of varices is nearly straight. A topotype, received from Mr. Cuming, is figured for comparison, Pl. XIV, figs. 1, 1a.

Melanella inflexa (Blainv.) (as *Phasianella inflexa*, Blainville, *Manuel de Malacologie*, p. 439, Pl. 35, fig. 5), from Isle of France, is a smaller, much more broadly conic species, according to the figures. It is certainly not identical with *M. major*, as surmised by Tryon.

Melanella cumingi medipacifica n. subsp. Pl. XIV, figs. 4, 4a.

This form is less robust than *M. cumingi* A. Ad.,⁶ with a narrower aperture. It is very slightly bent, almost straight. The varices are at irregular intervals of from a half to about three-fourths of a whorl, the last whorl with none. They appear on the last 10 whorls at least. The shell is white throughout.

Length 24, diam. 7.5 mm.; 12 whorls, several at the apex lost.

Hilo, Hawaii, D. Thaanum. Type and paratype No. 108473 A. N. S. P.

This may be the adult form of *Eulima conoidalis* Sowerby, *Conch. Icon.* XV, 1866, Pl. 3, fig. 22, described from the Sandwich Islands, Mus. Cuming. It is a point to be settled by further investigation, and the comparison of half grown examples of *medipacifica* with *conoidalis*.

Melanella labiosa (Sowerby). Pl. XIV, figs. 3, 3a.

1834. *Eulima labiosa* Sowb., P. Z. S. p. 7 (Island of Annaa, Pacific Ocean); *Conchol. Illustr.* fig. 2.

1855? *Eulima labiosa* Sowb. A. Adams, *Thes. Conch.* II, Pl. 169, fig. 31.

1886. *E. labiosa* Sowb. (as synonym of *E. brevis* Sowb.), Tryon, *Man. Conch.* VIII, p. 267, Pl. 68, fig. 2.

The shell is white, rather solid, somewhat curved, conic, the whorls noticeably convex. Varices in a single lateral series on the right side, which recedes to a dorsal position on the early whorls. The aperture is rather broadly ovate; outer lip prominent above the middle, strongly receding from there to the suture.

Length 19, diam. 7.6, length of aperture 6 mm.; 11½ whorls, the tip wanting.

Hilo, Hawaii, D. Thaanum. Figured specimen is No. 117067 A. N. S. P., from No. 3807 Thaanum collection.

While related to *M. thaanumi*, this is easily distinguished by its

⁶ *Eulima cumingi* A. Adams, *Proc. Zool. Soc.* 1851, p. 277; Sowerby's *Thesaurus Conchyliorum* II, Pl. 169, fig. 26. Lord Hoods Island, South Seas, on *Avicula margaritifera*.

much more conic form, whiter color, etc. The specimens vary a good deal in degree of curvature, some being less, others more curved than the one figured. The Hilo specimens agree well with the figures of *E. labiosa*, but I have not had topotypes for comparison. Tryon considered *labiosa* a synonym of *Eulima brevis* Sowb., but this appears to me improbable. The description and figure are from a Hilo shell.

Melanella vafra n. n. Fig. 11*e, f*.

1867. *Eulima inflexa* Pease, Amer. Journ. of Conch. III, p. 294. Not *Phasianella inflexa* Blainville, also a *Melanella*.

The spire is attenuate above and has a gentle double curvature. There is one series of varices, beginning a little behind the aperture on the penult whorl receding upward to a dorsal position. The outer lip is thin, strongly and evenly arched, the basal margin not retracted. The shell is bluish white, but slightly transparent, having the usual opaque white area behind the lip; sutural border gray.

Length 8.4, diam. 3.8 mm.; 14 whorls.

Viti Islands, A. J. Garrett. Type No. 59233 A. N. S. P. Hilo, Hawaii, D. Thaanum.

Mr. Tryon thought this a synonym of *Eulima solida* Sowb., but in a considerable series seen, the outer lip is never thickened as Sowerby described and figured for his species. The present form appears to resemble *Melanella pyramidalis* (A. Ad.), from the Philippines, which, however, has a thicker spire. The spire appears a little more curved in a view intermediate between those drawn in figures *e* and *f*.

The Hilo specimens are a little more curved than those from Fiji. One is figured, Pl. XIV, fig. 7.

Melanella aciculata (Pease). Fig. 11*a, b, c*.

1860. *Eulima aciculata* Pease, P. Z. S., p. 438 (Sandwich Islands).

1866? *Eulima aciculata* Pease, Sowerby, Conch. Icon. XV, Pl. 5, figs.

36*a, b*. Not *Pasithea aciculata* Lea, 1833, = *Strombiformis aciculata* (Lea).

A specimen from the Pease collection, No. 31705 Mus. Comp. Zool., is drawn in figs. 11*a, b*. The upper third is quite slightly bent in two directions. There is a slight bulging close to the apex (fig. 11*b*), the earlier three whorls forming a wider cone than the later ones. This is noticeable on both specimens in the Pease collection, but not in those from Hilo. There are very few inconspicuous varices, one each on the penult and next earlier whorls are all I can make out. The suture is a fine line. Some distance below it there is a creamy band (marking the internal suture) in the bluish white

shell. The whorls are almost flat. The outer lip is rather strongly and evenly arched forward.

Length 5.8, diam. 1.9, length of aperture 1.6 mm.; about 12 whorls.

Length 5.5, diam. 1.8 mm.

This species is a true *Melanella* conchologically, though some examples are nearly straight in front view. It certainly differs from *M. acicula* (Gld.) (*Stylifer acicula* Gld.), of which specimens of the original lot from Gould have been compared. The very much narrower sutural margin, the straighter form and more transparent shell of *M. acicula* are characteristic. *Eulima exilis* Pease⁷ is a

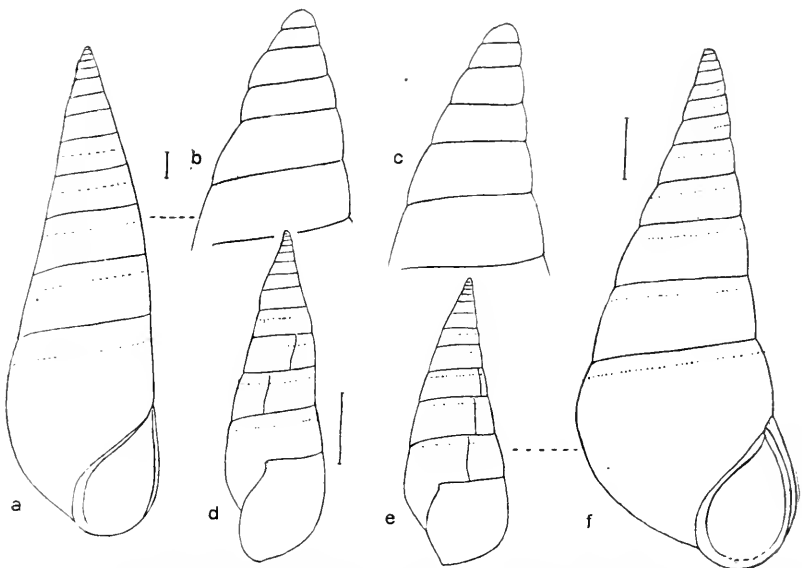


Fig. 11.—a, b, *Melanella aciculata*, Pease coll. c, *M. aciculata*, Hilo. d, *M. kahoolawensis*. e, f, *M. vafra*.

⁷ *Eulima exilis* Pease, P. Z. S., 1862, p. 242; Amer. Journ. of Conch. III, p. 294, Pl. 24, fig. 25. It has been united by Tryon with *E. pusilla* Sowerby, from Sta. Elena, Bay of Guayaquil, Ecuador, but in my opinion erroneously; Sowerby's figure, *Conch. Illustr.* fig. 6, is very different. It is not *Eulima exilis* Gabb, *Journ. Acad. Nat. Sci. Phila.* IV, p. 385 (November, 1860). As the original description of *E. exilis* Pease was inadequate, the published figure poor, and the name preoccupied, the species may be redescribed as follows:

Eulima pisorum. (Figs. 12a, b.)

The shell is almost straight, bluish white, opaque white at the last third of the last whorl. Suture linear, inconspicuous, having a narrow clear margin, rather sharply defined, more opaque below the margin. Whorls hardly perceptibly convex. There is a rather inconspicuous variceal line preceded by an opaque area on the back of the antepenult whorl, another on the second whorl above it.

more slender shell, with the sutural margin narrower, and the spire less bent.

Eulima venusta Pease, from the Paumotus, is very closely related to *aciculata*, but perfect specimens have a larger apex; the outer lip, also, is somewhat more arched forward.

So far as I know, there is no reliable record of *Eulima acicula* (Gld.) from the Hawaiian group. Tryon's record seems to have pertained to *Eulima aciculata* Pease, of Sowerby, which he appears to have thought was not the true *aciculata* of Pease, but was a synonym of *acicula*. This opinion seems to me without adequate foundation. Tryon has recorded two synonyms of *E. acicula*: *Eulima vitrea* A. Ad. (Fiji) and *Leiostraca pyramidalis* Sowb. (Hab. unknown.) From the figures, these appear to be rightly placed.

Mr. Thaanum's specimens of *M. aciculata* from Hilo, Hawaii (No. 82228 and 108472 A. N. S.), differ from the Pease examples by being a little more robust, with the early whorls slightly more attenuate (fig. 11c).

Length 9, diam. 2.75, length of aperture 2.3 mm.; 16 whorls (Pl. XIV, fig. 8a).

Length 8.8, diam. 2.75, length of aperture 2.5 mm. (Pl. XIV, fig. 8).

The aperture is narrowly ovate. Outer lip runs rather far forward and is retracted again at the base.

Length 10.9, diam. 3.1 mm.; length of aperture 3 mm.; 14 whorls.

It resembles *M. aciculata* (Pse.), but the margin below the suture is narrower, the last whorl is wider, and especially, the apex is larger.

Viti Islands. Type No. 19773, collected by A. Garrett. Others from the same source are in the collection received from Pease.

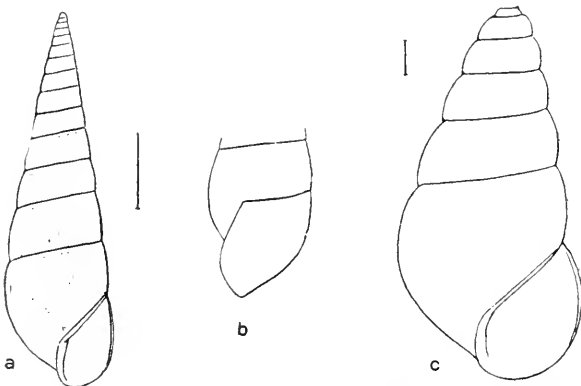


Fig. 12a. b. *Melanella pisorum*. Fig. 12c, *Mucronalia nitidula*.

Melanella kahoolawensis n. sp. Pl. XIV, fig. 9.

The shell is irregularly but slightly curved, acuminate near the apex, solid, whitish. The whorls are nearly flat, suture not impressed, bordered below by a rather wide grayish-white band. On the penult whorl there is one varix near the left side, the two preceding whorls each having a varix on the right side. The aperture is ovate; outer lip blunt, strongly retracted above (fig. 11*d*). Columella vertical, somewhat thick.

Length 9.4, diam. 3.25 mm.; length of aperture 3 mm.; about 12 whorls.

Kahoolawe, northern shore; type No. 116219, collected by Pilsbry, 1913.

This species is related to *M. acicula*, but the spire is stouter, more attenuate near the apex, the aperture is larger and the outer lip more retracted above.

Melanella opaca (Sowerby).

Eulima opaca Sowb., Conch. Icon. XV, 1865, Pl. 4, fig. 30 (Sandwich Is.).

Specimens from Hilo, "found only on sea cucumbers" by Mr. Thaanum, are figured, Pl. XIV, fig. 11. The identification is provisional, as Mr. Sowerby's description does not mention several important characters.

The shell is solid, slippery, opaque white, without a distinct margin below the suture. The spire is slightly curved, the apex deciduous. Whorls are slightly convex, and have a straight series of *deeply impressed* varix-grooves along the right side. The outer lip is rather thick, a little contracted, and only weakly arched forward.

Length 11, diam. 4 mm.; $8\frac{1}{2}$ whorls remaining.

The specimens are No. 94583 A. N. S. P., from No. 845 of Mr. Thaanum's collection.

Melanella solida (Sowerby).

Eulima solida Sowb., Conch. Icon. XV, 1865, Pl. 3, fig. 18 (Sandwich Is.).

I have not seen this species, which should be recognizable by the thick lip.

Melanella conoidalis (Sowerby).

Eulima conoidalis Sowb., Conch. Icon. XV, 1865, Pl. 3, fig. 22 (Sandwich Is.).

Possibly an immature shell.

Melanella acanthyllis (Watson).

Eulima acanthyllis Wats., Challenger Rep., Gastropoda, p. 512, Pl. 35, fig. 8, (Reef off Honolulu, 40 fathoms).

A minute species, about 2.5 x 0.8 mm.

Mucronalia nitidula Pease. Fig. 12c.

1860. *Mucronalia nitidula* Pease, P. Z. S. p. 437 (Sandwich Is., lives on Holothurie).
 1866. *Eulima nitidula* Pease, Sowerby, Conch. Icon. XV, Pl. 5, figs. 35a, b.
 1886. *Eulima (Mucronalia) nitidula* Pease, Tryon, Man. of Conch. VIII, p. 284.

Not *Eulima nitidula* A. Ad., 1855.

The shell is solid, opaque white, straight, of rather *strongly convex* whorls; apex lost, but the first whorl of those retained is disproportionately small. There are no varices. Aperture is ovate, the outer lip arching forward in the middle.

Length 4.5, diam. 2.2 mm.; 6 whorls remaining. Length of aperture 1.7 mm. (Metatype of *E. nitidula* Psc.).

Length 3.9, diam. 2.1 mm., $5\frac{1}{2}$ whorls remaining. Length of aperture 1.5 mm. (Quarantine Island, Honolulu).

Quarantine Island, Honolulu, D. B. Kuhns, 1915.

The contained animal gives a faintly ochraceous tint to part of the last whorl. The solidity and convex whorls are characteristic.

The larger of two specimens of *M. nitidula* Psc. in the Pease collection, No. 31711 Mus. Comp. Zool., is drawn in fig. 12c. The specimens from Quarantine Island are slightly smaller but otherwise identical in characters.

Mucronalia rosea (Pease).

1860. *Mucronalia rosea* Psc., P. Z. S., p. 437 (Sandwich Is., lives on Echini).
 1866. *Eulima rosea* Psc., Sowerby, Conch. Icon. XV, Pl. 5, fig. 39.
 1886. *Eulima (Mucronalia) rosea* Pease, Tryon, Man. Conch. VIII, p. 284.

Mucronalia sandvichensis (Sowerby).

1866. *Eulima sandvichensis* Sowb., Conch. Icon. XV, Pl. 3, fig. 21 (Sandwich Is.).
 1886. *Eulima (Mucronalia) sandvichensis* Sowb., Tryon, Man. Conch. VIII, p. 284.

The original figure is 16 mm long.

Mucronalia ovata Pease.

1860. *Mucronalia ovata* Psc., P. Z. S., p. 437 (Sandwich Is.).

"Shell elongately ovate, light, dull shining; whorls 5, slightly convex; inner lip thickened at the base and extending by a callosity over the columella to the junction of the outer lip. Colour dull white. Lives on *Echini*." A lost species, which can scarcely be identified without dimensions, figure or type.

Scalenostoma (Hyperlia) apiculatum (Souverbie). Pl. XIV, figs. 10, 10b.

- Scalenostoma apiculatum* Souv., Journ. de Conchyl. 1876, p. 383; 1877, p. 77, Pl. 1, fig. 1.

Hilo, Hawaii. Mr. Thaanum found four specimens. Two were in holes in coral from which they could not escape, nor could they

move, apparently, being firmly wedged in; two others were found free, on coral.

Two specimens sent are figured. It is the narrower one which agrees with Souverbie's description and figure. It measures, length 7.8, diam. 3.7 mm. The wider one measures, length 7, diam. 3.9 mm. With so small a number, one can hardly tell whether the difference is merely individual variation or of specific significance. Temporarily the wide variety may be called form *lucior* (fig. 10*b*).

S. apiculatum was described from a single example from Mauritius, not from New Caledonia, as Tryon stated (*Man. Conch.* VIII, p. 287).

The apical whorls of this shell are like those of *Stylifer*, and unlike *Scalcnostoma*. It may be taken as type of a new section distinguished by the smooth attenuate early whorls, and to be called *Hyperlia*. Whether an operculum is present has not been ascertained. It appears much nearer to *Mucronalia* than to *Melanella* in characters of the shell.

Stylifer robustus Pse. is reported by Mr. Pease as living on Echini, but the exact locality in the Islands was not given.

Subularia metcalfei (A. Adams). Fig. 13*a, b*.

1855? *Leiostraca metcalfei* A. Ad., in Sowerby's *Thesaurus Conch.* II, p. 802, Pl. 170, figs. 12, 13.

1853. *Leiostraca metcalfei* A. Ad., H. and A. Adams, *Gen. Rec. Moll.* I, p. 238, Pl. 25, fig. 3*a*.

1917. *Subularia metcalfei* A. Ad., Bartsch. *Nautilus* XXX, p. 134, Pl. 5, fig. 2 (enlarged copy from *Thes. Conch.*).

Pease was the first to determine the locality of this peculiar snail to be the "Sandwich Islands," but as usual did not note the exact place. One of his shells, No. 19822 A. N. S. P., is drawn. It is bluish-white with ochraceous⁸ markings disposed as in the figure. None of the shells seen have them in such regular festoons as are shown in the *Thesaurus* figure, which apparently served as the original of Dr. Bartsch's enlarged view. The spire is just perceptibly bent in the upper part, composed of slightly convex whorls. There is series of curved, linear varix-lines on both right and left sides, the lines receding a little with ascent of the spire, so that in the upper part they are dorsal and ventral. The later whorls are rather conspicuously compressed between dorsal and ventral sides, as shown in the basal outline, fig. 13*b*, and there is a flattened area on the face, near the base, banded by an acute, ascending curved angulation on

⁸ The specimens are beach shells, and the color has probably faded more or less.

the left, shown as a short line in fig. 13a. The aperture is very narrow, inner lip straight, and heavily calloused in the middle.

Length 8.8, diam. 3 mm.; about 9 whorls.

Subularia has recently been restricted by Dr. Bartsch to the type *S. metcalfei* A. Ad. *Leiostraca distorta* Pease forms a second species of the group, no others being known to belong to it.

Subularia differs from *Melanella* (*Eulima*) by its compressed shape and by having a flattened area at the base of the ventral side, between the columella and a short angular longitudinal ridge on the left side; the aperture is very narrow, more than twice as long as wide, and the inner lip is straight.

Subularia is somewhat like *Strombiformis* (*Leiostraca* of most authors) in its narrow mouth, but it is probably more closely related to *Melanella* by the varices. The flattened area is a unique feature. The genus *Chileutomia* Tate and Cossmann differs by its projecting varices.⁹

The two species known are very distinct by the following characters.

Spire nearly straight, with varix-lines on the right and left sides (Section *Subularia*); colored markings present. *S. metcalfei*.

Spire strongly curved, with varix-lines on the right side only (Section *Hemiliostraca*). Shell without color markings, *S. distorta*.

A very minute specimen from Smuggler's Bay, Kahoolawe, a larger one from the north coast of Molokai and several from the beach near Waikiki, Oahu, seem to be *Subulariæ*, but as part are single specimens and none in fresh condition they are mentioned here merely as an indication that there are other species. Single shells are particularly inconclusive in this family, as there is nothing to definitely mark the adult stage.

Subularia distorta (Pease). Fig. 13c, d.

1860. *Leiostraca distorta* Pease, P. Z. S., p. 438.

1866. *Leiostraca distorta* Pease, Sowerby, Conch. Icon., Pl. 3, fig. 15.

1886. *Eulima peasci* Tryon, Man. Conch. VIII, p. 281.

One of two specimens in the Pease collection, No. 31706 Mus. Comp. Zool., is figured. The spire is bent to the right, and in the upper part it bends towards the ventral side. There are linear, inconspicuous, impressed varix-lines on the right side of the last two whorls. In a basal view the shell is seen to be strongly compressed between dorsal and ventral sides (fig. 13c). The ventral side is flattened near the base, the flattening bounded by a longitudinal angulation on the left side. The internal axis is faintly visible

⁹See Hedley, *Proc. Linn. Soc., N. S. Wales*, 1910, p. 505.

through the bluish-white shell. The suture is very inconspicuous, indeed difficult to see, not distinct as the line figure shows. There is a wide border below the suture, bounded by a white line, on the last two whorls. The aperture is very narrow and long, the inner lip nearly straight, calloused. The outer lip curves forward somewhat in the middle.

Length 5.75, diam. 2 mm.

Length 5.6, diam. 1.8 mm.; about 7 whorls.

This species is related to *S. metcalfei*. It also has some resemblance to *Melania distorta* Philippi, *Eulima curva* Jeffr., and *E. incurva*

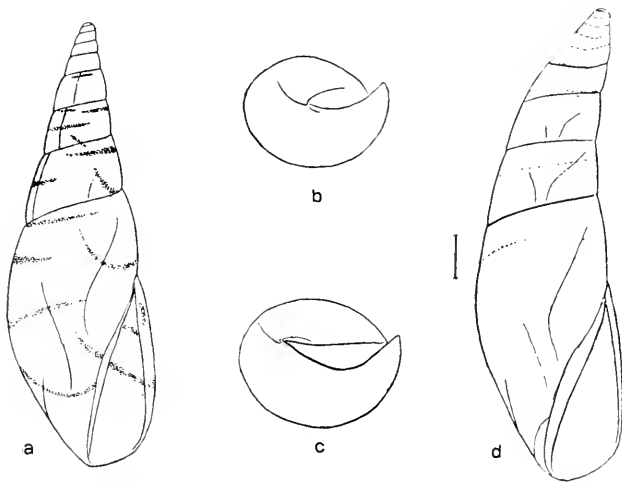


Fig. 13a, b.—*Subularia metcalfei*. c, d. *S. distorta*. Figs. b and c are basal outlines.

Ren., of the Mediterranean. In these the mouth is somewhat narrower than in *Melanelia*, and a single series of linear varices runs up the right side and curves towards the dorsal side as usual; but they do not have the other characters of *Subularia*.

On account of the prior use of the name *distorta* for species belonging to *Eulima* (*Melanelia*), Tryon renamed this species *E. peasei*; but if we consider *Subularia* a group of generic rank there is no conflict of names.

***Niso sandwichensis* Sowerby.**

Niso sandwichensis Sowb., Conch. Icon. XV, Pl. 1, fig. 1 (Sandwich Is.).

Niso sandwichensis Sowb., Tryon, Man. Conch. VIII, p. 288.

EXPLANATION OF PLATES XIV AND XV.

NOTE.—Figs. 1 to 6a are twice natural size; figs. 7 to 11, $3\frac{1}{4}$ times nat. size.

PLATE XIV.—Figs. 1, 1a.—*Melanella major* (Sowerby). Tahiti.

Figs. 2, 2a.—*Melanella robillardiana* n. sp., Mauritius.

Figs. 3, 3a.—*Melanella labiosa* (Sowb.). Hilo, Hawaii.

Figs. 4, 4a.—*Melanella cumingi medipacifica* n. subsp., Hilo, Hawaii.

Figs. 5, 5a.—*Melanella thaunumi* n. sp., Hilo, Hawaii.

Figs. 6, 6a.—*Melanella thaunumi*, a younger individual of the same lot.

Fig. 7.—*Melanella vafra* n. sp. Variety from Hilo, Hawaii.

Figs. 8, 8a.—*Melanella aciculata* (Pse.). Hilo, Hawaii.

Fig. 9.—*Melanella kahoolawensis* n. sp., Kahoolawe.

Figs. 10, 10b.—*Scalenostoma apiculatum* (Souv.). Hilo, Hawaii.

Fig. 11.—*Melanella opaca* (Sowb.). Hilo, Hawaii.

PLATE XV.—Figs. 1, 2.—*Alcyna rubra* Pse. Pease coll., 31720 M. C. Z.

Fig. 3.—*Alcyna kapiolaniae* n. sp., 117052 A. N. S. P.

Fig. 4.—*Alcyna lineata* Pse. Pease coll., 31724 M. C. Z.

Figs. 5, 6.—*Alcyna subangulata* var. *flammulata* n. var. Pease coll., 31723 M. C. Z.

Fig. 7.—*Alcyna subangulata virgata* n. subsp., 116297 A. N. S. P.

Fig. 8.—*Alcyna kuhnsi humerosa* n. subsp., 117049 A. N. S. P.

Fig. 9.—*Alcyna kuhnsi* n. sp., 117053 A. N. S. P.

Fig. 10.—*Phasianella molokaiensis* n. sp., 117054 A. N. S. P.

Fig. 11.—*Phasianella variabilis kahoolawensis* n. subsp., 116188 A. N. S. P.

Figs. 12, 14.—*Phasianella thaunumi* n. sp., 117053 A. N. S. P.

Fig. 13.—*Phasianella bryani* n. sp., 116320 A. N. S. P.

DERMAPTEROLOGICAL NOTES.

BY MORGAN HEBARD.

In the many large exotic collections at hand, but very few specimens of Dermaptera are to be found. In no case are the forms of the order sufficiently represented to give anything but a fragmentary faunistic knowledge, excepting in the West Indian, Mexican, Costa Rican and Panamanian series, which are being reported on separately. The study of these important series has offered an opportunity to determine the one hundred and four specimens discussed below. In several instances features of decided interest are encountered, the types of several old species are discussed, while among the thirty-one species recorded, one new genus and six new species are found.

Our hearty thanks are accorded to Dr. F. E. Lutz, of the American Museum of Natural History, Dr. Samuel Henshaw, of the Museum of Comparative Zoology and Prof. Lawrence Bruner, of the University of Nebraska, not only for the loan of undetermined material, but of historic specimens and types as well, enabling us to work out a number of vexing problems. Mr. A. N. Caudell, of the United States National Museum, has also helped us greatly, but the rule of his institution, preventing the loan of types, has obliged us to omit the consideration of certain species which bear on our work, the status and relationship of which is not at present clearly understood.

PYGIDICRANIDÆ.

PYRAGRINÆ.

Pyragra fuscata Serville.

1831. *Pyragra fuscata* Serville, Ann. Sci. Nat., XXII, p. 34. [Cayenne.]
Chunchamayo, Peru, 1 ♀, [A. N. S. P.]

Pyragropsis brunnea (Burr).

1909. *Pyragra brunnea* Burr, Ann. Mag. Nat. Hist., (S), III, p. 254. [Fon-
teboa, Brazil (*nec* Peru); Iguapo, Peru.]

Kangaruma, British Guiana, VII, 13, 1911, (F. E. Lutz; in forest trail),
1 ♂, [A. M. N. H.]

Kaitour, British Guiana, VIII, 12, 1911, (F. E. Lutz; taken by sifting),
1 ♀, [A. M. N. H.]

The male is in every way typical. The female is larger; length of body, 13.2, of forceps 2.9 mm. This female has the head, pronotum, tegmina and exposed portion of wings lustreless blackish brown;

this, under the microscope, found to be due to a thin but solid coating of some foreign matter.

LABIDURIDÆ.

PSALINÆ.

Psalis festiva Burr.

1910. *Psalis festiva* Burr, Trans. Ent. Soc. London, 1910, p. 182. [Bahia, Brazil.]

Cariacuito, Venezuela, I, 1911, (S. Brown), 2 ♀, [A. N. S. P.].

We are by no means convinced that this insect is merely a small, non-melanistic, wingless form of *P. gagathina*, as indicated by Burr.¹ The truncate tegmina alone are visible in these specimens. Length of body 15.8 and 17.5, of forceps 3.4 and 4 mm.

The head is mahogany red, the pronotum burnt sienna. The tegmina are mars yellow, except narrowly on the caudal margin and more broadly on the cephalic margin, where they are blackish brown, like the abdomen and forceps. The limbs are clear mars yellow.

Spandex percheron (Guerin and Percheron).

1838. *Forficula percheron* Guerin and Percheron, Gen. Ins., Orth., Pl. VII. [French Guiana.]

San Carlos, Costa Rica, 1 ♂, type of *Psalis pulchra* Rehn, [U. S. N. M.].

Trinidad, (H. D. Chipman), 2 ♀, types of *Labia pictipennis* Bruner, [Bruner Cln.].

Caparo, Trinidad, VI and VIII, 1913, (S. M. Klages), 1 ♂, 1 ♀, [A. N. S. P. and Hebard Cln.].

Kaiteur, British Guiana, VIII, 11, 1911, (Crampton), 1 ♀, [A. M. N. H.].

Rio Caiary-Uaupes, Amazonas, Brazil, XI, 1906, (H. Schmidt), 1 ♂, [A. M. N. H.].

The original figure of this distinctive species is excellent, and we do not understand why Burr, after placing *pulchra* (with a query) and *pictipennis* in the synonymy under *percheron* in the *Genera Insectorum*, has more recently mentioned and also designated *pulchra* as genotype of *Spandex*.²

These specimens show little variation except in pronotal coloration. The pronotum varies from solid Sanford's brown, to almost solid blackish bay, two examples showing an intermediate and maculate condition.

The Brazilian specimen differs from all others before us in having the femora heavily and very broadly annulate with blackish brown.

The male penultimate ventral abdominal segment is remarkable

¹ *Ann. k.-k. Naturhist. Hofmus. Wien*, XXVI, p. 334, (1912). Burr also included there *pulchra* of Rehn, actually an absolute synonym of *Spandex percheron* (Guerin and Percheron).

² *Jour. Royal Microsc. Soc.*, 1915, p. 537, (1915).

in having the distal margin narrowly and very weakly emarginate mesad, slightly thickened at each extremity of this emargination and with a minute, elongate-conical styloform process situated in each, directed caudad. From the original description of Burr's *Psalis rosenbergi*, it would appear probable that this condition is also found in that species and that it is likewise a member of the genus *Spandex*.

Minute tubercles are found along the caudal margins of the fifth to ninth dorsal abdominal segments, particularly in females, these tubercles strongest laterad, from each of which springs a very elongate hair.

***Metalabis saramaccensis* (Zacher).**

1911. *Eu[labis] saramaccensis* Zacher, Zool. Jahrb., Abth. Syst., XXX, p. 378. [Sanboden, Saramacca District, and Paramaribo, Dutch Guiana.]. Paramaribo, Dutch Guiana, VIII, 26, 1911, (F. E. Lutz), 1 small juv., [A. M. N. H.].
 Tukeit, British Guiana, VII, 21, 1911, (F. E. Lutz; under boat), 1 small juv., [A. M. N. H.].
 Kaiteur, British Guiana, VIII, 11 and 12, 1911, (F. E. Lutz), 1 ♂, 2 ♀, 1 large juv. ♂, 1 small juv., [A. M. N. H.].
 Ireng River to Roraima, Brazil, VIII, 6, 1911, (Crampton), 1 ♀, [A. M. N. H.].

The brief, longitudinal, rounded, dorso-lateral keels of the disto-dorsal abdominal segment readily distinguish males of this insect from the numerous other generally similar species of the *Psalides*.

The present series averages smaller than the type series as measured by Zacher ("Long. tot. 19-22 mm."), but no other features to warrant specific separation appear to exist. Length of body, ♂, 12.; ♀ 11.5 to 12.; of forceps, ♂, 2.6; ♀, 2.3 to 2.4 mm.

***Euborellia scudderi* (Bormans).**

1900. *Ps[alis] scudderi* Bormans, Ann. Mus. Civ. Stor. Nat. Genova, (2), XX, p. 449. [Puerto 14 de Mayo, Upper Paraguay [now in Bolivian Chaco]; Olivenza, Amazon River [Brazil].]
 Chanchamayo, Peru, 3 ♂, [A. N. S. P.].

We are not certain that these specimens represent *scudderi*, as none of them have the wings showing. They are unquestionably conspecific with the material from Pará, Brazil, recently recorded, with a question, as *scudderi* by Rehn.³

There is little doubt but that *scudderi* Bormans and *Psalis burri* Borelli are referable to *Euborellia*, these species being, in fact, closely related to *Euborellia janeirensis*. The present specimens, when compared with males of *janeirensis* before us, are found to differ only in the slightly heavier build, complete and rectangular tegmina and

³1916. *Trans. Am. Ent. Soc.*, XLII, p. 218.

slightly heavier punctulation and lateral carinae of the dorsal abdominal segments.

Euborellia ambigua (Borelli).

1906. *Anisolabis ambigua* Borelli, Boll. Mus. Zool. Anat. comp. Univ. Torino, XXI, No. 531, p. 3. [Jesus Maria River, Costa Rica.]

Port of Spain, Trinidad, III, 4, 1910, (Crampton & Lutz), 1♂, [A. N. S. P.].

This species is closely related to *Euborellia janeirensis*. The antennae are not annulate.

Euborellia annulipes (H. Lucas).

1847. *Forficisila annulipes* Lucas, Ann. Soc. Ent. France, (2), V, p. LXXXIV. ["Jardin des Plantes, Paris"; probably introduced.]

Tomb of Maximus, Rome, Italy, VII, 24, 1908, (M. Hebard; under stone on Campagna), 1 juv., [Hebard Cln.].

LABIDURINÆ.

Labidura xanthopus (Stål).

1855. *Forficisila xanthopus* Stål, Oefv. Vet.-Akad. Förh., XII, p. 348.

Caracaraña, Argentina, (L. Bruner), 1♂, 1♀, [A. N. M. H.].

Labidura riparia (Pallas).

1773. *Forficula riparia* Pallas, Reise, Russ. Reichs, pt. II, p. 727. [Shores of Irtysh River, western Siberia.]

Biskra, Algeria, 1889, (Desbrothers), 1♂, [Hebard Cln.].

Tamatave, Madagascar, 1♀, [Hebard Cln.].

The specimen from Biskra is rather pale, with wings scarcely showing beyond the tegmina and with the two, latero-median projections of the disto-dorsal abdominal segment distinct. The specimen from Tamatave is rather dark, with wings projecting one millimeter.

Forcipula despinosa new species. Pl. XVI, fig. 1.

This is the only species of the genus which has the sides of the abdomen smooth. This character would assign the species to *Labidura* in the existing keys, but there is no question that *Forcipula* is the genus to which the species properly belongs, and it is, indeed, not widely separated from other Indian species, as might be inferred from that single feature.

In the body pubescence the species agrees with *F. trispinosa* and *F. pugna*, but shows closer similarity to *F. quadrispinosa* in the shape of the forceps. It is very distinctive in entirely lacking projections of the dorsal abdominal segments and in the microscopically pitted surface of the metazona, tegmina and wings.

Type: ♂; Northern India. [Hebard Collection, Type No. 437.]

Size slightly smaller, form similar to that of *quadrispinosa*. Head, pronotum, tegmina, exposed surface of wings and dorsal surface of

abdomen, except ultimate segment, very finely pubescent, each minute hair springing from a minute pit, these smaller on head and prozona.⁴ Head otherwise similar to that of *quadrispinosa*. Antennæ with first and third joints subequal in length, fourth joint about half again as long as broad.⁵ Tegmina and wings fully developed, broadly rounding laterad, not showing a feeble precurrent keel as in *quadrispinosa*. Dorsal surface of abdomen without projections, but with segments, to the penultimate, milled at their caudal margins; ultimate segment narrower than in *quadrispinosa*, width not two and one-half times length,⁶ with a decided medio-longitudinal sulcus and with surface showing microscopic, irregular, impressed lines, which are strongest meso-distad. Pygidium declivent, large, fitting tightly between forceps, roughly rhomboidal, with distal portion curving inward and margin there broadly convex, surface convex distad, showing two minute, blunted projections. Forceps elongate, internal margin broadly concave in slightly more than proximal half, with minute widely spaced teeth, thence straight, with more numerous, slightly larger serrations to the distal third of this portion where it is concave and smooth to the apex: shaft in proximal fourth heavy, triquetrous, tapering, with dorsal margin smooth, thence slender, nearly cylindrical to slightly beyond middle point, where it is slightly enlarged and more flattened horizontally, tapering distad to the acute apex. Ventral surface of abdomen strongly pubescent, distal margin of penultimate segment subtriangularly convex. Limbs rather long, slender; caudal metatarsus hairy, in length equalling that of the third tarsal joint, with a heavy fringe of hairs along the external margin; tarsal claws elongate and slender.

Length of body, 16.2; of pronotum, 2.4; of tegmen, 4.9; of forceps 8.; width of pronotum, 2.3; of ultimate dorsal abdominal segment, 3.2 mm.

Head, pronotum, tegmina, exposed portion of wings and abdomen chestnut brown, slightly darker on face, shading to claret brown on

⁴ In *quadrispinosa* the head is much more weakly pubescent, the prozona almost smooth and hairless, the tegmina and exposed surface of wings more polished, finely granulose and hairless, and the metazona and dorsal surface of the abdomen, except the ultimate segment, is more thickly and minutely granulose, with hardly any hairs.

⁵ In *quadrispinosa* the first joint is longer than the combined length of the second and third, the fourth joint as broad as long.

⁶ Burr's figures show, in his *Fauna British India, Dermapt.*, that he meant rectangular, when he characterized this segment as square, for the species of *Forcipula*.

polished ultimate dorsal abdominal segment, forceps claret brown. Palpi and limbs cinnamon-buff.

The type is unique.

Forcipula quadrispinosa (Dohrn).

1863. *L[abidura] quadrispinosa* Dohrn, Stett. Ent. Zeit., XXIV, p. 311. [Tranquebar, India; Ceylon.]

Phuc-Son, Annam, XI and XII, (for H. Fruhstorfer), 1 ♂, [Hebard Cln.]

This specimen fully agrees with Burr's more adequate diagnosis of the species.⁷

PARISOLABINÆ.

Pseudisolabis elegans new species. Pl. XVI, figs. 2, 3.

The present species is related to *P. burri* and *P. tenera*, easily separable in the male by the much more elongate and evenly curved forceps. It agrees more nearly with *tenera* in form, coloration and antennal joints, but with *burri* in the form and contour of the ultimate dorsal abdominal segment and proportions of the tarsal joints.

Type: ♂; Kulu, Kangra, India. (M. M. Carleton.) [Museum of Comparative Zoology.]

Size rather small; form compact, greatest width mesad on abdomen. Dorsal surface shining, of head and pronotum smooth with hardly any hairs, of abdomen exceedingly finely pubescent, each minute, microscopic hair springing from a minute, microscopic pit, proximal segments with a few small bristles laterad. Head with sutures subobsolete, a few very feeble depressions indicated meso-caudad on the occiput. Antennæ with third joint elongate, distinctly longer than sixth, (in the majority of specimens longer than any other excepting the first. The fourth joint is normally wider than long, but varies to appreciably longer than wide.) Pronotum wider than long, rectangular, with angles sharply rounded; surface weakly convex with a feeble medio-longitudinal sulcus, which is obsolete caudad; concave narrowly laterad, the concavity feebly extending mesad at the juncture of the prozona and metazona, which are fused without further demarkation; lateral margins cingulate. Mesotum and metanotum very short. Dorsal abdominal segments simple, with straight caudal margins, which are not produced laterad and are broadly convex latero-ventrad; ultimate segment very short, fully four times as wide as long, slightly depressed and declivent distad in mesal section, with a feeble medio-longitudinal sulcus; caudal margin truncate, feebly rotundato-angulate produced above

⁷ *Fauna British India, Dermapt.*, p. 94, (1910).

the forceps. Pygidium declivent; subtrigonal, with apex rounded; moderately tumid. Forceps simple, elongate, gradually tapering and evenly curved to the aciculate apex, cylindrical except in median portion, where the inner surface is flattened. Penultimate ventral abdominal segment strongly transverse; caudal margin very broadly convex laterad, very feebly concave in broad mesal portion. Limbs short, femora stout. Caudal tibia (normally) with two minute, disto-ventral spines, caudal metatarsus hairy ventrad, with two rows of minute spines and a heavy internal fringe of hairs. Caudal metatarsus slightly longer than combined length of second and third tarsal joints, second joint more than half as long as third.

Allotype: ♀; same data as type. [Museum of Comparative Zoology.]

Agrees with male except in the following features: Disto-dorsal abdominal segment very much smaller, projections above forceps slightly broader. Forceps very short, triquetrous, tapering to the aciculate apex and very weakly curved inward distad; margins smooth, but internal margin feebly lamellate proximad. Penultimate ventral abdominal segment with distal margin broadly rounded, showing a feeble mesal emargination.

Measurements (in millimeters).

	♂ Length of body.	Length of pronotum.	Width of pronotum.	Width of abdomen.	Length of forceps.
<i>Type</i>	9.2	1.7	2.2	2.8	3.
<i>Paratype</i>	8.3	1.6	1.9	2.4	2.8
♀					
<i>Allotype</i>	9.	1.8	2.3	2.9	1.8
<i>Paratype</i>	10.2	1.8	2.3	2.8	1.8
<i>Paratype</i>	10.	1.9	2.3	2.8	1.9

General color shining bay, deepest on head, forceps and distad on abdomen, tarsi paler.

Specimens Examined.—5; 2 males and 3 females.

Kulu, Kangra, India, (M. M. Carleton), 2♂, 3♀, *type, allotype, paratypes*. [M. C. Z., Hobard Cln. and A. N. S. P.]

LABIIDÆ.

SPONGIPHORINÆ.

Spongiphora bogotensis (Rehn).

1905. *Opisthocosmia bogotensis* Rehn, Proc. U. S. Nat. Mus., XXIX, p. 511, fig. 8. [Bogotá, Colombia.]

1911. *Pilex bogotensis* Shelford, Proc. U. S. Nat. Mus., XXXVIII, p. 460. (New genus based on Rehn's type.)

Compared with material of the genotype, *S. croceipennis*, the unique type of the present species, now before us, is found beyond doubt

to be a member of the genus *Spongiphora*. The peculiar and distinctive character of the second tarsal joint in the present genus clearly led Rehn to refer the species incorrectly to the Forficulidæ, but Burr's erection of a new genus for *bogotensis* is unwarranted and would not have occurred had comparisons been made.

The species has the general facies, head, proximal antennal joint, tegmina, wings, tarsal joints and general character of proximal dorsal abdominal segments, pygidium and forceps as typical for *Spongiphora*. In this genus, the second tarsal joint is nearly as long as the third and both are enlarged; the second is, however, hardly broader than the third and, enlarging suddenly in the proximal portion, does not form the heart-shaped lobe characteristic of the Forficulidæ. The roughness of the abdominal surface in *bogotensis*, and particularly of the specialized ultimate dorsal segment, are striking features of specific value. The tarsal joints are thickly supplied with hairs ventrad, as in *croceipennis*, these hairs, however, being coarser in the present species.

***Microvostox basalis* (Burr).**

1912. *Spongovostox basalis* Burr, Ann. k.-k. Naturhist. Hofmus. Wien, XXVI, p. 337, fig. 16. ["El Zumbador" = El Tumbador, San Marcos, Guatemala.]

Cacao, Trece Aguas, Alta Vera Paz, Guatemala, III, 27 to IV, 26, 1906, (Barber and Schwarz), 3 ♂, 2 ♀, 5 juv.,⁹ [U. S. N. M.].

Burr's figure is excellent. Though the males of this species and of *M. bilineatus* (Scudder) are extremely different, the females are by no means easily separated. Those before us of *basalis* have the pygidium with disto-lateral projections smaller and very slender, the proximal dorso-internal brief shelf of the forceps as broad proximad as distad, the metazona entirely translucent¹⁰ and the longitudinal pale bands at the tegminal shoulders and proximo-external pale areas of the exposed portion of the wings yellowish. In females of *bilineatus* the disto-lateral projections of the pygidium are acute-angulate, but scarcely project caudad of the distal margin, the proximal dorso-internal brief shelf of the forceps narrows proximad, the pronotum is only slightly paler narrowly laterad on the metazona and the pale markings of the tegmina and wings are pale buffy.

⁸ Recorded, in 1907, by Caudell as *Spongophora pygmaea*, and a pair of the same series by Burr, in 1910, as *Spongophora ghilianii*.

⁹ Recorded by Caudell, in 1907, as *Sparatta flavipennis*.

¹⁰ This naturally more noticeable laterad.

LABINÆ.

*Labia barberi*¹¹ new species. Pl. XVI, fig. 1.

1907. *Labia bilineata* Caudell, (not of Scudder, 1869), Proc. U. S. Nat. Mus., XXXIII, p. 173. [Cacao, Trece Aguas, Alta Vera Paz, Guatemala.]

1910. *Labia bilineata* Burr, (not of Scudder, 1869), Proc. U. S. Nat. Mus., XXXVIII, p. 453. (Same specimen.)

The marking of pronotum and organs of flight are similar to those found in *Microstox bilineatus* (Scudder),¹² the male of which species was unknown at the time this specimen was recorded by Caudell and Burr.

The present species is an aberrant member of the Championi Group. It is distinctive in the remarkably large eyes and features of the male pygidium and foreceps.

Type: ♂; Cacao, Trece Aguas, Alta Vera Paz, Guatemala. April 20, 1906. (Barber and Schwarz.) [U. S. National Museum.]

Size very small, form slender. Head smooth, shining, convex, but with occiput weakly bilobate, due to presence of a distinct medio-longitudinal suture caudad. Eyes large, fully twice as long as cheeks.¹³ Antennæ with first joint large, nearly as long as combined length of second and third joints; second joint minute; third elongate-expanding slightly only distad; fourth three-quarters as long as third; fifth slightly longer than fourth; succeeding joints increasing slightly in length distad, ovate, the longest slightly more than twice as long as broad. Pronotum with form as in *L. micans* Hebard, smooth, with a single bristle at each cephalic angle, length appreciably less than greatest (caudal) width; caudal margin feebly convex; median portion of surface weakly convex, triangular, with apex truncate at caudal margin of pronotum, remaining narrow lateral portions deplanate, feebly ascendent toward lateral margins. Tegmina and wings fully developed; smooth, shining, hairless. Abdomen polished, moderately well supplied with hairs laterad; disto-lateral portions of segments not produced, except of eighth, which is broadly rounded. Ultimate dorsal abdominal segment smooth; caudal margin transverse between foreceps, feebly concave laterad. Pygidium twice as long as mesal width, weakly declivent, convex, with disto-lateral productions deplanate; lateral margins of proximal portion parallel, but each showing a brief convexity; distal portion bifurcate, forming two large, acute-angulate, slightly divergent projections, whose

¹¹ We take pleasure in naming this interesting species for its collector, our friend Mr. H. S. Barber, an enthusiastic collector and entomological student.

¹² See Hebard, *Trans. Am. Ent. Soc.*, XLIII, (1917).

¹³ The large eyes are remarkable in the genus *Labia*. A closer approach to the condition here found, is met with in species of the genus *Microstox*.

margins show a very weak convexity. Forceps nearly straight, showing a weak and regular inward curvature in distal half; surface well supplied with hairs; shaft triquetrous in proximal half, with internal perpendicular face deplanate and ventro-internal margin feebly cingulate, bearing at its distal extremity a very minute but distinct tooth, for one-third the remaining distance the shaft is cylindrical, thence to the aciculate apex flattened cylindrical, with ventro-internal margin again feebly cingulate. Penultimate ventral abdominal segment with distal margin weakly convex laterad, feebly and broadly concave mesad. Caudal metatarsus equal to combined length of second and third tarsal joints.

Length of body, 3.67; of pronotum, .68; of tegmen, 1.29; of exposed portion of wing, .7; of forceps, 1.36; width of pronotum, .75 mm.

Head and abdomen shining blackish chestnut brown; median portion of pronotum, tegmina and wings slightly paler. Lateral portions of pronotum, shoulders of tegmina in an elongate maculation and exposed portion of wings proximo-laterad in a rounded maculation, warm buff. Forceps ochraceous-tawny. Limbs buffy; femora, in all but distal portion, suffused with chestnut brown.

The type is unique.

Labia curvicauda (Motschulsky).

1863. *Forficulisa curvicauda* Motschulsky, Bull. Soc. Nat. Moscou, XXXVI, p. 2, Pl. II, fig. 1. [Nura-Ellia Mountains, Ceylon.]
Trinidad, British West Indies, VI, 1905, (A. Busek), 1 ♂,¹⁴ [U. S. N. M.].

Labia arcuata Scudder. Pl. XVI, fig. 6.

1876. *Labia arcuata* Scudder, Proc. Bost. Soc. Nat. Hist., XVIII, p. 257. [Vassouras, 100 miles north of Rio de Janeiro, Brazil.]
Cacao, Trece Aguas, Alta Vera Paz, Guatemala, III, 24 to IV. 20, 1906, (Barber and Schwarz), 4 ♂, 1 ♀,¹⁵ [U. S. N. M.].
Port Limon, Costa Rica, (F. Knab), 1 ♀, [U. S. N. M.].
Carillo, Costa Rica, (Schild and Burgdorf), 1 ♀,¹⁶ [U. S. N. M.].

Labia nodifer¹⁷ new species. Pl. XVI, fig. 5.

1907. *Labia arcuata* Caudell, (in part not of Scudder, 1876), Proc. U. S. Nat. Mus., XXXIII, p. 173. [Cacao, Trece Aguas, Alta Vera Paz, Guatemala.]

The present insect is very closely related to *Labia arcuata* Scudder,

¹⁴ Recorded in 1907 by Caudell as *Labia trinitatis*.

¹⁵ Correctly recorded in 1907 by Caudell, but the series of the following species there included under this name.

¹⁶ Recorded by Rehn in 1903 as *Labia annulata*, of which he considered *arcuata* a synonym.

¹⁷ In allusion to the knobbed tooth of the male forceps.

agreeing fully in general appearance and structure, except in the following characters. The large series before us, though showing frequent slight individual variations, contains no specimen showing a tendency toward *arcuata*.

A. ♂. Seventh, eighth and ninth dorsal abdominal segments rather sharply produced and distinctly keeled. Pygidium with lateral angles produced in minute, acute, conical projections. Forceps with inner tooth showing an enlarged and knob-like apex.¹⁸

♀. Pygidium with lateral angles produced in slender, almost aciculate projections, each nearly one-third as long as the distance between their bases *Labia nodifer* new species

AA. ♂. Eighth and ninth dorsal abdominal segments weakly produced and keeled. Pygidium with lateral angles produced in moderately stout, acute, conical projections. Forceps with inner tooth tapering to acute apex.

♀. Pygidium with lateral angles produced in minute, acute points, each scarcely longer than its proximal width. *Labia arcuata* Scudder

In addition to the diagnostic characters given above, we would add the following to the description of the species.

Type: ♂; Cacao, Trece Aguas, Alta Vera Paz, Guatemala. April 26, 1906. (Barber and Schwarz.) [U. S. National Museum.]

Size minute, form moderately robust. Entire insect thickly covered with microscopic hairs. Head with vertex moderately convex, showing a very feeble medio-longitudinal suture. Eyes decidedly less than cheeks in length. Antennæ with first joint equalling combined length of second and third joints; second quadrate; third elongate; fourth about three-quarters as long as third; fifth nearly as long as third; succeeding joints elongate ovate, the longest over four times as long as broad. Tegmina and wings normal for group. Scent glands distinct, but not strongly developed. Pygidium perpendicular, broader than long; surface very feebly bilobate, with few subobsolete rugæ; lateral margins feebly and evenly convergent distad; caudal margin, between disto-lateral projections, feebly concave. Forceps strongly bowed, enclosing a mitre-shaped area, as broad as long when the arms touch at their apices; excavate in median internal portion, proximad with a decided longitudinal flange and just beyond its extremity is situated ventrad a decided tooth. Ventral surface of abdomen thickly covered with

¹⁸ The proximal ventro-internal flange of the forceps varies in intensity in both *nodifer* and *arcuata*, but shows an average more decided development in the latter species.

minute, short hairs. Penultimate ventral abdominal segment with distal margin broadly convex between the forceps. Caudal metatarsus elongate and slender, distinctly longer than combined length of second and third tarsal joints.

Allotype: ♀; same data as type, but taken March 29, 1906. [U. S. National Museum.]

Agrees with male except in the feature noted above and as follows: Pygidium subrectangulate, slightly broader than long, lateral margins very feebly and evenly convergent distad. Forceps widely separated;¹⁹ shaft slender, simple, cylindrical, tapering and weakly incurved in distal half to the aciculate apex.

Measurements (in millimeters).

♂	Length of body.	Length of pronotum.	Width of pronotum.	Length of tegmen.	Length of forceps.
Cordoba, Mexico	5.4	.82	.82	1.63	1.16
<i>Type</i> , Cacao	4.7	.8	.8	1.6	1.22
<i>Paratypes</i> , (7) Cacao	3.8-5.2	.71-.77	.73-.78	1.44-1.3	1.09-1.16
♀					
Fortin, Mexico	5.	.88	.7	1.65	1.63
<i>Allotype</i> , Cacao	4.4	.75	.68	1.45	1.38
<i>Paratypes</i> , (11) Cacao	4. -4.8	.75-.81	.7 - .82	1.36-1.5	1.22-1.29

The series shows quite marked individual size variation. This is greatest in pronotal proportions and length of forceps.

Head dark brown, antennae with proximal joints dark, one or two distal joints pale. Pronotum, tegmina and wings shining black, weakly metallic, showing a faint bluish lustre in some lights. Limbs dark brown, becoming slightly paler toward the apex of the femora and base of the tibiae.²⁰

Specimens Examined: 22; 8 males, 13 females and 1 immature individual.

Fortin, Vera Cruz, Mexico, XI, 1887. (L. Bruner), 1 ♀, [Hebard Cln.].

Cordoba, Vera Cruz, Mex., III, 1908. (F. Knab; in bromeliads), 1 ♂, [U. S. N. M.].

Cacao, Trece Aguas, Alta Vera Paz, Guatemala, III, 29, and IV, 26, 1906, (Barber and Schwarz), 7 ♂, 12 ♀, *type*, *allotype*, *paratypes*, 1 juv., [U. S. N. M.].

¹⁹ See Pl. XVI, fig. 7.

²⁰ In some individuals the contrast is more decided than in others.

Prolabia modesta (Bruner).

1906. *Labia modesta* Bruner, Jour. N. Y. Ent. Soc., XIV, p. 137.²¹
[Trinidad.]

The unique female type of this species is now before us and is found to represent a species of the Unidentata Group of the genus *Prolabia*.

It shows very close relationship to the recently described *Prolabia dominica* Hebard, differing from females of that species in the decidedly larger size, exposed portion of wings with a large proximo-external yellowish buffy spot and ultimate dorsal abdominal segment with a few minute rugæ in the medio-distal depressed area, before the marginal row of minute rugæ, which row is broken mesad. The males will probably show much more decided differences between these species.

The measurements of this type are: length of body 7.5, of pronotum 1.2, of tegmen 2.1, of exposed portion of wing 1.4, of forceps 2.2; width of pronotum 1.15, greatest width of abdomen 1.8 mm.

Both *modesta* and *dominica* are distinctive in the females having no large, blunt, dorso-proximal projection on the internal face of the forceps.

Prolabia ascensionis new species. Pl. XVI, figs. 8, 9.

This small insect, which is shining reddish brown with a pale spot on the exposed portion of each wing, is of the characteristic color type of the Unidentata Group of the genus *Labia* and of numerous species of the *Spongiphorina*.

The male pygidium is quadrate as in *P. arachidis*, but with distal portion differently sculptured and the forceps, though bidentate, much as is normal in that species, are less flattened. The insect is smaller and distinctly less robust than *arachidis* and does not have the befouled, greasy appearance of that insect.

Type: ♂; Ascension Island, South Atlantic. [Museum of Comparative Zoology.]

Size rather small; form moderately robust, but not nearly as robust as *arachidis*. Head much as in that species, sutures subobsolete. Antennæ (in series with eleven to thirteen joints), with third about equal in length to first, fourth slightly over half as long as third;

²¹ Professor Bruner has very kindly sent for examination the types of the species of Dermaptera described by him in this paper. The synonymy will be discussed under the species involved, in the series of dermapterological studies about to appear, the names being assignable as follows:

Labia modesta = *Prolabia modesta* (Bruner).

Labia pictipennis = *Spandex percheron* (Guerin and Percheron).

Labia insularis = *Vostox brunneipennis* (Serville).

Labia trinitatis = *Labia dorsalis* (Burmeister).

succeeding joints pyriform, the longest about three times as long as broad. Pronotum subquadrate; lateral margins cingulate and very feebly diverging caudad, caudal angles more broadly rounded than cephalic angles, caudal margin very weakly convex; prozona weakly convex, metazona subdeplanate, very weakly convex caudad. Tegmina fully developed, nearly twice as long as pronotum; wings fully developed, extending beyond tegmina distinctly more than pronotal length, costal margin rounding broadly distad to sutural margin. Dorsal abdominal segments with third showing very weakly developed stink glands, fourth with these glands slightly larger, eighth and ninth segments feebly produced dorso-laterad with margin there convex. Ultimate dorsal abdominal segment smooth, triangularly weakly concave meso-distad, not three times as broad as long, rectangular, with caudal margin truncate. Pygidium quadrate, feebly declivent; surface in minute proximo-mesal area triangularly feebly concave, thence feebly convex on each side, with surface showing minute, scattered projections; lateral margins almost parallel, with a few, minute median projections, very feebly convex to disto-lateral angles, which are terminated by a small point; thence the distal margin on each side is briefly very weakly oblique to small rounded knobs, between which the median portion, comprehending over half the distal margin, is feebly concave. Forceps much as in *arachidis*, cylindrical, moderately flattened horizontally, but not as much as in that species; shaft feebly convex, with ventro-internal margin feebly lamellate to just beyond pygidium, this lamella there terminating in a minute tooth, directed caudad, and with a similar tooth, but perpendicular to the shaft, slightly more than half the distance from the proximal tooth to the apex. Caudal metatarsus appreciably longer than combined length of second and third tarsal joints, ventral surface well supplied with hairs.

Allotype: ♀; same data as type. [Museum of Comparative Zoology.]

Agrees with type except in the following features. Pygidium much as in this sex of *arachidis*, very briefly and broadly triangularly deplanate proximad, thence with surface declivent and concave, produced ventrad between the forceps in a small, subquadrate projection, with disto-lateral angles produced in minute, conical projections and ventral surface very feebly convex and rugulose. Forceps straight to near apex, feebly triquetrous, enlarged at base, thus embracing the pygidium, thence tapering to the moderately incurved apices, with internal face and ventral margin supplied with a few blunt tubercles.

Measurements (in millimeters).

	Length of ♂ body.	Length of pronotum.	Width of pronotum.	Length of tegmen.	Exposed length of wing.	Length of forceps.
<i>Type</i>	6.6	1.2	1.25	2.	1.5	2.8
<i>Paratype</i> ...	6.5	1.2	1.25	2.1	1.4	2.7
♀ <i>Allotype</i>	6.1	1.1	1.2	2.1	1.3	1.9

General coloration (dried after immersion in alcohol) shining chestnut brown, with distal portion of abdomen and, in the type, the tegmina paler. Wings with exposed surface warm buff, with apex and sutural margin chestnut brown. Femora, except brief distal portion, chestnut brown. Tibiæ, tarsi and brief distal portion of femora paler, suffused warm buff.

Specimens Examined.—3; 2 males and 1 female.

Ascension Island, South Atlantic, 2♂, 1♀, *type, allotype, paratype*, [M. C. Z. and Hebard Cln.].

***Prolabia arachidis* (Yersin).**

1860. *Forficula arachidis* Yersin, Ann. Soc. Ent. France, (3), VIII, p. 509, Pl. X, figs. 33 to 35. [[Adventive at] Marseilles, France.]

Kaitour, British Guiana, VIII, 11, 1911, (F. E. Lutz; on open savannah), 1♂, [A. M. N. H.].

This specimen agrees fully with the North American series before us of this unpleasant domiciliary insect.

***Sphingolabis hawaiiensis* Bormans.**

1882. *F[orficula] hawaiiensis* Bormans, Ann. Mus. Stor. Nat. Genova, XVIII, p. 341. [Different Hawaiian Islands.]

Sapit, Lombok, Lesser Sunda Islands, 2000 meters, IV, 1896, (for Fruhstorfer), 1♂, [Hebard Cln.].

The species has already been recorded from Lombok, by Bormans.

SPARATTINÆ.

***Sparatta pygidiata* Kirby.**

1896. *Sparatta pygidiata* Kirby, Jour. Linn. Soc. Lond., Zool., XXV, p. 527, Pl. XX, figs. 10 and 10a. [Rio [de Janeiro, Brazil].]

Kaitour, British Guiana, VIII, 12, 1911, (F. E. Lutz; taken sifting), 3♀, [A. M. N. H. and Hebard Cln.].

We refer these specimens to *pygidiata* with doubt. We feel that the genus *Sparatta* will be found to include a great number of yet undescribed species. The synonymy and association of species under *Sparatta*, *Parasparatta* and *Prosparatta*, given by Burr in the Genera Insectorum, shows a number of serious errors. The specimens before us do not agree with Brazilian material in the Academy collection of *S. clarkii* and *S. semirufa*. Males of the present insect may show it to be not *pygidiata*, but an undescribed species.

The females have head and pronotum dark, moderately shining; the tegmina and wings shining black, with a metallic, purplish sheen. The pygidium is declivent proximad, the ventral portion produced, quadrate, with distal margin truncate, but showing three small, triangular productions. The forceps have a decided lamellate production of the internal margin which ceases abruptly at the base of the strongly incurved apices, this margin armed with a blunt median tooth and with minute denticulations in proximal half, these more numerous proximad. The caudal tibiae are armed disto-ventrad with two minute, but stout, spines. The caudal metatarsus is shorter than the third tarsal joint, and has the ventral surface fringed internally with a row of lamellate plates (agglutinated hairs) and externally with a row of minute, but stout, spines. Length of body, 8.2 to 8.5; of forceps 2.2 to 2.3 mm.

FORFICULIDÆ.

ANECHURINÆ.

Allodahlia macropyga (Westwood).

1839. *Forficula macropyga* Westwood, Royle's Illustr. Himalaya, Intr., p. 53, Pl. IX, fig. 12. [[Himalaya Mountains.]]

Chandkhira, Sylhet, Assam. 1 adult (forceps missing), [Hebard Cln.].

This specimen shows a striking color variation, with exposed surfaces of wings pale buffy. This condition has also been found in *A. scabriuscula*.

FORFICULINÆ.

Doru luteipenne (Serville).

1839. *Forficula luteipennis* Serville, Hist. Nat. Ins., Orth., p. 46. [♀, Brazil.]

Rio Caiary-Uaupes, Amazonas, Brazil, 1906, (H. Schmidt), 1 ♂ [A. M. N. H.].

Chanachamayo, Peru, 1 ♀, [A. N. S. P.].

Doru lineare (Eschscholtz).

1822. *Forficula linearis* Eschscholtz, Entomogr., p. 81. [Santa Catharina, Brazil.]

Chanachamayo, Peru, 1 ♀, [A. N. S. P.].

Forficula auricularia Linnaeus.

1758. [*Forficula*] *auricularia* Linnaeus, *Syst. Nat.*, Ed. X, I, p. 423. [Europe.]

Nunandorp, South Holland, Netherlands, VII, 16, 1908, (M. Hebard; colony under board), 3 ♂, 1 ♀, 5 juv., [Hebard Cln.].

La Guerche, Cher, France, VIII, 17, 1906, (M. Hebard; under leaves and moss in forest), 1 juv. [Hebard Cln.].

Gerardmer, Vosges, France, VIII, 17, 1906, (M. Hebard), 1 ♀, [Hebard Cln.].

ANCISTROGASTRINÆ.

LITOCOSMIA²² new genus.

This genus agrees with *Osteulecus* alone, of the genera of the present subfamily, in the male penultimate ventral abdominal segment lacking projecting processes, but differs from that genus in the form of this segment, the tegmina which are not keeled beyond the shoulders and in having the seventh dorsal abdominal segment alone specialized laterad, not considering the stink glands.²³ The abdomen, with greatest width mesad, gives a superficial resemblance to *Mixocosmia*. The evenly and not strongly areuate forceps suggest the type found in some species of *Paracosmia*, but are more simple.

GENOTYPE.—*Litocosmia roraimæ* new species.

Generic Characters.—Head feebly depressed meso-caudad. First antennal joint equal to combined length of second, third and fourth joints; fourth joint distinctly longer than third. Pronotum subquadrate; cephalic margin transverse, with lateral angles rather sharply rectangulate, caudal margin convex. Tegmina keeled only at shoulders. Abdomen gradually widening to seventh dorsal segment, thence gradually narrowing; stink glands of third segment well developed, of fourth segment strongly developed, tubular; seventh segment with a dorso-lateral oblique, rounded ridge on each side, ascending cephalad; other segments simple. Pygidium minute, simple. Forceps not complex in structure. Penultimate ventral abdominal segment rectangular, disto-lateral angles broadly rounded, distal margin transverse. Limbs elongate and slender; caudal metatarsus slightly longer than third tarsal joint, its ventral surface and that of second tarsal joint, hairy.

We believe the correct linear position of this genus to be after *Sarakas* and before *Mixocosmia*, then *Paracosmia*.

Litocosmia roraimæ new species. Pl. XVI, figs. 10, 11.

TYPE: ♂; Ireng River to Roraima, Brazil. August 18, 1911. (Crampton) [American Museum of Natural History.]

Size medium, form elongate and slender, with greatest abdominal

²² From $\lambda\alpha\gamma$ = simple.

²³ We are not as certain as we would like to be that the species, or at least the genotype, of Burr's genus *Sarakas*, will not also be found to have a simple male penultimate ventral abdominal segment. This segment is not described in the original descriptions. The genus is assigned to the opposite category in Burr's key in the *Genera Insectorum*, but we have already found this same key to be elsewhere misleading. From the description of the genotype, *Sarakas devians* (Dohrn), it appears that *Litocosmia* is at least separable by the dilated abdomen, with lateral portions of sixth and eighth dorsal segments unspecialized, and the much more simple type of forceps.

width mesad. Head²⁴ with paired impressions dorso-mesad of antennal sockets weakly indicated; eyes longer than cheeks. Pronotum narrower than head, with a weak medio-longitudinal sulcus; prozona moderately convex, lateral portions of metazona strongly ascendent to lateral margins, caudal portion feebly convex; lateral margins parallel. Tegmina and wings fully developed. Dorsal surface of abdomen convex; ultimate segment with sides straight and very feebly convergent caudad, surface weakly convex, except meso-distad where it is very feebly concave and distad on each side above the base of the forceps is found a more convex area, at each of which areas the distal margin is weakly convex. Pygidium declivent, longer than broad, rectangulato-oval. Forceps elongate and slender; shaft evenly and not strongly curved, moderately flattened cylindrical, stout proximad with a heavy truncate tooth, thence narrow in proximal third to a sharp medio-internal tooth, this portion with a row of minute, well spaced projections, thence the shaft is unarmed and of equal width to the slight internal swelling near the apex, from which point it tapers rapidly and curves more decidedly to the acute apex.²⁵

Length of body 10.2, of pronotum 1.6, of tegmen 3.6, of exposed portion of wing 1.8, of forceps 4.4; width of pronotum 1.6, greatest width of abdomen 2.7, of ultimate dorsal abdominal segment 2.1 mm.

Coloration of head, prozona and dorsal surface of abdomen tawny. Metazona, tegmina, exposed portion of wings, limbs and underparts ochraceous tawny. Forceps dull chestnut.

The type of this interesting species is unique.

***Osteuleus kervillei* (Burr).**

1905. *Ancistrogaster kervillei* Burr, Ann. Mag. Nat. Hist., (7), XVI, p. 490.
[Region of Merida, Venezuela.]
Merida, Venezuela, 1 ♂, [Hebard Cln.].

This topotype agrees in every way with Burr's original description, except in having the tegmina not carinate and in being somewhat larger than the maximum in the type series. There is no room for doubt that the present insect represents this species. In consequence, the characterization of the tegmina as keeled and Burr's figure,²⁶ showing this condition strikingly developed, are either incorrect

²⁴ The features given in the generic diagnosis are not repeated in this description.

²⁵ The form of the distal portion resembles a weakly curved claw. This general type is probably characteristic of all the species properly referable to the *Ancistrogasterinae*.

²⁶ *Genera Insectorum*, Fasc. 122, *Dermaptera*, Pl. VII, fig. 18, (1911).

or great variation occurs in the species in this usually constant feature. The present specimen has the tegminal shoulders rather sharply rounded, but a lateral keel is subobsolete and the tegmina should best be termed not keeled.

As noted above, the genus agrees with *Litocosmia*, alone of the genera of the Ancistrogastrinæ, in having a simple penultimate ventral abdominal segment in the male, but in the specialization of the dorsal abdominal segments shows much closer affinity to the *Ancistrogaster* type, being nearest *Praos* in this respect, before which genus, in linear arrangement, we would place *Osteuleus*. The forceps are distinctive and remarkable.

OPISTHOCOSMIINÆ.

Kleter aterrimus (Bormans).

1883. *A[ncistrogaster] aterrimus* Bormans, Ann. Soc. Ent. Belg., XXVII, p. 83, Pl. III, fig. 18. [Ecuador.]

Río Charape, Peru, IX, 14, 1911, (C. H. T. Townsend), 1 ♂, [U. S. N. M.]

This specimen is very slightly larger than the type, with the description of which it agrees throughout. The figure is exceedingly crude.

Except for the much broader last dorsal abdominal segment, a general superficial resemblance to the species of *Skalistes* is shown.

Eparchus burri (Bormans).

1903. *Opisthocosmia burri* Bormans, in Burr, Ann. Mag. Nat. Hist., (7), XI, p. 267. [Lompa Battau, South Celebes, at 3000 meters.]

Bua-Kraeng, South Celebes, 5000 meters, II, 1896, (for H. Fruhstorfer), 1 ♂, [Hebard Cn.]

The original description is very brief; valuable comparisons are later made by Burr.²⁷

EXPLANATION OF PLATE XVI.

Fig. 1.—*Forcipula despinosa* new species. ♂, *type*. Northern India. Dorsal outline. (X 2.16).

Fig. 2.—*Pseudisolabis elegans* new species. ♂, *type*. Kulu, Kangra, India. Dorsal outline. (X 4).

Fig. 3.—*Pseudisolabis elegans* new species. ♀, *allotype*. Kulu, Kangra, India. Dorsal outline of ultimate dorsal abdominal segment and forceps. (X 10).

Fig. 4.—*Labia barberi* new species. ♂, *type*. Cacao, Trece Aguas, Alta Vera Paz, Guatemala. Dorsal outline. (X 14).

Fig. 5.—*Labia nodifer* new species. ♂, *type*. Cacao, Trece Aguas, Alta Vera Paz, Guatemala. Dorsal outline. (X 13).

Fig. 6.—*Labia arcuata* Seudder. ♂, *type*. Vassouras, Minas Geraes, Brazil. Dorsal view of distal dorsal abdominal segments and forceps. (X 7.7).

²⁷ *Fauna British India, Dermapt.*, p. 194, (1910).

- Fig. 7.—*Labia rotundata* Scudder. ♀, *type*. Mexico. Dorsal outline of ultimate dorsal abdominal segment, pygidium and forceps.²⁵ (X 8).
- Fig. 8.—*Prolabia ascensionis* new species. ♂, *type*. Ascension Island, South Atlantic. Dorsal outline. (X 8).
- Fig. 9.—*Prolabia ascensionis* new species. ♀, *allotype*. Ascension Island, South Atlantic. Dorsal outline of ultimate dorsal abdominal segment, pygidium and forceps. (X 7.4).
- Fig. 10.—*Litocosmia roraima* new species. ♂, *type*. Ireng River to Roraima, Brazil. Dorsal outline. (X 4.5).
- Fig. 11.—*Litocosmia roraima* new species. ♂, *type*. Ireng River to Roraima, Brazil. Ventral outline of:—A. Penultimate Ventral Abdominal Segment. B. Portions of Ultimate Dorsal Abdominal Segment folded over Subgenital Plate. C. One of the halves of the cleft Subgenital Plate. Mesad is the ventral surface of the pygidium, between the bases of the forceps.

²⁵ This figure is given to show the widely separated type of forceps, found also in both *nodifer* and *arcuata*.

NOTES ON MEXICAN MELANOPLI.

(Orthoptera: Acrididæ.)

BY MORGAN HEBARD.

In preparing a Revision of the Melanopli of North America, north of Mexico, it has been found necessary to consider all of the Mexican material at hand. We have before us the greater portion of the important material, including almost all the types, described by Scudder in his Revision of the Orthopteran Group Melanopli and by Bruner in the *Biologia Centrali-Americana*; the papers here referred to being the most important single contributions to the knowledge of this group for Mexico. The Philadelphia collections contain other types and important series previously recorded from Mexico. In addition, we have fortunately been able to assemble nearly all the recently collected Mexican Melanopli and take the present opportunity to record the same.

It is clear that great numbers of species of the Melanopli, found in the southern portions of the United States, will be found in northern Mexico, but as yet have not been taken in that country. In fact, the Melanopli assembled show that generally casual collecting has been done, a very few localities fairly well investigated, while vast areas still remain virtually unknown for this group. The last condition is particularly true for all the regions of Mexico adjacent to the United States. We would hesitate to report on collections so evidently incomplete were it not necessary to point out the considerable synonymy proven by the series at hand.

Five genera and ten species are shown to be synonymic in the present paper. A single new species is described. Four hundred and thirty-nine specimens, representing fourteen genera and thirty-six species, are here considered.

The superficial character of Scudder's Revision is best shown by the array of errors in his treatment of the species of the United States. The errors applicable to Mexican material, for which he erected two generic and six specific synonyms, did not come as a surprise after the other portions of his work had been studied.¹

¹ The new genera and species, described by Scudder in his Revision (December 28, 1897), all actually date from the key which was separately printed in advance, in the *Proceedings of the American Philosophical Society*. XXXVI, pp. 5 to 35, (April 5, 1897).

We wish to express our cordial thanks to the curators of the collections of the Museum of Comparative Zoölogy, United States National Museum, American Museum of Natural History, and Field Museum of Natural History for the loan of material. We are particularly indebted to Dr. Samuel Henshaw, of the Museum of Comparative Zoölogy, for permitting us to have for comparison and study the types from the Scudder Collection, without which we would have been unable to undertake the present work.

Netrosoma fusiforme Scudder.

1897. *Netrosoma fusiformis* Scudder, Proc. U. S. Nat. Mus., XX, p. 17, Pl. II, fig. 2. [Monclova (*nee* Montelovez²), Coahuila (*nee* Chihuahua³), Mexico.]
 1908. *Netrosoma fusiforme* Bruner, Biol. Cent.-Amer., Orth., II, p. 300. (Same material.)
 1910. *Netrosoma* *uniformis* Kirby, Syn. Cat. Orth., III, p. 486. (Lapsus calami.)
 Monclova, Coahuila, XI, 23, 1909, (F. C. Bishopp), 1♂, 2♀. [U. S. N. M.]

These strikingly beautiful examples are in no way different from paratypes now before us.

Netrosoma nigropleura Scudder.

1897. *Netrosoma nigropleura* Scudder, Proc. U. S. Nat. Mus., XX, p. 18, Pl. II, fig. 3. [Lerdo, Durango, Mexico.]
 1908. *Netrosoma nigropleurum* Bruner, Biol. Cent.-Amer., Orth., II, p. 300. (Same material.)
 Jaral, Coahuila, XI, 1 to 3, 1909, (J. Friesser), 1♀, [Field Mus. Nat. Hist.]

The size contrast between the sexes of the present species is even greater than in *N. fusiforme*. The female is also very different from the male type, in the Hebard Collection, in being almost solid rood's brown in general coloration, the two darker bands of the caudal femora being only very faintly indicated dorsad. As in the male, the caudal tibiae are pompeian red, this weaker externally proximad. The measurements of this female are as follows: length of body 20.8, length of pronotum 4.7, greatest (caudal) width of pronotum 6.1, length of caudal femur 11.6, width of caudal femur 3.5 mm. In the male type the length of the caudal femur is 8.8, its width 2.8 mm.

Dichroplus notatus Bruner.

1908. *Dichroplus notatus* Bruner, Biol. Cent.-Amer., Orth., II, p. 301. [♂, ♀; Amula, Guerrero, Mexico, 6000 feet.]
 Cuernavaca, Morelos, 1905, (W. L. Tower), 1♀, [Tower Cln.]

This specimen is slightly larger than a cotypic female in the Hebard Collection, being 19.7 mm. in length, and is more richly

² This error appears repeatedly in Scudder's revision, due to the incorrect entry of Palmer's assorting number 1221 in the book used by Scudder.

³ Scudder in some places gives Chihuahua incorrectly as the State, in other places he is more nearly correct, giving "Coahuila."

colored. In both specimens the greater portion of the caudal femora is deep bluish glaucous.

PEDIES Saussure.

1861. *Pedies* Saussure, Rev. et Mag. de Zool., (2), XIII, p. 157.

1893. *Paradichroplus* Brunner,⁴ Révis. Syst. Orth., Ann. Mus. Genova, XXXIII, p. 145.

Careful study of the literature and study of the specimens discussed below, proves to our full satisfaction the above synonymy. Saussure's description, though very brief, gives nearly all the features of importance. The efforts of Scudder and Bruner to locate *Pedies virescens*, the genotype by monotypy, have been decidedly incorrect, their supposition being that the position of the species was near *Dactylotum*. At the time *Paradichroplus* was described Bruner ignored the genus *Pedies*.

We would note that, from material before us, three species, *mexicanus* (Bruner), *variabilis* (Bruner) and *andeanus* (Caudell), in addition to the genotype, are referable to *Pedies*; but that *nigrigena* Rehn and *bruneri*, *fusiformis* and *bipunctatus* all of Giglio-Tos, assigned originally to *Paradichroplus*, can not properly be placed in the present genus.

Striking features in the genus *Pedies*, as given by Saussure, are: the strongly declivent and convex face; the sub-bicarinatè frontal costa; the conoid-arcuate apex of the head; the pronotum with strong percurrent median carina cut weakly by the principal transverse sulcus, with distinct percurrent lateral carinæ and with caudal margin distinctly emarginate, and male genitalia of the characteristic type found in *Dichroplus* and allied genera.⁵

Pedies mexicanus (Bruner).

1861. *Platyphyma mexicanum* Bruner, Verh. k.-k. Zool.-bot. Gesellsch. Wien, 1861, p. 224. [♀, Mount Orizaba, Mexico, "au pied de la neige."]

Mount Orizaba, 11500 feet, Hl, 1893, (western slope), 2♂, 2 juv. ♂, [Hebard Cln.].

An additional dried alcoholic female from the United States National Museum, without exact data, is at hand.

The prosternal spine in this insect is broadly truncate, cuneiform,

⁴ This genus was described without type designation; the type by first subsequent fixation is *Platyphyma mexicanus* Bruner, selected by Kirby, Syn. Cat. Orth., III, p. 492, (1910).

⁵ Certain of these features are not indicated in the aberrant *P. variabilis* (Bruner), see p. 254.

***Pedies variabilis* (Scudder).**

1897. *Melanoplus variabilis* Scudder, Proc. U. S. Nat. Mus., XX, p. 319, Pl. XXI, fig. 8. [♂, ♀; Mexico City and Querétaro, Mexico.]

Ocotlan, Jalisco, 5000 feet, VIII, 29 to IX, 1, 1906, (P. P. Calvert), 1 juv. ♀, [A. N. S. P.]

Yurecuaro, Michoacan, 5000 feet, IX, 4, 1906, (P. P. Calvert), 1♂, [A. N. S. P.]

Tlalpam, Distrito Federal, XI, 1887, (L. Bruner), 21♂, 6♀, [Hebard Cln.]

This insect, the single type of which is before us, is a distinctly aberrant member of the present genus. Compared with *P. mexicanus* it is found to differ in the slender, conical prosternal spine, the weakly obtuse-angulate caudal margin of the pronotum, the distinctly less retreating face, lanceolate and overlapping tegmina and distinctive male genitalia. The general structure, however, particularly of the head and pronotum, shows definitely a derivation from the stock of *P. virescens* and *mexicanus* rather than from any of the types of the genus *Melanoplus*.⁶

***Cephalotettix pilosus* (Stål).**

1878. *P(latyphyma) pilosus* Stål, Bih. till k. Svensk. Vet.-Akad., Handl., V, No. 9, p. 10. [♂, ♀; Mexico.]

1897. *Cephalotettix parvulus* Scudder, Proc. U. S. Nat. Mus., XX, p. 31, Pl. III, fig. 1. [♂; Atoyac and Orizaba, Vera Cruz, Mexico.]

1897. *Rhabdotettix pilosus* Scudder, *ibid.*, p. 35. [Generic assignment.]

1897. *Melanoplus geniculatus* Scudder, *ibid.*, p. 239, Pl. XVI, fig. 3.⁷ [♂, ♀; Mexico.]

Careful comparison of Scudder's type of *parvulus* and his type and allotype of *geniculatus* with Stål's description of *pilosus* proves the synonymy given above, Stål's material apparently differing only in being somewhat larger, (length 16 mm.). That size variation occurs in the species is shown by the two males before us, (length 12.7 and 14 mm.).

The specimens described as *geniculatus* have lost their natural brilliant coloration from immersion in alcohol. This explains the differences in Scudder's color descriptions of *parvulus* and *geniculatus*. Haste and carelessness fully explain the glaring errors made by that author. Unfortunately, his "Revision of the Melanopl" shows so frequent a succession of such serious errors that these would seem inexplicable, were the author's superficial method of procedure not known.

The black genicular areas of the caudal femora and bases of the

⁶ The peculiar precurrent lateral carinae of the pronotum and character of the surface of the lateral lobes are exactly as in *P. mexicanus*.

⁷ This figure is incorrect, the subgenital plate and cerci of the specimen figured being exactly as given on plate III, figure 1.

caudal tibiae are a striking and distinctive feature in the present insect.⁸

PHÆDROTETTIX Scudder.

1897. *Phædrotettix* Scudder, Proc. U. S. Nat. Mus., XX, p. 22.

1897. *Rhabdotettix* Scudder, *ibid.*, p. 32.

1897. *Cyclocercus* Scudder, *ibid.*, p. 36.

The genotype of *Phædrotettix*, *angustipennis*, is inseparable generically from the species of *Rhabdotettix*, of which *palmeri* is the genotype. It is true that *palmeri* and *dumicola*⁹ agree closely in distinctive features of male genitalic development, while in both the tegmina are ovate. In the other species of *Phædrotettix* the tegmina are linear, but this difference alone is utterly insufficient to warrant generic separation. The male genitalic development shows widely different features in a number of the species, this being much the greatest in *valgus*, but in our opinion generic separation is in no case warranted.

A careful comparison of the genotype, *Phædrotettix angustipennis*, with *accola*, genotype of *Cyclocercus*, shows also that the latter genus must fall in the present synonymy. The pronotum of *accola* shows a very slightly heavier median carina than is found in the other species of *Phædrotettix*. This feature is of no generic value, nor are the male genitalic features given by Scudder. In fact, were the latter given generic significance it would be necessary to separate *gracilis* and *bistrigata* as one, *litus* as another, *palmeri* and *dumicola* as another and *valgus* as still another genus.

Key to Males of the Species of *Phædrotettix*.¹⁰

A. Tegmina very slender, not elongate ovate or ovate.

B. Dorsum of pronotum pale, immaculate. Distal portion of abdomen not enlarged. (Fercula absent. Cerci moderately elongate, slender, tapering to blunt apex. Supra-anal plate elongate shield-shaped; truncate, obtuse-angulate distad. Subgenital plate simple, small, scoop-shaped.)

accola (Scudder).

⁸ Scudder failed to note that the bases of the caudal tibiae were black in the type of his *parvulus*.

⁹ The types, now before us, of Scudder's *Pezotettix dumicolus* and *Rhabdotettix concinnus* show the certain synonymy of these names, the former of which has priority. At the time *concinnus* was described, Scudder referred *dumicola* to the genus *Melanoplus*.

¹⁰ This key is based on examination of the type of each species considered and additional males of all except *bistrigata* and *litus*, which species are known from the unique type and allotype.

- BB. Dorsum of pronotum dark. Distal portion of abdomen enlarged.
- C. Distal portion of abdomen slightly enlarged. (Fercula present; small, broad, blunt, trigonal. Cerci moderately elongate, slender, tapering to acute apex. Supra-anal plate trigono-shield-shaped, with a minute dorsal tubercle proximad on each side. Subgenital plate simple, small, scoop-shaped) *gracilis* (Bruner).
- CC. Distal portion of abdomen decidedly enlarged.
- D. Fercula absent. Cerci decidedly elongate, very slender in distal portion but with apex blunt. Supra-anal plate short, trigono-shield-shaped. Subgenital plate simple, small, scoop-shaped. Pronotum with decided dorso-lateral pale lines *bistrigata* (Scudder).
- DD. Fercula represented by weak and broad convexities of the segment. Cerci and subgenital plate specialized. Supra-anal plate elongate, shield-shaped. Pronotum without decided dorso-lateral pale lines.
- E. Supra-anal plate elongate shield-shaped, truncate obtuse-angulate distad, with a minute dorsal tubercle proximad on each side. Cerci moderately elongate, distal portion moderately broad, tapering sharply at extremity to acute ventral apex. Subgenital plate small, produced in a small median, marginal, blunt tubercle *angustipennis* Scudder.
- EE. Supra-anal plate elongate shield-shaped, lateral margins cingulate, straight and convergent proximad, convex and convergent distad. Cerci heavy, elongate, with an acute proximal projection on ventral margin,¹¹ distal portion moderately broad, curving ventrad, with margins at extremity weakly convex to the acute apex. Subgenital plate large, the free margin above the plane of the supra-anal plate, with a large, very blunt, median, marginal tubercle feebly suggested *valga* (Scudder).
- AA. Tegmina longer, elongate ovate. Supra-anal plate simple, broadly shield-shaped. Cerci broad.
- B. Cerci broad, not bent inward, apex acute and situated dorsad, distal margin strongly oblique. Fercula minute, bluntly obtuse-angulate projections. General coloration green, locally washed with red, color pattern not complex. (Subgenital plate small, simple, with distal portion the more strongly rounded but not tuberculate) *litus* new species.
- BB. Cerci bent inward at near the middle, apex evenly rounded. Fercula very broad and extremely narrow plates with distal margin straight. General coloration brown to green, not washed with red, color pattern complex. (Pallium conical, produced.)

¹¹ This frequently projects downward between the supra-anal and subgenital plates and is in this position concealed.

- C. Cerci broad throughout, distal portion narrower but not slender. Pallium moderately produced. Subgenital plate with a weakly suggested, blunt tubercle meso-distad at the free margin. Size averaging smaller and color usually darker *palmeri* (Scudder).
- (C) C. Cerci broader, distal portion not as much narrower. Pallium greatly produced. Subgenital plate with distal portion evenly rounded. Size averaging larger and coloration usually paler *dumicola* (Scudder).

The females are less easily separated. Those of *accola* are distinctive in the pale dorsal surface of the pronotum; of *angustipennis* by the small size, immaculate dorsum of pronotum and somewhat maculate caudal femora; those of *valga* from the female allotype of *bistrigata* only by their smaller size and less robust form. The females of *litus*, *palmeri* and *dumicola* have the tegmina much broader than in any of the other species. The female of *litus* is readily separated by the distinctive coloration, which is similar to that of the male. Those of *palmeri* and *dumicola* are separable only by the usually different size and coloration as found in the males.¹²

The species *accola*, *palmeri* and *dumicola* are found within the United States and will be comprehensively treated in another study; of these *palmeri* alone is known from Mexico, in which country the type series was taken.

Phædotettix gracilis (Bruner).

1908. *Cyclocercus gracilis* Bruner, Biol. Cent.-Amer., Orth., II, p. 307.

[♂, Tampico, Tamaulipas, Mexico.]

Tamos, Tamaulipas, XII, 7, 1909, (F. C. Bishopp), 1♂, [Hebard Cln.].

Pueblo Viejo, Vera Cruz, XII, 8, 1909, (F. C. Bishopp), 1♂, [U. S. N. M.].

The present species shows nearest relationship to *P. bistrigata*. The males differ in the smaller size, lack of very decided dorso-lateral cephalic and pronotal pale lines, only slightly enlarged apex of abdomen, presence of small, bluntly triangular furcula and less elongate but even more slender cerci. The general coloration would appear to differ only in the decided dorso-lateral cephalic and pronotal pale lines found in the male type of *bistrigata*; which specimen is, however, in a poor state of color preservation, having been dried after immersion in alcohol.

The male from Tamos shows individual variation in having the dark dorsal and dorso-lateral surfaces of the head and pronotum solid, the ventral portion of the pronotal lateral lobes buffy white

¹² The female of *gracilis* is unknown.

and the furcula very slightly more produced with apices directed latero-caudad.

Phædrotettix angustipennis Scudder.

1897. *Phædrotettix angustipennis* Scudder, (in part), Proc. U. S. Nat. Mus., XX, p. 22, Pl. II, fig. 7. [♂, ♀; Mount Alvarez, San Luis Potosi, Mexico; Camacho, Zacatecas (nec Comancho, Durango) Mexico.]

The type series is before us. The species has never been taken north of Mexico, the Corpus Christi Bay, Texas, material originally included being referable to *P. accola*.

The much reduced tegmina are frequently absent, on one or both sides, as shown by the series before us. The caudal femora of this species and of *accola* differ from those of *gracilis*, *bistrigata* and *valga* in being not solidly colored, showing two broad, but normally very weak, darker suffusions dorsad.

Phædrotettix valga (Scudder).

1897. *Cyclocercus accola* Scudder, (in part), Proc. U. S. Nat. Mus., XX, p. 38. [♀, Lerdo, Durango, Mexico.]

1897. *Cyclocercus valga* Scudder, *ibid.*, p. 39, Pl. III, fig. 6. [♂, Sierra Nola, Tamaulipas, Mexico.]

Victoria, Tamaulipas, I, 14 and 15, 1903, (S. N. Rhoads), 2♂, 2♀,¹³ [A. N. S. P.]; XII, 10, 1909, (F. C. Bishopp), 2♂, [U. S. N. M.].

A large series of well preserved material of *P. accola* from near the type locality, now at hand, enables us to straighten out the past confusion. All of the material, described by Scudder from Corpus Christi Bay, Texas, as *Phædrotettix angustipennis* and *Cyclocercus accola*, is dried alcoholic and in very poor condition.

Rehn's misidentification was due to Caudell's mistakes in comparison. Scudder's figures for the two species are excellent.

Phædrotettix litus new species.

This species is distinctive in its striking green coloration washed with red. The eyes are appreciably more protuberant than in any

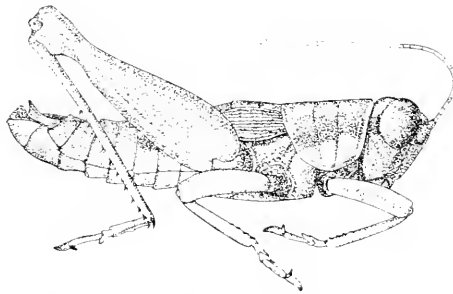


Fig. 1.—*Phædrotettix litus* new species. Lateral view of male. *Type.* (× 3.)

¹³ Incorrectly recorded by Rehn as *Phædrotettix angustipennis*, in 1904; following Caudell, who compared the material with cotypes of that species.

other species of the genus, while the male cerci are distinctive in form. The male supra-anal and subgenital plates are much as in *P. bistrigata*. The tegmina are more elongate but nearly as broad as in *P. palmeri* and *P. dumicola*.

Type: ♂; Victoria, Tamaulipas, Mexico. (O. W. Barrett.) [Hebard Collection Type No. 436.]

Size and form medium for the group, much as in *bistrigata*. Surface generally smooth, supplied with microscopic hairs, these particularly numerous on the caudal tibiae. Head with interocular space very narrow, hardly more than half as wide as proximal antennal joint, narrow sulcus of vertex distinct, vertex not decidedly produced, declivent; fastigio-facial angle rounded, rectangulate; face distinctly and evenly retreating; frontal costa broadly sulcate, a little the widest between antennal sockets, lateral margins more acute there, below becoming less distinct and parallel; supplementary facial carinae distinct, diverging slightly ventrad. Eyes protuberant, their dorsal surfaces slightly above the plane of the occiput, eyes distinctly longer than genae. Antennae filiform, slightly over twice as long as pronotum.

Pronotum without lateral carinae; dorsum scarcely expanding caudad, medio-longitudinal carina subobsolete, transverse sulci weak, the two on the prozona weaker and broken mesad, surface microscopically roughened on prozona, minutely punctulate on metazona, caudal margin broadly and feebly concave; lateral lobes of pronotum with cephalic margin feebly concave dorsad, feebly convex ventrad, ventral angles rounded obtuse-angulate, the ventro-caudal angles of greater degree, caudal margin moderately oblique, faintly concave. Tegmina lateral, elongate ovate, nearly two and one-half times as long as broad; apex bluntly rounded, the convexity strongest ventro-caudad; veins distinct, mainly longitudinal. Prosternal process well developed, acute conical, not deflected caudad. Mesosternal space distinctly longer than wide. Metasternal lobes narrowly separated.

Furcula subobsolete, represented by minute, bluntly obtuse-angulate projections of the segment. Supra-anal plate very broadly shield-shaped, simple. Cerci rather broad, narrowing gradually in proximal half, then subequal in width to base of distal portion; dorsal margin evenly and weakly concave to acute

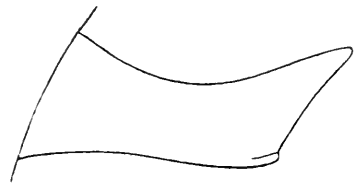


Fig. 2.—*Phadrotettix litus* new species. Lateral outline of cercus. *Type.* (Greatly enlarged.)

apex, ventral margin nearly straight, weakly undulating to sharply rounded, weakly obtuse-angulate disto-ventral angle, distal margin from this point feebly concave, oblique to the acute and produced disto-dorsal apex. Subgenital plate small, simple, scoop-shaped, the curvature of the surface sharp dorso-distad but with no indication of a tubercle. Limbs moderately stout. Caudal tibiae hairy, with numerous (9 and 10) external and (10 and 10) internal spines.

Allotype; ♀; same data as type. [Hebard Collection.]

Size much larger than male, form distinctly more robust. Eyes less protuberant; vertex more blunt; interocular space wider, equalling length of proximal antennal joint; frontal costa not sulcate but with minute pits above the antennal sockets, weakly and broadly sulcate below. Antennae about twice as long as pronotum. Median carina of dorsum of pronotum stronger, weak but distinct on metazona, caudal margin with broad concavity more distinct. Ovipositor valves moderately elongate; dorsal valves with dorso-external margins rather strongly toothed for the group and apical tooth almost straight, scarcely curved dorsad.

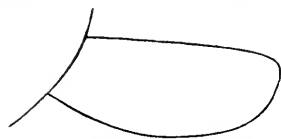


Fig. 3.—*Phædotettix litus* new species. Outline of female tegmen. *Allotype*. ($\times 3$.)

Measurements (in millimeters.)

	Length of body.	Length of pronotum.	Caudal width of pronotum.	Length of tegmen.	Width of tegmen.	Length of caudal femur.
♂. <i>Type</i>	17.	3.9	2.9	3.6	1.6	11.1
♀. <i>Allotype</i>	25.8	5.8	5.6	4.9	2.2	15.7

Coloration. Male. Dorsal surface of head, pronotum and abdomen, including tegmina, deep olive brown, shading to buffy olive laterad on abdomen. Face, cephalic and median limbs, ventral surface of sternum and lateral and ventral surfaces of abdomen buffy olive, becoming yellowish on sternum and proximo-ventral portion of abdomen. Antennae buffy olive, shading to deep olive brown in distal half. Eyes prout's brown. Genae buffy olive with a broad but weak brownish postocular band, weakly margined dorsad with buffy. Lateral lobes of pronotum in dorsal half claret brown, the band broadest caudad, its ventral margin concave; ventral half buffy, washed with claret brown. Caudal femora ceru olive washed with dragons blood red, this decided on the dorsal and ventral surfaces and proximad on the internal surfaces. Caudal tibiae

lettuce green proximad, becoming oil green; spines black tipped; hairs white.

The female is almost identically colored, the dorsal surface only showing a stronger green suffusion, yellowish oil green on the metazona.

The species is known from a single pair.

Sinaloa behrensii Scudder.

1897. *Sinaloa behrensii* Scudder, Proc. U. S. Nat. Mus., XX, p. 31, Pl. III, fig. 7. [♂, ♀; Sinaloa, Mexico.]

The type and allotype, belonging to the Museum of Comparative Zoölogy, are before us. The genus shows a general resemblance to *Phadrotettix*. The species resembles *P. gracilis* in general color pattern and *P. accola* in pronotal form and contour, but has the tegmina of the broader type found in *P. litus*, *palmeri* and *dumicola*. The elongate, slender, parallel male furcula, with a node on the dorsal surface of the subgenital plate on each side of these appendages are distinctive features in the present genus.

The specimens at hand are dried alcoholic but show the following features of coloration. Dorsal surface of head and pronotum rather pale, postocular dark stripe broad, less distinct but percurrent on the lateral lobes of the pronotum and continued on the tegmina, suffusing their ventral portions and with proximo-lateral dark areas on male abdomen which decrease in size caudad. Limbs pale, the genicular areas of the caudal femora suffused, dark brown.

Sinaloa nitida (Scudder).

1897. *Melanoplus nitidus* Scudder, Proc. U. S. Nat. Mus., XX, p. 207, Pl. XIV, fig. 2. (In part.) [♂, Tepic, Mexico.]

The type and an additional topotypic male, when compared with the male type of *Sinaloa behrensii* now before us, show the unmistakable consanguinity of these very distinct and little known species. The extraordinary male genitalia are very similar in the two species, the only noteworthy difference being in the greater distal width of the cerci in the genotype, *behrensii*.

When compared, we find the male of *nitida* to be more robust in structure, with pronotum shorter, prozona more convex, with transverse sulci as decided but not cutting the weak median carina, which is weakly convex in longitudinal outline and prozona laterad weakly but distinctly and more evenly concave in outline. In the present insect the large shining black spot of the dorsal portion of the lateral lobes of the pronotum, margined by a narrow buffy convex line above and below, immaculate sides of the metazona and unicolorous tegmina are distinctive features of coloration.

It is further evident that Scudder's *Barytettix peninsulae*,¹⁴ known from the unique female before us, is nearer *Sinaloa* than any other described genus and should be placed in this genus until the male sex is found to determine whether separation is necessary.

The female type of *peninsulae* is more robust, with pronotum proportionately much shorter, than the female allotype of *behrensii*. It differs further in the broader and non-sulcate facial costa, decided transverse sulci of the dorsum of the pronotum which cut the weak median carina,¹⁵ strikingly bicolored tegmina and marking of the lateral lobes of the pronotum, which is of the same general type as found in *nitida* but by no means as solidly, sharply and strikingly defined as in that species.

PHAULOTETTIX Scudder.

1897. *Phaulotettix* Scudder, Proc. U. S. Nat. Mus., XX, p. 29.

1907. *Calotettix* Bruner, Biol. Cent.-Amer., Orth., II, p. 309.

Scudder's description is based on an immature specimen, as demonstrated by the individual now before us. Without examination of this type Bruner had every reason to believe that his material represented an undescribed genus.

The genotype, by monotypy, is *Phaulotettix compressus* Scudder.

Phaulotettix compressus Scudder.

1897. *Phaulotettix compressus* Scudder, Proc. U. S. Nat. Mus., XX, p. 30, Pl. II, fig. 11. [[juv.] ♂; Monclova (nec Montelovez), Coahuila, Mexico.]

1904. *Sinaloa brevispinis* Rehn, Proc. Acad. Nat. Sci. Phila., 1904, p. 335. [♂, ♀; Victoria, Tamaulipas, Mexico.]

1908. *Calotettix bicoloripes* Bruner, Biol. Cent.-Amer., Orth., II, p. 309. [♂, Victoria, Tamaulipas, Mexico.]

1908. *Calotettix flavopictus* Bruner, *ibid.*, p. 310. [♀, Monclova (nec Montelovez), Coahuila, Mexico.]

1908. *Calotettix brevispinis* Bruner, *ibid.*, p. 311. (Generic assignment.)

1908. *Calotettix obscurus* Bruner, *ibid.*, p. 311. [♂, Tampico, [Tamaulipas], Mexico.]

Scudder's type is an immature individual in one of the later instars. We are able to associate it with adults, beyond doubt as to species, from a large series of both adults and young now at hand from the eastern portion of the arid southwestern United States.

All of the material noted in the above synonymy is now before us. Rehn's synonym is due to Scudder's description of *compressus* of a

¹⁴ 1897. *Barytettix peninsulae* Scudder, Proc. U. S. Nat. Mus., XX, p. 28. [♀, Lower California.]

¹⁵ The weak transverse sulci of the pronotal disk cut the weak median carina in the male type of *behrensii*, but do not do so in the female allotype of that species, the association of these specimens as sexes of the same species being unquestionably correct. This is probably due to individual variation and shows this feature to be of no diagnostic value in that species.

supposedly adult and, in consequence, very distinctive insect. Bruner's synonymic genus and three synonymic specific names are entirely attributable to Scudder's error and the remarkable color variation found in the species.

The males are either brilliant green, marked with buff, or brown with a greenish suffusion, marked with buff; the females are either solid and almost immaculate brown or green, marked with buff. The caudal tibiae and tarsi of the males are entirely jasper red to scarlet red, or this color only in the distal third or two-fifths of the tibiae, the remaining proximal portion being light terre verte or porcelain blue. The females have the caudal tibiae and tarsi usually much less brilliantly colored, entirely reddish, or bluish, changing gradually through purplish to reddish distad. The dorso-lateral pale lines of the pronotum are striking only in the green condition of both sexes, these vary in width and are sometimes abruptly terminated at the principal sulcus. None of these types of coloration have any further significance than the adaptation of the individual to local environmental conditions.

- Monclova, Coahuila, IX, 20, (E. Palmer), 3 ♀¹⁶, topotypes, (2 brown; 1 green with broad pereurrent pronotal stripes, caudal tibiae of all bluish to extremities), [M. C. Z.]; XI, 23, 1909, (F. C. Bishopp), 1 ♀, (green, with broken pronotal stripes not extending beyond principal sulcus, caudal tibiae briefly bluish proximad, remaining portions reddish), [U. S. N. M.].
 Victoria, Tamaulipas, XII, 10, 1909, (F. C. Bishopp), 1 ♀, (brown, caudal tibiae bluish to extremities), [U. S. N. M.].
 Tamos, Tamaulipas, XII, 7, 1909, (F. C. Bishopp), 1 ♀, (brown, caudal tibiae reddish), [U. S. N. M.].
 Pueblo Viejo, Vera Cruz, XII, 8, 1909, (F. C. Bishopp), 1 ♂, 1 ♀, (both brown, caudal tibiae red), [U. S. N. M.].

Agroecotettix modestus Bruner.

1908. *Agroecotettix modestus* Bruner, Biol. Cent.-Amer., Orth., II, p. 312. [♀, Lerdo, Durango, Mexico.]
 Monclova, Coahuila, IX, 20, (E. Palmer), 1 ♀, [M. C. Z.].

CONALCÆA Scudder.

1897. *Conalcaea* Scudder, Proc. U. S. Nat. Mus., XX, p. 23.
 1897. *Barytettix* Scudder, *ibid.*, p. 27.

The series now before us, including the single types of all the described species, prove beyond question the above synonymy, the features given by Scudder to distinguish these genera being fanciful or of no generic value.

The genotype, *Conalcaea miguelitana* Scudder, is closely related to *Conalcaea huachucana* Rehn, the latter may eventually prove to be a

¹⁶ In addition to juv. ♂ type of *Phaulotettix compressus* and ♀ type of *Calotettix flavopictus*

geographic race. To these species *C. truncatipennis* Scudder is rather closely related. To *crassus* Scudder, genotype of *Baryttix*, *Conalcaea neomexicana* Scudder is very closely related and may indeed prove to be a geographic race of that species. *Baryttix peninsulae* Scudder is a very distinctive insect, best referred at present to the genus *Sinaloa*.

Conalcaea crassa (Scudder).

1897. *Baryttix crassus* Scudder, Proc. U. S. Nat. Mus., XX, p. 28, Pl. II, fig. 10. [♂, San José del Cabo, Lower California, Mexico.]

1897. *Melanoplus nitidus* Scudder, *ibid.*, p. 207. (In part.) [♀, Cape St. Lucas, Lower California, Mexico.]

Scudder admits the questionable association of the sexes for his *M. nitidus*. The specimen from Cape St. Lucas is in every way similar to one of the smaller females from San José del Cabo. A number of topotypic specimens are before us. The entire series of this species is dried alcoholic.

Aidemona azteca (Saussure).

1861. *Platyphyma azteca* Saussure, Rev. et Mag. de Zool., (2), XIII, p. 161. [♂, Temperate Mexico.]

Mazatlan, Sinaloa, 1♂, (elongate), [A. M. N. H.]

Tepic, Tepic, 3 juv., [Hebard Cln.]

Guadalajara, Jalisco, (D. L. Crawford), 3♂, (elongate), [A. N. S. P.]

Amecameca, Mexico, I, 5, 1899, VII, 11, 1898, 2♂, 1♀, (1♂, ♀ elongate), [Hebard Cln.]

Eslava, Distrito Federal, 1♀, [Hebard Cln.]

Cuernavaca, Morelos, VI, (Barrett; Smith), 1♂, 2♀, [Hebard Cln.]

Matamoros, Morelos, VIII, 11, 1903, (W. L. Tower), 1♀, [Tower Cln.]

Rio Coetula, Guerrero, XII, 1898, (O. W. Barrett), 1♂, 2♀, (elongate), [Hebard Cln.]

Tepetlapa, Guerrero, 3000 feet, X, (H. H. Smith), 2♂, 1♀, (elongate), [Hebard Cln.]

Dos Arroyos, Guerrero, 1000 feet, IX, (H. H. Smith), 1♂, (elongate), [Hebard Cln.]

Mescala, Guerrero, (H. H. Smith), 1♀, (elongate), [Hebard Cln.]

Amula, Guerrero, 6000 feet, VIII, (H. H. Smith), 1♂, 1♀, (elongate), [Hebard Cln.]

Venta de Peregrino, Guerrero, (H. H. Smith), 1♀, (elongate), [Hebard Cln.]

Chilpancingo, Guerrero, 4600 feet, VI, (H. H. Smith), 3♂, 4♀, (elongate), [Hebard Cln.]

Omitlenc, Guerrero, 8000 feet, VII, (H. H. Smith), 1♂, (short), [Hebard Cln.]

Acapuleo, Guerrero, IX, (H. H. Smith), 1♂, 1♀, (elongate), [Hebard Cln.]

Xucumanatlan, Guerrero, 7000 feet, VII, (H. H. Smith), 5♂, (3 elongate), [Hebard Cln.]

Presidio, Vera Cruz, (Forrer), 1♀, (elongate), [Hebard Cln.]

Jalapa, Vera Cruz, VI, 1, 1894, 3♂, 3♀, 1 juv., [Hebard Cln.]

Xico, Vera Cruz, 1♂, [Hebard Cln.]

Mexllin, Vera Cruz, X, 1895, 4♂, 4♀, 1 juv., [Hebard Cln.]

Atoyac, Vera Cruz, V, XI and XII, (Smith; Bruner), 2♂, 2♀, 2 juv., [Hebard Cln.]

Cordoba, Vera Cruz, 1♀, [Hebard Cln.]

San Rafael, Vera Cruz, III and IV, (C. H. T. Townsend), 47♂, 14♀, [Hebard Cln.]

- Teapa, Tabasco, III, (H. H. Smith), 8♂, 4♀, [Hebard Cln.]
 Frontera, Tabasco, I, (H. H. Smith), 1♂, [Hebard Cln.]
 Merida, Yucatan, (Gaumer), 2♂, 1♀, [Hebard Cln.]
 Chichen Itza, Yucatan, (E. Thompson), 6♂, 6♀, [Field Mus. Nat. Hist.]
 Valladolid, Yucatan, (Gaumer), 5♂, 2♀, [Hebard Cln.]

Campylacantha similis Seudder.

1897. *Campylacantha similis* Seudder, Proc. U. S. Nat. Mus., XX, p. 52, Pl. IV, fig. 5. [♂, ♀; Lerdo, Durango, Mexico.]
 Monclova, Coahuila, XI, 22, 1909, (F. C. Bishopp), 1♂, [U. S. N. M.]
 Lerdo, Durango, XI, 1887, (L. Bruner), 1♂,¹⁷ [Hebard Cln.]

The five known forms of this genus all show rather close affinity. Nearest approach to the present insect is shown by *C. lamprolata* Rehn and Hebard. Compared with that insect, *similis* is found to be more robust, with coloration deeper and less brilliant. The males of *Campylacantha*, like those of *Hesperotettix*, differ from the majority of the species of the Melanopli in having the genitalia very much alike in all of the species belonging to the genus.

The male from Monclova has the tegmina reaching the apex of the supra-anal plate; in the Lerdo males the tegmina are shorter, about half as long as the abdomen.

Hesperotettix meridionalis Seudder.

1897. *Hesperotettix meridionalis* Seudder, Proc. U. S. Nat. Mus., XX, p. 59, Pl. IV, fig. 9. [♂, ♀; Guanajuato, Guanajuato, and Sierra Nola, Tamaulipas, Mexico.]
 Durango, Durango, (O. W. Barrett), 1♂, [Hebard Cln.]
 Guadalajara, Jalisco, VI and VII, 1903, (J. F. McClendon), 1♀, [A. M. N. H.]

This insect is the optimum development of the forms of the Viridis Group. The intensified coloration, particularly of the black markings, combined with its heavier build, gives the species a distinctive facies when compared with its nearest ally, *H. viridis*.

The male from Durango is less brilliantly colored and much smaller than the type, now before us.

The female specimen of *H. pratensis* labelled "Orizaba, Mexico" in the Hebard Collection ex Bruner, recorded both by Seudder and Bruner, is in our opinion probably incorrectly labelled.

We can find no material of *H. speciosus* from northern Chihuahua as recorded by Bruner and do not believe the species occurs in that region.

Melanoplus scitulus Seudder.

1897. *Melanoplus scitulus* Seudder, Proc. U. S. Nat. Mus., XX, p. 249, Pl. XVI, fig. 10. [♂, ♀; Mount Alvarez, San Luis Potosi, Mexico.]
 Sierra de San Miguelito, San Luis Potosi, (E. Palmer), 1♀, [Hebard Cln.]

¹⁷ In addition to the typical series in the Hebard Collection.

This specimen agrees fully in all diagnostic features with the type and paratype before us. It is slightly smaller than the female allotype and the coloration is less intense, the marginal fields of the short almost circular tegmina being feebly darkened and only in their proximal portion, the ventral surface of the caudal femora showing very faintly an orange tinge and the caudal tibiae being a much less intense glaucous.

The broad prosternal spine, with cephalic face weakly concave and distal margin broadly convex-truncate, is a striking feature in the present insect. Though different in this respect and in male genitalic features as well from *M. reflexus*, affinity to that species is clearly indicated in the head, pronotum, form of tegmina and general type of coloration.

***Melanoplus desultorius insignis* new subspecies.**

This handsome insect is clearly the optimum development of the species *desultorius* Rehn, showing sufficient differentiation to warrant its recognition as a geographic race. From typical *desultorius* the present insect differs in the larger size, richer greens of the body and red of the antennae, more uniform coloration of the external faces of the caudal femora and particularly in the more ample, conspicuously

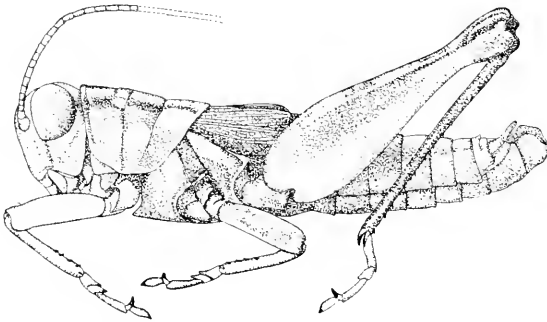


Fig. 4.—*Melanoplus desultorius insignis* new subspecies. Lateral view of male. Type. ($\times 3$.)

overlapping broad-ovate tegmina, which have their caudal margins truncate and showing weak concavity at the apex of the humeral trunk.

Of the species of the Aridus Group, *tristis* Bruner shows the condition developed under the most limiting environment, while *desultorius* represents a more favored development than *aridus* Scudder, to which very close affinity is shown. The male genitalia in all of

these species are of a closely similar type and do not afford the striking differential features usually found in the species of the genus *Melanoplus*.

Type: ♂; Copete Mine, thirty miles east of Carbo, Sonora, Mexico. (F. C. Nicholas.) [American Museum of Natural History.]

Size largest of the forms of the Aridus Group; form moderately robust, distinctly heavier than in typical *desultorius*. Interocular space slightly narrower than first antennal joint. Vertex and frontal costa as in *aridus* and *desultorius*. Eyes distinctly longer than infra-ocular portion of genæ. Pronotum much as in *desultorius*; disk gently arched transversely and longitudinally, the lateral margins rounded; median carina distinct on cephalic half of prozona and on metazona, obsolete on caudal half of prozona; transverse sulci well developed, the first failing by a very brief space to break the median carina, the other two complete, cutting the median line; caudal margin of pronotum rotundato-obtuse-angulate. Prosternal spine moderately elongate, rounding sharply distad to the acute apex. Interspace between mesosternal lobes slightly more than twice as long as least width; metasternal lobes contiguous. Tegmina broad ovate, decidedly overlapping, with caudal margin truncate and showing a broad but weak concavity toward the apex of the humeral trunk. The small, slightly divergent furcula, triangular and but little specialized supra-anal plate and elongate, very slender, moderately incurved cerci are much as in *desultorius*. The subgenital plate is broader than in that species, much broader than in *aridus*, with distal margin broadly rounded. Other features are found to be as described for *desultorius*.¹⁸

Allotype: ♀; same data as type. [American Museum of Natural History.]

Agrees with male except in the following features. Size much larger, form more robust. Interocular space slightly wider than first antennal joint. Pronotum with median carina percurrent, strongest on metazona, similarly cut by the transverse sulci. Interspace between mesosternal lobes with width contained in length about one and one-half times, that between metasternal lobes very narrow.

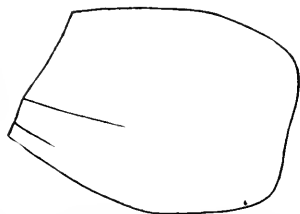


Fig. 5.—*Melanoplus desultorius insignis* new subspecies. Outline of female tegmen. *Allotype*. (× 3.)

¹⁸Py Rehn, Proc. Acad. Nat. Sci. Phila., 1907, p. 51, (1907).

Tegmina proportionately even broader than in male, with truncation of distal margin more noticeable. Ovipositor moderately stout, distal tooth of dorsal valves weakly curved.

Measurements (in millimeters).

	Length of body.	Length of pronotum.	Length of tegmen.	Width of tegmen.	Length of caudal femur.	Width of caudal femur.
♂. <i>Type</i> ..	22.7	5.7	4.6	3.	13.65	3.65
♀. <i>Allotype</i>	31.8	7.	6.2	4.	18.4	4.6

Coloration. The color pattern is shown by the figure. General coloration dark zinc green and antimony yellow. Head with vertex antimony yellow with a medio-longitudinal band of bottle green, eyes kaiser brown, antennae brilliant coral red, other portions of head yellowish, heavily obscured with dull greenish and with a postocular band of dark zinc green. Pronotum with pale markings antimony yellow, darker markings dark zinc green, those of the dorsum with a brownish suffusion and the darkest areas of the lateral lobes greenish black. In the female the dorsal band is solidly of this color. Tegmina olive brown, in the female shading proximad to clove brown. Abdomen and underparts yellowish. Cephalic and median limbs yellowish washed with green. Caudal femora with dorsal surface bright antimony yellow, with two broad bands of dark zinc green; internal surface antimony yellow; external surface dark zinc green shading into antimony yellow ventrad, leaving the ventral portion rather broadly this color, broadest proximad; genicular areas black with lobes antimony yellow washed with green. Caudal tibiae gobelin blue; spines black except at their immediate bases.

The pair is unique.

Melanoplus discolor (Scudder).

1897. *Pezotettix discolor* Scudder, Proc. Bost. Soc. Nat. Hist., XX, p. 81.

[♂, ♀; Dallas, Texas.]

1897. *Melanoplus discolor* Scudder, Proc. U. S. Nat. Mus., XX, p. 149,

Pl. X, fig. 7. (Same series.)

1897. *Melanoplus inornatus* Scudder, *ibid.*, p. 254, Pl. XVII, fig. 3. [♂, ♀; unknown locality; Monclova (nec Montelovez), Coahuila, Mexico.]

As the described male of *M. inornatus* had been destroyed, a female in the Museum of Comparative Zoölogy from Monclova has been selected as type. The above synonymy is evident when comparison of this specimen is made with cotypes of *discolor* and a considerable series of that species now at hand.

The species shows very unusual variation in females having the mesosternal space varying individually from subquadrate to dis-

tinety longer than broad. Variation in the male cerci is also found, but no approach is shown in the series before us to Scudder's figure for *inornatus*, showing a mesially constricted condition. The male without data, described as *inornatus*, may have represented a different species from the female. As the single type has been selected, a female, this would have no effect on the synonymy indicated above.

elanoplus thomasi Scudder.

1897. *Melanoplus thomasi* Scudder, Proc. U. S. Nat. Mus., XX, p. 365, Pl. XXV, fig. 1. [σ^7 , Lerdo, Durango, Mexico.]

Durango, Durango, (O. W. Barrett), 1 σ^7 , [Hebard Cn.]; XI, 27, 1909, (F. C. Bishopp), 2 σ^7 , 1 ϕ , [U. S. N. M.].

Escuinapa, Sinaloa, (J. H. Batty), 1 ϕ , [A. M. N. H.].

The pale lateral pronotal lines are wider in the Escuinapa example than in the others of this large and handsome insect.

Melanoplus differentialis (Thomas).

1871. *Caloptenus differentialis* Thomas, Proc. Acad. Nat. Sci. Phila., 1871, p. 149. [σ^7 , ϕ ; Jackson County, Illinois.]

Guanajuato, Guanajuato, (A. Dugès), 1 σ^7 , [U. S. N. M.]; XII, 11, 1898, 1 ϕ , [Hebard Cn.].

Vera Cruz, Vera Cruz, (T. Heyde), 2 σ^7 , [Hebard Cn.].

Medellin, Vera Cruz, IX, 1895, 2 σ^7 , 5 ϕ , [Hebard Cn.].

San Rafael, Vera Cruz, (C. H. T. Townsend), 2 σ^7 , [Hebard Cn.].

Melanoplus corpulentus Scudder.

1897. *Melanoplus corpulentus* Scudder, Proc. U. S. Nat. Mus., XX, p. 313, Pl. XX, fig. 10. [σ^7 , ϕ ; Tlalpam, Distrito Federal; San Luis Potosi and Sierra de San Miguelito, San Luis Potosi; Zacatecas, Zacatecas, and Sonora, Mexico; Silver City, New Mexico.]

Casas Grandes, Chihuahua, IX, 1902, (W. E. Hughes), 1 ϕ , [A. N. S. P.].

Eslava, Distrito Federal, IX, 1898, (O. W. Barrett), 1 σ^7 , [Hebard Cn.].

Tacubaya, Distrito Federal, IX, 1 ϕ , [A. N. S. P.].

Cuernavaca, Morelos, I, 4, 1899 and II, 1898, (O. W. Barrett), 1 σ^7 , 1 ϕ [Hebard Cn.].

Melanoplus regalis (Dodge).

1876. *Caloptenus regalis* Dodge, Can. Ent., VIII, p. 11. [Glencoe, Nebraska.]

1902. *Eoloplus crassus* Scudder and Cockerell, Proc. Davenport Acad. Nat. Sci., IX, p. 42. (In part.) [1 ϕ , San Luis Potosi, Mexico.]

Casas Grandes, Chihuahua, IX, 1902, (W. E. Hughes), 1 σ^7 , [A. N. S. P.].

San Luis Potosi, X, (from E. Palmer; G. Banoeta), 1 ϕ , *cotype* of *Eoloplus crassus* Scudder and Cockerell, [M. C. Z.].

Guadalajara, Jalisco, IX, 18, 1903, (J. F. McClellon), 1 σ^7 , [A. N. S. P.].

The present insect has not been previously recorded from Mexico as *regalis*. Marked variation is shown by the material at hand. The male from Guadalajara is very small and brilliantly colored, with bright greens and yellows on head, pronotum and dorsal surfaces of caudal femora and brilliant nopal red on the ventral and internal faces of the caudal femora, while the caudal tibiae are deep glaucous. The other specimens are larger, much less brilliantly colored and show only traces of greenish on head and pronotum.

This insect is extremely close to *M. picturatus* Bruner, the latter apparently differing only in the more robust form, decidedly larger average size and constant brilliant coloration, in which the prozona is normally conspicuously washed with pink, as are frequently the outer surfaces of the caudal femora.

Melanoplus femur-rubrum femur-rubrum DeGeer.

1773. *Acrydium femur-rubrum* DeGeer, Mém. l'Hist. Ins., III, p. 498, Pl. XLII, fig. 5. [1♀, Pennsylvania.]

Piedras Negras, Coahuila, 1♀, [U. S. N. M.].

Ciudad, Durango, 8100 feet, (Forrer), 2♀, [Hebard Cln.].

Aguascalientes, Aguascalientes, XI, 1887. (L. Bruner), 1♀, [Hebard Cln.].

Guanajuato, Guanajuato, (A. Dugès), 1♂, [U. S. N. M.].

Guadalajara, Jalisco, VIII, 3, (J. F. McClendon), 1♀; (D. L. Crawford), 1♀, [both A. N. S. P.].

Omiteme, Guerrero, 8000 feet, VII, (H. H. Smith), 1♀, [Hebard Cln.].

Merida, Yucatan, (Gaumer), 3♀, [Hebard Cln.].

Chichen Itza, Yucatan, (E. Thompson), 1♂, [Field Mus. Nat. Hist.].

It is of interest to note that though the species over the greater portion of its distribution has the caudal tibiae red, all of the present series, excepting those from Ciudad, Guanajuato and Omiteme, have the caudal tibiae glaucous. Decided size and color, but no structural, variation is shown by this material.

Melanoplus lakinus (Scudder).

1879. *Pezotettix lakinus* Scudder, Proc. Bost. Soc. Nat. Hist., XX, p. 79. [♂, ♀; Lakin and Pueblo, Colorado.]

1897. *Melanoplus marculentus* Scudder, Proc. U. S. Nat. Mus., XX, p. 139, Pl. X, fig. 1. [♂, ♀; Monelova (nec Montelovez), Coahuila; Sierra Nola, Tamaulipas; Sierra de San Miguelito, San Luis Potosi and Bledos, San Luis Potosi; Zacatecas, and Aguas Calientes—all Mexico.]

1897. *Melanoplus lakinus* Scudder, *ibid.*, p. 141, Pl. X, fig. 2. [Nebraska, Colorado, Kansas and New Mexico records.]

1897. *Melanoplus sonora* Scudder, *ibid.*, p. 143, Pl. X, fig. 3. [♂, ♀, Sonora, Mexico.]

The synonymy of *marculentus* is clearly proven by comparison of the different large series before us with the single type of *lakinus*¹⁹ and of *marculentus*.²⁰ An optimum condition, very robust in structure, is the basis for this name; the mesosternal differences noted by Scudder are wholly due to slight individual variation.

The typical series of *sonora* is lost; the material clearly representing dried alcoholic specimens of *lakinus*, in which the caudal tibiae have lost their glaucous coloration, becoming yellowish brown.²¹ Material similarly badly preserved is before us.

¹⁹ Here selected: ♂; Lakin, Kansas, September, 1; S. H. Scudder; Museum of Comparative Zoölogy.

²⁰ Selected by Rehn and Hebard, Proc. Acad. Nat. Sci. Phila., 1912, p. 78, (1912).

²¹ See Rehn, Proc. Acad. Nat. Sci. Phila., 1907, p. 51, (1907). Scudder, in his Revision, has frequently erred in studying such material, the effect of alcohol upon tissue and coloration being apparently ignored.

- Copete Mines, 30 miles east of Carbo, Sonora, (F. C. Nicholas), 1 ♂, [A. M. N. H.].
- Escuinapa, Sinaloa, (J. H. Batty), 1 ♀, [A. M. N. H.].
- San José del Cabo, Lower California, 5 ♀, [California Acad. Sci.].
- Casas Grande, Chihuahua, IX, 1902, (W. E. Hughes), 1 ♀, [A. N. S. P.].
- Colonia García, Chihuahua, (C. H. T. Townsend), 1 ♂, 1 ♀,²² (both macropterous), [Hebard Cln.].
- Monclova, Coahuila, (E. Palmer), 3 ♀, (1 macropterous), [M. C. Z.].
- Torreón, Coahuila, X, 30, 1909, (J. Friesser), 1 ♂, 1 ♀, (♀ macropterous), [Field Mns. Nat. Hist.].
- Tlahualilo, Durango, XII, 6, 1905, (A. W. Morrill), 1 ♀, [U. S. N. M.].
- Lerdo, Durango, XI, 1887, (L. Bruner), 2 ♀, [Hebard Cln.].
- Durango, Durango, XI, 27, 1909, (F. C. Bishopp), 5 ♂, 8 ♀, [U. S. N. M.].
- Camacho, Zacatecas, XI, 1887, (L. Bruner), 1 ♀, [A. N. S. P.].
- Zacatecas, Zacatecas, XI, 1887, (L. Bruner), 5 ♂, 8 ♀, including paratypes of *M. maculatus*,²³ [Hebard Cln. and A. N. S. P.].
- Aguascalientes, Aguascalientes, XII, 1, 1909, (F. C. Bishopp), 1 ♂, 6 ♀, (1 ♀ macropterous), [U. S. N. M.]; XI, 1887, (L. Bruner), 4 ♂, 2 ♀, [Hebard Cln. and A. N. S. P.]; XII, 9, 1898, 4 ♂, 5 ♀, (2 ♂, 1 ♀ macropterous), [Hebard Cln. and A. N. S. P.].
- Guanajuato, Guanajuato, XII, 11, 1898, 1 ♀, [Hebard Cln.].
- Ocotlán, Jalisco, 5000 feet, VIII, 29 to IX, 1, 1906, (P. P. Calvert), 1 ♂, [A. N. S. P.].

Specimens from Monclova, Coahuila, and a series including the type from Sierra Nola, Tamaulipas, show by far the optimum development, being exceptionally large and robust. Decided size variation, irrespective of geographic distribution, is found to occur, this particularly illustrated by the series from Aguascalientes. Very great color variation is usual; rare specimens are heavily washed with pink.

Melanoplus mexicanus mexicanus (Saussure).

1861. *Pezotettix mexicana* Saussure, Rev. et Mag. de Zool., (2), XIII, p. 160. [♂, ♀; Temperate Mexico.]
(*Melanoplus atlantis* of authors.)

Careful study of the literature and the extensive series at hand gives conclusive evidence that the widespread and abundant species, known universally as *M. atlantis*, must be called *mexicanus*, *atlantis* having been described in 1875. The name *atlantis* accordingly is alone retained for the race of *mexicanus* widely distributed throughout the eastern United States and vicinity. The species clearly divides into several geographic races, which will be fully discussed in a forthcoming study of the North American Melanopli found North of Mexico.

- Durango, Durango, XI, 27, 1909, (F. C. Bishopp), 1 ♂, 1 ♀, [U. S. N. M.].
- Aguascalientes, Aguascalientes, XI, 1887, (L. Bruner), 1 ♂, 1 ♀,²⁴ [Hebard Cln.].

²² Incorrectly recorded by Bruner as *M. cuneatus*, in 1908.

²³ In part incorrectly recorded by Scudder as *M. flabellifer* in 1897 and by Bruner as *flabellifer* in 1908.

²⁴ Recorded by Scudder as *M. atlantis* in 1897.

- Guadalajara, Jalisco, (D. L. Crawford), 2♂, 2♀; VIII, 18 to IX, 14, 1903, (J. F. McClendon), 6♂, 2♀.²⁵ [all A. N. S. P.]
 Querétaro, Querétaro, XI, 1887, (L. Bruner), 1♂, [Hebard Cln.]
 Mexico City, Distrito Federal, I, 6, 1892 and XI, 1887, (L. Bruner), 2♂, 5♀.²⁴ [Hebard Cln. and A. N. S. P.]
 Tacubaya, Distrito Federal, VIII and IX, (O. W. Barrett), 2♂,²⁷ 3♀, [Hebard Cln. and A. N. S. P.]
 Talpam, Distrito Federal, XI, 1887, (L. Bruner), 1♂, [Hebard Cln.]
 Cuernavaca, Morelos, VI, (O. W. Barrett), 1♀,²⁵ [A. N. S. P.]
 Atoyac, Vera Cruz, XII, (L. Bruner), 1♂, [Hebard Cln.]
 Patzcuaro, Michoacan, IV, 7, 1899, (S. N. Rhoads), 1♂,²⁹ [A. N. S. P.]
 Amula, Guerrero, 6000 feet, VIII, (H. H. Smith), 4♂, 5♀, [Hebard Cln.]
 Xucumanatlan, Guerrero, 7000 feet, VII, (H. H. Smith), 2♂, 2♀, [Hebard Cln.]
 Omilteme, Guerrero, 8000 feet, VII, (H. H. Smith), 5♂, 3♀, [Hebard Cln.]

In the present series, as given by Saussure for his typical material, individuals show both red and glaucous caudal tibiae, the glaucous type being much more frequently encountered in Mexico than in the United States. In the present series the following have glaucous caudal tibiae: 1♂, 1♀, Durango; 1♂, 1♀, Aguascalientes; 4♂, 2♀, Guadalajara; 4♂, 3♀, Amula; 2♂,⁵⁰ 2♀, Xucumanatlan, and 3♂, Omilteme. The ventral surfaces of the caudal femora are in all very red, as described by Saussure.

Melanoplus palmeri Scudder.

1897. *Melanoplus palmeri* Scudder, Proc. U. S. Nat. Mus., XX, p. 230, Pl. XV, fig. 7. [♂, ♀; Fort Wingate, New Mexico, and Fort Whipple, Arizona.]
 San Lorenzo, Chihuahua, (E. Palmer), 1♀,³¹ (dried alcoholic), [U. S. N. M.]
 Casas Grandes, Chihuahua, IX, 1902, (W. E. Hughes), 2♂, 1♀, 2 juv., (dried alcoholic), [A. N. S. P.]
 Colonia Garcia, Chihuahua, (C. H. T. Townsend), 1♀, [Hebard Cln.]
 Durango, Durango, (E. Palmer), 1♂, [M. C. Z.]; XI, 27, 1909, (F. C. Bi-hopp), 1♂, [U. S. N. M.]
 Escuinapa, Sinaloa, (J. H. Batty), 1♂, [A. M. N. H.]
 Zacatecas, Zacatecas, XI, 1887, (L. Bruner), 1♀,³² [Hebard Cln.]

Melanoplus elongatus Scudder.

1897. *Melanoplus elongatus* Scudder, Proc. U. S. Nat. Mus., XX, p. 160, Pl. XI, fig. 5. [♂, ♀; Finney County, Kansas; Las Cruces, New Mexico; Lerdo, Durango, Mexico; Guanajuato, Mexico and Bledos, San Luis Potosi, Mexico.]
 Sonora, 1♂, [A. M. N. H.]
 Mexclova, Coahuila, XI, 22, 1909, (F. C. Bi-hopp), 1♀, [U. S. N. M.]
 Tampico, Tamaulipas, XII, 1906, (C. A. Hart), 1♂,³³ [Hebard Cln.]

The males have the ventral surfaces of the caudal femora english red or mars orange.

²⁵ 5♂, 2♀ recorded incorrectly by Rehn as *M. spectis* in 1904.

²⁶ In part recorded by Scudder as *M. allanisi* in 1897.

²⁷ 1♂ incorrectly recorded by Rehn as *M. spectis* in 1900.

²⁸ Incorrectly recorded by Rehn as *M. arizona* in 1901.

²⁹ Recorded by Rehn as *M. allanisi* in 1902.

³⁰ Two have the caudal tibiae very pale.

³¹ Incorrectly recorded by Scudder as *M. spectis* in 1897.

³² Incorrectly recorded by Scudder as *M. flavellifer* in 1897.

³³ Incorrectly recorded by Bruner as *M. flavidus* in 1908.

Melanoplus complanatus Scudder.

1897. *Melanoplus complanatus* Scudder, Proc. U. S. Nat. Mus., XX, p. 298, Pl. XIX, fig. 10. [Cape St. Lucas, Lower California: Sonora, Mexico.]

San José del Cabo, Lower California, 13♂, 14♀, 2 juv., (dried Alcoholic), [Hebard Cln. and California Acad. Sci.].

Melanoplus pictus brownii Caudell.

1902. *Melanoplus brownii* Caudell, Can. Ent., XXXIV, p. 169. [♂, ♀, Yuma, Arizona.]

Study of the single types of *M. pictus* Scudder and *M. brownii* Caudell and large series of the latter condition before us, offers satisfactory evidence that *brownii* must be considered a geographic race of *pictus*. Full comparisons will be made in a study of North American Melanopli found North of Mexico.

Hermosillo, Sonora, IV, 1897, (A. Koebele), 1♂, [Hebard Cln.].

Melanoplus cinereus cyanipes Scudder.

1897. *Melanoplus cyanipes* Scudder, Proc. U. S. Nat. Mus., XX, p. 295, Pl. XIX, fig. 8. [♂, ♀; Los Angeles, Pasadena and San Diego, California.]

Careful consideration of the types of *cinereus* Scudder and the single type of *cyanipes* Scudder and large series of these and other closely related conditions, shows conclusively that *cyanipes* represents a geographic race of *cinereus*, which species develops still other geographic races over its wide distribution in the western United States. These will be treated in full in a forthcoming paper on the Melanopli of North America found North of Mexico.

San Quentin, Lower California, V, 1889, (C. D. Haines), 1♂, [Hebard Cln.].

Phœtaliotes nebrascensis (Thomas).

1872. *P[œtaliotes] nebrascensis* Thomas, Prelim. Rept. U. S. Geol. Surv. Montana and Terr., V, p. 455. [♀, Nebraska.]

Colonia Garcia, Chihuahua, (C. H. T. Townsend), 2♂, (macropterous), [Hebard Cln.].

Durango, Durango, (E. Palmer), 1♂, [M. C. Z.].

Guanajuato, Guanajuato, (A. Duges), 1♂, (macropterous), [U. S. N. M.].
Cordoba, Vera Cruz, IX, 28, 1♂, 1♀, [Cornell Univ. Cln.].

We find that four Mexican genera, *Philocleon*, *Perixerus*, *Pocillotettix* and *Dactylotum*,³⁴ show a distinct divergence from the true Melanopli, but insufficiency of material prevents us from determining whether these should be referred to a separate group, the Dactyloti. The forms all have a broad, blunt vertex, showing some depression, this often transverse, between the eyes; the prozona inflated, rounding

³⁴ There is little doubt but that *Pocpédetes* Saussure is a synonym of *Dactylotum* Charpentier.

broadly laterad and in the majority of species with transverse sulci deep, while the number of outer spines of the caudal tibiae, though individually variable, average in some of the species less than eight. All of the forms are variously brilliantly colored, but have a distinct general appearance of consanguinity.³⁵ Until much additional material is secured we feel that notes on the Mexican material of these genera would not be sufficiently complete to warrant publication.

The species of Melanopli which have been correctly recorded from Mexico.

(Material of the names marked with an asterisk is in the Philadelphia collections, two asterisks indicating that the type is in these collections and a dagger that the type has been at hand for examination during the preparation of the present paper.)

- | | |
|-----------------------------------------|--------------------------------------------------|
| 1. <i>Netrosoma fusiforme</i> * | 20. <i>Conalcaea miguelitana</i> |
| 2. <i>Netrosoma nigropleura</i> ** | Scudder* |
| 3. <i>Dichroplus notatus</i> Bruner* | 21. <i>Conalcaea truncatipennis</i> |
| 4. <i>Pedies virscens</i> Saussure | Scudder† |
| 5. <i>Pedies mexicanus</i> (Bruner)* | 22. <i>Conalcaea crassa</i> (Scudder)** |
| 6. <i>Pedies variabilis</i> (Scudder)** | 23. <i>Aidemona azteca</i> (Saussure)** |
| 7. <i>Cephalotettix pilosus</i> (Stål)* | 24. <i>Paraidemona mimica</i> |
| 8. <i>Phadrotettix gracilis</i> | Scudder* |
| (Bruner)** | 25. <i>Campylacantha similis</i> |
| 9. <i>Phadrotettix bistrigata</i> | Scudder** |
| (Scudder)† | 26. <i>Hesperotettix meridionalis</i> |
| 10. <i>Phadrotettix angustipennis</i> | Scudder*† |
| Scudder*† | 27. <i>Melanoplus scitulus</i> |
| 11. <i>Phadrotettix valga</i> | Scudder*† |
| (Scudder)**† | 28. <i>Melanoplus meridionalis</i> ³⁶ |
| 12. <i>Phadrotettix litus</i> Hebard** | Scudder*† |
| 13. <i>Phadrotettix palmeri</i> | 29. <i>Melanoplus cauceri</i> Scudder** |
| (Scudder)*† | 30. <i>Melanoplus desaltorius insignis</i> |
| 14. <i>Sinaloa behrensii</i> Scudder† | Hebard* |
| 15. <i>Sinaloa nitida</i> (Scudder)** | 31. <i>Melanoplus discolor</i> |
| 16. <i>Sinaloa peninsule</i> | (Scudder)*† |
| (Scudder)** | 32. <i>Melanoplus glaucipes</i> |
| 17. <i>Phaulotettix compressus</i> | (Scudder)* |
| Scudder*† | 33. <i>Melanoplus birittatus</i> (Say)* |
| 18. <i>Agrococtettix modestus</i> | 34. <i>Melanoplus thomasi</i> |
| Bruner** | Scudder** |
| 19. <i>Dasyseirtus olivaceus</i> | 35. <i>Melanoplus differentialis</i> |
| Bruner** | (Thomas)* |

³⁵ The genus *Philocteon* stands off by itself and shows this feature least.

³⁶ We have been unable to examine the type of *M. reflexus* Scudder, of which *meridionalis* may possibly be a synonym.

- | | |
|----------------------------------------------------------------------|-----------------------------------------------------|
| 36. <i>Melanoplus sumichrasti</i>
(Saussure)* | 43. <i>Melanoplus palmeri</i>
Scudder* |
| 37. <i>Melanoplus corpulentus</i>
Scudder* | 44. <i>Melanoplus elongatus</i>
Scudder* |
| 38. <i>Melanoplus regalis</i> (Dodge)* | 45. <i>Melanoplus complanatipes</i>
Scudder* |
| 39. <i>Melanoplus picturatus</i>
Bruner** | 46. <i>Melanoplus pictus brownei</i>
Caudell* |
| 40. <i>Melanoplus femur-rubrum</i>
<i>femur-rubrum</i> (de Geer)* | 47. <i>Melanoplus cinereus cyanipes</i>
Scudder* |
| 41. <i>Melanoplus lakinius</i>
(Scudder)*† | 48. <i>Phætaliotes nebrascensis</i>
(Thomas)* |
| 42. <i>Melanoplus mexicanus mexi-</i>
<i>canus</i> (Saussure)* | 49. <i>Edalconotus jucundus</i>
(Scudder)* |

We are unable to locate *Melanoplus selectus* Walker, described from Mexico.

Bruner has incorrectly quoted *Pezotettix varicolor* Stål, since referred to *Paradichroplus* then to *Chlorus*, as having been recorded from Mexico.

Kirby has incorrectly quoted *Conalcaea ncomexicana* as having been recorded from Mexico.

Uhler's record of *Hesperotettix viridis* from Mexico is probably referable to *H. meridionalis*.

The other incorrect determinations and the synonyms for the Mexican *Melanopli* have already been discussed in the present paper.

CONCERNING RAFINESQUE'S PRÉCIS DES DÉCOUVERTES SOMIOLOGIQUES.

BY DAVID STARR JORDAN.

In Palermo, in 1814, Constantine Samuel Rafinesque published a mean little pamphlet which he called "Précis des Découvertes Somiologiques, ou Zoologiques et Botaniques." By his newly invented word "Somiology" Rafinesque meant Systematic Zoölogy and Botany. In another paper of the same date he gives the "Principaux Fondamentaux de Somiologie, ou les Lois de la Nomenclature et de la Classification de l'Empire Organique ou des Animaux et des Végétaux."

These laws of nomenclature are mostly reasonable enough, except that they justify the substitution of new names on trivial grounds. A name may be too long or too short, and all names indicating likeness to other genera, as *Gobioïdes*, *Scomberomorus*, *Scomberesox*, were discarded. These rules he applies at once to numerous plant genera and in his "Analyse de la Nature," in 1815, to many others also.

The "Précis de Découvertes" has been rarely seen by naturalists. The only copy I have examined is in the library of the Department of Agriculture. In it the following species are described, from Sicily, unless otherwise noted:

Phycis macronemus, p. 16.

This is apparently *Phycis blennioides* Brünnich.

Trisopterus fasciatus (new genus), p. 16.

"Corps comprimé: tête écailleuse: trois nageoires dorsales et anales opposées, les intermédiaires les plus grandes. Il appartient à la famille des Gadiens. *T. fasciatus*: Jaune doré rayé transversalement de brun: ligne laterale droite et brune: queue fourchée."

According to Risso this is the same as his *Morua capelanus* or *Brachygodus minutus* (L.). This identification is probably correct, in which case *Trisopterus* replaces *Brachygodus* Gill.

Bothus diagrammus, p. 16.

Left side rosy, unspotted. Two lateral lines, the upper straight, the lower curved. Dorsal beginning over opercles.

Bothus punctatus, p. 17.

Upper side reddish, dotted with brown; lateral line arched in front; dorsal beginning over mouth.

Bothus diaphanus, p. 17.

Hyaline, a red spot on opercle; two at base of caudal; 12 along body near dorsal and anal; dorsal beginning over mouth; lateral line straight.

These three species are plainly larval flounders, the first possibly *Flesus flesus* (L) the others perhaps *Bothus rhombus* (L).

Monochirus hispidus, p. 17. New genus.

This is a valid genus and species for which Rafinesque's name must stand.

Blennius lanceolatus, p. 17.

Body lanceolate; tail sharp; silvery, dotted with brown; back greenish; ventral rays 3; a barbel under the mouth. (Not identified, possibly *Ophidion barbatum* L.)

Phycis agrammus, p. 17.

Brown, with two rows of whitish spots; no lateral lines, no barbels; two appendages on nostrils; ventral rays 5; front dorsal rays 20. (Not identified.)

Lutianus flavus, p. 18.

Entièrement jaune foncé, une tache noire sur l'opercule postérieur et une autre à la base de la queue qui est entière; ligne latérale courbe postérieurement. This is *Crenilabrus ocellatus* (Forskål), originally from Smyrna.

Holocentrus ruber, p. 18.

Rouge pâle, une tache violette sur l'opercule postérieur, un rang de taches olivâtres sur le dos; iris violette; queue entière, ligne latérale courbe postérieurement. Unidentifiable. Possibly *Paracentropistis hepatus* (L.), the name *ruber* preoccupied in *Holocentrus*.

Perca nebulosa, p. 18.

Variée de brun plus ou moins clair ou rougeâtre, mâchoire inférieure plus courte, à un barbillon très-court en dessous; nuque carénée, ligne latérale presque droite, queue entière, première nag. dorsale à 10 rayons. This is *Umbrina cirrhosa* (L).

Gobius aterrimus, p. 18.

Entièrement d'un noir foncé uniforme sur tout le corps et les membres; joues enflées, ligne latérale droite, queue arrondée, première nag. dorsale à 5 rayons. This is probably *Gobius niger* L.

Esox reticulatus, p. 18.

Corps comprimé, sans ligne latérale, réticulé de noir bleuâtre sur un fond argenté, bouche grande noire, à dents crochues inégales; nageoires blanchâtres, les dorsale et anale à 16 rayons, queue fourchue.

This seems to be the common European pike, *Esox lucius* L. The name invalidates the later name of *Esox reticulatus*, given in 1818 by Le Sueur to the Grass Pike or Green Pickerel of Eastern States of America. For this, the name *Esox tredecimlineatus* given by Professor Mitchill in 1852, to his "Federation Pike" from Oneida Lake, should apparently stand. Mitchill was impressed with the patriotic agreement of this fish, having 13 dorsal rays, 13 anal rays and 13 branchiostegals, with the thirteen American States.

Esox phaleratus Say, 1818, from East Florida, was never described. The few words quoted from Say by Le Sueur, apply better to the little banded pickerel, *Esox americanus* Gmelin. "Body dusky with a vertical fulvous vitta and three or four fulvous fasciæ."

Balistes fuscatus, p. 19.

Brownish, with 3 large black spots. Dorsal spines 3, the first very rough. Pectorals with 15 rays, the first very rough. Between the Azores and the United States. This seems to be *Balistes forcipatus* Gmelin.

Chironectes variegatus, p. 19.

Compressed; gray olive above with large spots and streaks of black and small white spots; two appendages above eyes. Between the Azores and the United States. This is apparently *Histrio tumidus* (Osbeck). *Chironectes variegatus* of Cuv. & Val. is a different species.

The three following are from streams flowing into Chesapeake Bay:

Centropomus albus, p. 19. D. VIII, 16. A. 12.

Tail half forked; upper jaw the longer. This seems to be *Morone americana* Gmelin, but the number of dorsal rays should be IX-1, 12.

Centropomus luteus, p. 19.

Yellow with brown bands; lower fins red; jaws almost equal; tail almost entire; second dorsal unspotted. This is *Perca flavescens* (Mitchill) of the same date, 1814.

Sparus mocasinus, p. 19.

Bluish, rosy on the flanks; 2 spots on opercle, one black, one red; tail lunulate. D. X. 14. A. III, 14. This is *Eupomotis gibbosus* (L.), but the number of fin-rays agrees with those of no sun-fish.

ON A FORGOTTEN GENUS OF SHARKS DESCRIBED BY NARDO.

DAVID STARR JORDAN.

In a paper entitled "Osservazione Ittiologiche" in the *Annali delle Scienze del Regno Lombardo-Veneto*, 1843, Professor Gian Domenico Nardo, described a genus of sharks, to which I have seen no subsequent allusion. He calls the genus *Caninoa* or *Caninotus* in honor of Charles Lucien Bonaparte, prince of Canino.

The type is *Squalus barbarus* Nardo or *Caninoa cicceghini* Nardo. This shark is said to have but one dorsal fin, inserted behind the ventrals, the gills 5 as in ordinary sharks; no spiracles; the teeth equal, triangular, elongate, very sharp, dentate at the base. The tail is not described.

This agrees with no known shark. It is barely possible that it is based on an individual of *Carcharhinus commersoni* which had its first dorsal fin bitten off while very young. The Hexanchidæ, sharks with one dorsal fin, have spiracles, and teeth of a different type. A deep water shark, *Pentanchus* Smith & Radcliffe, lately described from the Philippines, has but one dorsal and five gill openings. The small dorsal is, however, inserted over the very long anal and the tricuspoid teeth could hardly be described as merely dentate at base. *Pentanchus* has minute spiracles. *Caninoa* is therefore based on a mutilation or on some shark not seen since the original discovery.

NEW AND LITTLE KNOWN GASTROPODA FROM THE UPPER CRETACEOUS
OF TENNESSEE.

BY BRUCE WADE.

An announcement of the discovery of unusually well preserved Upper Cretaceous fossils in the Ripley formation on Coon Creek in McNairy County, Tennessee, was made in the *Contributions to Geology* of the March, 1917, number of the *Johns Hopkins University Circular*. A somewhat detailed description of the locality and a few preliminary observations on the fauna were made in the same article. The studies of this fauna have since been pursued further and more than 350 species have been recognized.

The Gastropoda of this fauna are especially interesting, since this class is so prolific and so well preserved. A systematic study of these gastropods has recently been submitted as a dissertation from the Geological Laboratory of the Johns Hopkins University. In this study 151 species of Gastropoda from the Coon Creek locality have been differentiated and described. As a result of the evidence furnished by this large assemblage of perfect or nearly perfect univalve shells, it has been found necessary, in order to classify all of these forms, to propose several new generic groups. Descriptions of some of the more interesting of these new genera and species have been published recently² and it is the purpose of the present paper to present several additional forms of especial interest from this locality.³

Family **CONIDÆ**.

Genus **CONORBIS** Swainson.

Conorbis mcnairyensis n. sp. Pl. XVII, figs. 1, 2.

Description.—Shell very small and biconic in outline; spire elevated, its altitude equal to about half that of the entire shell; whorls abruptly

¹ Published by permission of Dr. A. H. Purdue, State Geologist of Tennessee.

² Proc. Acad. Nat. Sci., Phila., July, 1916, pp. 455-471, Pls. XXIII, XXIV. *Am. Jour. Sci.* (IV), Vol. 43, pp. 293-297, figs. 1, 2, 1917.

³ The writer wishes to express his indebtedness to Prof. W. B. Clark and his associates in Paleontology, Prof. E. W. Berry and Dr. J. A. Gardner, under whose guidance this study has been conducted. The writer is also indebted to Drs. W. H. Dall, T. W. Stanton, L. W. Stephenson, C. W. Cooke, and J. B. Reeside, Jr., of the U. S. Geological Survey, and Dr. H. A. Pilsbry, of The Academy of Natural Sciences of Philadelphia, for the privilege of studying their collections, for the kindly interest they have shown in the work, and for their assistance in helping to determine the biological relations of some of these forms.

shouldered or strongly tabulated, the maximum diameter falling in front of the median horizontal, volutions closely appressed and increasing gradually in size, probably four in number in a perfect individual; sculpture subdued and irregular; well-defined axial costae not developed; spirals low and crowded, about six in number on the penultima, and more than sixteen on the ultima, spirals crossed by numerous irregular, sharply incised incremental lines which give the surface of the shell a subcancellate aspect; suture impressed; body shouldered posteriorly and sloping gently and evenly in front; aperture narrow; margin of outer lip broken away; inner lip concave medially; columella slightly flexed near the anterior extremity; umbilicus indicated by a narrow depression along the outer margin of the reflected inner lip.

Dimensions.—Altitude 4.3 mm.; maximum diameter 2.5 mm.

This form is represented by a single specimen. The species has been referred to the genus *Conorbis* since it shows all the generic features revealed in the type of the genus, *Conus dormitor* (Sowerby)⁴ from the Eocene of western Europe. The Tennessee form is probably the first typical *Conorbis* to be reported from the Upper Cretaceous. An imperfect individual from the Senonian of Ria Piabas, Brazil, has been described under the name of *Conorbis restitutus*,⁵ but the correctness of this generic determination has been questioned by Cossmann.⁶

Family VOLUTIDÆ.

Genus **HYLLUS** n. gen.

Etymology: *Hyllus*, a son of Hercules.

Type: *Hyllus callilateras* n. sp.

Shell large and subovoid in outline; spire obtuse or only slightly elevated; whorls closely appressed, increasing in size rapidly to a much inflated body; protoconch unknown; sculpture absent, external surface free from ornamentation except for incremental lines which show through the glazed surface; sutures obscured by callus; body slightly inflated and sometimes flattened dorso-ventrally, gently constricted behind, and in front it slopes gradually into a broad, slightly curved short pillar; aperture broad and lenticular, distinctly notched in front or produced into a short canal, slightly notched posteriorly; outer lip simple and broadly arcuate; inner lip

⁴ Cossmann, M., 1896, *Ess. de Pal. Comp.*, livr. II, p. 149, Pl. VIII, figs. 16 et 18.

⁵ White, C. A., 1888, *Archiv de Museu Nacional de Rio de Janeiro*, vol. VII, p. 119, est. X, figs. 4, 5.

⁶ Cossmann, M., *loc. cit.*, p. 150.

excavated near the anterior extremity; columella marked by one or two strong oblique columellar folds; parietal wall glazed with a callus which in some forms is quite heavy; anterior fasciole broad and obscured by a callus.

This genus is proposed for a group of *Volutes* represented by two species from Coon Creek and a third species from Owl Creek which are characterized by large, inornate shells with expanded bodies and low spires. This group is probably nearer *Liopeplum*⁷ than any other described genus but differs from that genus very essentially in the character of the spire, the outline of the body, and further in the obliqueness and number of the columellar plaits. Another closely related group of *Volutes* in the Upper Cretaceous is represented by the species *Melo pyriformis* Forbes from the Arrialoor, South India,⁸ a species which Cossmann has referred to the genus *Scaphella*.⁹

Hyllus callilateris n. sp. Pl. XVII, figs. 5, 6.

Description.—Shell large and subovoid in outline, spire elevated but its height probably less than the length of the aperture; number of whorls unknown; volutions increasing in size with a fair degree of rapidity; apex broken away, protoconch unknown; sculpture absent, external surface free from ornamentation except incremental lines which show through the glazed surface, especially on the anterior fasciole; suture hidden by callus; body slightly flattened dorso-ventrally, somewhat inflated and sloping gently posteriorly and likewise anteriorly where it merges into a broad curved pillar which is marked by a wide, low anterior fasciole partly hidden by callus; aperture broad and lenticular, distinctly notched or canaliculate anteriorly but the posterior notch is not well defined; outer lip simple and well rounded; inner lip excavated near the anterior extremity; columella marked by a single strong oblique fold; parietal wall heavily calloused; callus deposited over practically the entire surface of the shell and very conspicuously developed on the side of the body opposite the aperture into a broad, thick, well-rounded ridge.

Dimensions (imperfect individual).—Altitude 97 mm.; length of aperture 67.3 mm.; maximum diameter 58 mm.

In 1860 Conrad¹⁰ figured a form and referred to it in his index of

⁷ Dall, W. H., 1890, *Trans. Wagner Free Inst. Sci.*, Vol. III, pt. I, p. 73.

⁸ Stoliczka, F., 1868, *Geol. Survey India, Pal. Indica, Cret. Faunas South India*, Vol. II, p. 83, Pl. VI, figs. 9, 9a.

⁹ Cossmann, M., 1899, *Ess. de Pal. Comp. livr.*, III, p. 127.

¹⁰ Conrad, T. A., 1860, *Jour. Acad. Nat. Sci. Phila.*, 2d ser., Vol. IV, Pl. XLVII, fig. 14, p. 298.

the figures of the plate as *Ancilla cretacensis*, but there is no reference in his text to the species nor has mention of it been found elsewhere in his writings. This figure does not show all the shell features but it presents characteristics that seem sufficient to say that Conrad's form is a species of the new genus *Hyllus*.

The species, *Hyllus callilateris*, is the type of the genus and is represented in the present collection by one specimen which is well preserved except for the loss of the apex. The species is well characterized by the broad flat body with a heavy callus deposit on the body opposite the inner lip and further by the single columellar plait.

Hyllus coloratus n. sp. Pl. XVII, figs. 3, 4.

Description.—Shell of medium size and ovoid in outline; length of aperture and anterior canal greater than the elevation of the spire; whorls of cone probably four in number and increasing in size with a fair degree of rapidity; sculpture absent, external surface smooth and free from ornamentation except for incremental lines which show through a brilliant glaze; suture indistinct, hidden by a glazed callus which coats the entire surface of the shell; body evenly rounded posteriorly and medially but gently constricted anteriorly into a short broad pillar which is marked by a gently elevated anterior fasciole formed by increments of the anterior siphonal notch; aperture lenticular, produced anteriorly into a short canal; posterior siphonal notch shallow and subangular, directly in front of posterior commissure, notch indicated behind margin of aperture by incremental lines; outer lip simple and smooth; inner lip excavated; columella marked by two strong oblique folds; parietal wall thinly washed with callus.

Dimensions (imperfect individual).—Altitude 5.2 mm.; maximum diameter 2.4 mm.

There are two specimens of this species and both are incomplete. One of these shows a dark yellow color banding which is fixed in the glaze of the external surface and is no doubt a remnant of an original color pattern. The species is well characterized by the two columellar folds which are conspicuous on the inner lip, the imbricate external surface and further by the subelliptical outline of the shell. This species differs from *Hyllus callilateris* by being much smaller and having two columellar plaits instead of one and further by not having a heavy deposit of callus on the body opposite the inner lip.

Genus **FALSIFUSUS** Grabau.¹¹

Falsifusus mesozoicus n. sp. Pl. XVII, figs. 11, 12.

Description.—Shell small and fragile, fusiform in outline, spire elevated and acute, pillar very long, slender and straight; elevation of spire much less than length of aperture and canal; angle of spire increasing with age; whorls closely appressed, five in number, whorls of spire sharply convex or subangular in cross-section, body inflated; protoconch small, smooth and trochoid, coiled thrice; sculpture of body axial and spiral; axials strong, about ten in number on the body; axial ribs angular and spinose on the keel of the shoulder of the body but well rounded or nodulated on the whorls of the spire; axials absent on the shoulder and obsolete on the base of the body; spiral sculpture elaborate and may be described in groups as follows: a half-dozen subequal liræ on the shoulder, three on the sides of the whorls of the spire, including the spiral which outlines the periphery; twice as many on the medial portion of the body with intercalated secondaries; four or five irregular and obscure spirals on the posterior portion of the base, four stronger equal and equispaced liræ upon the anterior portion of the base; about a dozen increasingly finer spirals upon the pillar; suture impressed and undulated by the costæ of the preceding whorl; body abruptly constricted anteriorly into a long, slender pillar; aperture narrow, ovate, produced in front into a long, narrow canal with proximate, parallel margins; outer lip thin and simple; inner lip excavated at the base of the body; columella smooth, slightly twisted at the entrance of the anterior canal; parietal wall thinly glazed.

Dimensions.—Altitude 20.4 mm.; maximum diameter 8.2 mm.

The slender and fragile shells of this species are well characterized by the spinose terminations of the axials along the shoulder angle of the body, the elaborate spiral sculpture and the slightly bent slender pillar. The Mæstrichtian species *Fusus bicinctus* Kaunhowen¹² from Belgium is probably a related species of this genus. Kaunhowen's species has a higher spire and a much longer pillar than the Tennessee species and resembles the type of the genus more closely. These two species are the first Upper Cretaceous forms to be referred to Grabau's genus *Falsifusus*.

¹¹ Grabau, A. W., 1904, "Phylogeny of *Fusus* and its Allies." *Smiths. Misc. Coll.*, Vol. XLIV, p. 80.

¹² Kaunhowen, F., 1897, *Pal. Abhandl.*, Achter Bd., p. 82, Taf. X, figs. 1, 2, 3, 4.

Genus **BOLTENELLA** n. gen.

Etymology: Name given in honor of Bolten who applied the name *Busycon* to the type genus of this family.

Type: *Boltenella excellans* n. sp.

Shell of medium size, thin, fulguroid in outline; elevation of spire less than the length of the aperture and anterior canal; whorls closely appressed and increasing rapidly in size; protoconch smooth and paucispiral, fairly large and bulbous but not greatly inflated; sculpture subdued, both axial and spiral elements present; aperture pyriform; outer lip simple; parietal wall washed with callus; columella reinforced near the entrance of the anterior canal; pillar slender, either straight or curved.

This new genus is proposed to include a group of forms known from two species, one from Coon Creek, represented by several well preserved individuals and another from the Upper Cretaceous of Vaals, Germany, well illustrated and described by Holzapfel. The German species, *Hemifusus coronatus* (Roemer) Holzapfel¹³ has been variously assigned by different authors since the days of Roemer to such genera as *Pyrula*, *Fusus*, *Rapa*, *Tritonidea*, *Tudicla*, and lastly to *Hemifusus* by Holzapfel. The discovery of a related species in the Ripley formation of Tennessee is further evidence of the existence of a well defined group, characterized by a fulguroid outline, a large, paucispiral protoconch and further by the subdued spiral and axial ornamentation of the outer surface, as well as a slender pillar in front of an inflated body. The fulguroid outline and fairly large protoconch seem sufficient to tie the group to the family Busyconidae, yet there are many features that suggest the Fusidae. The genus *Boltenella* is probably intermediate between these two families but more nearly like the Busyconidae yet not near enough to true *Busycon* to be included in the group *Protobusycon*¹⁴ since it is a much smaller form with a different type of pillar and external ornamentation. Among the Fusidae it resembles *Falsifusus* Grabau,¹⁵ but that group is typically more slender. Its spire is elevated and acuminate and the pillar is very long and straight. It is not typically fulguroid in outline as is the group for which the name *Boltenella* is proposed.

¹³ Holzapfel, E., 1888, *Paläontographica*, Bd. XXXIV, p. 105, Taf. XI, figs. 8-13.

¹⁴ Type: *P. cretaceum* Wade, 1917, *Am. Jour. Sci.*, Vol. XLIII, No. 256, p. 293, figs. 1, 2.

¹⁵ Grabau, A. W., 1904, *Smiths. Misc. Collections*, Vol. XLIV, p. 80, S1, fig. 4.

Boltenella excellans n. sp. Pl. XVIII, figs. 3, 4.

Description.—Shell of medium size and thin; elevation of the spire less than the length of the aperture; whorls closely appressed and strongly shouldered by a broad concave shelf, whorls five in number, increasing in size from a minute apical whorl to a much inflated body; protoconch fairly large and bulbous; smooth and naticoid, coiled two and a half times; sculpture well defined but somewhat subdued; axials elevated and low, well rounded and short, persisting on the whorls of the spire to the anterior suture but evanescent a little in front of the shoulder angle of the body, axial ribs nodulated on the body, nodes occurring directly upon the shoulder angle while the axials persist for a short distance across the shoulder; spiral sculpture low and fine, slightly irregular with secondary spirals developed in the interspiral depressions near the aperture; spirals microscopically roughened by the intersection of numerous incremental lines; suture appressed and undulated by the axial ribs of the preceding whorl; body much inflated, shouldered behind, rounded or globose in front, and merging into a long straight pillar which may be straight or curved; aperture broadly ovate, grooved at the posterior commissure and produced in front into a narrow canal; outer lip thin and simple; inner lip excavated at the base of the body; columella smooth, reinforced at the entrance of the anterior canal by a deposit of callus; parietal wall thinly glazed, outer margin of the wash sharply defined.

Dimensions.—Altitude 38.4 mm.; elevation of spire 13.5 mm.; maximum diameter 18.7 mm.

This species is represented in the Coon Creek collection by several well preserved specimens, a few of which show the protoconch. The species is characterized by fulguroid shells which are ornamented on the external surface both by axial and spiral sculpture. They have a broad, slightly concave shoulder and the angle of the shoulder is nodulated on the body by the axial elevations.

Genus **SCOBINA** n. gen.

Etymology: *Scobina*, a file or rasp, name applied because of the rasp-like character of the incremental serrations along the anterior carina of the type species.

Type: *Scobina bicarinata* n. sp.

Shell moderately large and strong, top-shaped in outline; spire acute at the apex, its elevation less than half the total altitude of the shell; protoconch scar small; whorls closely appressed, obliquely shouldered, whorls of spire unicarinate, body flattened along the

narrow peripheral region, abruptly constricted in front of the periphery; sculpture spiral, spinose and laminated in the type species; incrementals sinuous in character, forming a reëntrant angle along the posterior keel; aperture subovate, produced in front into a narrow canal; outer lip sinuous at the shoulder angle; inner lip reflected, not always adnate to the body and pillar, a chink occasionally present between the inner lip and pillar; pillar slender and elongate often curved or bent near the anterior extremity.

This genus has an acute spire and is characterized by a highly inflated body with a narrow peripheral region abruptly constricted in front of this periphery. The pillar is long and variable. The sculpture is dominantly spiral with laminar, somewhat zig-zag incremental lines. This genus is proposed to include two known species, one from Coon Creek and another from both Ripley and Dumas, Mississippi, both of which are represented by several well preserved specimens that present generic features that cannot be included within the limits of any of the described groups. The general form of the genus suggests *Hereorhynchus*¹⁶ or possibly *Pyrifusus*. However, the strong sinuations of the axials along the shoulder is a character by which it may be readily separated from any of the previously known Busyconidae. There is a tendency toward low, obtuse spires in most of the genera of this family, yet some forms, such as *Pyrifusus*, are acute at the apex. With age, however, this low angle of the spire greatly increases, a feature very characteristic of *Scobina*. The strongly inflated, bicarinate body of the South Indian Upper Cretaceous form *Rapa cancellata* (ex parte) Stoliczka¹⁷ resembles *Scobina* somewhat but the South Indian form is umbilicate, and not acute spirally. *Rapa* has a well defined umbilicus. *Pyropsis* differs from *Scobina* in having a low spire and no laminar incremental ornamentation. These characters will also serve to separate *Scobina* from *Trochifusus*.¹⁸

Scobina bicarinata n. sp. Pl. XVIII, figs. 1, 2.

Description.—Shell of medium size and top-shaped; spire acute at the apex, its elevation less than half the total altitude of the shell; angle of spire increasing with age; whorls six in number, closely appressed, increasing in size to an inflated body, whorls of spire

¹⁶ Conrad, T. A., 1860, *Jour. Acad. Nat. Sci. Phila.*, 2d ser., Vol. IV, p. 286, Pl. XLVI, fig. 4; 1868, *Amer. Jour. Conch.*, Vol. IV, p. 247.

¹⁷ Stoliczka, F., 1868, *Geol. Survey India, Pal. Indica, Cret. Faunas South India*, Vol. II, p. 154, Pl. XII, figs. 12-16.

¹⁸ Gabb, W. M., 1876, *Proc. Acad. Nat. Sci., Phila.*, p. 285.

strongly shouldered and unicarinate; protoconch scar small; body broad and angular, the peripheral area narrow, flattened, bicarinate, the posterior body slope broad and conspicuous, the anterior slope is a little more gentle and a little broader than the posterior slope, especially in old individuals; sculpture both axial and spiral, spiral ornamentation consisting of the two carinae on the periphery and six or seven low spiral ridges on the anterior slope of the body and on the pillar; posterior slope of whorls free from well defined sculpture; spirals intersected by deeply angular and laminar axials which are irregularly spaced and about twenty or less in number on the body; spirals spinose at the intersections of the incrementals; spines strongest along the posterior carina, anterior carina an aggregation of six or seven strong spiral threads that terminate sharply at the incremental lines, making axials at these points finely serrate; three or four similar threads appear between the two carinae on the peripheral area: on the anterior slope of the whorl spines are low or tuberculate; aperture ovate, slightly angular behind and produced in front into a long, narrow canal with proximate parallel margins; margin of outer lip thin, deeply angulated at the posterior carina, abruptly constricted at the base of the body; inner lip excavated medially, reflected and adnate on the body and the pillar on immature individuals but not in adults, a deep, broad and elongate cavity developed in mature forms between the inner lip and the pillar; columella smooth; pillar slender, slightly curved or bent in an irregular manner near the anterior extremity.

Dimensions (slightly imperfect individual).—Altitude 26.6 mm.; maximum diameter 25.2 mm.

This species is well characterized by its pyriform outline, and especially by its bicarinate widely expanded body which is ornamented with laminar spinose axial lines. It is common at Coon Creek and represented in the present collection by a number of individuals which show a wide variation in form and size. Further collecting at the type locality may result in the isolation of other species of this group. An undescribed tricarinate species of this genus occurs at Owl Creek, Mississippi.

Genus **LIROSOMA** Conrad.

Lirosoma cretacea n. sp. Pl. XVIII, figs. 5, 6.

Description.—Shell fairly large and stout, pyriform; spire low and obtuse, its elevation less than half the total altitude of the shell; whorls five to eight in number, strongly and evenly convex, rapidly

increasing in size; protoconch rather small, smooth and very low, coiled two and a half times, initial turn minute and completely immersed in the succeeding whorl, remaining nuclear turns very low and broadly rounded, becoming increasingly higher toward the close of the protoconch; sculpture very ornate, incremental striations very numerous and well developed in interspiral depressions but obsolete for the most part on the crests of the spiral fillets, axial ribbing irregular in strength and occurrence, tending to develop into varices at more or less regular intervals; spiral bands or fillets about fourteen in number on the body, becoming low and crowded on the pillar, fillets narrow, rectangular in cross-section, widely and irregularly spaced; suture sharply impressed; body well rounded, constricted in front into a narrow slightly curved pillar, aperture pyriform; outer lip broken away; inner lip excavated at the base of the body, reflected but adnate along the middle of the pillar; columella smooth, enlarged at the entrance of the anterior canal; parietal wash very thin.

Dimensions (immature individual).—Altitude 24.9 mm.; maximum diameter 14.8 mm.

This species is well characterized by its stout fusiform outline, deeply impressed suture and highly ornate external surface. Only two individuals are known. They were collected from Coon Creek and are the first representatives of this genus to be reported from the Cretaceous. It is interesting to find these shells in the American Cretaceous since the genus is already well known in the American Tertiary. *Lirosoma cretacea* resembles *L. sulcosa* Conrad¹⁹, the type of the genus which comes from the Chesapeake Miocene, in general form, lirate ornamentation and character of the protoconch, but differs widely from the Miocene species in detail of sculpture and in the presence of irregular axial ribs which tend to develop into varices at more or less regular intervals. The species *Tortifusus curvirostra* Conrad from the Miocene of North Carolina and Virginia is regarded by Cossmann²⁰ as another species of *Lirosoma*.

The genus *Ranularia* Schumacher is another group of forms which should be considered in determining the generic relations of the Upper Cretaceous species described above. The French Eocene form *Ranularia piraster* (Lamarek) which is figured and regarded by Cossmann²¹ as very typical of that genus, has a stout fu-siform

¹⁹ Conrad, T. A., 1830, *Jour. Acad. Nat. Sci. Phila.*, Vol. VI, 1st ser., p. 220, Pl. IX, fig. 8; Martin, G. C., 1904, *Id. Geol. Survey*, Miocene, p. 183, Pl. XLVII fig. 1.

²⁰ Cossmann, M., 1901, *Ess. de Pal. Comp.*, livr. iv, p. 79.

²¹ *Idem.*, 1903, livr. v, p. 97, Pl. III, fig. 12.

outline, lirate sculpture and varicose axials, all of which present a general aspect which strongly suggests the Cretaceous species under discussion. *Ranularia piraster*, however, has a dentate inner margin on the outer lip, a feature characteristic of the Tritonidæ but not present on *Lirosoma erectacea* and uncommon in the Busyconidæ.

Family **BUCCINIDÆ**.

Genus **SEMINOLA** n. gen.

Etymology: *Seminoles*, a tribe of Indians who formerly lived in the southeastern coastal plain region.

Type: *Seminola crassa* n. sp.

Shell compact, of medium size or large, globose; spire low; whorls not very numerous, increasing rapidly in size to an inflated body; protoconch unknown; both axial and spiral sculpture developed, the axial more or less obsolete on the body of the adult; suture obscure or deeply impressed; body well rounded medially, constricted and folded inward at the base of the body where a deep sulcus, parallel to the spiral sculpture, separates the body from the pillar: aperture broad and subovate, produced anteriorly into a short, recurved canal; outer lip simple or varicose, a strong tooth-like projection occurring on the margin at the anterior extremity of the spiral sulcus at the base of the body; inner lip excavated medially; columella reinforced, marked by an oblique plication near the anterior extremity and along the margin of the anterior canal; parietal wall calloused, sometimes heavily; pillar broad and short, slightly recurved; umbilical chink shallow; anterior fasciole broad, oblique, heavily corrugated.

This genus is well characterized by globose shells of different sizes, having both spiral and axial sculpture variously developed. The pillar is broad and short, being separated from the body by a deep spiral sulcus that terminates with a tooth-like projection on the margin of the outer lip, a shell character which possibly indicates the former position of the eye-stalk of the animal. The genus is proposed to include five species heretofore unknown in the literature: two from Coon Creek, one from Owl Creek, and two from the Ripley of Texas; and one species from Pataula Creek, Georgia, described by Gabb under the name of *Nassa globosa*.²² There is no figure of this species, but the type, which is imperfect, may be seen at the Museum of The Academy of Natural Sciences of Philadelphia. The generic deter-

²² Gabb, W. M., 1876, Proc. Acad. Nat. Sci. Phila., p. 282.

mination of Gabb's species was questioned by Johnson²³ in 1905. The evidences furnished by recently discovered material from Coon Creek shows that these related species from the Ripley do not belong to the genus *Nassa* but represent a large, undescribed group of magnificent forms which belong to the family Buccinidae. This group is no doubt near Meek's genus *Odontobasis*.²⁴ *Seminola* differs from *Odontobasis* in having a globose or ovoid form rather than a fusiform outline. Another closely related genus of the Buccinidae is *Pseudoliva*²⁵ Swainson, represented in the Senonian by *Pseudoliva zitteli* Pethö²⁶ from Hungary. The spiral groove in *Pseudoliva* occurs well up on the body and is nothing more than a deep spiral sulcus in the sculpture pattern and differs very decidedly from the deep spiral sulcus at the base of the body of *Seminola*. The Nassidae usually have a crenulate or dentate outer lip and lack the marginal fold on the anterior end of the columella and do not have such a deep spiral sulcus at the base of the body which terminates in a tooth on the outer lip of the aperture.

Seminola crassa n. sp. Pl. XIX, figs. 6, 7.

Description.—Shell large and globose; spire low and obtuse, its elevation about one-third the total altitude, whorls six in number and increasing rapidly in size to a much inflated body; sculpture elaborate, axials sharply rounded, coarse and strong; twelve in number on the later whorls of the type, short and retractive, very prominent on the shoulders of the whorls but disappearing abruptly just in front of an undulating sutural band and persisting, though with somewhat diminished strength, to the anterior suture and on the early part of the body to the base; on the final half turn, however, restricted almost entirely to the posterior third; spiral sculpture low and irregular, consisting of a half-dozen equal and equi-spaced coarse and somewhat flattened cords upon the penult and twice as many on the early part of the ultima, secondary spirals are introduced near the base of the first half and these increase in prominence so that toward the aperture, they are almost as strong as the primaries; there are two or three feeble secondary spirals on the sutural band; suture deeply impressed, strongly canaliculate on the later volutions; body constricted posteriorly, sloping rapidly in

²³ Johnson, C. W., 1905, Proc. Acad. Nat. Sci. Phila., p. 23.

²⁴ Meek and Hayden, 1876, U. S. Geol. Survey of the Terr., Vol. IX, pp. 351-354, text figs. 41, 42, 43, Pl. 191, figs. 1, a, b, c.

²⁵ Cossmann, M., 1901, *Ess. de Pal. Comp.*, livr. IV, pp. 191, 192.

²⁶ Zittel, Text-book of Paleontology, English ed., 1913, Vol. II, p. 556, fig. 1012

front to the base, where it is abruptly constricted or wrinkled, forming a conspicuous spiral sulcus which separates the body from the pillar; aperture subovate, grooved posteriorly and produced anteriorly into a short, broad, slightly recurved canal; outer lip thin and crenulated along the margin in harmony with the spiral sculpture, thickened or varicose in very old individuals; inner lip excavated and calloused; parietal wash very thick and heavy in old individuals; columella reinforced, marked by a very oblique fold near the anterior extremity and along the margin of the anterior canal; pillar short and broad; umbilical chink shallow; anterior fasciole a broad and oblique ridge registering the incremental stages of the anterior canal, extremity broadly and quite deeply emarginate.

Dimensions (immature individual).—Altitude 54.5 mm.; maximum diameter 35 mm.

This magnificent species is common at Coon Creek but even though the shells are thick and fairly strong the specimens are nearly always crushed as they occur in the matrix, so that perfect specimens are rarely obtained. The shells reach considerable dimensions; imperfect specimens in the collection show that some individuals had an altitude of about 80 mm. and a maximum diameter of about 50 mm. The species is well characterized by the retractive axials which are unusually elevated and strongly rounded. The interaxials are unusual because they are so deep and narrow. The spiral sculpture consists of both primary and secondary cords. The peculiar spiral sulcus at the base of the body is conspicuous on the outer wall of the shell but produces little or no effect on the inner surface of the shell wall within the body cavity.

Seminola solida n. sp. Pl. XIX, figs. 1, 2.

Description.—Shell of medium size and rather stout or coarse, globose in outline; spire low and obtuse, its elevation about one-third the total altitude of the shell; whorls five in number on an incomplete individual, rapidly increasing in size to an inflated body; sculpture elaborate, both axial and spiral, axial costæ seventeen to eighteen on the body, subequal and subequispaced, very narrow, abruptly elevated, somewhat incremental in character, terminating abruptly at the shoulder and diminishing in strength upon the anterior slope of the body; inter-costal spaces concave and not so wide as the costæ; spirals less coarse than axials but overriding them; fillets ten in number on the ultima and two on the penultima, spirals equal and equispaced, more prominently elevated on the summits of the costals than in the inter-costal areas; an unornamented sutural

ridge developed just behind the shoulder and in front of the suture, closely appressed to the preceding whorl; suture impressed, crenulated by the costals of the preceding whorl; body abruptly constricted, cut off from the pillar by a conspicuous spiral sulcus; aperture pyriform, produced anteriorly into a short, sharply recurved canal; outer lip crenulated along the margin in harmony with the spirals; inner lip heavily calloused, excavated medially; columella reinforced, marked by a strong, oblique marginal fold; parietal wash heavy and terminating in a sharp line along its outer margin; umbilical chink shallow and obscure; anterior fasciole well defined, deeply emarginate at its extremity.

Dimensions.—Altitude 24.4 mm.; maximum diameter 19.4 mm.

This species is well characterized by its low spire and globose outline. It differs from *Seminola crassa* in that it is much smaller in size, in character of the pillar and in having long axial costæ parallel to the axis and persisting from the shoulder to well down on the anterior part of the body. The axial costæ of *Seminola crassa* are retractive and more deeply impressed, even in young individuals. *S. solida* has a pillar and marginal columellar fold much the same as Gabb's species of this genus, which was described under the name of *Nassa globosa*²⁷ but that species is much larger, its external ornamentation tends to become obsolete on the later whorls.

Family PURPURIDÆ.

Genus **ECPHORA** Conrad.

Ecphora proquadricostata n. sp. Pl. XVIII, fig. 7.

Description.—Shell small and fragile, umbilicate pyriform, spire depressed; whorls four or five in number and increasing rapidly in size; line of separation between conch and protoconch not sharply marked, two and a half nuclear turns, the initial turn is minute and completely submerged in the rounded second whorl which becomes increasingly higher toward its close, the shoulder angle is initiated at the beginning of the third turn and toward the close of this turn this angle develops into a spiral; sculpture spiral, consisting of four regularly spaced and abruptly elevated, narrow spiral ridges on the body whorl and only two on the volutions of the spire; interspiral spaces concave and profound, approximately twice as wide as the spirals, spiral depressions crossed by numerous, faint incremental lines; suture line appressed and following the second spiral; body

²⁷ Gabb, W. M., 1876, Proc. Acad. Nat. Sci. Phila., p. 282.

laterally expanded, equally strongly constricted anteriorly and posteriorly, forming a broad shoulder behind and a decided constriction at the base of the body; aperture subcircular, produced in front into a short, slightly curved canal with proximate parallel margins, outer lip thickened a little along the margin, serrated by the extremities of the four spiral ridges, shallow sulcus occurring on the inner surface beneath each spiral ridge of the outer surface, two low denticles developed between each pair of sulci along the inner margin of the outer lip; inner lip broadly excavated at the base of the body, sharply angulated at the entrance of the anterior canal; umbilicus profound; umbilical keel prominent, slightly varicose and flaring.

Dimensions.—Altitude 11.4 mm.; maximum diameter 9.5 mm.

This species is well characterized by its low but acute spire, its four strong spiral ridges and further by a slightly dentate inner margin of the outer lip. It is represented in the Coon Creek collection by four or five specimens, the one selected for the type is perfectly preserved and its generic relations can hardly be doubted. This elegant little species is of special interest since it is the first representative of this genus, so well known in the later Tertiary of the Atlantic Coastal Plain to be found in the Upper Cretaceous. No Eocene representatives are known from the Coastal Plain of the United States so that the discovery of a typical *Ecphora* in the Upper Cretaceous indicates that species of this well known genus may be expected in the earliest Tertiary marine sediments of the Southeastern United States. About a half-dozen species of *Ecphora* are known from the Oligocene and the Miocene and are given in 1903 in Cossmann's *Essais de Paléoconchologie Comparée* as follows:

Oligocene—

Stenomphalus cancellatus Sandberg, France.

Rapana tampaensis Dall, United States.

Peristernia succincta T. Woods, Australia.

Miocene—

Ecphora quadricostata Conrad, United States.

Ecphora tricostata Martin, United States.

Stenomphalus wicchmanni von Koenen, Germany.

Rapana moulini Brochon, France.

The protoconch of *Ecphora proquadricostata* is similar to that of *E. quadricostata* Conrad²⁵ the type of the genus, though different in

²⁵ Conrad, 1843, Proc. Acad. Nat. Sci. Phila., Vol. I, p. 310. See synonymy in Martin, G. C., 1904, Maryland Geol. Survey, Miocene, p. 207.

detail. Both are small, shelly, coiled two and a half times and not sharply differentiated from the conchs. Both nuclei are elevated or trochoid but that of the type species is the higher. The apical tips or initial points of the protoconchs of both species are immersed in the later nuclear turns but this is probably more pronounced in *E. proquadricostata*.

Genus **PARAMOREA** n. gen.

Etymology: *Μαρά*, near, *Morea*, a genus of gastropods.

Type: *Paramorea lirata* n. sp.

Shell small and porcellanous, ovate-conic in outline; spire acute, less than half the total altitude of the shell; protoconch scar small; conch solid and slightly glazed, paucispiral; axial sculpture absent; spiral sculpture well defined; aperture ovate, deeply notched in front; outer lip well rounded, its margin simple or slightly crenulated; inner lip excavated and thinly glazed; columella slender and marked by a feeble oblique plait or twist of the pillar near the anterior extremity; umbilical chink narrow, oblique and deep, canal short and broad.

This genus is proposed to include a single species from Coon Creek which seems to represent a group of univalves related to *Morea*. This species is well characterized by its sharp spiral sculpture, deeply notched aperture, and further by its very oblique and narrow umbilicus or umbilical chink with a general aspect and generic features that do not allow it to fit naturally into any known genus of related shells. The type of the genus *Morea*²⁹ was described from the Ripley formation. Two or three species other than the type also occur at that horizon so that it is not surprising to find another group related to this very unique genus in the Upper Cretaceous of the southeastern states. The genus *Paramorea* differs from *Morea* in having instead of a well defined umbilicus a narrow and oblique chink, and in the development of only spiral ornamentation instead of both spiral and axial, in the acute spire and in the absence of a strongly reflected inner lip such as that of *Morea*. In general aspect, i. e., the acute spire, strong spiral sculpture and narrow umbilicus this genus greatly resembles *Trichotropis* in features as presented by the recent North Atlantic species *Trichotropis borealis* Broderip and Sowerby,³⁰ but differs from that form in having a strong anterior notch or short open canal. In 1889, C. A. White described and figured an imperfect specimen from the Chico series of Shasta county, California, a species

²⁹ Conrad, T. A., 1860, *Jour. Acad. Nat. Sci. Phila.*, 2d ser., Vol. IV, p. 290, Pl. 46, fig. 30.

³⁰ Adams, H. and A., 1858. *Genera Recent Moll.*, Vol. I, p. 279, Pl. 29, fig. 6.

which he questionably referred to the genus *Stomatia*. This form, *Stomatia obstricta* White,³¹ although it is represented by a cast, presents an outline together with a spiral ornamentation and an indication of an umbilical chink which suggest the genus *Paramorea*. Until more perfect specimens of the California species are known its generic position will probably remain uncertain.

Paramorea lirata n. sp. Pl. XVII, figs. 9, 10.

Description.—Shell small and porcellanous, ovate-conic in outline; spire acute, its elevation a little less than the length of the aperture; whorls closely appressed and shouldered; increasing in size with a fair degree of rapidity; protoconch scar small; sculpture sharply spiral, consisting of six well defined liræ on the penult and thirteen on the ultima, liræ strongest and most widely spaced on the posterior edge of the whorls, on the anterior portion of the body the spiral threads are closely spaced, the interspaces being narrower than the liræ, liræ intersected and slightly interrupted by incremental lines; suture distinct; body abruptly constricted posteriorly, forming a narrow shoulder, body convex medially and well rounded in front; aperture ovate, deeply notched anteriorly; outer lip evenly rounded, very slightly crenulated along the margin, subangular and a little thickened at the entrance of the anterior canal; inner lip excavated, parietal wall washed with a thin callus; columella slender, marked by a very feeble and oblique fold or twist of the pillar near the anterior extremity; umbilical chink very narrow and oblique, the last of the body spirals abnormal and constituting an obtuse umbilical keel; anterior canal short and open.

Dimensions.—Altitude 7.3 mm.; maximum diameter 4.7 mm.

Only two individuals of this elegant little species, which is the type of the genus, are known. They are well characterized by their spiral ornamentation, deeply notched aperture and further by the very oblique and narrow umbilical chink. The shell material is porcellanous and hard. One of the specimens has a brownish axial banding fixed in the shell material which seems to be a remnant of an ancient color pattern.

Family **CERITHIDÆ**.

Genus **NUDIVAGUS** n. gen.

Etymology: *Nudus*, unadorned; *vagus*, a straggler.

Type: *Nudivagus simplicus* n. sp.

³¹ White, C. A., 1889, *Bull. U. S. Geol. Survey*, No. 51, p. 18, Pl. IV, figs. 10, 11

Shell fairly large and simple, elongate conical; spire elevated and acute; aperture less than one-third as high as the entire shell; whorls of conch numerous, flattened and wide, increasing in size regularly and slowly; protoconch small and trochoid, coiled about three times, line between the conch and protoconch poorly defined; external surface usually smooth and glazed; sculpture absent and subdued; incremental varices occasionally present; suture simple and distinct; body abruptly constricted in front of the periphery into the short, curved pillar; aperture lenticular, angular behind and produced in front into a short canal; outer lip thin and simple; inner lip excavated; parietal wall glazed; columella smooth.

This genus is proposed to include a group of gastropods characterized by simple, elongate-conical shells with unadorned external surfaces. The aperture is subovate, considerably narrowed toward each end, terminating anteriorly in a short canal. Besides the type, two other species are known, one of which was described under the name of *Cerithium (Fibula ?) detectum*³² by Stoliczka from the Arriallor group of beds from the Upper Cretaceous of South India: the other under the name of *Pseudomelania astonensis*³³ by Huddleston from the upper division of the Inferior Oolite of England. *Nudivagus* differs from *Cerithium*, however, in the character of the aperture and in the absence of a strongly twisted columella and from *Clava* in having a non-plicate columella. *Nudivagus* is probably near *Gymnocerithium*³⁴ but differs from the latter in having less numerous whorls which are of greater height and less convexity. The new genus differs from *Pseudomelania* in the presence of an anterior canal. Meek's genus *Closteriscus*³⁵ includes elongate-conical forms somewhat similar to *Nudivagus* in outline and lack of external ornamentation, but the former, however, possesses well defined tooth-like, internal varices not found in the body cavities of the latter.

Nudivagus simplicus n. sp. Pl. XIX, figs. 4, 5.

Description.—Shell fairly large and simple; thick but very friable, outline elongate-conical; spire elevated and acute, its elevation more than twice as great as the length of the aperture; whorls ten in number, closely appressed; obliquely flattened, increasing gradually and

³² Stoliczka, F., 1868, *Geol. Survey of India, Pal. Indica*, Cret. Faunas Southern India, Vol. II, p. 192, Pl. XV, fig. 1.

³³ Huddleston, W. H., 1896, *Pal. Soc. London*, Monogr. Inferior Oolite, Gastropoda, p. 245, Pl. XVIII, figs. Sa, b.

³⁴ Cossmann, M., 1906, *Ess. de Pal. comp.*, livr. VII, p. 36, Pl. VII, fig. 17.

³⁵ Meek and Hayden, 1876, *U. S. Geol. Survey of the Terr., Inw. Pal.* Vol. IX, p. 306.

regularly in size from the apex to the ultima; protoconch not distinctly separate from the conch, consisting probably of three volutions which slope less steeply than do those of the conch; external surface highly polished; sculpture absent, excepting for very fine and crowded spirals and faint incrementals, discernible with a lens in the glaze of the external surface; suture indicated by a simple slightly impressed spiral line; body abruptly constricted in front of the periphery and produced into a narrow recurved pillar; aperture lenticular; terminating anteriorly in a narrow, rather long, recurved canal; outer lip thin and simple; inner lip excavated medially, washed with a thin callus; columella smooth.

Dimensions (slightly imperfect individual).—Altitude 76.2 mm.; maximum diameter 22.5 mm.

This species is the type of the genus and is well characterized by its broad, flat whorls and the fine, crowded spiral lines that show through the glaze of the external surface. The shells are relatively thick but not strong. They are fairly common at Coon Creek, but so fragile that not a single perfect specimen has as yet been recovered from the sediments.

Genus **ASTANDES** n. gen.

Etymology: Ἀστάνδης, a messenger.

Type: *Astandes densatus* n. sp.

Shell small and trochoid in outline; aperture of the type specimen less than half the entire length of the shell; protoconch small, smooth and trochoid; whorls of conch circular in cross-section and increasing gradually in size; external sculpture both axial and spiral, axials well rounded and retractive; spirals lirate; suture impressed; body equally constricted in front and behind; aperture D-shaped and produced in front into a short shallow canal; outer lip thickened and dentate; parietal wall washed with a callus; umbilicus imperforate.

This genus is very much like *Cerithioderma* Conrad³⁶ in general outline, the circular cross-section of the whorls and in the axial and spiral sculpture, but differs from it in the less acuminate spire and the imperforate umbilicus. It resembles *Paludmete* Gardner,³⁷ but differs from that group in having a short anterior canal. The genus is proposed to include a species recently discovered at Coon Creek and two other known species in the European Upper Cretaceous.

³⁶ Conrad, T. A., 1860, *Jour. Acad. Nat. Sci. Phila.*, 2d ser. Vol. IV, p. 295, Pl. 47, fig. 30. Cossinann, M., 1906, *Ess. de Pal. Comp.*, livr. VII, p. 191.

³⁷ Gardner, J. A., 1916, *Id. Geol. Survey, Upper Cret.*, p. 412, Pl. XVIII, figs. 14, 15.

One of these occurs in the Aachen Cretaceous of Vaals, Germany, and was described in 1851 by Müller, and referred to the genus *Tritonium*;³⁸ the other is a closely related form from the Maastrichtian of Belgium which Kaunhowen³⁹ compares with Müller's species from Vaals, but does not apply a name to it. *Astandes* differs from *Tritonium* or *Nyetilochus* in lacking of true varicose axials and in a shorter and much less strongly developed anterior canal.

Astandes densatus n. sp. Pl. XVII, figs. 7, 8.

Description.—Shell small and nearly trochoid in outline; spire moderately elevated and more than half the length of the entire shell; protoconch small and smooth; whorls of conch six in number, circular in cross-section and increasing in size gradually; external sculpture both axial and spiral; axials fairly coarse, well rounded and retractive, evanescent on the base of the body; axials overridden by numerous elevated spiral lines; aperture D-shaped, produced anteriorly into a short shallow canal; outer lip slightly thickened and dentate; parietal wall washed with a callus.

Dimensions.—Altitude 11.5 mm.; maximum diameter 7 mm.

This species is characterized by the elevated spiral lines which override the protractive axials and further by the dentate outer lip. It is represented in the present collection by several individuals. No closely related American species is known, but the Tennessee form may be compared with the Maastrichtian species *Tritonium cf. cretaceum* (Müller) Kaunhowen,⁴⁰ which resembles it very much in form of aperture and character of external ornamentation but differs in details of external sculpture.

Family SCALIDÆ.

Genus **ACIRSA** Möreh.

Acirsa microstriata n. sp. Pl. XVIII, fig. 8.

Description.—Shell of medium size, thin and strong; form an elongate, simple, slender cone; spire acuminate; volutions eleven on the type individual which has the apical tip broken away, probably fourteen on the original, whorls increasing regularly in size from apex to ultima, volutions flattened laterally, penultima and ultima very slightly constricted toward the sutures; protoconch unknown;

³⁸ *Tritonium cretaceum* Holzapfel, 1858, *Palæontographica*, Band xxxiv, 113, Taf. x, figs. 5-7.

³⁹ Kaunhowen, F., 1897, *Pal. Abhandl.*, Acht. Bd., p. 77, Taf. ix, figs. 1, 4a; Taf. xiii, Fig. 12.

⁴⁰ Kaunhowen, F., 1898, *loc. cit.*

sculpture barely visible to the unaided eye, axial sculpture restricted to strong and conspicuous incremental lines, occurring at irregular intervals, and to low, obscure and unequal axial wrinkles on the periphery of the whorl; spiral sculpture microscopically fine but sharp, consisting of about fifteen closely spaced feebly impressed lines to each of the whorls of the spire, but about thirty-five on the sides and base of the body; suture simple and appressed, posterior edges of whorls very sharp in front of suture; peripheral angle obtuse, base of body broadly rounded; aperture holostomous, obliquely ovate, angulated at the posterior commissure; outer lip rounded and slightly effuse at the anterior, its curvature higher than that of the inner lip; inner lip smoothly glazed and reflected concealing the umbilical chink; parietal wash thin, columella smooth.

Dimensions.—Altitude 31.5 mm.; maximum diameter 9.9 mm.

Only one shell of this species is known and this individual aside from the loss of its apical tip is as strong and well preserved as if it were a recent shell. *Chemnitzia cerithiformis* Meek and Hayden⁴¹ from the Fox Hills group of the Upper Missouri Cretaceous no doubt belongs to the same genus. In 1860, Meek and Hayden⁴² in a check list referred this species to the genus *Scala* (*Acirsa*) but in their final description it was assigned to the genus *Chemnitzia*. After a study of Cossmann's very comprehensive work on the Scalidae⁴³ and three species, including *Chemnitzia cerithiformis*, recently collected from Coon Creek, it seems that Meek and Hayden's species was an *Acirsa* and that the other two Tennessee species are congeneric.

Acirsa corrugata n. sp. Pl. XVIII, fig. 9.

Description.—Shell small and slender; form elongate-conic, spire acuminate; whorls eleven in number, slightly convex and increasing in size regularly and very slowly; protoconch scar small; sculpture elaborate, consisting of both axial and spiral elements; axial elevations strong and crowded on the early whorls of the spire, but becoming lower and more widely spaced on the later volutions; spiral sculpture overriding the axials, but very obscure on their summits; spiral sculpture consisting of low, crowded thread-like liræ, sixteen to twenty in number on the later whorls of the spire and with slightly wider additional spirals on the base of the body; interspiral areas marked by very fine and regular pittings; suture distinctly impressed;

⁴¹ Meek and Hayden, 1876, *U. S. Geol. Survey of the Terr.*, Vol. IX, p. 339, Pl. 32, figs. 10a, b.

⁴² Meek and Hayden, 1860, *Proc. Acad. Nat. Sci. Phila.*, XII, p. 185.

⁴³ Cossmann, M., 1912, *Ess. de Pal. Comp.*, pp. 16-102.

body very slightly constricted in front of the posterior margin; peripheral angle obtuse, base of body obliquely flattened or very broadly rounded; aperture holostomous, broadly and obliquely ovate, angulated at the posterior commissure; outer lip thin and simple, slightly patulous in front; inner lip excavated medially, thin and reflected, adnate to the body wall; columella smooth.

Dimensions.—Altitude 14.7 mm.; maximum diameter 4.1 mm.

This species is well characterized by its sharply defined axial costæ which are crowded on the early whorls of the spire but become more widely spaced on the later volutions, and further, the species is characterized by fine regular pittings in the interspiral spaces. Both *Acirsa corrugata* and *Acirsa microstriata* differ from *Acirsa cerithiformis* M. and H.⁴⁴ in the more elongate and slender outline and the details of the external ornamentation. *Acirsa corrugata* is smaller than *Acirsa microstriata* and unlike the latter exhibits a well developed axial sculpture over the entire shell.

The very elegantly ornamented species *Scalardia dense-striata* Kaunhowen,⁴⁵ from the Mæstrichtian of western Europe is probably a member of the genus *Acirsa* and may be compared with *Acirsa corrugata*.

Genus **HEMIACIRSA** de Boury.

Hemiacirsa cretacea n. sp. Pl. XIX, fig. 3.

Description.—Shell fairly large for the group, slender, turrated and conical in outline; spire acuminate; spire of the type slightly curved, possibly an individual characteristic due to three accidents in the life of the animal, each of which resulted in the breaking of the shell (as scars on the type specimen show) on the same side of the spire or possibly a specific character of this many-whorled form; whorls flattened, very closely appressed posteriorly, less tightly coiled toward the aperture; whorls twelve and a half on the imperfect type, at least two have been broken away, volutions increasing gradually in size; protocone unknown; sculpture dominantly axial, axial costæ abruptly elevated and subangular on the crests, somewhat flexuous, costæ sixteen in number on the body of the type, regularly spaced, persistent from suture to suture on the whorls of the spire, interaxial spaces concave and a little wider than the costæ; spiral sculpture subdued but well defined in the interaxial depressions,

⁴⁴ Meek and Hayden, 1876, *U. S. Geol. Survey of the Terr.*, Vol. IX, p. 339, Pl. 32, figs. 10, a, b.

⁴⁵ Kaunhowen, F., 1897, *Palæontol Abhandl.*, Neue Folge, Bd. IV, p. 43, Taf. III. Figs. 3, 4.

consisting of eleven on the body whorl and about the same number on the whorls of the spire; spiral lines on base of body very faint; suture impressed; base of body nearly flat; angular edge between base and sides of body well rounded; aperture ovate; margin of outer lip broken away; inner lip strongly and smoothly excavated medially; parietal wall washed with a thin glaze of callus; columella smooth.

Dimensions (apex of individual broken away).—Altitude 39.4 mm.; maximum diameter 11.1 mm.

This species is well characterized by its long, slender, rather large spire, and its flattened base, by its well defined axial costæ but obscure spirals. Whether the bend in the spire is an individual or specific character of this many-whorled species cannot be determined without additional material. Only one specimen is known at present but it is of special significance since it is the first evidence of the presence of this genus in the Upper Cretaceous. In Europe a number of species of *Hemiacirsa* have been reported ranging in age from the Montian⁴⁶ up to the recent species now living in the Gulf of Lyons. One species only is known from the Eastern United States. This is *Hemiacirsa perlaqucata* (Conrad) Cossmann,⁴⁷ a form originally described as a *Turritella* by Conrad,⁴⁸ later referred to the genus *Trachyrhynchus* Mörch by Martin⁴⁹ and finally to the genus *Hemiacirsa* by Cossmann in 1912.

Family PYRAMIDELLIDÆ.

Genus **CREONELLA** n. gen.

Etymology: A diminutive of Creon, king of Corinth.

Type: *Creonella triplicata* n. sp.

Shell small and smooth, in outline a simple, slender cone; whorls closely appressed and increasing in size slowly; whorls of spire generally flat and narrow; protoconch very small and heterostrophous with only two volutions; sculpture absent except for microscopic incremental lines in the glaze of the external surface; suture sharply impressed; body well rounded in front; aperture ovate; outer lip thin and simple, inner surface of the outer wall of the body strongly lirate; inner lip excavated medially; columella marked by two plaits, the posterior of which is the stronger; just behind the strong colu-

⁴⁶ Cossmann, M., 1912, *Ess. de Pal. Comp.*, livr. IX, pp. 97, 98.

⁴⁷ *Ibid.*, p. 97.

⁴⁸ *Turritella perlaqucata* Conrad, 1841, *Proc. Acad. Nat. Sci. Phila.*, Vol. I, p. 32.

⁴⁹ *Trachyrhynchus perlaqucatus* Martin, 1904, *Miocene Text, Md. Geol. Survey*, p. 239, Pl. LVII, fig. 9.

mellar plait on the body is another plait similar to a columellar fold; parietal wall glazed with callus; umbilicus imperforate.

This genus is well characterized by three conspicuous folds on the inner lip. The most posterior of these folds is situated on the body of the preceding whorl and the other two occur on the columella. The posterior one of the columellar plaits is the stronger and on either side of it there is a deep columellar sulcus. The genus is probably near *Pyramidella*, but the umbilicus of that genus is typically imperforate. The genus *Creonella* is proposed for a group represented by two species from Coon Creek which are unlike any known species of this family in either the Upper Cretaceous or the early Tertiary. A representative of the genus *Obeliscus*⁵⁰ which occurs at Coon Creek and also in the Monmouth of New Jersey, has a single columellar plait, otherwise, in simple, slender, conical forms of the inornate shells, the two groups resemble each other very much.

Creonella triplicata n. sp. Pl. XIX, fig. 8.

Description.—Shell small and slender, in outline a very sharp cone; spire acuminate, angle of spire constant whorls closely appressed, numerous and narrow, seven in the imperfect type; probably almost twice as many in a perfect form; sculpture absent except for protractive incrementals of irregular strength and spacing that scar the glazed external surface; suture distinctly impressed; body very abruptly constricted in front of the periphery; peripheral angle well rounded; aperture narrow, outer lip broken away; inner surface of labrum corrugated within, with about half a dozen prominent liræ, subequal, closely and evenly spaced; columella marked by two strong transverse folds behind which and on the body is another fold, the posterior of the columellar plaits is the strongest of these three plaits, on either side of the strong columellar fold are two deep spiral sulci around the columella.

Dimensions (imperfect individual).—Altitude 14.4 mm.; maximum diameter 3.3 mm.

This species is well characterized by its narrow, numerous whorls and its very sharp, strongly impressed suture. The species is known from only two specimens neither of which is perfect, but sufficiently preserved to show all characteristic features.

⁵⁰ *Obeliscus canellus* Whitfield, 1892, *Mon. U. S. Geol. Survey*, Vol. XVIII, p. 151, Pl. 19, fig. 1.

EXPLANATION OF PLATES XVII-XIX.

PLATE XVII.—Figs. 1, 2. *Conorbis mcnairyensis* n. sp.

1. Front view. x4.

2. Rear view. x4.

Figs. 3, 4. *Hyllus coloratus* n. gen. et sp.

3. Front view. Nat. size.

4. Rear view of another individual. Nat. size.

Figs. 5, 6. *Hyllus callilateris* n. gen. et sp.

5. Front view. Nat. size.

6. Rear view. Nat. size.

Fig. 7, 8. *Astandes densatus* n. gen. et sp.

7. Front view. x3.

8. Rear view. x3.

Figs. 9, 10. *Paramorca lirata* n. gen. et sp.

9. Front view. x4.

10. Rear view. x1.

Figs. 11, 12. *Falsifusus mesozoicus* n. sp.

11. Front view. x3.

12. Rear view. x3.

PLATE XVIII.—Figs. 1, 2. *Scobina bicarinata* n. gen. et sp.

1. Rear view. x2.

2. Front view. x2.

Figs. 3, 4. *Boltenella excellens* n. gen. et sp.

3. Front view. x2.

4. Rear view. x2.

Figs. 5, 6. *Lirosoma cretacea* n. sp.

5. Front view. x2.

6. Front view of a smaller individual. x2.

Fig. 7. *Ecphora proquadricostata* n. sp.

Front view. x3.

Fig. 8. *Acirsa microstriata* n. sp.

Front view. x2.

Fig. 9. *Acirsa corrugata* n. sp.

Front view. x3.

PLATE XIX.—Figs. 1, 2. *Seminola solida* n. gen. et sp.

1. Front view. x3.

2. Rear view. x3.

Fig. 3. *Hemiacirsa cretacea* n. sp.

Front view. x2.

Figs. 4, 5. *Nudiragus simplicis* n. gen. et sp.

4. Front view. Nat. size.

5. Front view of a larger individual. Nat. size.

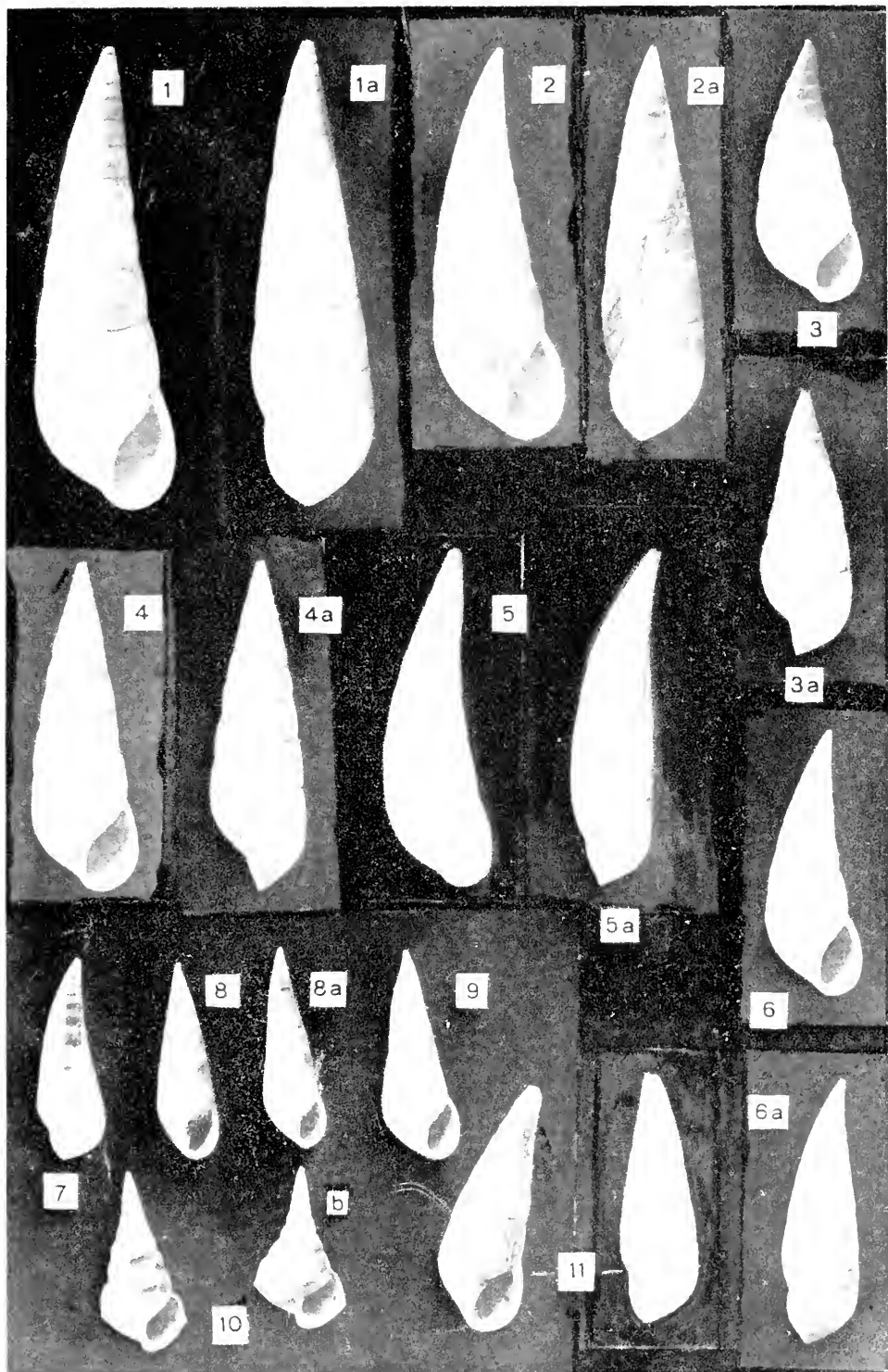
Figs. 6, 7. *Seminola crassa* n. gen. et sp.

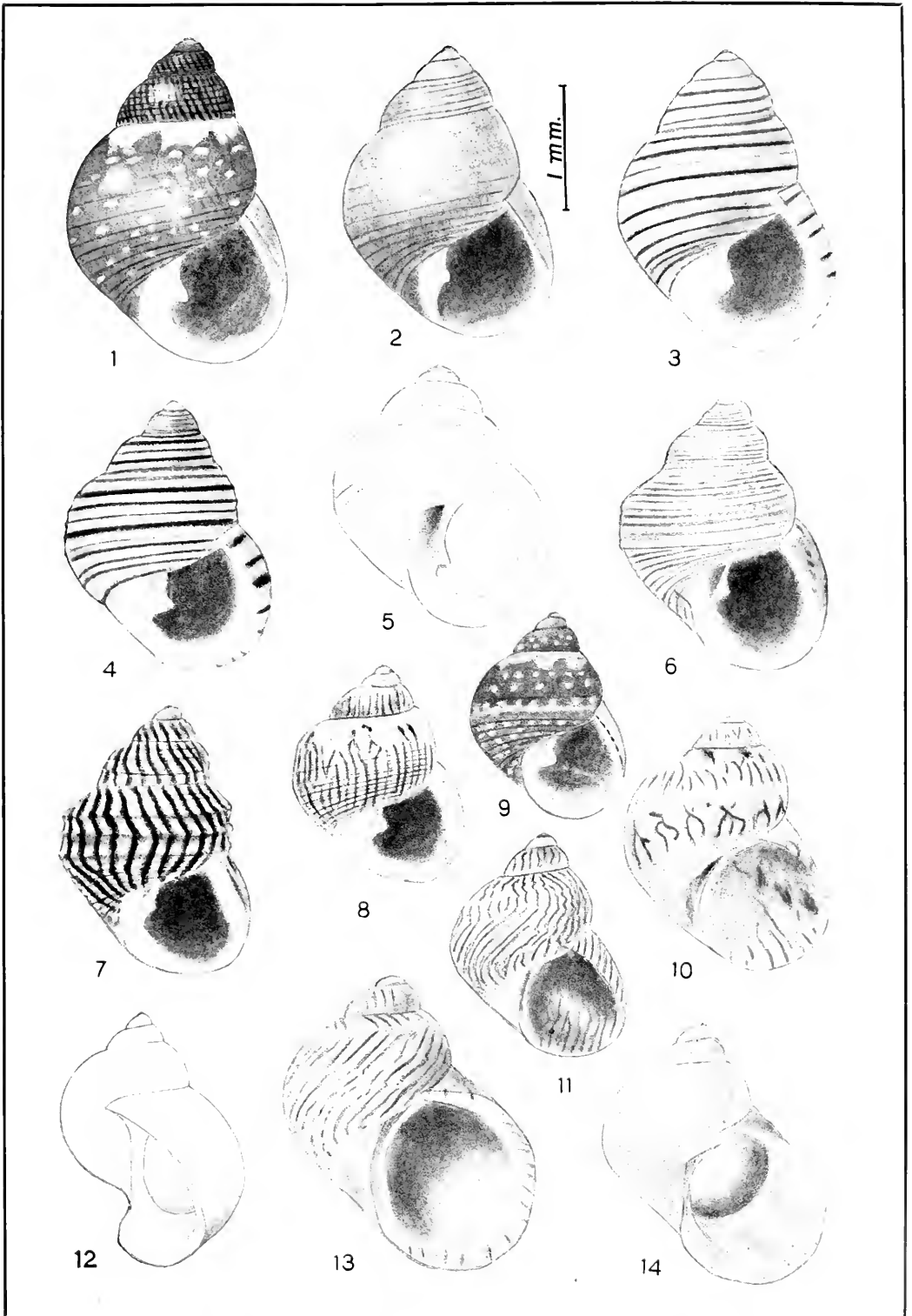
6. Front view. $x1\frac{1}{2}$.

7. Rear view. $x1\frac{1}{2}$.

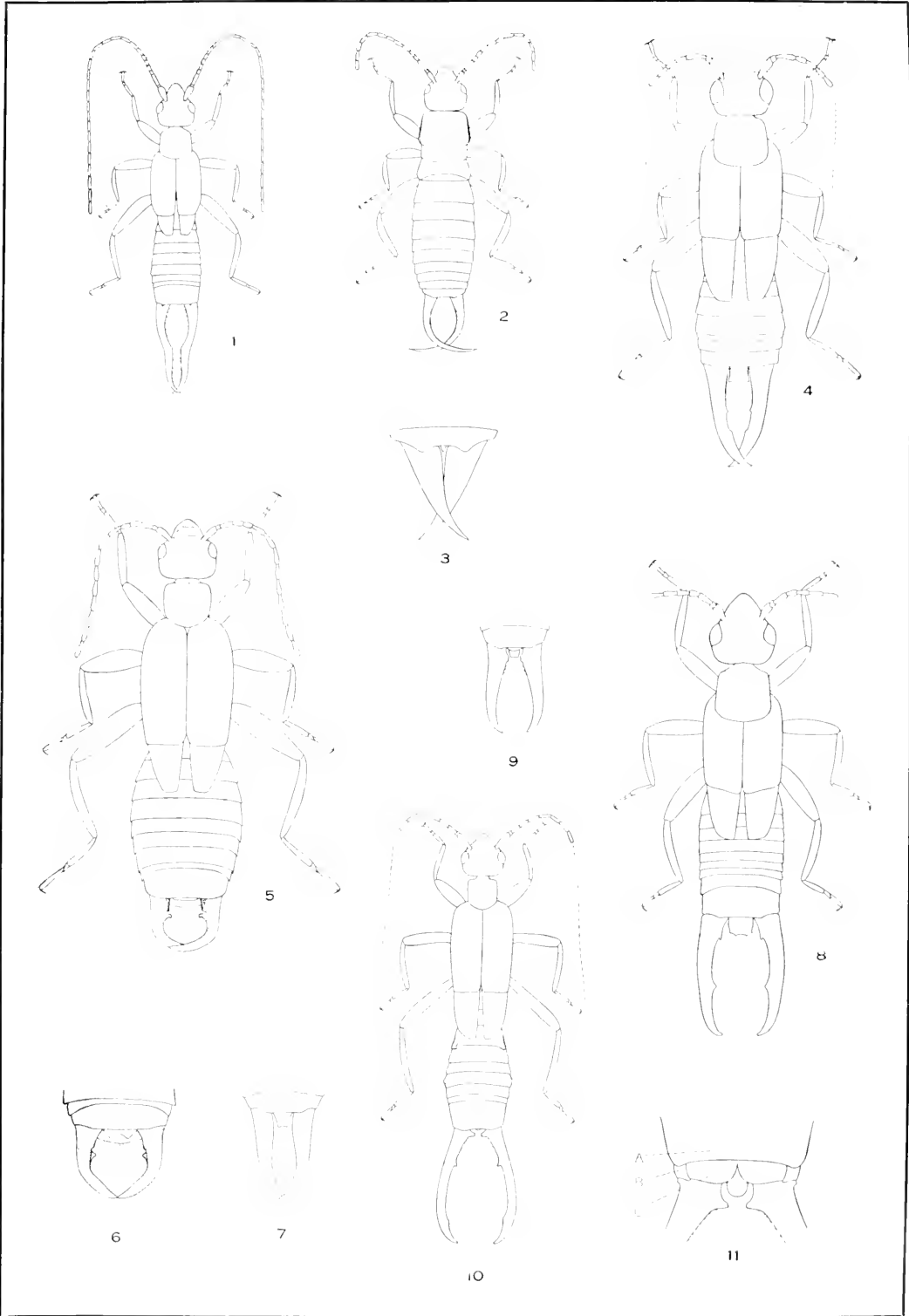
Fig. 8. *Cronella triplicata* n. gen. et sp.

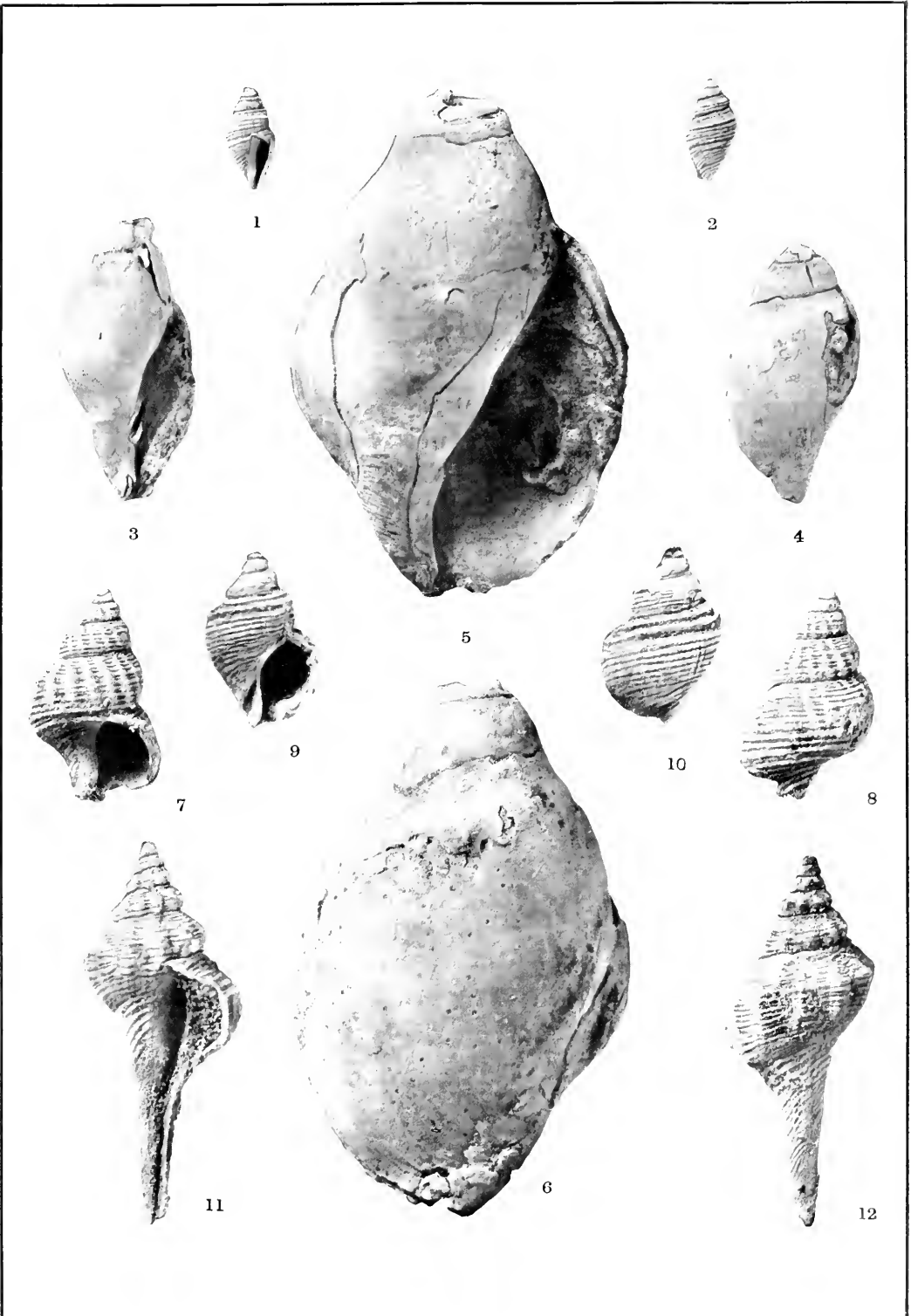
Front view. x2.



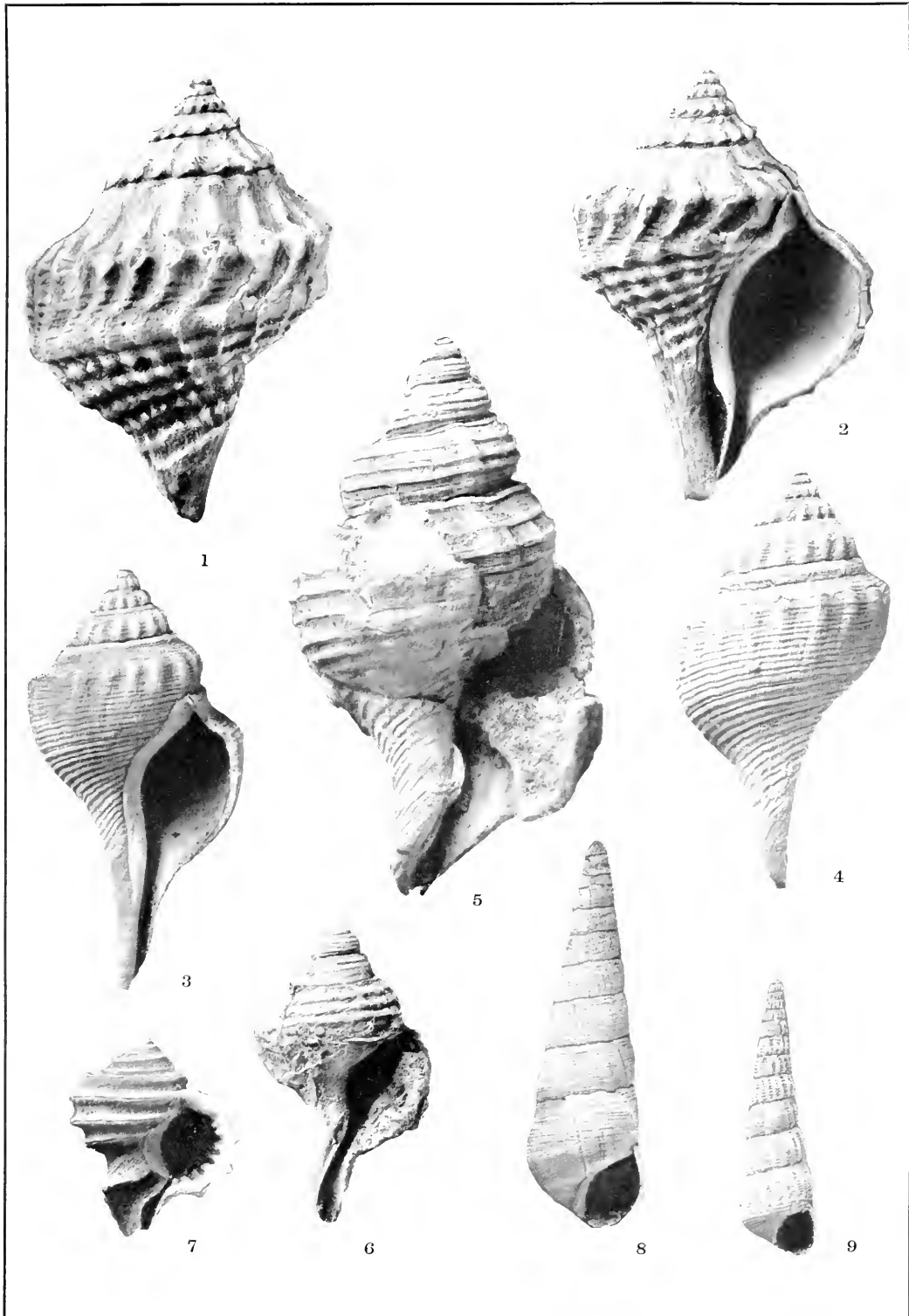


PILSBRY: MARINE MOLLUSKS OF HAWAII.





BRUCE WADE: CRETACEOUS GASTROPODA OF TENNESSEE.



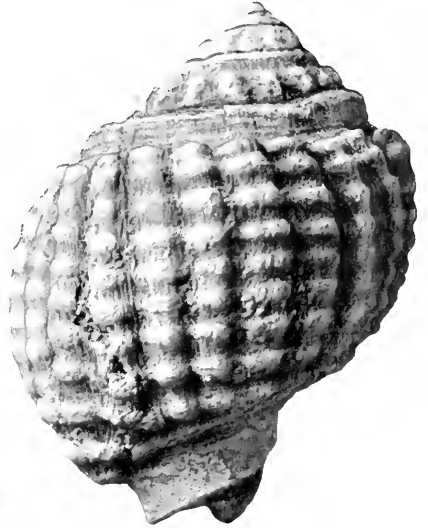
BRUCE WADE: CRETACEOUS GASTROPODA OF TENNESSEE.



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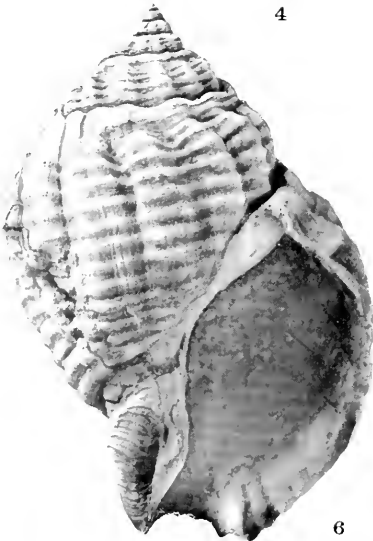
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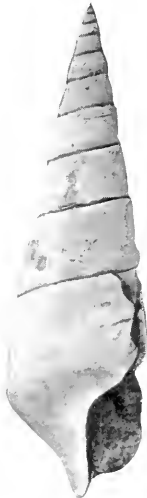
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7

COLPICHTHYS, THYRINOPS. AND AUSTROMENIDIA,
New Genera of Atherinoid Fishes from the New World.

BY CARL L. HUBBS.

COLPICHTHYS new genus.

GENOTYPE.—*Atherinops regis* Jenkins and Evermann (Gulf of California).

Colpichthys regis is related to the species of *Atherinops*, with which it has heretofore been considered congeneric. But the Gulf species differs in so many ways from the typical species from the outer coasts of Lower California, and from California and Oregon, that a new genus may be erected for its sole reception.

Compared with *Atherinops*, *Colpichthys* may be distinguished as follows. The head is depressed, although the body is deeper and more strongly compressed than in *Atherinops*. The mouth is sub-inferior, being on a level with the lower margin of the eye; the upper lip is thickened. The uniserial teeth are Y-shaped, but the inner fork is usually much the shorter. The gill-rakers, 16 to 18 in number along the lower limb of the outer arch, are strongly compressed, curved, serrate on their inner margins, and relatively short, being about one-fourth as long as the eye. In typical *Atherinops* the gill-rakers are rather more numerous, 20 to 25, and they are slender, terete, straight, nearly smooth, and about two-fifths as long as the eye.

The scales of *Colpichthys* differ markedly from those of *Atherinops*, although constructed on a similar plan. The posterior or exposed field of the scale is marked outward from the focus to the first annulus or seasonal ring by circuli similar to those of the anterior field, but beyond this mark the circuli assume a sharply and irregularly undulate course paralleling the posterior margin of the scale. In *Atherinops* proper (*A. affinis*) the circuli of the posterior field throughout maintain a nearly even course, and are all greatly crowded, while in *Colpichthys* only those in the annuli or year checks are closely approximated. In *Colpichthys* there are about six basal radii within the first annulus, beyond which the number is abruptly decreased. In *Atherinops*, on the other hand, the radii are often absent, but on some scales 1, 2, or even 3, are in evidence; and these radii are not

modified at the first annulus. In *Colpichthys* further, the scales are rather thicker and larger than in *Atherinops*, the number of transverse series 47 to 51, instead of 52 to 72.

(*Colpichthys*, a fish of the bay or gulf.)

THYRINOPS new genus.

GENOTYPE.—*Atherinichthys pachylepis* Günther, 1864 (= *Menidia pachylepis* Jordan and Evermann 1896 = *Thyrina pachylepis* Jordan and Evermann 1898, and Regan 1907 = *Kirtlandia pachylepis* Gilbert and Starks 1904).

Thyrinops pachylepis, the only species of the genus, occupies a position almost exactly intermediate between *Kirtlandia* and *Atherinella*, agreeing with both of these genera as well as with *Menidia*, etc., in the posterior position of the anal fin, which is not advanced as in *Thyrina* and *Eurystole*. *Thyrina* closely resembles *Thyrinops*, and is probably a fresh-water derivative from some such form. This conclusion is strengthened by the fact that some species of *Thyrina*, especially *T. sardina*, have the scales on the sides more or less laciniate.

Thyrinops may be diagnosed as follows: form moderately slender, contracted ventrally as in *Thyrina*. Head rather pointed; gape strongly arched downward posteriorly; jaws forming a semicircular curve when viewed from above; maxillary not reaching to below front of orbit. Teeth in villiform bands, rather wide in the upper jaw, but narrow in the lower; outer series of premaxillary teeth spaced and a little enlarged; entire palate toothless. Scales thickened, rather deeper than long; the free margin rounded, but the dorsal, ventral, and basal margins nearly straight; circuli absent from the apical field, which is crossed by numerous fine, subparallel radii, between which the scale is produced so as to form a border more finely laciniate than in *Membras* (*Kirtlandia*); basal field usually crossed by a line or two along which the circuli are curved inward; basal radii usually absent on the trunk scales, or only a few shallow ones developed, whereas on the tail the scales are deeply sculptured with well developed radii;¹ The number of scales is about 40 in lateral series. Fin rays: dorsal, IV or V-I, 6 to 8; anal I, 20 to 23. Anal base decidedly longer than head, as in *Thyrina*; soft dorsal and anal fins scaleless, falcate in outline; origin of spinous dorsal well behind that of the anal, about an orbital length separating the two

¹ This variation has been entirely too much neglected in recent studies of fish scales, not so much in this family as in other groups.

verticals; pectorals falcate and elongate, reaching nearly to or even beyond, the tips of the pelvic fins.

Two specimens of *T. pachylepis* are at hand; they were collected January 5, 1908, by Anastasio Alfaro, in the Estero at Tivives near Puntarenas in Costa Rica. Lengths to base of caudal, 88 and 113 mm. The so-called annuli or seasonal rings on the scales are well developed, and resemble those of California Atherinids; the scales show respectively 2 and 3 of these rings, probably indicating the age in years of the two fishes. Dorsal rays, IV-I, 7 (both specimens); anal, I, 20 and I, 21; pectorals reaching a little past tips of pelvics, their length being contained 3.4 and 3.6 times in the total. Scales 40-9 and 42-9.

AUSTROMENIDIA new genus.

Atherinichthys (in part) Günther, Cat. 3, p. 402 (not *Atherinichthys* Bleeker = *Chirostoma* Swainson).

Basilichthys of authors (not of Girard, Proc. Acad. Nat. Sci. Phila., 1854, p. 198, *microlepidotus* = *regia*, hence *Basilichthys* = *Gastropterus* Cope = *Pisciregia* Abbott; see Thompson, Proc. U. S. Nat. Mus., 50, 1916, pp. 463-466).

GENOTYPE.—*Basilichthys regillus* Abbott.

Austromenidia is used to replace *Basilichthys* of authors and not of Girard, whose original type belongs to the genus later called *Gastropterus* and *Pisciregia*.

The fishes of this genus, referable to several species, inhabit both coasts of southern South America. They are of comparatively large size, and are of commercial importance. The scales are notably small, numbering from 67 to over 100 in lateral series. Both jaws are strong and arched downward posteriorly; the premaxillary is dilated distally. The teeth are disposed in narrow bands along the jaws, and are usually absent from the vomer, although a few teeth or even a small patch, may be present on that bone. The first dorsal fin begins well before the anal, at a point about midway between base of snout and base of caudal.

It will be noted from the foregoing diagnosis that *Austromenidia* resembles *Menidia* very closely, differing from it in the larger size, the stronger jaws, and the much finer scales.

The species of *Chirostoma*, confined to the fauna of the Lerma River System in Mexico, form a large series with diverse extremes. The scales are usually larger (37 to 75)² than in *Austromenidia*; the

² Regan's extreme count for *diazi*: the number probably includes the scales on the base of the caudal fin. The scales are usually larger in *Chirostoma*.

lower jaw stronger, projecting beyond the upper, at least at the symphysis,³ and forcing the gape into an oblique direction.

Species of "*Atherinichthys*" have been recorded by Günther and others from Australia and Tasmania, but they cannot be congeneric with any New World genera.⁴ The same is true of *Atherinichthys nouhuysi* Weber⁵ from New Guinea. The original type of *Atherinichthys* is identical with that of *Chirostoma* an earlier name.

Two genera related to *Austromeniida*, *Odontesthes* and *Kronia*, have been described from the east coast of South America.

Odontesthes Evermann and Kendall⁶ has a peculiarly pikelike form, produced by the strength of the jaws, and by the positions of the dorsal and anal fins, which are inserted much farther back than in *Austromeniida*; the spinous dorsal originates nearly opposite the anal. The scales are of medium size (about 50 to 70 transverse series). The teeth on the jaws are in two series, and there are 2 or 3 groups of vomerine teeth. *Kronia*, recently described by Ribeiro,⁷ is said to have 3 linear groups of vomerine teeth; large sublacinate scales (in 54 series); and the dorsal origin directly over the anus. Perhaps *Kronia* is synonymous with *Odontesthes*, but it is not the same as *Austromeniida*.⁸

³ The species have all been reexamined as regards this character; the single exception is *C. promelas*, in which the upper jaw has secondarily become hooked over the lower, somewhat as in the breeding male of *Oncorhynchus*.

⁴ See McCulloch, Proc. Roy. Soc. Queensland, 24, 1912, p. 49.

⁵ Notes Leyden Mus., 32, 1910, p. 229.

⁶ Proc. U. S. Nat. Mus., 31, 1906, p. 94.

⁷ Arch. Mus. Nat. Rio de Janeiro, 17, 1915 (Fauna Brasiliensis, Peixes, *Trematolepides*, p. 9).

⁸ *Atherina argentincensis* Cuvier and Valenciennes (Hist. Nat. Poiss., 10, 1835, p. 472) seems to be referable to *Odontesthes*. It is described as having scales in ten longitudinal series, they being smaller than in *Meniida brasiliensis* but larger than in *Austromeniida latichuria*; and as having the spinous dorsal opposite the anus.

MARINE MOLLUSKS OF HAWAII, IV-VII.

BY HENRY A. PILSBRY.

Since the publication of the first paper of this series,¹ the writer has been able to study part of the important collection of Hawaiian marine shells made by Professor Wm. Alanson Bryan and Mrs. Bryan, which they had brought to the Academy for identification. It is very rich in the shells of Kauai, Oahu and Molokai, also several of the islets of the northwestern group as far as Laysan. The present paper treats also of shells collected by Mr. D. Thaanum, minutiae picked out of shell-sand sent many years ago by Mr. Frederick Stearns, and material collected by the author.

IV. EULIMIDÆ.

Melanella bryani n. sp. Fig. 1.

Laysan Island, Wm. Alanson Bryan, 1902. Type No. 117595, A. N. S. P., paratypes in Bryan collection.

The shell is obliquely conic, the upper half rather strongly curved to the right and backward; smooth, white; the later whorls having

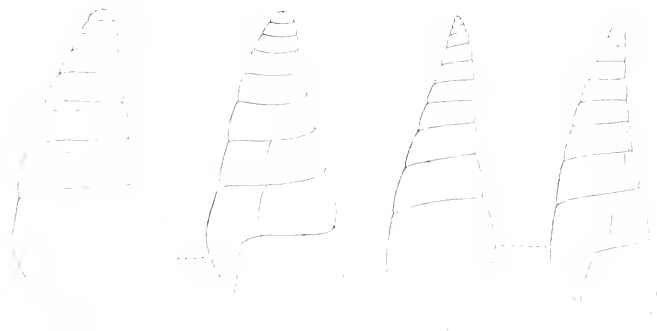


Fig. 1. — *Melanella bryani*.

Fig. 2. — *Melanella nimus*.

a broad gray border below the suture, which is somewhat impressed. A single series of well impressed linear varices runs up the right side, receding to a dorsal position in the upper whorls. The whorls are slightly convex. The aperture is small, subvertical. The columella

¹ "Marine Mollusks of Hawaii, I-III, these *Proceedings*, pp. 207-230, August, 1917.

is deeply concave; parietal wall rather heavily calloused. The outer lip, in profile view, is almost straight, not arching forward.

Length 10, diam. 5, length of aperture with peristome 3 mm.

Melanella mimus n. sp. Fig. 2.

Kailua, Oahu, W. A. Bryan. Type No. 117593, A. N. S. P., paratypes in Bryan coll.

The shell is rather slender, the spire having a distinct double curvature; smooth, white; the suture linear, not impressed. A series of linear varices runs up the right side, spirally receding to the dorsal side as usual. The whorls are almost flat, the last being very obtusely subangular. The aperture is ovate; columella moderately concave, parietal callous thin. The outer lip arches strongly forward.

Length 5.3, diam. 2, length of aperture 1.5 mm.

Melanella kanaka n. sp. Fig. 3.

Kailua, Oahu, W. A. Bryan. Type No. 117594, A. N. S. P., paratype in Bryan coll.

The shell is very small, conic, attenuated and recurved in the upper third; smooth, whitish, the suture linear, superficial, broadly gray margined below, the margin defined by a whitish line. A continuous series of impressed, linear varices runs up the right side, receding but little upward. The whorls of the spire are scarcely

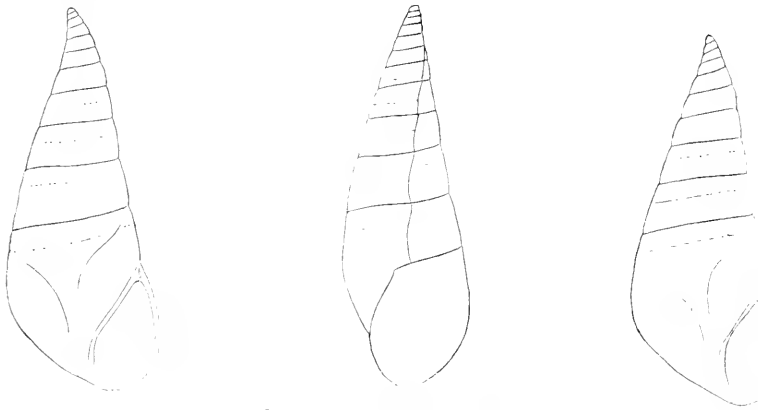


Fig. 3.—*Melanella kanaka*.

convex, the last being moderately convex. The aperture is small, subovate, the inner margin much less curved than the outer. The outer lip arches very strongly forward, as seen in profile.

Length 4.2, diam. 1.62, length of aperture 1.45 mm.; about 10 whorls.

E. inflexa Pse., from the Paumotu, is similar in shape but far larger.

A form from Kahala, Oahu (right fig.), collected by Mrs. A. F. Letson, differs by being a little more conic, the last whorl nice ample in the peripheral region. Length 4, diam. 1.7 mm.

Melanella ima n. sp. Fig. 4.

Paumahu, Oahu, W. A. and E. L. Bryan. Type No. 11592, A. N. S. P., paratypes in Bryan coll.

The shell is small, slender, the upper half curving strongly to the right; smooth, whitish, the linear suture rather narrowly bordered with gray. The whorls are very slightly convex. The series of linear varices on the right side recedes to the dorsal side above.

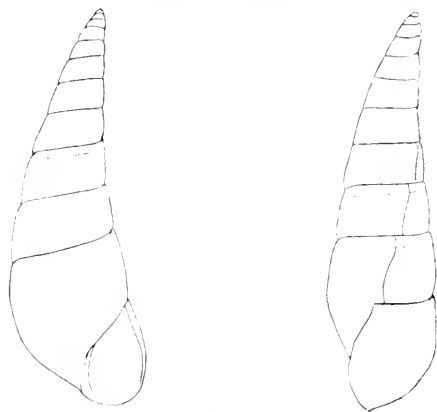


Fig. 4.—*Melanella ima*.

The aperture is shaped as in *M. kanaka*, and as in that species the outer lip arches forward strongly.

Length 4.3, diam. 1.35, length of aperture 1.05 mm.

More slender than *M. kanaka*, and curved for a greater part of its length. The shape of the last whorl distinguishes it from *M. minus*.

Melanella letsonae n. sp. Fig. 5.

Mokapu Point, Oahu. Type No. 117633, A. N. S. P., collected by Mrs. A. F. Letson. Also in Bryan collection.

The shell is very slender, white, moderately curved to the right, somewhat solid. There is a row of varix-lines on the right side, becoming dorsal in the upper part of the spire. The whorls are nearly flat, the suture superficial having a broad gray border below. Last whorl is obtusely subangular above the middle, the base tapering.

slightly convex. The aperture is small, ovate. The outer lip curves forward very strongly in the middle.

Length 4.5, diam. 1.6, length of aperture 1.2 mm.; 10 whorls.

Melanella lunata n. sp. Fig. 6.

Mokapu Point, Oahu. Type No. 117634, A. N. S. P., collected by Mrs. A. F. Letson.

The shell is rather slender, somewhat solid, white, very strongly curved to the right and a little backward above. The whorls are nearly flat, and marked with varix-lines on the right, becoming dorsal above. Suture superficial, distinctly but shortly descending to each varix-line and to the aperture, broadly bordered below with gray. The aperture is small, ovate. The outer lip moderately arched forward in the middle.

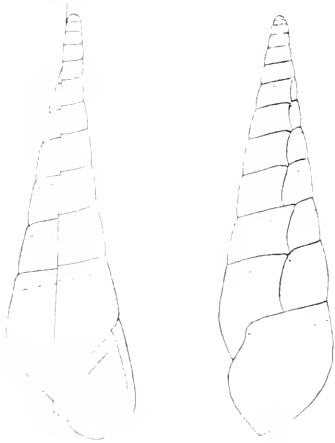


Fig. 5.—*Melanella letsoni*.

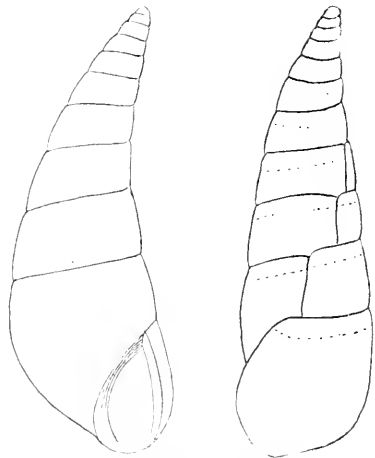


Fig. 6.—*Melanella lunata*.

Length 6.6, diam. 2.3, length of aperture 1.75 mm.; 10 whorls remaining, the apex being imperfect.

By its strong curvature this species resembles *Subularia distorta* Peag. but there is no ridge or keel on the left side of the base, as in the species of *Subularia*.

Subularia delicata n. sp.

Mokapu Point, Oahu. Type No. 117632, A. N. S. P., collected by Mrs. A. F. Letson.

The shell resembles *S. nutcalli*, but differs by being smaller and decidedly more slender. It is thin, pellucid, showing the internal column and partitions through the shell. The spire is straight,

whorls slightly convex, having varix-lines on both sides, the last whorl having a short keel below, characteristic of the genus.

Length 4.3, diam. 1.3, length of aperture 1.4 mm.; 9 whorls.

This species will be figured in connection with material on *Subularia* in the next paper of this series.

V. THE PYRAMIDELLIDÆ.

Further species of this family are to follow when illustrations can be prepared.

Turbonilla Chemnitzia oblectamentum n. sp. Fig. 8.

Haleiwa, Oahu. Type No. 116543, A. N. S. P., coll. by H. A. Pilsbry, 1913. Also Haena, Kauai, W. A. and E. L. Bryan.

The shell is turritid, diameter contained slightly less than three times in the length. Nuclear shell of at least two whorls, tilted towards its spire which is low and half immersed. First post-nuclear whorl having vertical ribs, the rest moderately convex, with sculpture



Fig. 7.—*Turbonilla kawaiiensis*.

Fig. 8.—*Turbonilla oblectamentum*.

of rather large, rounded, protractive ribs, about 17 on the last whorl, parted by intervals slightly wider than the ribs. On the last whorl the concave intervals stop abruptly at the periphery; yet very slight continuations of the ribs, or part of them, are visible on the base. The suture is deeply impressed, almost channelled. The aperture is ovate, the columella thick, barely perceptibly sinuous, almost straight.

Length 2.45, diam. 0.85, length of aperture 0.6 mm.; $6\frac{1}{2}$ post-nuclear whorls.

Turbonilla (*Chemnitzia*) *kahoolawensis* n. sp.

North shore of Kahoolawe. Type No. 116179, A. N. S. P., coll. by Pilsbry, 1913.

The shell is similar to *T. oblectamentum* except in the following characters. It is relatively narrower. The ribs are similar but more numerous, about 30 on the last whorl, and as wide as the intervals. The suture is very deeply impressed, a little more channelled than in the other species. The nuclear whorls are too much worn to show the shape well. The lateral outlines of the spire are distinctly convex.

Length 3, diam. 0.85 mm.; $7\frac{1}{2}$ post-nuclear whorls.

Turbonilla (*Turbonilla*) *kauaiensis* n. sp. Fig. 7.

Haena, Kauai. Type No. 117626, A. N. S. P., coll. by W. A. and E. L. Bryan; paratype in Bryan coll.

The shell is slender, the diameter contained about $3\frac{1}{2}$ times in the length, nuclear whorl elevated, smooth. Subsequent whorls are slightly convex, sculptured with smooth, straight, rounded vertical ribs, equal to their equally smooth intervals, and 24 in number on the penult whorl. On the last whorl the ribs extend upon the base, but weaken there. Aperture is rhombic, the columella stout, very weakly sinuous.

Length 2.75, diam. 0.8, aperture 0.6 mm.; $7\frac{1}{2}$ post-nuclear whorls.

This very minute species differs from *T. kahoolawensis* by the simple suture, the extension of the vertical ribs upon the base, and the nearly straight outlines of the spire.

Turbonilla (*Chemnitzia*) *thaanumi* Pils. and Van.

1908. *Turbonilla* (*Chemnitzia*) *thaanumi* P. and V., *Nautilus*, vol. 22, p. 58, fig. 3.

Hilo, Hawaii, D. Thaammi.

This minute shell differs from the preceding by the abrupt termination of the intercostal valleys on the last whorl.

Turbonilla (*Evaletta*) *elizabethæ* n. sp. Figs. 9, 9a.

Waianae, Oahu. Type and paratypes No. 117596, A. N. S. P., coll. by W. A. and E. L. Bryan; paratypes in Bryan coll. Also from Waikiki beach (Stearns), Honolulu Harbor, Paumotu, Mokapu Point (Bryan), and Kahala (Mrs. Letson), Oahu. Haena and Hanalei River, Kauai (Bryan), Kailua, Kona coast of Hawaii (Bryan), Laysan Island (Bryan).

The shell is subulate, the upper third or half pink, the rest white.

The initial whorl is low, with inturned tip, following whorls are convex, regularly increasing, very densely microscopically striate spirally. The suture is narrowly channelled. The slopes of the spire are nearly straight. The aperture is ovate, oblique. The columella bears a small fold, visible in oblique view in the mouth, but so far immersed that it is not seen in direct front view.

Length 6.7, diam 1.65, length of aperture 1.65 mm.; 10 whorls (type).

Length 7.6, diam. 2, length of aperture 1.7 mm. (largest specimen seen).

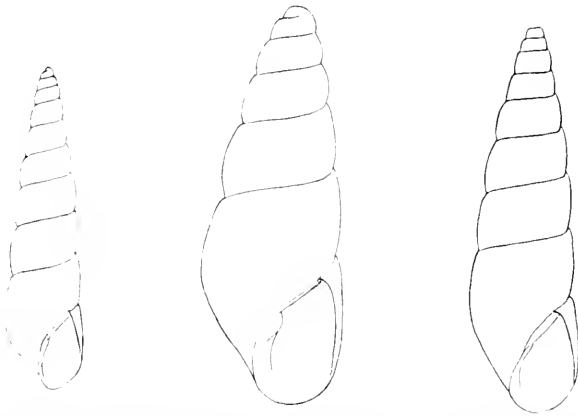


Fig. 9.—*Turbonilla elizabetha*. 9a.—A young specimen from Honolulu, length 2.8 mm.

Fig. 10.—*Turbonilla laysanensis*.

This pretty, delicately colored shell is named for Mrs. W. A. Bryan. The nuclear whorl is so far immersed that it resembles that of *Odostomia*. By Dr. Bartsch's key, it runs nearest to the subgenus *Careliopsis* Möhrh; but that differs by the characters of the nuclear shell. *T. elizabetha* is here made the type of a new subgenus to be called *Evaletta*, characterized by the low, inturned nuclear whorl and the evenly convex whorls, microscopically striate spirally. The lengthened form and numerous whorls separate it from *Odostomia*, wherein it approaches the subgenus *Evalina* somewhat.

Turbonilla (*Evaletta*) *laysanensis* n. sp. Fig. 10.

Laysan Island. Type No. 117627, A. N. S. P., collected by W. A. Bryan.

Shell similar in color and shape of the whorls to *T. elizabetha*, but of decidedly broader form, and of fewer whorls in a shell of greater length. The type has lost the nuclear whorl.

Length 8.7, diam. 2.2 mm.; 8 post-nuclear whorls.

Turbonilla (Lancella) varicosa (A. Ad.). Pl. XXII, figs. 5, 6, 7.

1853. *Chemnitzia varicosa* A. Ad., P. Z. S., p. 181, Pl. 20, fig. 15.

1860. ? *Turbonilla decussata* PEASE, P. Z. S., p. 438.

Off Honolulu in 6-8 fathoms, dredged by Mr. D. B. Kuhns. Also in the Thaanum-Kuhns collection. Some young specimens were taken at Haena, Kauai, by Prof. and Mrs. Bryan.

The shell is slender, turritid, with long, attenuate spire, cinnamon colored, or nearly white with cinnamon bands. Nuclear shell of one smooth elevated whorl, the spire exposed, low. Post-nuclear whorls are moderately convex, with sculpture of close, rounded, axial ribs, their intervals deep and equal to the ribs on the upper whorls, about half as wide as the ribs on the last four whorls. There are also swollen white varices as wide as three to five ribs, at irregular intervals, more numerous in the lower whorls; in all 8 in the specimen shown in fig. 5. The axial ribs and varices are crossed by rather strong spiral cords, about 10 between sutures, the fourth from above being a little larger than the others. The last whorl is rounded peripherally and has a short, convex base. The aperture is trapezoidal, angular at the base of the columella. Columella vertical, with a sharp, very oblique spiral fold at the base. Parietal callous scarcely noticeable.

Length 22, diam. 4.7, length of aperture 4.2 mm.; 15 post-nuclear whorls.

Chemnitzia varicosa was described from the "Eastern Seas." The description and figure agree well with Hawaiian specimens.

I have not seen *T. cornelliana* Newc., from Honolulu.

The subgenus *Lancella* Dall and Bartsch was founded by W. H. Pease under the preoccupied name *Lancca*) for large, varicose *Turbonillas* having conspicuous vertical and spiral sculpture, a prominent nucleus tilted towards its very low spire, and a small spiral fold emerging *near the base* of the columella. In this last feature it differs from all other *Turbonillas*, and perhaps the group should be ranked as a genus.

Besides the species described or mentioned below, the following belong here: *T. elongata* Pease (name preoc., = *T. peasei* D. and B.), the genotype, from Paumotu. *T. bella* D. and B., of Japan. Also, apparently *T. cornelliana* Newc., from Honolulu, and possibly *T. grandis* (*Chemnitzia grandis*) Ads. and Rye., neither of which I have seen.

Turbonilla (Lancella) vitiensis n. sp. Pl. XXII, fig. 1.

The shell is turritid, white; embryonic whorl on edge but leaning towards its spire, which is low. Subsequent whorls with sculpture

of low, rounded vertical ribs, somewhat unequal, and parted by narrow furrows: there are about 24 such ribs on the penult whorl; also very few swollen varices, in the type three: on the left side of the last whorl, on the third, and on the sixth whorls above the last. Over ribs, intervals and varices there are seven low spiral cords, much wider than their intervals, on each whorl to the last, which has 17, the lower cords being narrower there. The aperture is trapezoidal; outer lip simple; columella straight, vertical, having a small, steeply ascending spiral fold near the base. It joins with the basal margin in a rather small curve, but there is no angle at the junction.

Length 15.5, diam. 4 mm.; aperture 3.3 mm. long; 13 post-embryonic whorls.

Viti Islands. Type and 2 other specimens are No. 20046, A. N. S. P., collected by A. J. Garrett.

Several lots sent by Mr. Garrett at different times show this to be rather constant in size and other characters. There are usually two distinct and often one small varix. The name *vitiensis* was used on one of Garrett's labels, but I cannot find that he published it.

Turbonilla vitiensis clavus n. subsp. Pl. XXII, fig. 3.

The shell is similar to *T. vitiensis* except that it is more slender; penult whorl with 20 vertical ribs.

Length 12.5, diam. 2.9 mm.; length of aperture 2.5 mm.; 13 post-embryonic whorls.

Viti Islands. Type No. 117597, A. N. S. P., collected by A. J. Garrett.

Odostomia (Odostomella) patricia n. sp. Fig. 11.

Waikiki beach, near Honolulu. Type No. 93944, A. N. S. P., collected by Frederick Stearns.

The shell is oblong, solid, white, the last whorl encircled with three cinnamon bands, two of which are visible on the penult and one on the preceding whorl. The nuclear whorl is rather well elevated, smooth. Subsequent whorls have rounded axial ribs as wide as their intervals, about 20 on the last whorl, where they continue over the base, though weaker below. Under a high power some weak spiral striation is visible on the base. The suture is narrow and rather deeply impressed. The aperture is rather narrowly ovate, oblique. Columellar fold small.

Length 1.6, diam. 0.7, length of aperture 0.55 mm.; $4\frac{1}{2}$ whorls.

This species is smaller than *O. doliolum*, with narrower ribs, but much the same coloring.

There is a similar pink form with roseate apical whorl, which may be called var. *rosa*, and another form, similarly colored, with only about 16 larger ribs on the last whorl and having the nuclear whorl larger; it may be named var. *rhodocephala*.



Fig. 11.—*Odostomia patricia*.



Fig. 12.—*Odostomia syrtites*.

Odostomia (*Chrysallida*) *stearnsiella* n. sp. Fig. 14.

Waikiki beach, near Honolulu, Oahu. Type No. 93931, A. N. S. P., collected by Frederick Stearns.

The shell is ovate-conic, solid, white. Nuclear whorl regular, well raised, the apex turned in; two or three following whorls have weak axial folds. All of the post-nuclear whorls have narrow spiral furrows; on the last whorl there are four above the periphery, the upper one widest, and after a peripheral smooth zone the base has about 6 weak spiral cords. The aperture is ovate, the columellar fold strong.

Length 3.5, diam. 1.4, length of aperture 1.3 mm.; $5\frac{1}{2}$ post-nuclear whorls.

Odostomia (*Miralda*) *syrtites* n. sp. Fig. 12.

Waikiki beach, Oahu. Type No. 93934, A. N. S. P.

The shell is ovate-conic, white. Nuclear whorl smooth, somewhat elevated, the apex depressed. Following whorls of the spire having a broad raised zone, indistinctly bipartite, bearing somewhat oblique ribs; this is followed by a spiral sulcus and a stout smooth spiral ridge. On the last whorl the depression dividing the upper zone is deeper; there are about 26 oblique ribs. From the periphery down there are about seven spiral ridges, the last three quite weak. The aperture is ovate, oblique. Columellar fold strong, rather thick.

Length 1.7, diam. 0.95, length of aperture 0.65 mm. $4\frac{1}{2}$ whorls in all.

There are more basal keels than in *O. scopulorum* Watson, and the

shell is broader. Though larger, it has a whorl less than Watson's species.

Odostomia (Miralda) *scopulorum* Watson. Fig. 13.

Odostomia scopulorum WATSON, Challenger Rep., Gastrop., p. 485, Pl. 31, fig. 5.

Reefs off Honolulu, 4 fathoms (Challenger). Hilo, Hawaii (D. Thaanum).

The original figures are copied. The specimen measures 1.2 mm. long, 0.5 wide, having 5 whorls. There is "a strong, oblique, deep-set tooth about the middle" of the inner lip.

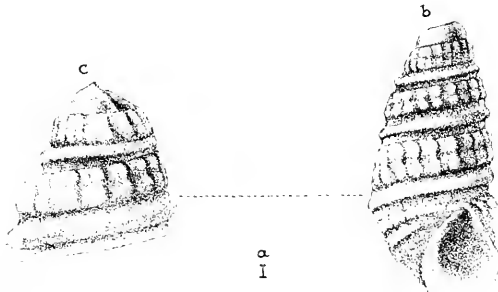


Fig. 13.—*Odostomia scopulorum*, after Watson. Shell $\times 35$ and apex $\times 60$.

Mr. Thaanum's specimens agree well with the type description and figures.

Odostomia (Miralda) *paulbartschi* n. sp. Fig. 15.

North shore of Kahoolawe. Type No. 116163. A. N. S. P., coll. by Pilsbry, 1913. Also beach cast of Honolulu, No. 93940.

The shell is tapering-oblong, white. The nuclear whorl is smooth, convex, low, with depressed tip. Following whorls of the spire have two large, rounded spiral ridges, bearing slightly oblique nodes which are weakly connected across the median depression: a narrow smooth cord revolving immediately above the suture. On the last whorl the post-sutural cord continues at the periphery, and there are three spiral cords on the base. The aperture is somewhat oblique. Outer lip scalloped. The columella is narrow, terminating above in a small fold.

Length 2.3, diam. 0.95, length of aperture 0.8 mm.; a trifle over 6 whorls.

A single perfect example of this *Miralda* was found in beach debris on Kahoolawe, and two from near Honolulu. It is obviously distinct from *O. scopulorum* Watson, the only related species described from the islands.

Odostomia (Miralda?) pupu n. sp. Fig. 16.

Waikiki beach, near Honolulu, Oahu. Type No. 93943, A. N. S. P.

The shell is oblong-conic, white, solid. Nuclear whorl is rounded, rather elevated, smooth. Subsequent whorls of the spire are sculptured with three smooth, subequal, strongly raised spiral keels, their summits rounded. The intervals are equal to the keels in width, and have sculpture of spaced axial threads. On the last whorl there are six spirals, the anterior two very low. The aperture is ovate, oblique. Columellar fold is rather strong.

Length 2.4, diam. 1.05, length of aperture 0.75 mm.; $5\frac{1}{2}$ whorls.

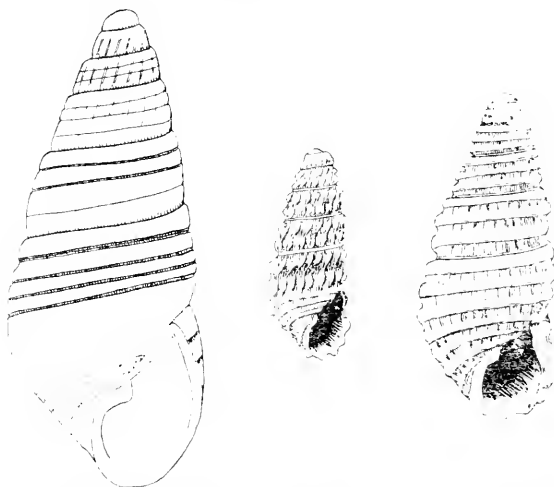


Fig. 14.—*Odostomia*
sharusiella.

Fig. 15.—*Odostomia*
prulbarschi.

Fig. 16.—*Odostomia*
pupu.

Odostomia *Evalina* *waikikiensis* n. sp. Fig. 17.

Waikiki, Oahu. Type No. 117624, coll. by Pilsbry, 1913.

The shell is oblong-conic, white. Nuclear whorls subglobose, uptilted, half immersed. The next two whorls appear to be smooth except for some fine vertical striation. Last three whorls have sculpture of numerous very low axial folds crossed by rather coarse impressed lines, of which there are 15 on the penult whorl. On the last whorl the axial folds weaken as they approach the periphery; and do not pass upon the base. The whorls are rather convex, the suture deeply impressed. The aperture is ovate. There is a small, immersed columellar fold, visible in an oblique view, but not in front.

Length 2.8, diam. 1 mm., length of aperture 0.8 mm.; $5\frac{1}{2}$ post-nuclear whorls.

Odostomia (*Evalina*) *haleiwnensis* n. sp. Fig. 19.

Haleiwa, Oahu. Type and a smaller specimen No. 116546, A. N. S. P., collected by Pilsbry, 1913. Paumalu, coll. by Mrs. A. F. Letson.

The shell is imperforate, oblong. The nuclear whorls are depressed. Axial sculpture consists of numerous extremely low plications, which become still weaker on the last whorl. These are crossed by fine, impressed spiral lines, of which there are about 10 on the penult whorl. The whorls are rather convex, parted by a deeply impressed almost channelled suture. Aperture is ovate. Columellar fold low but distinct, scarcely visible in a direct front view.

Length 3, diam. 1.05, length of aperture 1 mm.: $5\frac{3}{4}$ whorls.

It is closely related to *O. gracilis* Pease, yet much smaller in all its parts, less densely striate spirally, and less attenuated near the summit.

Odostomia (*Evalina*) *gracilis* Pease. Fig. 18.

Odostomia gracilis Pease, Amer. Jour. of Conch. Vol. III, p. 292, Pl. 24, fig. 20 (Hawaii).

Pease confused two species under *gracilis*. His description was evidently framed to cover both; but the figure was drawn (very

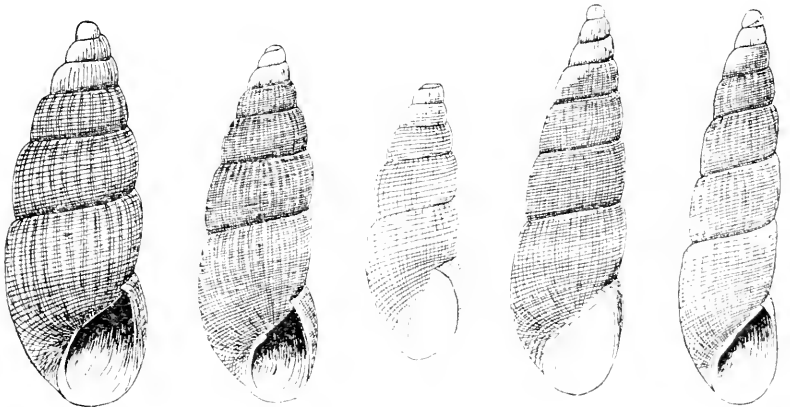


Fig. 17.—*O. waikikiensis*.

Fig. 18.—*O. gracilis*.

Fig. 19.—*O. haleiwnensis*.

Fig. 20.—*O. c. nematodroma*.

Fig. 21.—*O. selecta*.

badly) from the stouter shell, and I have selected this as the type (fig. 18). It is No. 19967, A. N. S. P.

The surface is inconspicuously and very weakly plicate, and densely striate spirally. The lateral outlines are distinctly convex.

The suture is narrowly channelled. Length 3.85, diam. 1.45, length of aperture 1.1 mm.

Odostomia (Evalina) eclecta n. sp. Fig. 21.

Haena, Kauai. Type No. 117599, A. N. S. P., coll. by W. A. and E. L. Bryan. Paratypes in Bryan coll. Also from Oahu at Paumalu and Honolulu Harbor, W. A. and E. L. Bryan, and Kahala, Mrs. A. F. Letson.

The shell is subulate, slender, white. Nuclear whorl globose. Succeeding whorls are rather convex, separated by a narrowly channelled suture, having axial sculpture of very low, scarcely noticeable plications, crossed by very numerous spiral threads, which are a little unevenly spaced. The suture is deeply impressed and crenulated by the axial folds. The aperture is ovate, oblique. There is a low columellar fold.

Length 4.15, diam. 1.1, length of aperture 1.1 mm.; $6\frac{1}{2}$ post-nuclear whorls.

This slender species has the contour of *Turbonilla*. It was confused by Pease with his *O. gracilis*.

Some of the specimens taken at Kahala, Oahu, have two cinnamon bands.

Odostomia eclecta nematoderma n. subsp. Fig. 20.

Waikiki beach, Oahu. Type No. 93953, A. N. S. P.

The shell is turritid, resembling *O. eclecta* except that the form is constantly stouter, tapering more rapidly. Sculpture of crowded, unequal spiral threads. There is scarcely any trace of axial plication, though there are some impressed lines. The type is white, but several smaller specimens in the lot have two cinnamon bands, one at the periphery of the last whorl, the other midway between that and the suture.

Length 4.2, diam. 1.2, length of aperture 1.2 mm.; $6\frac{1}{2}$ post-embryonic whorls.

Odostomia (Cyclodostomia) suta n. sp. Fig. 22.

Waikiki beach, near Honolulu. Type No. 93942, A. N. S. P., collected by Frederick Stearns.

The shell is oblong-conic, with obtuse (worn) summit. Subsequent whorls of the spire are concave in the middle, with large elevated spiral cords contiguous to the suture above and below. In the upper whorls the cords are closely pressed together across the suture. The last whorl has three cords, one subsutural, another peripheral

and the third smaller, below the periphery. The aperture is ovate; columellar fold deeply immersed.

Length 1.9, diam. 0.9 mm.

Four specimens, of which the most perfect has been selected for type and figure. The largest is more than twice the size of this one, but the base and aperture are broken. It belongs to the subgenus *Cyclodostomia*, apparently.

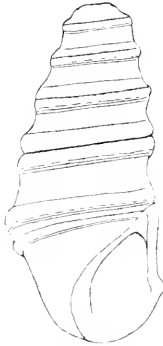


Fig. 22.—*Odostomia sutu*.



Fig. 23.—*Odostomia letsonae*.

Odostomia letsonae n. sp. Fig. 23.

Paumalu, Oahu. Type No. 117600, A. N. S. P., collected by Mrs. A. F. Letson.

The shell is oblong-conic, white. Nuclear whorls are worn. The rest of the whorls of the spire have two broad, rounded, contiguous spiral ridges in the upper part. In the last whorl the ridges are more separated, the lower one being narrower and median on the whorl; there is also a third and smaller ridge around the axial region. Over the whole surface there is a dense microscopic spiral striation. The aperture is oblique, the outer lip irregular. The columella is very thick, but shows no fold.

Length 2.6, diam. 1.1, length of aperture 0.85 mm.; 8 whorls.

The subgeneric position of this strongly sculptured little *Odostomia* is not clear to me. In Dr. Bartsch's key it comes nearest to *Cyclodostomia*. It was picked from beach debris by Mrs. Letson, whose work on the minute shells of this locality has brought many interesting species to light.

Odostomia Odostomia kahoowawensis n. sp. Fig. 24.

Northern shore of Kahoolawe. Type No. 116166, A. N. S. P., coll. by Pilsbry, 1913.

The shell is imperforate, conic, grayish white, with some opaque

white spiral bands. The nuclear whorl is rather large, moderately elevated, the tip turned in. Subsequent whorls are smooth, moderately convex, separated by a deeply but narrowly impressed suture. The aperture is ovate, oblique. Columellar fold strong and sharp. Within the outer lip there are several spiral lirae, which show through the shell as white bands, visible externally.

Length 1.5, diam. 0.9, length of aperture 0.75 mm.; $4\frac{1}{2}$ whorls.

Odostomia (*Odostomia*) *loxocephala* n. sp. Fig. 26.

Haena, Kauai. Type No. 117598, A. N. S. P., coll. by W. A. and E. L. Bryan.

The shell is conic, whitish, entirely smooth. The nuclear whorl is large, subglobose, set excentrically at the summit. Following whorls are moderately convex, with a few white axial lines but no



Fig. 24.—*Odostomia kahoolawensis*.

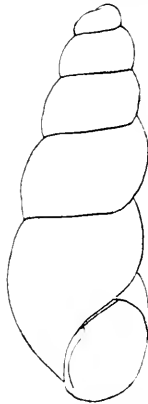


Fig. 25.—*Odostomia gulicki*.



Fig. 26.—*Odostomia loxocephala*.

striae. The aperture is large, ovate and oblique. The strong columellar fold emerges.

Length 1.85, diam. 0.95, length of aperture 0.8 mm.; 4 whorls.

The initial whorl is more elevated than in *O. kahoolawensis*.

Odostomia (*Odostomia*) *gulicki* n. sp. Fig. 25.

Waikiki, near Honolulu, Oahu. Type No. 93949, A. N. S. P. Also Haena, Kauai, Bryan.

The shell is rather thin, white, slowly tapering to the obtuse summit. Initial whorl well elevated, smooth. Following whorls are rather strongly convex, smooth except for very faint growth-lines, no microscopic striation visible. The suture is deeply impressed. The aperture is oblique, broadly oval. Columellar fold weak and low.

Length 2.2, diam. 0.85 mm.; $5\frac{1}{2}$ whorls in all.

This small, smooth species appears to belong to the section *Brachystomia*.

Odostomia (*Nesiodostomia*) *prima* n. sp. Fig. 27.

Mokapu Point, Oahu. Type No. 117622, A. N. S. P., collected by W. A. and E. L. Bryan. Paratypes in Bryan collection.

The shell is cylindric-fusiform, strong, glossy, white, with a broad gray margin below the suture and a broad tawny zone in the middle of the last whorl, its upper edge showing as a band above the suture on two or three whorls preceding. Sculpture of indistinct spiral impressed lines, rather widely spaced, and a few irregular axial lines. The nuclear whorl projects somewhat nipple-like, its tip turned in. Subsequent whorls are nearly flat, parted by a narrowly but deeply cut suture. The aperture is narrowly piriform. The outer lip is thin, and arches slightly forward. The inner margin is covered with a heavy callous, which spreads well forward. It is straight except near the base, where it passes into the narrow, deeply concave columella. Internally there is a spiral fold, which does not emerge to the aperture, and is visible only on breaking the shell.

Length 7.4, diam. 2.2, length of aperture 3.2 mm.; 7 whorls.

This species may be considered the type of the subgenus *Nesiodostomia*, characterized by the straightened inner lip, covered with a heavy, spreading callous, the columellar fold deeply immersed. The aperture is shaped much as in *Subularia*.

Odostomia (*Nesiodostomia*) *secunda* n. sp. Fig. 28.

Mokapu Point, Oahu. Type No. 117620, A. N. S. P., collected by Mrs. A. F. Letson. Paratypes in Bryan collection.

The shell resembles *O. prima* in form. It is chamois colored, imperfectly transparent, having a wide gray sutural margin. The surface is glossy, and shows some impressed axial striae. The last whorl descends shortly to the aperture.

Length 4.2, diam. 1.3, length of aperture 1.6 mm.; 5 post-nuclear whorls.

While this is evidently adult, by the descent of the suture just preceding the aperture, it is much smaller in all its parts than *O. prima*, and quite unlike young shells of that species of the same length.

Odostomia (*Nesiodostomia*) *tertia* n. sp. Fig. 29.

Paumalu, Oahu. Type No. 117621, A. N. S. P., collected by W. A. and E. L. Bryan.

The shell is aculeate, the upper half of the spire attenuated, lateral

outlines distinctly concave; chamois colored with a wide, more grayish border below the suture and an ill-defined cinnamon zone around the middle of the last whorl, the base below it almost white. The surface is glossy, with weak sculpture of spiral impressed lines and slight, coarse axial striae. The summit is broken. Remaining whorls of the spire nearly flat, the last long, weakly convex. The suture is but slightly impressed, and descends rather abruptly but shortly to the aperture. The aperture is very narrowly piriform. The outer lip arches gently forward. The inner margin is convex, covered with a spreading callous. Columella is narrow, deeply concave, and very short.

Length 7.7, diam. 2.3, length of aperture 3.3 mm.: 7 whorls remaining, the summit broken.



Fig. 27.—*Odostomia prima*.



Fig. 28.—*Odostomia secunda*.

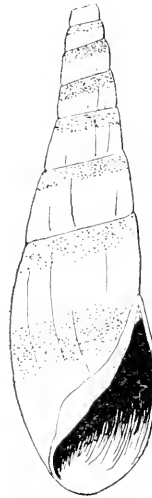


Fig. 29.—*Odostomia tertia*.

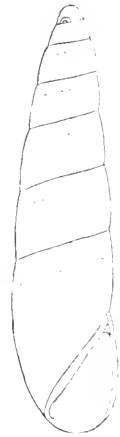


Fig. 30.—*Odostomia quarta*.

Odostomia (*Nesiodostomia* *quarta* n. sp. Fig. 30.

Waikiki beach, Oahu. Type No. 93927, A. N. S. P., coll. by F. Stearns.

The shell is cylindrical-tapering, smooth, very glossy, cinnamon-rufous. A wide subsutural margin is defined by a rather indistinct line in the color. Outlines of the spire are barely convex, nearly straight. The nuclear whorl is large, on edge, hemispherical; subsequent whorls are nearly flat, separated by a narrowly impressed suture; the last whorl tapering below. The aperture is sub-piriform. The inner margin is straight, rather heavily calloused. Columella

is very short and concave. The outer lip arches well forward in the middle.

Length 3.4, diam. 0.9, length of aperture 1 mm.; $5\frac{1}{2}$ post-nuclear whorls.

The slender figure, the narrow form of the aperture and the glossy surface give this little shell a superficial likeness to the genus *Strombiformis*.

VI. THE OSTREIDÆ.

Of the four species of *Ostrea* known from the islands, two are apparently extinct. The existing species are quite small oysters. *O. sandvichensis* is common on stone and shell bottom in Pearl Harbor. *O. hanleyana* appears to inhabit open shore and reefs.

Professor Bryan² has recorded the unsuccessful attempts to introduce eastern and Californian oysters. It could not reasonably be expected that oysters from waters so much colder would thrive, and so far as is known, they have died out completely. There is a large valve of the Virginia oyster in the Bryan collection, picked out of material dredged in Honolulu Harbor, probably a ballast shell.

Ostrea sandvichensis Sowerby. Pl. XXI, figs. 4 to 8.

1871. *Ostrea sandvichensis* SOWERBY, Conch. Icon. Vol. 18, Pl. 27, fig. 66 (Sandwich Islands).

1916. *Ostrea rosacea* Bryan, Natural History of Hawaii, p. 457, Pl. 104, fig. 8.

Oahu: Eastern Loch (Pilsbry), Ford's Island and Waipahu (Bryan), in Pearl Harbor, fossil at the latter place. Honolulu Harbor (Bryan).

Kauai: Lualualei basin, Milolii, fossil (Bryan).

Molokai: Kainalu (Bryan).

This fluted oyster is abundant in Pearl Harbor. It rarely exceeds a length of 35 or 40 mm., and is usually smaller. It varies from rounded to subtriangular in contour. The attached valve is generally strongly plicate at the free edge. The other valve may be strongly plicate, but is often nearly smooth. In color it varies from dull purple to pale fleshy, with or without purple rays or clouds. The interior is whitish or olive. There is more or less minute crenulation near the hinge. The valves are of the same size, or the lower one may project very slightly beyond the other. The specimens growing on *Trochus sandvichensis* imitate the sculpture of the gastropod (fig. 8, Ford's Island). Figs. 4 and 5 are from examples taken in the Eastern Loch.

A fossil form from Ford's Island, Pearl Harbor is heavier and in

² The Natural History of Hawaii, p. 445.

the average larger than *sandvichensis*; there is rarely any trace of corrugation, and the beaks are often very long. This form may prove to be a distinct species when perfect specimens come to hand. It may temporarily be called *O. sandvichensis margaritæ* (Pl. 21, fig. 9).

According to Bryan, the native name of this oyster is *piocoe*. It is too small to be of economic value.

Ostrea hanleyana Sowerby. Pl. XXI, fig. 1.

1871. *Ostrea hanleyana* Sowerby, Conch. Icon. Vol. 18, Pl. 28, fig. 72 (Sandwich Islands).

Oahu: Mokuoloe Island, Kaneohe Bay (Kuhns and Thaanum); Mokapu Point; Paumalu (Bryan). Molokai: Kainalu (Bryan). Hawaii: Hilo (Thaanum).

This is a rounded or oval oyster, usually showing slight traces of fluting, or in others this is scarcely noticeable, creamy white outside, *white within*, or having vinaceous stains. The attached valve generally projects broadly beyond the other. The adductor scar is small, shortly oval. There is some minute crenulation of the inner edges near the beaks, which are always very short. The usual length is 35 to 60 mm.

Ostrea retusa Pease & Sowerby. Pl. XXI, figs. 2, 3.

1871. *Ostrea retusa* Pease, SOWERBY, Conch. Icon. Vol. 18, Pl. 19, fig. 42 (Sandwich Is.).

1916. *Ostrea retusa* Pease, BRYAN, Natural History of Hawaii, p. 115 (Pearl Harbor, fossil).

Pearl Harbor, Oahu (Bryan, Kuhns, Pillsbury).

This oyster has not yet been found living, the specimens being from deposits believed to be pleistocene, on the shores of Pearl Harbor. I found it in abundance in a railroad cut about one-fourth mile east of Waipio, where a section of the ancient oyster bed is exposed.

It has been taken by Prof. and Mrs. Bryan at Waipahu, and by Kuhns and Bryan on the southern border of Ford's Island.

The extinction of the species may have been due to an inflow of hot water from one of the tufa cones northward, as Prof. Bryan suggests to me; or possibly a heavy fall of volcanic ash was blown over Pearl Harbor, and the shell fish were smothered by the turbid water. At all events, the species has not been found elsewhere in the islands, either recent or fossil. We may infer that it had been remarkably restricted in distribution for sometime previous to its extinction.

It is always a long, narrow oyster. The lower valve is frequently

somewhat fluted distally, though not often so much as in fig. 2. The flat upper valve is generally smooth except for the usual rough growth-lines. Both have crenulated inner edges when young, as shown in the figures, but this feature is generally indistinct or lost in old shells. The lower valve varies from having a rather deep beak-cavity to none. A large specimen measures 14 cm. long, 6 wide; others apparently adult are 10 cm. long.

Ostrea bryani n. sp. Pl. XX, figs. 1, 2.

Waianae, Oahu, from an excavation, about 20 ft. below the surface of a reef elevated 60 to 80 ft. above sea level. Collected by Wm. A. Bryan.

The shell is very large, ponderous, oblong, extremely thick. The more convex valve has a strong sculpture of rounded radial ridges, some of which branch; at the lower edge there are about 15. Inside, the beak occupies nearly half the total length. The flat valve has a thin layer of calcareous material over most of the outside, but it does not appear to be ribbed; towards the distal border, where it is not encrusted, some coarse concentric laminae appear. Neither valve shows any crenulation of the inner borders.

Length of flat valve 210, width 140 mm. Weight of both valves 5 lbs. 9 oz.

This huge oyster differs from *O. hyotis* by its thick shell, long beaks and far smaller corrugations. The associated shells are recent species, so that the deposit is probably pleistocene.

VII. VARIOUS GASTROPODS AND PELECYPODS.

Strombus hawaiiensis n. sp. Pl. XXII, figs. 1, 2.

Pearl and Hermes Reef. Type collected by Lt. W. H. Munter, Kauai at Haena and Milolii; Oahu at Paumalu and Waianae; and Molokai at Moomuni, all collected by W. A. and E. L. Bryan.

The shell is turritid, speckled or mottled, and on the back of the expanded lip banded with white. The last 4 or 5 whorls are angular midway between sutures on the spire, and at the shoulder of the last whorl. The earlier whorls are rounded. Nucleus smooth; three following whorls having many low, narrow axial folds crossed by spiral threads; on the subsequent whorls the folds weaken above the angle and become nodular upon it; the slope above the angle becomes concave. On the last two whorls the axial folds disappear and the nodules become stronger. The spiral cords on the last whorl are strong and subequal below the nodules, weak above them. A lump precedes the anterior sinus of the outer lip. The lip expands, and is produced

upward in a long straight process, as in *S. aratum*. The aperture is white within, striate, especially above and below, the striae being weaker in the middle. The thick outer lip is tinged with brown at the edge. The callous of the inner lip and ventral face is white, with a faint brown tint on the convexity, but no chestnut blotch. Other characters about as in *S. aratum*.

Length 75, diam. about 41 mm.; 10 whorls.

While this shell has much in common with *Strombus aratum* Martyn, it differs in color of the aperture and ventral callous, and in the far stronger spiral sculpture. It appears to be widely spread in the islands, but is nowhere common.

Phasianella variabilis (Pease). Fig. 31.

In a peculiar color-variety of this species, which may be called mutation *trizonalis*, the pattern is reduced to three spiral bands.

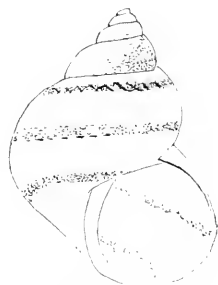


Fig. 31.—*Phasianella variabilis* mut. *trizonalis*.



Fig. 32.—*Neritina bryanæ*.

It is from Kailua, Hawaii. Illustrated in fig. 31, from the Bryan collection.

Neritina bryanæ n. sp. Fig. 32.

Paumahu, Oahu. Type No. 117631, A. N. S. P., coll. by W. A. and E. L. Bryan. Paratypes in Bryan collection.

The shell is very small, semiglobose, polished, pale gray, having four principal spiral bands of oblong, opaque white spots, and two zones composed of fine reddish longitudinal lines. The spire is very short, whorls about $2\frac{1}{2}$. The aperture is very oblique. The callous is not extensive, bluish or grayish white. Columellar edge straight, having two or three teeth and notches barely indicated. In profile view a strong tooth may be seen at the upper third of the columellar edge. The operculum is unknown.

Length 2.1, diam. 2.2 mm.

Tellina (*Arcopagia*) *elizabethæ* n. sp. Pl. XXII, fig. 8.

Flint Island, coll. by C. D. Voy. Type No. 80253, A. N. S. P. Also Haena, Kauai, W. A. and E. L. Bryan. Hilo, Hawaii, D. Thaamum.

The shell resembles *T. scobinata* (L.) but differs by the somewhat more produced beaks, the slopes in front and behind them straight, and inclined to form a smaller angle. The basal margin is less deeply curved. The posterior angle of the right valve is more prominent, and there is a broad concave depression before it. The scales of the surface are about half as large as in *T. scobinata*, much lower, and thicker, being lengthened granules rather than scales in the lower parts of the valves. Between the scales there are fine concentric striae as in the other species; as in that, also, the scales are notice-

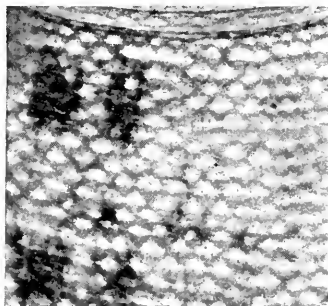
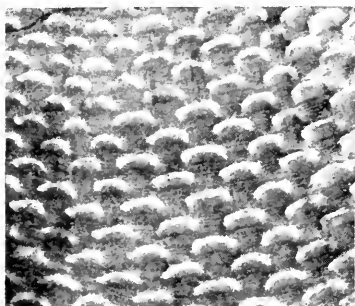


Fig. 33.—Surface of *Tellina scobinata* $\times 3$. Fig. 34.—Surface of *T. elizabethæ* $\times 3$.

ably larger in the right valve than in the left. The right valve is slightly larger, projecting above the left.

The shell is white, with a few rays of irregular cinnamon spots (which photograph abnormally dark). The interior does not differ materially from *T. scobinata*.

Length $60\frac{1}{2}$, alt. 57, diam. 27 mm.

Comparative views of the sculpture of *T. scobinata* (fig. 33) and *T. elizabethæ* (fig. 34) are from corresponding parts of the right valves of each.

Two valves from Haena are $61\frac{1}{2}$ and 81 mm. long. The specimen from Hilo is young, $32\frac{1}{2}$ mm. long. At this stage the processes of the surface are more scale like.

This species was recorded from Flint Island under the name *T. scobinata* in these Proceedings for 1905, p. 292. Its distinctness from that species was brought to my attention by Mrs. Bryan, for whom it is named. It has been compared with a long series of

T. scobinata, from the Loochoo Islands, various East Indian localities, and the Fijis.

A section *Scutarcopagia*, with *T. scobinata* as type, may be formed for the Arcopagiae having scaly or granose sculpture.

Tellina exculpta hawaiiensis n. subsp.

Honolulu Harbor, Oahu, Bryan. Midway Isl., Mrs. D. Morrison. Ocean Island, Capt. J. H. Brown.

Differs from typical *T. exculpta* by having the thread-like striæ of both valves continuous over the posterior end, not interrupted in front of the posterior ridge and weakened behind it, as in *exculpta*. The posterior end is also a little wider.

Length 48.3, height 20.3, diam. 10.5 mm.

Codakia thaanumi n. sp. Pl. XXII, fig. 9.

Hilo, Hawaii. Type No. 115958, A. N. S. P., collected by Mr. D. Thaanum.

The shell is subcircular, rather convex, the diameter over half the height; white. Sculpture of unequal rounded radial ribs. On the anterior slope these ribs are narrower than their intervals; on the median segment they are decidedly wider; and at the posterior end, they abruptly become much smaller. There are 38 ribs exclusive of the fine posterior group. Over all there are fine, obtuse, subregular concentric threads, and a number of impressions denoting growth-arrest. The beaks are moderately prominent. The lunule is cordiform, small, and rather deeply impressed. The interior is white, tinted with sulphur yellow at the adductor scars; the tooth-plate and pallial line straw yellow. It has either very few or rather numerous punctures in the cavity. Teeth are substantially as in *C. punctata* (L.).

Length 53, alt. 52.5, diam. 28.3 mm.

This handsome clam is somewhat related to *C. punctata* (L.), from which it differs by the greater convexity and by the stronger, narrower ribs. It is also relatively higher, with more prominent beaks.

Some specimens have the whole interior sulphur yellow.

EXPLANATION OF PLATES XX, XXI, XXII.

PLATE XX. *Ostrea bryani*, n. sp. External and internal views of the valves of the holotype.

PLATE XXI.—Fig. 1. *Ostrea hanleyana* Sowerby. Mokuoloe Island, Kaneohe Bay.

Figs. 2, 3.—*Ostrea retusa* Sowerby. East of Waipio, Oahu. Two views of the same specimen, a lower valve growing upon an upper.

Figs. 4, 5.—*Ostrea sandwicensis* Sowerby. Eastern Loch of Pearl Harbor, No. 116680.

Figs. 6, 7.—*Ostrea sandwicensis*. External and internal views of a specimen from Ford's Island.

Fig. 8.—*Ostrea sandwicensis* growing on *Trochus sandwicensis*. Ford's Island, Pearl Harbor.

Fig. 9.—*Ostrea sandwicensis margaritæ*. Ford's Island, Pearl Harbor.

PLATE XXII.—Figs. 1, 2. *Strombus hawaiiensis* n. sp. Two views of the type. Pearl and Hermes Reef.

Fig. 3.—*Turbonilla vitiensis clavus* n. subsp. Viti Is.

Fig. 4.—*Turbonilla vitiensis* n. sp. Viti Is. No. 20046, A. N. S. P.

Figs. 5, 6, 7.—*Turbonilla varicosa* A. Ad. Honolulu.

Fig. 8.—*Tellina elizabethæ* n. sp. Flint Island.

Fig. 9.—*Codakia thaanumi* n. sp. Hilo, Hawaii.

POLARIZATION AND COLOR EFFECTS EXHIBITED BY CERTAIN DIATOMS.

F. J. KEELEY.

The June, 1917, issue of the *Journal of the Royal Microscopical Society*, reprints a paper by E. M. Nelson, describing polarizing effects shown by certain diatoms, in which the suggestion is made that "it may be that silex deposited by animals does not exhibit polariscope effects, while that deposited by plants, such as diatoms, will do so." Hence a satisfactory explanation of this effect seems desirable.

When plane polarized light impinges on the surface of a transparent isotropic substance so oriented as to be neither parallel nor normal to the plane of polarization, each ray is, to a greater or less extent, resolved into two polarized rays, vibrating parallel and normal to the plane of incidence, transmitted and reflected respectively. If the angle of incidence happens to correspond to the angle of maximum polarization of the reflecting substance, the effect will be almost complete, but only partial at other angles. Such reflected and refracted rays, therefore, vibrate in planes different from that of the original polarized light and would pass through an analyzer placed at right angle to the polarizer.

In using a polarizing microscope arranged to illuminate the object with parallel rays and an objective of small aperture, there is little chance of such reflected or refracted rays entering into the formation of the image, and isotropic substances appear dark between crossed prisms no matter what their shape, but the arrangement described by Mr. Nelson includes a condenser above the polarizer and an objective of fairly wide aperture, .5 N. A., under which conditions, rays reflected up to the maximum polarizing angle or their refracted components, may be transmitted through the objective, and the corresponding structural elements of the object will appear bright on a dark field, or modify the field color if a selenite film is interposed. The structure of diatoms and other minute silicious organisms is now sufficiently well understood to render it apparent that the innumerable surfaces capable of reflecting light, amply account for the polarizing effects noted, and, when illuminated under the described conditions, all diatoms, radiolaria, sponge spicules, powdered

glass, or even the surface of a ground glass plate, will show bright polarization, provided they are mounted dry or in a medium of high refractive index such as realgar. When in balsam, or other media approximating their own index, the reflections are nearly or quite eliminated and most such objects become invisible, although some of the thicker polycystina and diatoms may still appear faintly contrasted with the black background, but Mr. Nelson calls attention to the interesting fact that there are certain species of diatoms that show almost equally brilliant polarizing effects when mounted in balsam.

In 1901, there was published in these PROCEEDINGS, a short communication by me, relating the results obtained from the examination of a series of diatoms in media of various refractive indices, which demonstrated that the secondary structure of certain species of *Aulacodiscus* differed from that of most diatoms by remaining equally distinct in all media, including a liquid with refractive index 1.42 to 1.43, in which diatoms generally became practically invisible. This structure has the appearance of fine granules arranged uniformly, but not symmetrically, between the larger cells constituting the primary structure, instead of over or under the latter as is the case with the perforated plates forming the secondary structure of most species of *Coscinodiscus*, *Triceratium* and many of *Aulacodiscus*. It is exhibited most distinctly by *Aulacodiscus formosus*, on which it can be well shown with a half inch of .60 N. A., but is present on many species of this genus, including *argus*, *rogersii*, *oregonus*, etc.; and is well displayed in a photograph of *A. sturtii* used as one of the illustrations in recent editions of Carpenter, "The Microscope and its Revelations." It may be accounted for by various hypotheses, among which, by a process of elimination, the most satisfying is to assume that the apparent granules are hermetically closed cavities, impenetrable by any medium in which the diatom is immersed.

It will be found that almost all the diatoms which exhibit bright polarization when mounted in balsam, are included in the species having this secondary structure, and, as it is not penetrated by the balsam, the same explanation will apply as to dry mounted forms.

Mr. Nelson specially mentions *Auliscus oamaruensis* as giving a most charming image with polarized light, and it is likewise one of the best forms available for elucidating the subject. This was one of the species which I formerly studied sectionally, and the markings consist of slender tubes penetrating an unusually thick silicious plate. It was not included among those examined in media of

different refractive indices, but its appearance under high powers indicates that the tubules are not penetrated by the mounting medium. Its most important characteristic for the present purpose is that the markings do not extend throughout the valve but are confined to curved bands with clear interspaces and a large area of clear silica in the center. On examination with polarized light, using the highest power and aperture objective that will stand dark field illumination without halation, which in my experience, is a 4 mm. of .65 N. A., it will be noted that the polarizing effect is confined strictly to the tubular markings, while the interspaces and central area remain dark, indicating that the silica, itself, is entirely devoid of polarizing action.

Probably everyone who has mounted many slides of selected and arranged diatoms, has at times been annoyed to find that the gelatine fixative has sealed up some of the cellular structure of the diatoms, preventing penetration by the mounting medium and producing unsightly patches. However unsightly, they become interesting with polarized light as the manner in which the air filled cells light up, while the remainder of the valve is practically invisible, can leave no doubt in the mind of the observer as to the cause of the polarization effect. This was particularly noticeable on an arranged group of marine diatoms from California, which on completion, I regarded as greatly impaired by the manner in which the central portion of several valves of *Hyalodiscus maximus* had been rendered semi-opaque by the gelatine preventing complete penetration of the balsam. With polarized light, the minute air filled cells closely resembled, except in their symmetrical arrangement, the corresponding assumedly air filled cells of the secondary structure of *Aulacodiscus formosus*. A similar condition seems to exist naturally in *Hyalodiscus subtilis*, in which the so called umbilicus contains markings like the margin, but being impenetrable to balsam, remains comparatively dark when mounted in that medium, while the outer zone becomes very transparent. It is hardly necessary to add, that the central space reacts with polarized light.

Microscopists accustomed to the employment of polarized light for the purpose of determining whether a substance is isotropic or doubly refracting, have long been familiar with the effects of reflection and refraction and the necessity of avoiding them by the use of parallel illumination and mounting media of similar refraction to the material examined. In this explanation, I have confined myself to phenomena connected with the effect of such reflection and

refraction on plane polarized light, but in an exhaustive treatment of the subject it would be necessary to further consider that plane polarized light, by internal total reflection or reflection from metallic surfaces, at certain angles, may become circularly or elliptically polarized, and in this form pass through the analyzing prism. This may account for the fact that light reflected from the edge of a tin foil cell, used by some preparers in mounting selected diatoms, will appear bright between crossed prisms except where such edge is parallel to the axis of either prism.

In the communication referred to above, I mentioned that some of the species of *Aulacodiscus* with the peculiar secondary structure, exhibited bright colors with ordinary transmitted light, which I was then unable to account for, but which I would now suggest may be due to optical resonance. The group of phenomena classed under this head, includes the scattering of light by particles or molecules in the atmosphere, causing the blue color of the sky, and similar but not identical effects produced by minute particles embedded in or deposited on the surface of solids. The latter phase of the subject has been extensively studied in connection with the so called "ultra microscopy" and it is unnecessary to give details here beyond stating that one of the methods of illustrating it consists of distributing minute globules of gold on a glass surface by means of electrical discharges from the end of a gold wire. Such films reflect various colors according to the size of the particles and transmit the complementary color.

Some years ago, Mr. T. C. Palmer called my attention to the possibility of depositing thin films of gold from a solution of its chloride in collodion, and gave me some of the prepared solution, with which I experimented in depositing the gold on various organic structures with the view of their elucidation, but found the film too coarsely granular to be generally satisfactory. The films, when deposited on glass, transmitted various colors, generally dark blue, and one in particular, after heating until the surface of the glass was fused, gives brilliant red and blue color effects by transmitted light, reflecting the complementary green and orange tints, due to optical resonance from the minute granules in which the metal was deposited. On examination under the microscope, the granular film shows a startling resemblance to the secondary structure of the group of *Aulacodisci* previously referred to, and suggests that the color shown by some of them with transmitted light may be due to the same cause. In most of these diatoms the structure is too coarse to

produce color by this means, merely giving them a more or less opaque or sometimes metallic appearance, but in such forms as *A. oregonus*, in which the structure is almost as fine as on the gold film described, fairly bright colors appear, generally a bronzy green by transmitted light, and the complementary color, pink, when illuminated from above, which is as it should be, if the color is due to optical resonance from the granules of the secondary structure.

But the diatoms that show by far the brightest colors by transmitted light, are certain species of *Actinocyclus*, notably *ralfsii*, in which, as far as I am aware, no secondary structure has hitherto been noted, yet if this theory was correct they should contain such a structure and, to account for the brighter colors, it should be finer than in any species of *Aulacodiscus*. On examination, this structure was readily found to be present and particularly visible in the central blank space and wedge shaped radial segments between the coarser cellular structure of *A. ralfsii*. It is extremely delicate and will afford an excellent test for the definition of wide aperture objectives, although after finding it with an oil immersion and selecting a well-marked valve, was able to see it distinctly with a well-corrected water immersion of about 1.00 N. A., and even with an exceptionally fine dry objective of slightly less aperture.

If it should prove that this structure in *Actinocyclus* has been previously seen by others (as is usually the case with all supposedly new observations with the microscope) it will not make the slightest difference in this connection, as it was entirely unsuspected and new to me, and being found, not by accident, but because its presence was indicated theoretically, it seems to furnish rather strong evidence in favor of the correctness of the theory. As in the case of *Aulacodiscus*, *Actinocyclus* shows complementary colors with transmitted and reflected light, and fairly bright polarizing effects when mounted in balsam. On examination in a fluid of about 1.43 refractive index, it remained visible and showed bright colors by transmitted light.

All the diatoms with this peculiar secondary structure which I have as yet examined in media of various refractive indices, show brighter, higher order colors as the refractive index is increased, although the structure itself shows no change in visibility, indicating that the internal structure is combined with surface irregularities that permit the index of the medium to modify the color in accordance with the change in wave length of light transmitted through it. A hypothetical view would be that the structure corresponds to that of a foam, both with respect to the internal closed cavities, and the external surface.

NOVEMBER 20.

HENRY SKINNER, M.D., in the Chair.

Forty-four persons present.

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

"Marine Mollusks of Hawaii, I-III," by Henry A. Pilsbry.

"Notes on Mexican Melanopli," by Morgan Hebard.

"Concerning Rafinesque's Précis des Découvertes Somnologiques," by David Starr Jordan.

"On a forgotten genus of sharks," by David Starr Jordan.

"The Myth of the ship-holder: Studies in Echeuis and Remora, I," by E. W. Gudger.

"New and little known Gastropoda from the Upper Cretaceous of Tennessee," by Bruce Wade.

"Colpichthys, Thirinops, and Austromeniida. New Genera of Atherinoid fishes from the New World," by Carl L. Hubbs.

The deaths of the following members were announced:

Henry P. Dixon.

William D. Winsor.

Amos Peaslee Brown, Ph.D.

The death of William Bullock Clark, a correspondent, was also announced.

PROFESSOR WILLIAM ALANSON BRYAN made a communication entitled "A Diplomatic Adventure of a Naturalist on a Pacific Island." (No abstract.)

The following were elected members:

Henry D. Moore.

E. M. Wistar.

George B. Evans.

Thomas Skelton Harrison.

Effingham B. Morris, Jr.

Milton Campbell.

Philip A. Castner.

William B. Linn.

Charles M. Rainsford.

John Frederick Lewis.

Marshall S. Morgan.

George Barrie.

J. W. Green.

David B. Shepp.

Samuel W. Cooper.

John Dickey, Jr.

Charles J. Bender.

John D. Mellhenny.

J. Leslie Davis, M.D.

C. Herbert Bell.

A. Van Rensselaer.

A. Robinson McIlvaine.

John J. Boericke.

Ellis D. Williams.

Gideon Boericke.

Felix A. Boericke, M.D.

Eldridge R. Johnson.

William H. Morris.

A. Clayton Woodman.

Ellis Pusey Passmore.

George E. Earnshaw.

William B. Read.

DECEMBER 18.

HENRY SKINNER, M.D., in the Chair.

Thirty-four persons present.

The Publication Committee reported the reception of the following papers:

“The Marine Mollusks of Hawaii, III-VII,” by Henry A. Pilsbry.

“Polarization and Color Effects exhibited by certain Diatoms,” by F. J. Keeley.

The following annual reports were ordered to be printed:

REPORT OF THE RECORDING SECRETARY.

The Recording Secretary respectfully reports that late in September, he was disabled by an affection of the right side which has reduced him to a passive administration of the affairs of his offices of Recording Secretary and Librarian, the active duties of the position being performed by the Assistant Librarian, William J. Fox.

The Secretary, in the hope of being able to resume the duties of his offices with the opening of the New Year, has been sustained by the sympathy of the President and the other administrators of the Academy, to whom, and to other friends, he returns his sincere thanks.

The following report, and that of the Librarian, have been prepared by Mr. Fox, whose efficiency is cordially recognized by the Secretary and Librarian.

Acknowledgment is also made to Dr. J. Percy Moore and Dr. Philip P. Calvert for services at the meetings of the Academy and Council.

Meetings were held on December 16, 1916, January 16, February 20, March 20, April 17, June 12, and November 20, 1917. Communications were made by William E. Hughes, Mrs. Arthur R. Iliff, John G. Rothermel, Philip P. Calvert, and William Alanson Bryan.

Twenty-three papers have been presented for publication as follows: E. Caziot (translated by William H. Dall), 1; Henry W. Fowler and Emmett Reid Dunn, 1; Henry A. Pilsbry and Amos P. Brown, 1; Junius Henderson and L. E. Daniels, 1; Henry A. Pilsbry, 4; E. G. Vanatta, 1; Harold Heath, 1; Henry A. Pilsbry and J. H. Ferriss, 1; Henry W. Fowler, 2; Henry A. Pilsbry and Charles W. Johnson, 1; Henry L. Viereck, 1; Witmer Stone, 1; Morgan Hebard, 2; David Starr Jordan, 2; E. W. Gudger, 1; Bruce Wade, 1; Carl L. Hubbs, 1.

Seventeen of these papers have been published (and one is in course of publication) in the PROCEEDINGS, one has been accepted for publication in the JOURNAL, two have been referred to other sources of publication, and two have been returned to the authors.

Six hundred and thirty-two pages of the PROCEEDINGS, with thirty-six plates, have been issued.

The American Entomological Society (the Entomological Section of the Academy) has published four hundred and eighty-nine pages,

with thirty-four plates, of its TRANSACTIONS; two hundred and eighty-four pages, with ten plates, of MEMOIRS; and five hundred and seven pages, with thirty-one plates, of the ENTOMOLOGICAL NEWS.

One hundred and forty-three pages, with twenty plates, have been issued of the MANUAL OF CONCHOLOGY.

The total number of pages is two thousand and fifty-five, and 131 plates, being an increase of 130 pages and twenty-two plates over last year.

One hundred and two members and one correspondent have been elected. Fourteen deaths have been announced. Resignations have been received from Warren M. Foote, Theodore Brooks, and Walter Sonneberg. Five were dropped from the roll.

The increase in new members is due to the activities of the Committee on Membership and Endowment. The financial results of the campaign of this committee will, no doubt, be referred to in the Treasurer's report.

The special appointments of the Council are as follows: The Standing Committees, the Councillor, the Curator of the William S. Vaux Collections, and the Custodian of the Lea Collections. In addition, there were appointed a Committee of Council on By-Laws, and a Committee on Correspondents.

The Hayden Memorial Geological Award, a gold medal, for the best work of a geologist or a paleontologist, was conferred on Professor William Morris Davis, of Harvard University.

A meeting of the American Society of Ichthyologists and Herpetologists was held in the lecture hall in March.

The Ludwick Institute Free Lecture Courses were given at the Academy on Mondays and Fridays, January 8 to April 23, by Witmer Stone, B. Franklin Royer, Henry Skinner, Spencer Trotter, and Henry A. Pilsbry. Ten lectures on the natural history of Philadelphia and vicinity, especially adapted to school children, were given by Messrs. Stone, Moore, Pilsbry, and Skinner, of the Academy staff.

EDWARD J. NOLAN, *Recording Secretary.*

REPORT OF THE CORRESPONDING SECRETARY.

The volume of incoming correspondence, which is somewhat of an index of scientific activity abroad, fell during the past year to a point where it was barely one-third of the receipts of the years immediately preceding the war.

William Morris Davis, the recipient of the last Hayden Medal, was elected a correspondent and Émile Henri Sauvage and William Bullock Clark, correspondents, died.

No international scientific congresses were held and no invitations whatever to participate in important scientific activities were received by the Corresponding Secretary.

Thanks were received from the University of Pennsylvania Chapter of the Society of the Sigma Xi and the American Society of Ichthyologists and Herpetologists for courtesies received in connection with their meetings held in the Academy's building.

Considerable scientific information was furnished to inquiring correspondents.

Statistics of the correspondence follow:

Communications received:

Acknowledging the receipt of the Academy's publications.....	149
Transmitting publications to the Academy.....	24
Requesting exchanges or the supply of deficiencies.....	2
Invitations to learned gatherings, celebrations, etc.....	0
Notices of deaths of scientific men.....	1
Circulars concerning the administration of scientific and educational institutions, etc.....	13
Photographs and biographies of correspondents.....	4
Letters from correspondents.....	6
Miscellaneous letters.....	58
Total received.....	257

Communications forwarded:

Acknowledging gifts to the library.....	1069
Requesting the supply of deficiencies.....	147
Acknowledging gifts to the museum.....	123
Acknowledging photographs and biographies.....	2
Letters of sympathy or congratulation, addresses, etc.....	1
Diplomas and notices of election of correspondents and delegates' credentials.....	1
Miscellaneous letters.....	107
Annual reports and circulars sent to correspondents.....	180
Total forwarded.....	1,630

Respectfully submitted,

J. PERCY MOORE, *Corresponding Secretary.*

REPORT OF THE LIBRARIAN.

The Librarian has stated in the report of the Recording Secretary that he has been compelled by a disabling affection since last September to depend on the Assistant Librarian, William J. Fox, for the performance of the duties of both offices, a service which he has

performed with efficiency and accuracy. The statistics which follow have been prepared by Mr. Fox. It is hoped the Librarian will be able to resume his services in the Academy at the beginning of the year.

Total additions, 5,902. 569 were volumes, 5,185 were pamphlets and parts of periodicals, and 147 were maps, and 1 sheet.

They were received from the following sources:

Exchanges	2,541	War Department.....	5
Isaiah V. Williamson Fund	1,190	Edward J. Nolan	5
Estate of Benjamin Sharp.....	750	American Iron and Steel Institute	5
United States Department of Agriculture	581	Lowell Observatory.....	5
General Appropriation for purchase of books	97	Publication Committee of the Academy.....	5
Authors	78	Nela Research Laboratory.....	5
American Entomological Society	73	Samuel G. Gordon	5
Editors	71	Mrs. Samuel R. Shipley	5
United States Bureau of Education	65	University of Michigan.....	5
Library of Congress	43	Queensland Department of Mines	4
Illinois State Geological Survey	43	Commissioners of Fisheries and Game, Mass.....	4
James Aitken Meigs Fund	25	Scripps Institute for Biological Research	4
Imperial Department of Agriculture of the British West Indies	25	Imperial Geological Survey of Japan	4
Pennsylvania Department of Agriculture	24	Clarence B. Moore	4
Thomas B. Wilson Fund	22	New Jersey Department of Conservation and Development ..	3
Secretaria de Fomento, Mexico	22	Indiana University	3
Oklahoma Geological Survey	22	Danish Government	3
New York Agricultural Experiment Station	18	Colorado Museum of Natural History	3
Dr. Henry Skinner	14	Commission of Conservation, Canada.....	3
Pennsylvania Department of Health	14	Michigan Geological and Biological Survey	3
Scientific Society of San Antonio	13	Henry A. Pilsbry	3
California State Commission of Horticulture	12	California Fish and Game Commission	3
Illinois State Geological Survey	12	University of Tennessee.....	3
Pan-American Union	12	Bermuda Biological Station for Research	3
Frank J. Keeley	11	San Diego Society of Natural History	2
Pennsylvania State Library	10	Cuerpo de Ingenieros de Minas del Peru	2
Vermont Agricultural Experiment Station	9	Geological Survey of Alabama..	2
Trustees of the British Museum	9	Wistar Institute of Anatomy and Biology	2
Comissão de Linhas Telegraficas Estrategicas de Matto Grosso ao Amazonas... ..	9	Henry Tucker	2
David Jayne Bullock.....	9	Department of Trade and Customs, Australia.....	2
United States Department of the Interior	8	Delaware Valley Ornithological Club.....	2
United Department of Commerce and Labor.....	7	Argentine Government.....	2
Nova Scotia Department of Agriculture	7	William J. Fox.....	2
University of Wyoming.....	6		
George Vaux, Jr.	6		

South Dakota State College of Agriculture.....	2	Zoological Society of Philadelphia	1
Department of Marine and Fisheries, Ottawa.....	1	Charles M. Burns.....	1
Washington Academy of Sciences	1	Coleman Sellers, Jr.....	1
Iowa Geological Survey	1	Witmer Stone	1
Pennsylvania Water Supply Commission	1	Government of India	1
The Southwest Museum	1	Government of Formosa.....	1
Department of Fisheries of Bengal, etc.....	1	Justus Perthes' Geographische Anstalt	1
Mississippi State Geological Survey	1	Geological Survey of Georgia	1
Boston City Hospital	1	Westwood Astrophysical Observatory	1
Observatorio de Madrid	1	North Carolina Geological and Economic Survey.....	1
Western Reserve University	1	Warren Academy of Sciences	1
Henry Fairfield Osborn	1	Board of Water Supply, New York City	1
George M. Greene	1	Game Commissioners of Pennsylvania	1
Pennsylvania Department of Forestry	1	Charles W. Richmond	1
United States Brewers' Association	1	Thornwall Museum	1
Delaware County Institute of Science	1	Carl Hering	1
		Estacion Sismologica de Cartuja	1

These additions have been distributed to the various departments of the library as follows:

Journals.....	3,434	Physical Sciences.....	34
Agriculture.....	768	Ichthyology	32
Geology	409	Mammalogy	23
Entomology	252	Medicine	19
Anatomy and Physiology	203	Voyages and Travels.....	19
General Natural History	134	Mathematics	14
Geography	130	Chemistry	13
Botany	82	Herpetology	11
Helminthology	75	Mineralogy	9
Conchology	71	Bibliography	5
Anthropology.....	63	Philology	1
Ornithology	38	Miscellaneous	63

Some of the more important works received are:

- Mededeelingen van de Rijksopsporing van Delfstoffen. Holland.
 Thorburn, A. British Birds. 4 vols.
 Bateman, J. The Orchidaceae of Mexico and Guatemala. Folio. 1843.
 Aristotle. Totius Naturalis Philosophiæ in Physicam Aristotelis Epitome, etc Hieronymo Vuilkenbergio Aurimontano autore. 1544.
 Rafinesque, C. S. Analyse de la Nature. 1815.
 Reichenbach, H. G. L. Zoologie oder Naturgeschichte des Thierreichs. 2 vols. in one. Dresden, etc. 1828-36.
 Paleontographica Americana.

The following journals are new to the collection:

- Abstracts of Bacteriology. Baltimore.
 Annales du Service des Epiphyties.
 Association of American Geographers, Annals.
 Bermuda Biological Station for Research, Contributions. Cambridge
 British Mycological Society, Transactions.
 Bulletin Biologique de la France et de la Belgique. Paris.

Department of Agriculture, Ceylon. Leaflet.
 Dublin Quarterly Journal of Science.
 Entomological Society of Nova Scotia, Proceedings.
 Genetics. Princeton.
 Institut Colonial de Marseille. Bulletin.
 Junta de Ciencias Naturals, Barcelona. Series Biologico-Oceanografica: Series Botanica; Series Zoologica.
 Magasin Encyclopédique. 122 vols. 1795-1816.
 Nova Scotia Department of Agriculture, Bulletin.
 Osborn Botanical Laboratory, Yale University, Contributions.
 Midland Naturalist (London). 16 vols. 1878-1893.
 Rivista Italiana di Speleologia. Bologna.
 Royal Society of Western Australia, Journal and Proceedings.
 Revue Zoologique Russe. Moscow.
 Scientific Society of San Antonio, Bulletin.
 Secretaria de Fomento, etc. Mexico, Boletin Oficial.
 Sutton and Sons, Bulletin. Reading, England.
 University of Michigan Museum of Zoology, Miscellaneous Publications.
 Westwood Astrophysical Observatory, Occasional Scientific Papers.

Sixty-five works in seventy-one volumes have been loaned. 1146 works in 1678 volumes have been used by the attachees in connection with their studies.

Five hundred and seventy-three volumes have been bound.

Mr. Furman S. Wilde, Assistant in the Library, has been serving in the National Army since November 3, 1917.

Miss H. N. Wardle has kindly rendered efficient aid as caretaker of the Library during the Assistant Librarian's absence.

EDWARD J. NOLAN, *Librarian.*

REPORT OF THE CURATORS.

The Curators, at the close of the present year, are able to report the collections and buildings in their care, in excellent condition. The museum staff has been constantly employed in the study, arrangement, and display of the collections in the various departments as described in detail below.

Most of this work has consisted in carrying out the arrangement of material in the new study and exhibition cases, as outlined in last year's report, but much new material has also been cared for.

At the session of the State Legislature, which closed early in the past summer, an appropriation of \$15,000 was made for the needs of the Academy. From this fund it was possible to paint the entire outside wood and iron work of the building, which was much in need of attention. Plans have been prepared for necessary alterations in the heating plant, which will be carried out at once. The consideration of other improvements made possible by this appropria-

tion has been temporarily postponed owing to the illness of the President and Executive Curator, Dr. Samuel G. Dixon.

The attendance of visitors, both the general public and the classes of school children from the city and nearby towns, has been large, and the educational importance of the museum is constantly increasing.

In field work, Mr. Clarence B. Moore has continued his explorations among the Indian mounds of the Southern States. Mr. J. A. G. Rehn, through the liberality of Mr. Morgan Hebard, was enabled to join him on an entomological trip of several weeks in central Florida and northern Georgia, the Academy sharing in the material collected. Dr. Stone received leave of absence for several weeks during the spring and summer, and collected considerable botanical and entomological material for the Academy in central South Carolina and southern New Jersey, and local field work was carried on by various members of the staff. While the Academy sent out no expeditions during the year, several valuable collections of mollusks, birds, fishes and insects were obtained by purchase.

Details of work in the several departments follow:

MAMMALS.

Many osteological preparations have been made by the taxidermist from material received from the Zoological Society of Philadelphia, which are ready to be placed in the study series, and a number of specimens from the same source, as well as two sea lions from the Philadelphia Aquarium, have been prepared as skins. Material has been loaned to Dr. J. A. Allen.

BIRDS.

By removing a number of duplicates from the general exhibition collection of birds, space was secured for the display of a large part of the groups of North American birds recently received from Mr. Geo. B. Benners, an exhibit which has attracted much attention. During the spring the services of Miss Emma P. Merriek were secured as an aid in the ornithological department, and with her help, Dr. Stone was enabled to make a great advance in the arrangement of the study series of birds.

The entire series of hummingbirds were examined and many of the specimens made over, while all were identified and relabeled. The Jewel collection and the Rhoads Guatemala collections were

also identified and relabeled, and together with the Carriker collection of Colombian birds, were distributed through the study series, and 1,173 specimens were catalogued.

The entire collection of birds eggs has been carefully cleansed and all the North American specimens placed in uniform glass-covered boxes secured for the purpose. In these they are absolutely protected and present a very handsome appearance.

Several important accessions have been received, notably the collection of bird skins of the late Samuel Wright, presented by Mrs. Wright; the Charles J. Pennock collection of eggs and skins, presented by Mrs. Pennock; and collections of Colombian birds and of Hummingbirds obtained by purchase. A number of visiting ornithologists have made use of the collections during the year and specimens have been loaned to J. E. Law, and W. E. Clyde Todd.

REPTILES AND BATRACHIANS.

Mr. Henry W. Fowler has had charge of this department and has looked after the welfare of the specimens along with those of the ichthyological department. 200 specimens have been catalogued, representing part of the material received during the year. A number of West Indian reptiles have been loaned to Dr. Thomas Barbour, of the Museum of Comparative Zoology, who is studying them critically and redetermining them while a series of African reptiles has been borrowed by the American Museum of Natural History. Mr. G. K. Noble visited the Museum in the summer and made use of the collections while Mr. E. R. Dunn has studied certain of the Salamanders and in conjunction with Mr. Fowler, has prepared a paper upon them.

During the summer Dr. Stone and the Taxidermist, Mr. McCadden, made experiments in preparing casts of local reptiles for exhibition and material was obtained for several groups of turtles and toads. Specimens were loaned to Dr. Thos. Barbour, G. K. Noble, Mary C. Dickerson and Karl P. Schmidt.

FISHES.

Mr. Fowler reports large accessions to the ichthyological collections, of which 1,134 have been catalogued. He has identified a collection of Philippine fishes for the Philadelphia Commercial Museum, in return for which the Academy has received a valuable series of specimens, while in the same way he has secured from the Museum of Comparative Zoology, a series of cyprinoid fishes from

India. The Academy is again especially indebted to Messrs. E. S. and W. I. Mattern, who have presented collections of local fishes from various parts of Pennsylvania and New Jersey, aggregating 5,000 specimens. On March 8, the second meeting of the American Society of Ichthyologists and Herpetologists was held at the Academy, which brought together specialists in these fields from various parts of the country and proved in every way most successful.

Three papers dealing with the collections were published by Mr. Fowler during the year. Specimens were loaned to Dr. C. H. Eigenmann.

MOLLUSKS.

Dr. Henry A. Pilsbry, Special Curator of Mollusks, states that specimens have been received from 82 persons and institutions since the last report. Among other valuable gifts were large accessions to the collection of Hawaiian Mollusca, received from Mr. D. Thaanum, of Hilo, Hawaii, and from Prof. and Mrs. W. A. Bryan, of Honolulu, who spent several months at the Academy studying the collections. Also the important Rocky Mountain and California material from Prof. Junius Henderson and Mr. Jas. H. Ferriss.

New cases installed last year have permitted the expansion and rearrangement of the whole study series of shells, which is now in excellent order.

Dr. Pilsbry has completed the first volume of the "Monograph of the Pupillidae," begun last year, the final number being now in press. He has also published three papers on the anatomy of West American snails, and in collaboration with Mr. Ferriss, a study of the mollusks of the Black Range, New Mexico. Also papers on Hawaiian marine shells.

Mr. Vanatta has been occupied with labeling and arranging accessions to the collection and in determining specimens for correspondents. Miss Ziegler has made good progress in the long task of cataloguing the collection of shells.

The collection has been extensively used by visiting naturalists. Specimens have been loaned to Dr. Paul Bartsch, Prof. A. E. Verrill and E. P. Chase.

INSECTS.

In the department of Entomology, Dr. Henry Skinner reports that during the year, two thousand three hundred and eighty-six insects have been received, and the greater part of them has been relaxed, mounted and placed in the cabinets.

The usual care has been devoted to the preservation of the collections and a considerable amount of rearrangement in the new metal cases carried into effect. In the Coleoptera the family Cerambycidae has been rearranged in its entirety. The Silphidae, Scydmænidæ and Pselaphidæ have also been rearranged.

In the Lepidoptera the genus *Argynnis* has been rearranged, and many additional specimens added. Some work has also been done on the exotic species. Mr. R. C. Williams, Jr., arranged the Lycænidæ according to his studies of the genitalia of the family.

In the Diptera, Mr. E. T. Cresson, Jr., has continued his systematic studies of the family Ephydridæ, and has also determined and rearranged the Sciomyzidæ and Sarcophagidæ.

In the Orthoptera, Mr. J. A. G. Rehn has continued the rearrangement of the specimens in the new type of large glass-covered boxes, and the work has been nearly completed. Numerous small collections have been mounted, labeled, and stored. A report on extensive Brazilian collections has been completed, as well as a study of the genus *Mermiria* both of which will be published as soon as the illustrations are completed. Numerous specimens have been determined for correspondents.

Mr. Morgan Hebard has spent most of his time at the Museum during the year and in the course of his studies on his various collections, has presented much valuable material to the Academy. His expedition to Florida and Georgia, already referred to, was productive of collections of much importance. Many visiting entomologists have studied the collections of insects during the year and specimens have been loaned to Jas. S. Hine, G. C. Crampton and W. T. Davis.

VERTEBRATE FOSSILS.

The collections of vertebrate fossils have been removed to the new series of cases provided for them last year. The main collections are arranged in trays in the storage closets under the cases, while a representative series has been selected from them for exhibition. The mammals and birds have been arranged by Mr. Rehn, the reptiles and fishes by Mr. Fowler. Mr. Rehn has also compiled extensive data from which comprehensive labels will be prepared, describing the exhibition for the benefit of the public.

INVERTEBRATE FOSSILS.

Accessions to this department have not been large during the past year. Dr. Pilsbry and the late Prof. Amos P. Brown have published

a paper describing a small, but valuable lot of fossils from Colombia, given by Mr. Lloyd B. Smith. A preliminary report on Santo Domingo fossils by Dr. Pilsbry and Mr. C. W. Johnson, has also been published.

HERBARIUM.

Mr. Stewardson Brown, who has been able to again take active control of the herbarium, spending every other day at the Museum, reports much progress in the work in this department.

During the year Miss Ada Allen has mounted 3,388 sheets of plants, which have been catalogued and distributed in the general herbarium by Mr. Brown, while Mr. S. S. Van Pelt, who has continued his voluntary services during the year, has mounted 2,400 sheets for the local herbarium.

Mr. Brown has studied and identified the collections made in California by Dr. Witmer Stone, and in New Mexico by Dr. Henry A. Pilsbry during 1915, and has also prepared for distribution to the New York Botanical Garden, St. Louis Botanical Garden, Gray Herbarium and U. S. National Herbarium, 1,723 duplicate specimens, in return for valuable accessions received from these institutions.

Mr. Van Pelt has rearranged nearly the entire Porter collection, placing the specimens in systematic order so that they are readily accessible, while he and Mr. Bayard Long have critically studied certain families and separated out the local material, much of which has been mounted. Mr. Long has continued his voluntary care of the local herbarium.

Dr. J. C. Arthur and Mr. C. L. Shear spent a week in the study of the deSchweinitz cryptogamic herbarium and rearranged much of it, giving the Academy the benefit of their expert knowledge of these obscure plants.

Specimens have been loaned to Prof. M. L. Fernald, W. W. Eggleston, Francis J. Pennell, C. V. Piper, Mrs. Agnes Chase and Prof. A. S. Hitchcock.

MINERALS AND ROCKS.

Mr. Samuel G. Gordon, a student on the Jessup Fund, has continued to render excellent service in caring for the collections of minerals and rocks. During the year he has thoroughly cleansed and relabeled the collection of minerals deposited by the Franklin Institute and arranged them in the new cases in the mineral hall, part of them being placed on exhibition and the others in the study

collection. A number of small collections aggregating 6,000 specimens which have been stored in the basement were critically examined, specimens of value placed in the general series and the others packed away for disposal as duplicates.

On several field trips to northern New Jersey, Virginia, etc., Mr. Gordon secured a number of valuable rocks and minerals for the collection.

The arrangement of the William S. Vaux collection has been completed, and Mr. George M. Greene was employed to prepare new labels for the entire collection. This work was completed early in the year. Further labeling of groups, etc., has been done by Mr. Gordon.

ARCHEOLOGY.

Mr. Moore's field expedition during the first three months of 1916, made a re-investigation of aboriginal sites along the lower Mississippi River and in northwest Florida and Southern Alabama. The autumn expedition was devoted to the region of northwest Florida and southwest Georgia. The results of both expeditions being largely pottery, regarded as duplicate, proved the thoroughness of his earlier investigations. The collections of archaeological material in the museum have been partly rearranged during the year, by Miss H. N. Wardle, who has continued to care for the department and many specimens have been identified for visitors and correspondents.

A number of local collectors have consulted the collections during the year.

WITMER STONE *Chairman*,
SAMUEL G. DIXON,
HENRY A. PILSBRY,
HENRY TUCKER.

REPORT OF THE CURATOR OF THE WILLIAM S. VAUX COLLECTION.

Completion of re-labeling, during the early months of the year, has brought the William S. Vaux Collection into satisfactory condition.

Accessions during the year include ten specimens of meteorites and fifteen of minerals, acquired by purchase, and the following gifts:

Thaumasite, Paterson, N. J., and Cacoxenite, Hellertown, Pa., presented by Samuel G. Gordon; Stevensite, Paterson, N. J., and

Pectolite, Great Notch, N. J., presented by John Holzman; Babingtonite, Paterson, N. J., presented by R. A. Mercer; Beraunite, Hellertown, Pa., presented by Fred. Oldach; and Rutile, Rowlands-ville, Philadelphia, presented by Harry A. Warford.

Samuel G. Gordon has continued to give valuable assistance in caring for the collection.

Respectfully submitted,

F. J. KEELEY, *Curator Wm. S. Vaux Collection.*

REPORTS OF THE SECTIONS.

THE BIOLOGICAL AND MICROSCOPICAL SECTION.—The Biological and Microscopical Section held eight meetings during the year. The attendance and membership have increased.

The Conservator reports the gift of a Hartnaek microscope and more than eight hundred slides of Invertebrata from the estate of the late Dr. Benjamin Sharp. Some work has been done in the arrangement of the general collection of slides.

Numerous communications have been made by members including Messrs. T. C. Palmer, Hugo Bilgram, W. H. Van Sickle, Dr. Thomas S. Stewart, F. J. Keeley, J. G. Rothermel, S. L. Schumo, B. F. Ray, and C. S. Boyer.

The following officers were elected for the year 1918:

<i>Director</i>	J. Cheston Morris, M.D.
<i>Vice-Director</i>	T. Chalkley Palmer.
<i>Treasurer</i>	Thomas S. Stewart, M.D.
<i>Conservator</i>	F. J. Keeley.
<i>Recorder and Cor. Sec.</i>	Charles S. Boyer.

CHARLES S. BOYER, *Recorder.*

ENTOMOLOGICAL SECTION.—Six stated meetings were held during the year, with an average attendance of ten persons. Interesting communications were made by: Morgan Hebard, Philip P. Calvert, Henry Skinner, James A. G. Rehn, Philip Laurent, Roswell C. Williams, Jr., Ernest Baylis and Henry W. Fowler were elected contributors, and Charles W. Frost was elected a member. The death of W. D. Kearfott, a contributor, was announced. The purchase was made of a Bausch & Lomb Combined Balopticon, suitable for the projection of lantern slides and opaque objects.

The following officers and committee were elected to serve for 1918:

<i>Director</i>	Philip Laurent.
<i>Vice-Director</i>	R. C. Williams, Jr.
<i>Treasurer</i>	E. T. Cresson.
<i>Conservator</i>	Henry Skinner.
<i>Secretary</i>	J. A. G. Rehn.
<i>Recorder</i>	E. T. Cresson, Jr.
<i>Publication Committee</i>	E. T. Cresson, Philip P. Calvert, E. T. Cresson, Jr.

E. T. CRESSON, JR., *Recorder*.

BOTANICAL SECTION.—At the annual meeting of the Botanical Section, held November 19, 1917, officers for the ensuing year were elected as follows:

<i>Director</i>	Dr. Ida A. Keller.
<i>Vice-Director</i>	Joseph Crawford.
<i>Recorder</i>	Dr. John W. Eckfeldt.
<i>Conservator and Treasurer</i>	Stewardson Brown.

STEWARDSON BROWN, *Conservator*.

MINERALOGICAL AND GEOLOGICAL SECTION.—The Section held three meetings with the usual interested attendance. Prof. Florence Bascom discussed the Geology of Mt. Desert. Miss Emma Walter called attention to remarkable erosion of limestone near Devault. There was also discussion of isostasy and the Himalayas, and other subjects.

There were four field excursions, with an average attendance of about seventeen. The parties visited: 1. The crystalline rocks near Unionville and Northbrook, Chester County; 2. The crystalline rocks near Rocky Run and Dismal Run, Delaware County; 3. The Cambrian quartzites and the limestones between Westtown and Brinton's Bridge, Chester County; 4. The limestone exposures between Devault and Malvern, Chester County.

The following were elected officers of the Section for 1918:

<i>Director</i>	Benjamin Smith Lyman.
<i>Vice-Director</i>	F. J. Keeley.
<i>Recorder and Secretary</i>	W. B. Davis
<i>Treasurer</i>	W. B. Davis.
<i>Conservator</i>	F. J. Keeley.

BENJAMIN SMITH LYMAN, *Director*.

ORNITHOLOGICAL SECTION.—The Section has been active in promoting Ornithological research at the Academy during the year. The Delaware Valley Ornithological Club and the Pennsylvania Audubon Society have continued to hold their meetings in the building and many valuable specimens have been received through the coöperation of these organizations.

The details of work in the Ornithological department will be found in the report of the Curators.

At the annual meeting the following officers were elected for the year 1918:

<i>Director</i>	Spencer Trotter, M.D.
<i>Vice-Director</i>	George Spencer Morris.
<i>Recorder</i>	Stewardson Brown.
<i>Secretary</i>	William A. Shryock.
<i>Treasurer and Conservator</i>	Witmer Stone.

WITMER STONE, *Conservator*.

The annual election of Officers, Councillors, and members of the Committee on Accounts, was held December 18 1917, with the following result:

PRESIDENT	Samuel G. Dixon, M.D., LL.D., Sc.D.
VICE-PRESIDENTS	Edwin G. Conklin, Ph.D., Sc.D. John Cadwalader, A.M.
RECORDING SECRETARY	Edward J. Nolan, M.D., Sc.D.
CORRESPONDING SECRETARY	J. Percy Moore, Ph.D.
TREASURER	George Vaux, Jr.
LIBRARIAN	Edward J. Nolan, M.D., Sc.D.
CURATORS	Samuel G. Dixon, M.D., LL.D., Sc.D. Henry A. Pilsbry, Sc.D., Witmer Stone, A.M., Sc.D., Henry Tucker, M.D.
COUNCILLORS TO SERVE THREE YEARS	Charles B. Penrose, M.D., Charles Morris, Spencer Trotter, M.D., William E. Hughes, M.D.
COUNCILLOR TO SERVE UN- EXPIRED TERM	T. Chalkley Palmer.
COMMITTEE ON ACCOUNTS	Charles Morris, Samuel N. Rhoads, John G. Rothermel, Thomas S. Stewart, M. D., Walter Horstmann.

COUNCIL FOR 1918.

Ex-Officio.—Samuel G. Dixon, M.D., LL.D., Sc.D., Edwin G. Conklin, Ph.D., Sc.D., John Cadwalader, A.M., Edward J. Nolan, M.D., Sc.D., J. Percy Moore, Ph.D., George Vaux, Jr., Henry A. Pilsbry, Sc.D., Witmer Stone, A.M., Sc.D., Henry Tucker, M.D.

To serve three years.—Charles B. Penrose, M.D., LL.D., Ph.D., Charles Morris, Spencer Trotter, M.D., William E. Hughes, M.D.

To serve two years.—Edwin S. Dixon, Henry Skinner, M.D., Sc.D., Robert G. LeConte, M.D., George Spencer Morris.

To serve one year.—Philip P. Calvert, Ph.D., Frank J. Keeley, Walter Horstmann, T. Chalkley Palmer.

COUNCILLOR	George Vaux, Jr.
CURATOR OF MOLLUSCA	Henry A. Pilsbry, Sc.D.
CURATOR OF WILLIAM S. VAUX COL- LECTIONS	Frank J. Keeley.
CUSTODIAN OF ISAAC LEA COLLECTION	Joseph Willecox.
ASSISTANT LIBRARIAN	William J. Fox.
ASSISTANTS TO CURATORS	Henry Skinner, M.D., Sc.D., Stewardson Brown, Edward G. Vanatta, Henry W. Fowler, James A. G. Rehn, Ezra T. Cresson, Jr.
ASSISTANT IN LIBRARY	Furman Sheppard Wilde.
AID IN ARCHÆOLOGY.....	Harriet Newell Wardle.
AID IN HERBARIUM	Ada Allen.
<i>Taxidermist</i>	David McCadden.
<i>Janitors</i>	Charles Clappier, Daniel Hechler, James Tague, Jacob Aebly, Adam E. Hechler.

STANDING COMMITTEES, 1918.

FINANCE.—Effingham B. Morris, John Cadwalader, A.M., Edwin S. Dixon, Walter Horstmann, and the Treasurer.

PUBLICATION.—Henry Skinner, M.D., Sc.D., Witmer Stone, A.M., Sc.D., Henry A. Pilsbry, Sc.D., William J. Fox, Edward J. Nolan, M.D., Sc.D.

LIBRARY.—Henry Tucker, M.D., George Vaux, Jr., Frank J. Keeley, Witmer Stone, A.M., Sc.D., Spencer Trotter, M.D.

INSTRUCTION AND LECTURES.—Henry Skinner, M.D., Sc.D., Henry A. Pilsbry, Sc.D., Charles Morris, James A. G. Rehn, George S. Morris.

ELECTIONS IN 1917.

The names of the members elected during 1917 will be found on pages 1, 31, 82, 149, 206, 339 and 340.

ADDITIONS TO THE MUSEUM.

1917.

MAMMALS.

BERNICE PAUANI BISHOP MUSEUM (for determination). Paratype of *Mus hawaiiensis* Stone, Hawaiian Islands.

H. W. FOWLER. Skull of Dolphin (*Delphinus delphis*), Riverton, New Jersey.

W. J. FOX. Skull of Dolphin (*Delphinus delphis*), Sea Isle City, New Jersey.

DAVID McCADDEN. Skeleton of Muskrat (*Ondatra zibethica*), Pennsylvania.

SAMUEL MASON. Five Rice Rats (*Oryzomys palustris*), Odessa, Delaware.

PENNSYLVANIA GAME COMMISSION. Skin of Mink (*Mustela vison lutrecephala*), Pennsylvania.

PHILADELPHIA AQUARIUM. Three Sea Lions (*Zolophus californianus*), Skins and skulls.

PURCHASED. Weasel (*Putorius noveboracensis*) in winter pelage, Westtown, Pennsylvania.

ARCHICLAUS P. WILLETS. Three House Mice (*Mus musculus*), New Jersey.

ZOOLOGICAL SOCIETY OF PHILADELPHIA. Specimens prepared as follows: Mounted: Chimpanzee (*Pan satyrus*), Hainan Gibbon (*Hylobates nasutus*). Skins and Skulls: White-crowned Monkey (*Lasiopyga petronella*), Brown Macaque (*Pithecus speciosus*), Black-handed Spider Monkey (*Ateles geoffroyi*), Jaguarundi Cat (*Felis jagouaroundi*), Raccoon-like Dog (*Canis procyonoides*), Philippine Deer (*Rusa alfredi*), Cape Hyrax (*Procavia capensis*), Patagonian Cavy (*Dolichotis patagonicus*), Great Anteater (*Myrmecophaga tridactyla*), Lund's Opossum (*Didelphys albiventris*), Opossum (*Didelphys* sp.). Skeletons: Black Rhinoceros (*Diceros bicornis*), South African Giraffe (*Giraffa camelopardalis capensis*), Eland (*Taurotragus oryx*). Skulls: Moustached Monkey (*Lasiopyga cephus*), Anubis Baboon (*Papio anubis*).

BIRDS.

GEORGE W. BASSETT. Sparrow Hawk (*Falco sparverius*), and four specimens of Evening Grosbeak (*Hesperiphona vespertina*), New Jersey.

MISS HELEN LOUISE COATES. Great Horned Owl (*Bubo virginianus*).

CHAS. FEARON. Cardinal Grosbeak (*Cardinalis cardinalis*).

T. HAMSON GIBSON. Horned Grebe (*Colymbus auritus*), Wildwood, N. J.

MUD HOLE GUN CLUB. Shoveller Duck (*Spatula clypeata*), New Jersey.

W. M. PACK. Yellow Rail (*Coturnicops noveboracensis*), Pennsylvania.

MRS. CHAS. J. PENNOCK. C. J. Pennock Collection of bird skins and eggs.

MISS TOWN. Small collection of birds' eggs.

DR. H. R. WHARTON. Snow Bunting (*Plectrophenax nivalis*) and Mallard (*Anas platyrhynchos*), Salem, New Jersey.

ARCHICLAUS P. WILLETS. Screech Owl (*Megascops asio*) and Red-winged Blackbird (*Agelaius phoeniceus*), New Jersey.

E. W. WOOLMAN. American Bittern (*Botaurus lentiginosus*), Philadelphia.

Mrs. SAMUEL WRIGHT. Collection of local bird skins, made by the late Samuel Wright.

ZOOLOGICAL SOCIETY OF PHILADELPHIA. Specimens prepared in the following manner: Mounted: Condor (*Sarcorhamphus gryphus*). Skins: Black-footed Penguin (*Spheniscus demersus*), Goliath Heron (*Ardea goliath*), Stanley Crane (*Tetrapteryx paradisea*), Helmeted Guinea-fowl (*Numida coronata*), Chattering Lory (*Lorius garrulus*), Blue-orbited Passerine Parrakeet (*Psittacula conspicillata*), White-crowned Turacou (*Turacus leucolophus*), Great Barbet (*Megalania viridis*), Great Bird of Paradise (*Paradisaea apoda*), Painted Bunting (*Passerina leucaucheri*), Tanager (*Schistochlamys capistratus*). Skull and Sternum: Wedge-tailed Eagle (*Aquila audax*).

BY PURCHASE. Three hundred specimens of Colombian Birds. Ninety-two specimens of Hummingbirds.

DELAWARE VALLEY ORNITHOLOGICAL CLUB. Six nests and eggs of Pennsylvania and New Jersey birds and four mounted birds.

REPTILES AND AMPHIBIANS.

ARTHUR A. BAUR. Portion of skin of Alligator (*Alligator* sp?), Guayaquil, Equador.

JACK DORSETT. Jar of reptiles and amphibians, North Carolina.

PHILIP LAURENT. Skink (*Eumeces* sp.), Florida.

BAYARD LONG. *Hyla picheringii*, New Jersey.

E. S. and W. I. MATTERN and H. W. FOWLER. Collection of amphibians, Pennsylvania.

S. N. RHOADS. Collection of reptiles and amphibians, Wilmington, N. C.

A. F. SATTERTHWAIT. Four Cricket Frogs (*Acris gryllus*), Charleston, Missouri. Three Frogs, near Charleston, Missouri.

DR. WITMER STONE. Collection of reptiles and amphibians, South Carolina. Collection of amphibians, New Jersey. Several reptiles and amphibians, California and Arizona.

J. F. STREET. Virginia Snake (*Virginia valeria*), Virginia.

PUCHASED. Collection of reptiles and amphibians obtained by D. E. Harrower in Panama.

FISHES.

R. M. ABBOTT. Bottle of small fishes, South River, Maryland.

H. H. BURTON and H. W. FOWLER. Jar of fishes, Pennsylvania.

MESSRS. CORMAN and LIPSCHULTZ. Thread Mackerel (*Blepharis cinctus*), New Jersey.

H. W. FOWLER. Collection of fishes, Virginia.

J. H. FERRISS. Eggs of darter, Illinois.

DR. W. E. HUGHES. Two Brook Trout (*Salvelinus fontinalis*), Maine.

W. T. INNES. Jar of aquarium fishes.

F. J. KEELEY. Blenny, Florida.

WALTER I. MATTERN. Blue Sunfish (*Lepomis incisus*), Pennsylvania. Jar of fishes, Maryland.

E. S. and W. I. MATTERN. Three collections of fishes, Pennsylvania.

E. S. and W. I. MATTERN and H. W. FOWLER. Collection of fishes, Pennsylvania and New Jersey.

W. L. PAULIN. *Pterophyllum scalare*, raised in Philadelphia.

HARTIE I. PHILLIPS. Dolphin (*Coryphæna hippurus*), New Jersey.

DR. R. J. PHILLIPS. Red Mullet (*Upeneus*), New Jersey.

CHARLES T. RAMSDEN. Young *Heros tetracanthus*, Cuba.

S. N. RHOADS. Jar of spawning brook lampreys (*Entosphenus apypterus*), New Jersey.

DR. WITMER STONE. Collection of fishes, South Carolina.

H. E. THOMPSON and H. W. FOWLER. Three jars of fishes, Pennsylvania.

R. W. WEHRLE. Six jars of fishes, Pennsylvania.

RECENT MOLLUSCA.

DR. W. L. ABBOTT. *Eurycratera dilatata* Pfr., near Porte de Paix, Haiti.

JACOB AEBLY. Five trays of shells, New Jersey and Italy.

BENJAMIN ALBERTSON. *Trivia europæa* Mont., England.

CHARLES H. BAKER. Nine species of shells, Florida and Massachusetts.

F. C. BAKER. Six trays of shells, Oneida Lake, N. Y.

DR. FRED BAKER. *Alvania obdroyda* Bart., S. Coronado Is., L. Cal.

DR. P. BARTSCH. Two varieties of *Amphidromus maculiferus* Sby., Mindanao.

S. S. BERRY. Thirty-six trays of shells, West America and Cuba.

DR. A. P. BROWN. Four trays of shells, Antigua.

PROF. W. A. and E. L. BRYAN. Eight species of shells, Hawaiian Islands.

H. C. BURNUP. Three species of *Truncatellina*, S. Africa.

DR. P. P. CALVERT. *Unio complanatus* Sol., Meredithtown, N. H.

GEORGE W. CARPENTER. One pearl.

E. P. CHACE. Five trays of shells, California.

C. E. CLAGHORN. *Harpa major* Bolten.

GEORGE H. CLAPP. Three species of shells, Alabama and Jamaica.

W. F. CLAPP. Six species of land shells, Peru.

T. D. A. COCKERELL. The type of *Polygyra texasiana tillandsæ* Ckll., Texas

C. M. COOKE. Seven trays of Hawaiian land shells.

DELOS E. CULVER. Five species of marine shells, Virginia.

J. FARQUHAR. Twelve species of African land shells.

J. H. FERRISS. Two hundred and forty-two trays of shells, western America.

J. H. FERRISS and L. E. DANIELS. Sixty-two trays of shells, western America

H. W. FOWLER. Twenty-one trays of shells, eastern America.

FRANKLIN INSTITUTE. (Deposited.) *Malleus albus* Lam.

LORRAINE S. FRIERSON. Four *Unios*, U. S. and Guatemala.

S. G. GORDON. Twenty-seven trays of shells, eastern America.

GEORGE M. GREENE. Two trays of shells, Virginia.

D. E. HARROWER. (Purchased.) One hundred and thirteen trays of shells, Panama.

MORGAN HEBARD. Eighteen trays of shells, Florida and Cuba.

ADAM HECYLER. *Crepidula aculeata* Gm., from a sponge.

CHAS. HEDLEY. Sixteen trays of Australian land shells.

JUNIUS HENDERSON. Nineteen trays of shells, Colorado and Wyoming

A. A. HINKLEY. Seven trays of shells, Arkansas and Mexico.

H. VON IHERING. Two land shells, South America.

- ARTHUR JACOT. Twenty-two trays of shells, North Carolina and New York.
C. W. JOHNSON. *Viviparus malleatus* Rye., near Boston, Massachusetts.
F. J. KEELEY. *Orula uniplicata* Sby., Hawks Park, Florida.
PHILIP LAURENT. Three trays of shells, Florida.
MRS. A. L. LETSON. The type of *Oolostomia letsoni* Pils., Oahu.
BAYARD LONG. Forty-five trays of shells, America.
J. G. MALONE. Six species of shells, Oregon.
E. S. MATTERN and H. W. FOWLER. Eight trays of shells, New Jersey and Pennsylvania.
E. S. and W. I. MATTERN. Ten trays of shells, New Jersey, Pennsylvania and Florida.
E. H. MATTHEWS. Two Australian marine shells.
W. G. MAZYCK. Six trays of Bullaria.
D. N. McCADDEN. Three trays of shells, Maryland and New Jersey.
R. E. B. MCKENNEY. *Veronicella*, Panama.
MRS. I. S. OLDRYD. Three trays of California shells.
FREE OTTEMILLER. Fifteen trays of shells, Pennsylvania and Florida.
W. H. OVER. Thirty-five trays of shells, South Dakota.
DR. R. J. PHILLIPS. Squid eggs, New Jersey.
MISS R. M. PIERCE. Two marine shells, New Jersey.
DR. H. H. PILSBRY. Seven hundred and seventy-two trays of shells, Hawaiian Islands, Cuba and United States. Two hundred and twenty-two trays of shells, New Mexico.
PRINCETON UNIVERSITY. Two chitons, Porto Rico.
CHARLES T. RAMSDEN. Sixteen trays of Cuban shells.
RUSSELL C. ROSENFELT. *Pisidium streatori* St., S. Worthington, Massachusetts.
A. F. SATTERTHWAIT. Thirteen trays of shells, Arkansas and Missouri.
DR. H. SKINNER. *Ceratuliscus ramsdeni* Pils., near Guantanamo, Cuba.
H. H. SMITH. One hundred and seventy-two trays of shells, Alabama and Tennessee.
MAXWELL SMITH. Thirty trays of land shells, Europe and Colorado.
G. W. H. SOELNER. *Veronicella cubensis* Pfr., Isle of Pines, Cuba.
SOWERBY and FULTON. (Purchased.) One hundred and ninety-three trays of shells.
IRWIN SPALDING. One *Pterodiscus*, Oahu.
DR. WITMER STONE. Two species of shells, New Jersey and North Carolina.
D. THAANUM. One hundred and fifty-two trays of Hawaiian marine shells.
MRS. L. D. THOMPSON. Sixteen trays of New England shells.
W. TOLLERY. Five species of marine shells, England.
H. TRUDEL and S. G. GORDON. Four land shells, North Carolina.
E. G. VANATTA. *Planorbis cornutus rubra* Bs., from an aquarium in Philadelphia, Pa.
BRYANT WALKER. Five trays of west American shells. A specimen of *Holospira bartschi*.
E. M. WALKER. *Arion circumscriptus* Jh., Toronto, Canada.
B. WALKER and H. F. WILSON. Two land shells, Wisconsin.

MISS H. N. WARDLE. Seven species of land shells, Pike County, Pennsylvania.

R. H. WEHRLE. Two trays of *Spharium*, Indiana County, Pennsylvania.

JOSEPH WILLCOX. Two marine shells, Peru.

H. W. WENZEL. *Polygyra abolabris* Say, Southern Pines, N. Carolina.

GEORGE WILLETT. *Ischnochiton willetti* Perry, Forrester Island, Alaska.

MISS HELEN WINCHESTER. Two trays of shells, New Jersey.

INSECTS.

W. L. ABBOTT. One hundred and nineteen insects, Hayti; twenty insects, Tortuga.

JACOB AEBLY. Seven insects, Pennsylvania.

AMERICAN MUSEUM OF NATURAL HISTORY. Fifty-two Dermaptera, West Indies, Mexico, British Guiana; eight Lepidoptera, United States.

ANASTASIO ALFARO. One hundred and seven Orthoptera, Costa Rica.

F. E. BLAISDELL. *Omus cupreonitens* (Paratypes), California. Eight *Elcodes*, California.

J. G. BONNIWELL. Thirty-one Lepidoptera, Florida.

A. F. BRAUN. Thirty-two *Nepitula*, United States; thirty-four *Lithocolletes*, United States.

H. H. BREHME. Six moths, United States.

MALCOLM BURR. One hundred and twenty-nine Orthoptera, Brazil.

P. P. CALVERT. Nine insects, Mt. Lake, Virginia.

D. M. CASTLE. Five Blattidae, Florida.

T. D. A. COCKERELL. Eight Orthoptera, Mississippi; New York.

CORNELL UNIVERSITY. Eight Dermaptera, New York; Mississippi. *Phlugiola redenbacheri*, Brazil.

ERICH DAECKE. Four *Ceuthophilus*, Pennsylvania.

W. T. DAVIS. Six Homoptera, Arizona, New Mexico.

MISS K. DIXON. One moth, Pennsylvania.

H. C. FALL. Seven types of Malachidae, United States.

J. H. FERRIS. Caddis fly nests, California.

HENRY FOX. One hundred and one Orthoptera, Virginia; ten Orthoptera, Indiana.

W. J. FOX. Two insects, Philadelphia.

C. W. FROST. Three beetles, Philadelphia.

E. H. GIBSON. One hundred and thirty-five Hemiptera.

W. H. GITHENS. One Orthopteron.

C. B. GOODERHAM. Twenty-nine Orthoptera, Nova Scotia.

MRS. F. I. GOWEN. One beetle, Philadelphia.

G. M. GREENE. Four Coleoptera, United States.

S. G. GORDON. Seven Orthoptera; one *Cychnus*, North Carolina.

FORDYCE GRINNELL, JR. Fifty-seven Orthoptera, California.

O. A. JOHANNSEN. Eleven Anthomyiidae, United States.

HENRY KRAEMER. Illustrations of early stages of *Coccus cacti*.

BAYARD LONG. Collection of insects from New Jersey; one beetle, Canada.

D. E. HARROWER. Twenty-three insects, Canal Zone, Panama.

MORGAN HEBARD. Fifty-nine Orthoptera, United States, Central and South America. One hundred and seven Dermaptera, Arizona, Mexico and Jamaica.

One hundred and eight Orthoptera, Mexico and Central America. Eighty-five Orthoptera, Mexico. Twenty-three Orthoptera, Costa Rica. Seven insects, United States; seven insects, Georgia. Thirty-seven insects, seven Arachnida, five Myriopoda, Africa. Ten Orthoptera, Arizona. Ninety-seven earwigs, Jamaica and Mexico. Three butterflies, Florida. Thirty-four Coleoptera, United States.

J. C. HUGENIN. Eight butterflies, California.

E. P. HEWLETT. Ten moths, California.

C. H. LANKESTER. Fifty-seven Orthoptera, Costa Rica.

PHILIP LAURENT. Fifteen Orthoptera, Florida; one Orthopteron, New Jersey; eighteen Lepidoptera, Pennsylvania and New Jersey.

LELAND STANFORD UNIVERSITY. Seventy-eight Gryllidae, Brazil.

R. A. LEUSSLER. Sixty-seven Lepidoptera, Nebraska.

J. E. MASON. Ten *Ceropia* cocoons, Philadelphia.

L. W. MENGEL. Eleven *Argynnis*, Idaho; one *Heliconius urania*, British Guiana.

C. E. MITCHEL. Twenty-one Hymenoptera, North America.

MUSEUM OF COMPARATIVE ZOOLOGY. One paratype of *Pseudisolabis elegans* Hebrd, India.

ROBERT K. NABOURS. Series of fifty-six *Paratettix texanus* illustrating the genetic studies of the donor.

R. OTTOLENGUI. Eleven *Pamphila*, California.

H. A. PILSBRY. One Acridid, New Mexico.

PURCHASED. Two hundred and seventy-nine Orthoptera, Madagascar.

R. F. PARKER. Four Sarcophidae, United States.

W. D. ROBINSON. One Odonat, Philadelphia.

A. F. SATTERTHWAIT. Several insects, Charleston, Missouri.

HENRY SKINNER. Ten Lepidoptera, California; thirty-eight insects, Wayne County, Pennsylvania.

WITMER STONE. Five hundred Orthoptera, New Jersey; thirty-seven Orthoptera, South Carolina; eleven insects, Maryland.

A. F. SWAIN. Eleven slides of Aphididae, California.

UNITED STATES NATIONAL MUSEUM. Thirty-nine Orthoptera, Brazil and Mexico; thirteen Dermaptera, Panama.

H. B. WEISS. Two Hymenoptera, New Jersey.

P. W. WHITING. Ninety-one Orthoptera, Pennsylvania and New England.

R. C. WILLIAMS, JR. Forty-one slides genitalia of *Thanaos*; fifty-five moths and butterflies, United States.

WISCONSIN EXPERIMENT STATION. Seventeen Orthoptera, Wisconsin.

HENRY WORMSBACHER. Three Lepidoptera, Ohio.

INVERTEBRATES.

(Other than Insects and Mollusks.)

ACADEMY EXPEDITION TO HAWAIIAN ISLANDS. Four crustaceans, six corals, Hawaiian Islands.

G. W. CARPENTER. Two specimens of red coral.

H. W. FOWLER. Collection of crustaceans and spiders, Virginia.

W. J. FOX. One isopod, New Jersey.

FREE MUSEUM OF SCIENCE AND ART. One *Coronula regina* Darwin.

D. E. HARROWER. *Polypus*, Colon, Panama.

ADAM HECHLER. Coral from sponge.

F. J. KEELEY. Isopod from tail of Silver Whiting.

CHAS. LAWALL. Two bottles of shrimps (*Crago septemspinus*), New Jersey.

DR. H. A. PILSBRY. Hermit Crab, La Jolla, California. Fourteen specimens from Hawaiian Islands.

PURCHASED. One hundred and fifteen trays of invertebrates. Pacific Ocean beach, Panama.

A. F. SATTERTHWAIT. One vial of leeches and one earthworm, near Charleston, Missouri.

DR. WITMER STONE. Collection of crayfishes, South Carolina. Collection of crabs, New Jersey.

D. THAANUM. Three barnacles, one lot of coral and one lot of brachiopods, Hawaiian Islands.

U. S. NATIONAL MUSEUM. *Coronula diadema* L. and *Conchoderma aurita* L., from the lip of a whale from Newfoundland.

C. M. WHEATLEY COLLECTION (Deposited). Two gorgonians.

JOSEPH WILLCOX. Two trays invertebrates from Peru.

INVERTEBRATE FOSSILS.

ACADEMY EXPEDITION TO HAWAIIAN ISLANDS. Four fossils, Hawaiian Islands.

DELOS E. CULVER. Six Miocene fossil shells, Buckroe Beach, Va.

DR. JOHN EVANS. Three trays of fossil *Arca*, Chiriqui, Panama.

H. W. FOWLER. Seven trays of fossils, Maryland and Pennsylvania.

BAYARD LONG. Collection of fossil shells, New Jersey.

DR. J. P. MOORE. Two fossils, Texas and Utah.

H. A. PILSBRY. Six trays of fossils, New Mexico and Hawaiian Islands.

LLOYD B. SMITH. Forty-seven trays of fossils, Cenizas, Colombia. Ten trays of fossils, Haiti.

D. THAANUM. *Ostrea retusa* Pease, Oahu, H. I.

H. VENDREYS. Two trays of fossils, Jamaica.

BRYANT WALKER. Six trays of Pliocene fossils, California.

W. W. WEBSTER. *Arca chiriquiensis* Gabb (fossil), Haiti.

JOS. WILLCOX. Four fossil shells, Peru.

MINERALS.

ALFRED C. BATES. Flint geode in chalk, England.

MORRELL G. BIERNBAUM. Xanthosiderite, Lake Superior.

ARTHUR BRATT. Fragments of minerals.

CLARK HILL. Concretion, Ohio.

CHAS. W. HOADLEY. Specimen of Datolite, Paterson, New Jersey.

JOHN HOLZMAN. Diabantite, Prehnite, Laumontite, Thaumassite. Paterson, New Jersey.

HENRY M. KOLB. Collection of Lake Superior minerals.

JOHN H. McFADDEN. Geological specimens, Shackleton Antarctic Expedition.

V. W. FIELD. Mimetite, Willemite, Utah.

SAMUEL G. GORDON. Molybdenite, Sussex Co., N. J.; Baddeleyite, Brazil; Cuprite, Hematite, Piedmontite, South Mountain, Adams Co., Pa.; Siderite, Argentine, Laumontite, Stilbite, Ward's Quarry, Delaware Co., Pa.; Quartz (a sixty pound crystal) Rolandville, Philadelphia; Pyrrhotite, Lansdowne, Pa.; Genthite, Actinolite, Gladwyn, Pa. Asbestos, Easton, Pa.; Caeoxenite, Hellertown, Pa.; Stevensite (6 specimens), Pectolite, Gothite, Analcite, Thaumassite, Gypsum, Mesolite, Datolite, Anhydrite, Paterson, N. J.; Sphalerite, Philadelphia; Specular Hematite, Phoenixville, Pa.; Quartz, Phoenixville, Pa.; Crocidolite, Philadelphia; Argentine, Amelia C. H., Va.; Zoisite, Calcite, Stilpnomelane, Falls of French Creek, Pa.; collection of volcanic rocks from Sussex Co., N. J.; four Pennsylvania and New Jersey geological specimens, illustrating slickensides, and dikes.

WILLIAM MADRENS. Specimen of Calcite, Sphalerite and Pyrite, Pennsylvania.

R. A. MERCER. Babingtonite, New Jersey.

DR. S. W. MORTON. Collection of minerals.

FREDERICK OLDACH. Specimen of Rutile and Beraunite, Pennsylvania.

FREDERICK OLDACH and S. G. GORDON. Quartz, Rolandville, Pa.

HARRY WARFORD. A specific gravity balance, Epidote and Barite, Pennsylvania.

HARRY WARFORD and S. G. GORDON. Hmenite, Pennsylvania.

H. L. WILLIG. Four crystals of Limonite pseudomorph after Pyrite, Pennsylvania.

. PLANTS.

W. M. BENNER. Sixteen sheets of local plants.

DR. GEORGE N. BEST. Collection of New Jersey and Pennsylvania plants.

BOTANICAL SECTION. Ten hundred and thirty-seven sheets New England plants.

O. H. BROWN. Fifty-three local plants.

HARLAN S. GATCHELL. Herbarium of the late Joel J. Carter.

BAYARD LONG. Nine sheets of local plants.

BAYARD LONG and HAROLD ST. JOHN. One hundred and five sheets of local plants.

W. H. LEIBELSPERGER. Thirty-six sheets of local plants.

ARTHUR LEED. Specimen of *Arctostaphylos*.

C. S. MANN. Specimen of Bartram Oak.

ST. LOUIS BOTANICAL GARDEN. Eight hundred and eighty-two sheets from the Mississippi Valley. (In exchange).

J. P. OTIS. Twenty-seven sheets of local plants.

H. W. PRETZ. Four hundred and seven sheets of local plants.

S. S. VAN PELT. Four local specimens.

U. S. NATIONAL HERBARIUM. Three hundred and fifteen sheets, mainly from the Canary Islands.

PERCY WILSON, through BAYARD LONG. Thirty-seven sheets of local plants.

F. W. PENNELL and BAYARD LONG. Fourteen sheets of local plants.

ARCHEOLOGY, ETC.

CHARLES BARTON. Head of an Egyptian king, Thebes.

ED ZALD H. BURR. Collection of Indian axes, spearheads, etc.

ELLWOOD C. ERDIS. Obsidian points, and potsherds from surface and ruins in the Apache National Forest, Arizona.

E. S. GINNANE. Potsherd and Indian artifacts of iron ore, Blount County, Alabama.

FRANK J. KEELEY. Fragment of heavy glass vessel from an Indian mound, Hawks Park, Volusia County, Florida.

CLARENCE B. MOORE. Additions to the C. B. Moore collection from burial mounds and cemetery sites along the lower Mississippi, and in southern Alabama and Georgia, and north-west Florida.

ESTATE OF BENJAMIN SHARP. Collection of Eskimo ethnographica, including bows, arrows and quiver, drills and bow, cord drills, seal club, knives, needles, carving tools, snow-knives, toy lamp and dish, child's skin shoes, sealskin boot, skin cup and vessel, bucket handle, toggles, etc

INDEX TO GENERA, SPECIES, ETC., DESCRIBED OR
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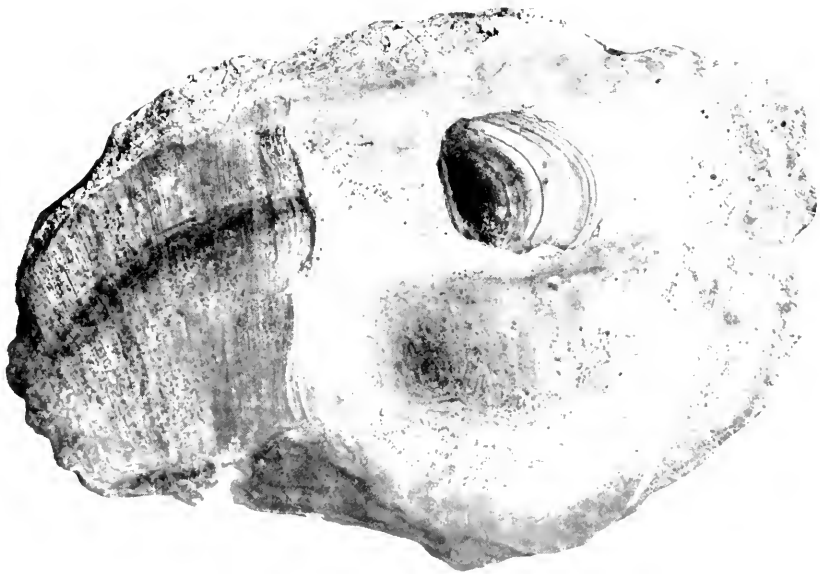
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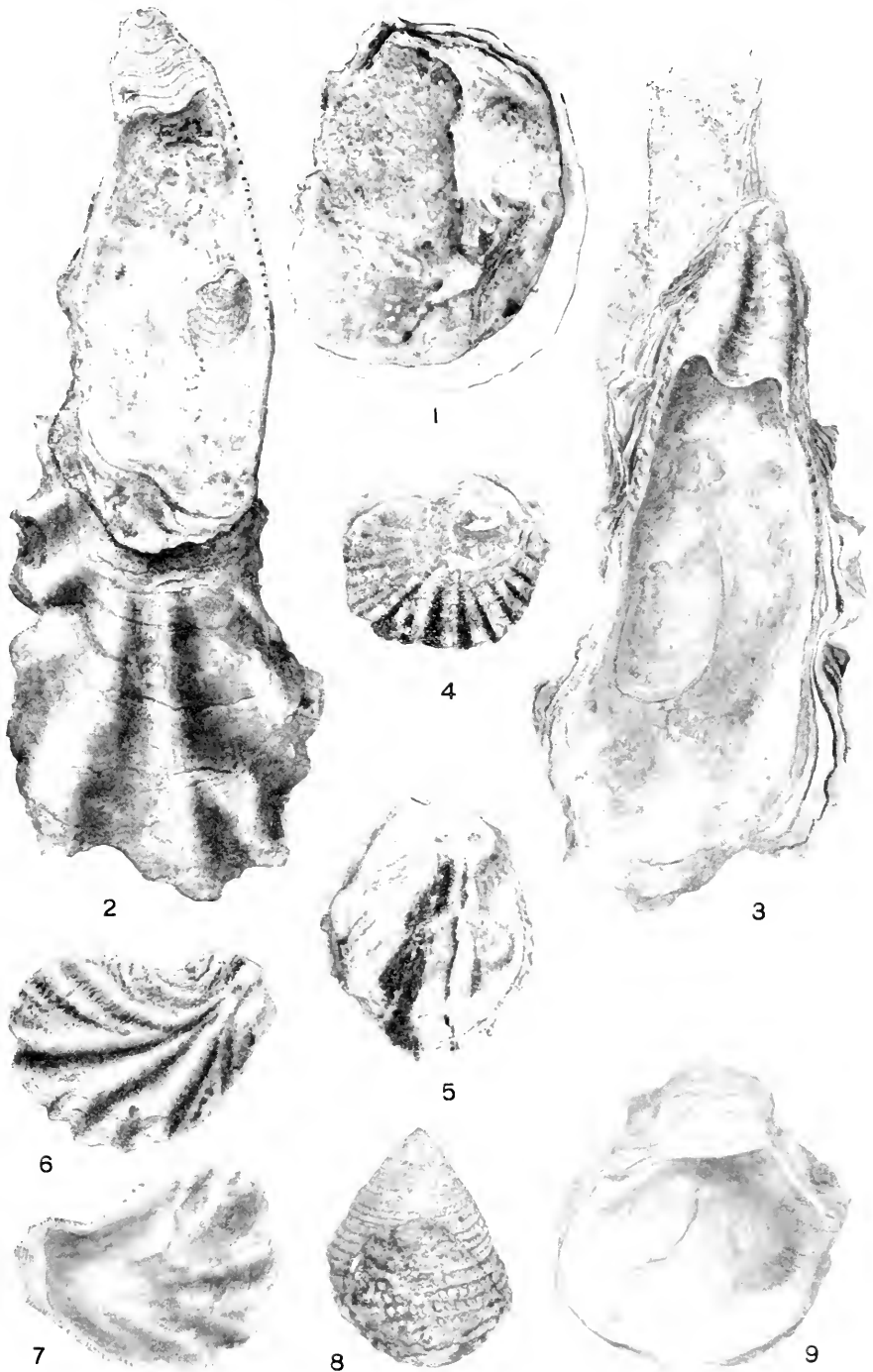
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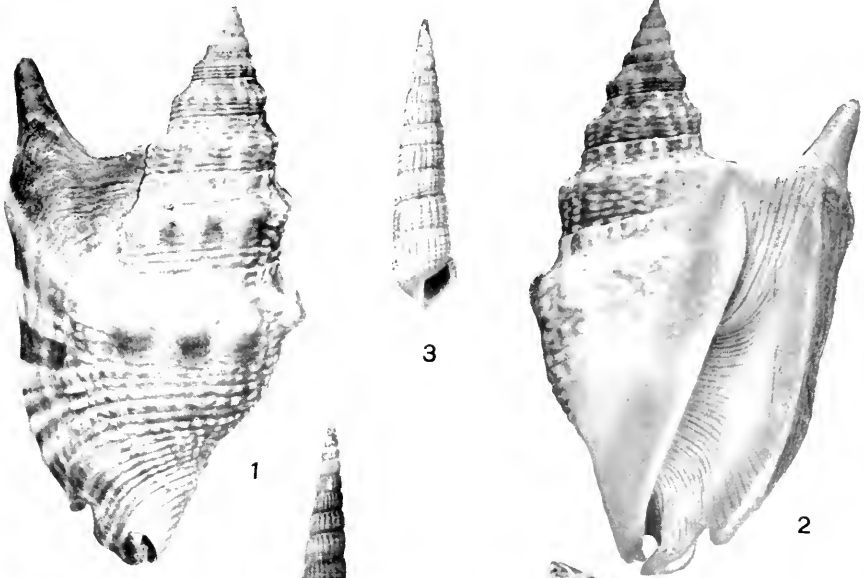
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PILSBRY: MARINE MOLLUSKS OF HAWAII, IV-VII.



PILSBRY: MARINE MOLLUSKS OF HAWAII. IV-VII.



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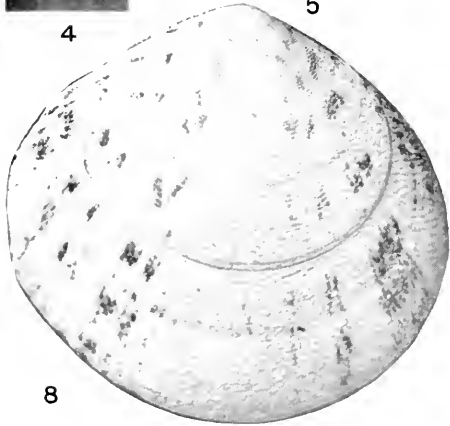
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