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PROCEEDINGS

OF THE

ACADEMY OF NATURAL SCIENCES

OF

PHILADELPHIA.

1898.

COMMITTEE ON PUBLICATION:

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121-23
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PHILADELPHIA:
ACADEMY OF NATURAL SCIENCES,
LOGAN SQUARE.
1899.

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ACADEMY OF NATURAL SCIENCES OF PHILADELPHIA,
January 31, 1899.

I hereby certify that printed copies of the PROCEEDINGS for 1898 have been presented to the meetings of the Academy and mailed as follows :—

Pages	9 to 152	mailed	April	5, 1898,	presented	April	5, 1898.
"	153 to 200	"	May	3, 1898,	"	May	3, 1898.
"	201 to 248	"	June	13, 1898,	"	June	14, 1898.
"	249 to 328	"	July	12, 1898,	"	July	12, 1898.
"	329 to 344	"	August	2, 1898,	"	August	2, 1898.
"	345 to 360	"	October	4, 1898,	"	October	4, 1898.
"	361 to 424	"	October	15, 1898,	"	October	18, 1898.
"	425 to 456	"	October	29, 1898,	"	November	1, 1898.
"	457 to 472	"	December	12, 1898,	"	December	13, 1898.
"	473 to 488	"	January	13, 1899,	"	January	17, 1899.
"	489 to 504	"	January	26, 1899,	"	January	31, 1899.

EDWARD J. NOLAN,
Recording Secretary.

DOCKER-FOSTER CO., PRINTERS, PHILA.

LIST OF CONTRIBUTORS.

With reference to the several articles contributed by each.

For Verbal Communications, Announcements, etc., see General Index.

PROCEEDINGS

OF THE

ACADEMY OF NATURAL SCIENCES

OF

PHILADELPHIA.

1898.

January 4.

Mr. Charles Morris in the Chair.

Twenty-five persons present.

Papers under the following titles were presented for publication:—

"Contributions to a Knowledge of the Hymenoptera of Brazil, No. 4, Thynninae and additions," by William J. Fox.

"The Summer Birds of Susquehanna Co., Penna.," by Francis R. Cope, Jr.

The Council reported that the following Standing Committees had been appointed to serve during the ensuing year:—

On Library.—Charles P. Perot, Arthur Erwin Brown, Thomas A. Robinson, Henry C. Chapman, M. D., Dr. C. Newlin Peirce.

On Publications.—Thomas Meehan, Charles E. Smith, Henry A. Pilsbry, Henry Skinner, M. D., Edward J. Nolan, M. D, On Instruction and Lectures.—Uselma C. Smith, Benjamin Smith Lyman, Samuel G. Dixon, M. D., Philip P Calvert and Samuel N. Rhoads.

Standing Committee of Council on By-Laws.—Isaac J. Wistar, Theodore D. Rand, Arthur Erwin Brown, Benjamin Sharp, M. D.

The Birdsboro Trap Quarries.—Mr. Theodore D. Rand remarked that the increasing demand for good roads has caused search to be made for the best material conveniently available. Not long ago Mr. John T. Dyer who has long wrought the extensive limestone quarries near Howellville, Chester Co., undertook the quarrying of trap rock on Hay Creek, a little over a mile southwest of Birdsboro, near Reading, Pa. The trap, probably a diabase, has come up through the Red Rocks, forming high hills on both sides of the creek, the valley of which has enabled the Wilmington and Northern R. R. to descend into the Schuylkill Valley. The remarkable feature of this trap is the evidence of intense dynamic action more recent than the rock itself. There are three quarries, two on the right and one on the left bank of the creek.

The lower quarries show breasts of about a hundred feet in height, increasing as the quarrying proceeds further into the steep and high hills. Everywhere, except some portions of the upper quarry, the rock is very full of joints, the major striking N. 65° E., the others seemingly in almost every direction, as if the rock had been crushed by a very sudden pressure. The joints show, usually, slickensides on their surfaces, but there is strong cohesion through the joints, but much less than through the rock itself. These joints, of course, greatly facilitate the quarrying and crushing, though sometimes interfering with the drilling. At the upper quarry some rock was seen much resembling that of French Creek, and capable, like it, of being quarried in large and regular masses. In this quarry, also, were found some specimens of heulandite and probably laumontite, giving promise of fine specimens.

The present output of the quarries is eleven hundred tons of crushed stone per day. The consumption of this large amount shows the remarkable increase in the use of this material.

A striking feature was the cleanliness of these quarries. The blasting is done usually twice a day, but after each blast some of the quarrymen are detailed to fork up the fragments, so that the horses and carts travel over a smooth and level surface. The horses were of a quality rarely seen in quarry work, and evidently were well cared for and well treated, while the men worked industriously, without the vigorous language too often heard in quarrying operations.

JANUARY 11.

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

Twenty-seven persons present.

Papers under the following titles were presented for publication :—

"Proceedings of a Meeting held in Commemoration of Doctor Harrison Allen and Doctor George Henry Horn."[1]

"Fossil Mollusks and Diatoms beneath the Dismal Swamp, Virginia and North Carolina," by Louis Woolman, with Notes on the Diatoms, by Charles S. Boyer.

JANUARY 18.

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

One hundred and thirty-five persons present.

The deaths of Crawford Arnold and John K. Valentine, members, were announced.

Dr. Persifor Frazer made a communication, illustrated with lantern slides, on "Glimpses of Russia in Europe, Asia, and Asia Minor." (No abstract. See Proceedings, 1897, p. 405.)

JANUARY 25.

CHARLES SCHAEFFER, M. D., in the Chair.

Fourteen persons present.

Papers under the following titles were presented for publication :—

"On a small Collection of Mammals from Northeastern China," by Samuel N. Rhoads.

"Notes on Alaskan Water Birds," by Alvin Seale.

Israel W. Morris, Charles G. Sower, D. M. Castle and Caroline A. Burgin were elected members.

The following was ordered to be printed :—

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[1] Ordered to be printed in the Proceedings for 1897. See page 505 *et seq.*

THE PLANTS OF LEWIS AND CLARK'S EXPEDITION ACROSS THE CONTINENT, 1804–1806.

BY THOMAS MEEHAN.

The expedition of Captains Merewether Lewis and William Clark, from what was then the village of St. Louis, to the sources of the Mississippi and across to the Pacific Coast, was one of the marvels in the early history of the American Republic. The interior of the continent was utterly unknown. That it was surely inhabited by wild races of men, and that wild beasts roamed through its trackless forests, comprised almost all that could be told about it. A little band of some half hundred men was detailed to explore these dark corners of our recently acquired territory in face of the fact that they would be lost to home and civilization for several years. Captain Lewis started from Washington to take charge of the party on the 5th of July, 1803. They crossed the continent, reaching the mouth of the Columbia River, and with the loss of but one man, returned and arrived at St. Louis on the 23d of September, 1806. To carry a band of men such as he commanded safely through a journey of so many miles, over a period of three years, and in a strange country inhabited by wild people whose habits and character were wholly unknown, and where the subsistence for his men must have been a continual source of anxiety, called for coolness, good judgment, and executive ability of no mean order. It is a question whether the services of these great men—Lewis, and his able coadjutor, Clark—have ever been fully appreciated by the country they served. To aid somewhat in doing full justice to the memories of these great explorers has been one of the inducements to prepare the present paper, which it is hoped may also be regarded as a contribution to botanical history.

The idea of exploration originated with Jefferson. In 1792 he tried to interest the American Philosophical Society in the plan. It was approved, and it was decided to place the expedition in charge of André Michaux. Reasons of State policy arising out of our relation with Michaux's country, caused its abandonment. Lewis was Jefferson's private Secretary, and under him the expedition finally started. Among his other instructions from Jefferson, they were to note the food plants of the Indians and the "dates at which particular plants put forth flowers and leaves." If only they had been authorized to make complete botanical collections, and a competent collector made part of the expedition, how great a boon would it not have been to botanical science! From the few they did collect, Pursh in his "Flora Americæ Septentrionalis," published in London in 1814, refers to 119, many of which he described as wholly new.

What became of the complete collection has never been definitely ascertained up to this time. Pursh says in his preface to the work cited, that after his return from his expedition to the Great Lakes in 1806, Captain Lewis gave him the collection in order to describe and figure those he thought to be new. "The collection was made during the rapid return from the Pacific. A much more extensive one made on their slow ascent toward the Rocky Mountains and the chains of the northern Andes, had unfortunately been lost, by being deposited among other things at the foot of these mountains. The loss of this fine collection is the more to be regretted, when I consider that the small collection communicated to me, consisting of about 150 specimens, contained but about a dozen plants well known to be natives of North America." It was understood that Pursh took these plants to England, and that they were left by him to Mr. A. B. Lambert, Vice-President of the Linnæan Society, under whose roof, and by whose aid, Pursh's great work was completed. Lambert's herbarium was finally distributed, and, in some way not known to the writer, a number of Lewis' plants, forming Pursh's types, and marked "from Lambert's Herbarium" became part of the Herbarium of the Academy of Natural Sciences of Philadelphia.

Two years ago Professor C. S. Sargent suggested to the writer the possibility of some of the material being yet in the custody of the American Philosophical Society. The special attention to natural history of the Academy of Natural Sciences of Philadelphia —the leading members of this and the American Philosophical Society being the same—has not warranted the formation of natural history collections by the latter. After long and diligent search, packages of plants were found which could only be these, as the localities on the label slips were about the same as those given in Pursh's work. But the hand-writing was that of a German, and occasionally there would be a reference to a genus or family of plants exhibiting more botanical knowledge than Captain Lewis or any one in his command was known to possess. The plants are in the original packages as presented many years ago. The paper on which the specimens were placed had been in botanical use before. On one of these was written the following expense bill:—

May 26.	Books and paper	$2 00
	Stage fare	3 00
	Expenses that night	37
May 27.	Expenses on the road to Easton	1 00
May 28, 29, 30.	Easton, including breakfast 31, and supper 29.	4 37
May 31.	Richmond dinner, supper, lodging and drinks	1 00

It so happened that I had the pleasure of giving to the public in the *Gardener's Monthly* of 1869, what was believed to be Pursh's diary of his trip to the Great Lakes. It commences by saying May 26th, "prepared myself for the journey," and 27th, "at 4 o'clock this morning we left Philadelphia, the stage being remarkable full of passengers"—"arrived at 10 o'clock at Easton." On another sheet was found written, as if trying the virtue of a new quill pen, "Frederick Pursh, his hand." There could be no doubt about these being Lewis' plants, and that they had been through Pursh's hands. It was still a mystery how Pursh came to make all the memoranda incident to the collecting of each specimen, on each of these labels.

With the freedom of three-quarters of a century the museum beetles had made sad work in the bundles. In a few cases the specimens had been wholly reduced to dust, and only fragments were left in other cases. Generally, however, they were in fair condition. The Philosophical Society wisely accepted a proposition to deposit these and other collections with the Academy of Natural Sciences, where they would be properly cared for.

The collection was, as Pursh stated, made for the most part on the return trip. Many specimens, as the labels show, were collected and saved between the Rocky Mountains and Fort Clatsop, their winter quarters near the Columbia River.

While in doubt as to the authorship of the labels attached to the specimens, note was made of an entry in the minutes of the American Philosophical Society under date of Nov. 15, 1805, that a box of plants was received from Captain Merewether Lewis. The seeds were sent to Mr. William Hamilton, and the "Hortus Siccus referred to Dr. Barton to examine and report." A full examination of the collection, revealed this package also. It contained the plants collected in 1804 between St. Louis and Fort Mandan. Pursh had evidently been over this, as in many instances the labels were similar to those in the other package; but a number had the original memoranda in the hand-writing of Captain Lewis. These were written wholly across the sheet containing the specimens. Pursh had evidently copied them in order to have small compact labels for the specimens, and while doing so, had occasionally added the more technical botanical points already adverted to. He evidently studied these collections before starting to Europe with them, leaving the duplicates, where there were any, and those which were too imperfect to be easily recognized. A comparison of Lewis's own labels and Pursh's copies shows that the latter were not always strictly copied—differences can be seen in the comparisons made in the Catalogue. Pursh's notes were probably made from Lewis's original memoranda carried away with the specimens, and are, therefore the more likely to be the exact statements of the collectors, than the copies left with these.

After determining the plants in the collection as far as I could, considering the fragmentary condition of many of them, I handed them over for correction to Dr. B. L. Robinson of the Gray Herbarium. With their return, I received the following letter.

"The identification of the Lewis and Clark plants has now been completed and I am happy to be able to send you a list, as Mr. Greenman and I understand them. We have worked over the plants together for greater accuracy, discussing almost every specimen. In any reference to work done here upon the plants, kindly associate the name of Mr. Greenman with my own. The plan of the list is to show in double columns:—1st, what the plant actually is, according to present ideas of classification, then the actual locality and date which the accompanying label bears; 2nd, in the other column, is shown what Pursh appears to have called the plant in his *Flora*, provided he mentioned it clearly; also the locality and date which he there ascribed to it. I think that the advantage of this parallel column presentation of this important collection will be readily evident to you.

Perhaps the most interesting find in the collection is the unlabelled *Clematis*. Now as this is the only *Clematis* represented, and the only one mentioned by Pursh as having been collected by Lewis and Clark was his *C. hirsutissima*, there is every reason to believe that this is the real type (or portion of type) of *C. hirsutissima* Pursh. But the specimen is certainly *C. Douglasii* Hook., a later species, and not *Anemone patens*, as it has been traditionally interpreted. On reading the description of *C. hirsutissima* in Pursh's *Flora* it is impossible to doubt that it refers to *C. Douglasii* with its 4 sepals, not *Anemone patens* with its 5 to 8 sepals. This fact was, I think, guessed by Mr. Coville, some years ago, but I fail to find any publication of it. Certainly Prof. Britton in his *Flora* does not challenge the identity of *Anemone patens*, var. *Nuttalliana* with *Clematis hirsutissima*, for he still keeps up his *Anemone hirsutissima* (Pursh) Britton.

It seems only right that *C. Douglasii* Hook. should give place to the older and well described (although long misunderstood) *C. hirsutissima* Pursh. This is certainly an interesting point. Perhaps before publishing it, it might be courteous to Mr. Coville to inquire whether he had already published or had in press anything on the subject, which is unlikely. Some reference also might be made to the fact that he had independently and without a knowledge of Lewis's type discovered from the description the probable identity of *C. hirsutissima* Pursh.

In the list, *Anemone quinquefolia* is used to mean all N. American "*A. nemorosa*," not in the sense in which Pursh understood it, namely as covering only the quinquefoliolate form.

The type of *Cleome serrulata* Pursh (at least one of the specimens) shows slight serrulation of the leaves, so that the name ought not to give place to the later *C. integrifolia* Torr. & Gray, although the latter is, in general, more appropriate, or would be if the authors had only written *integrifoliolata*.

The specimen of *Lewisia triphylla* (*Claytonia triphylla* Wats.) extends the known range of the species to Idaho.

Pursh's *Oxytropis argentata* is evidently larger than *O. nana* Nutt. to which it has traditionally been referred, and also has longer, more slender calyx lobes. Perhaps these are only varietal differences. Their value can be told only by some one with a monographic knowledge of the genus.

Strangely enough Pursh's *Pedicularis elata* looks exceedingly like *P. scopulorum* Gray from a very different range. It is certainly not *P. bracteosa* Benth. to which it is traditionally referred.

There are two species of *Festuca* upon which we cannot give any definite opinion; might they not be referred to Prof. Scribner at Washington?

The alga (*Egregia Menziesii*) was identified by Dr. Farlow.

Various other points will be apparent to you from the list. Possibly you will be able to identify still more of the plants (as now named) with the descriptions of Pursh's Flora.

I wish once more to express my gratitude to you for the great privilege of examining this remarkably valuable and interesting collection. The plants, carefully packed, are to-day returned."

The work by Messrs Robinson and Greenman is so carefully and thoroughly done, that I have used their manuscript. I have added by way of notes, such matters as may not have been covered by the work of these good friends.

LEWIS AND CLARK PLANTS AS DETERMINED BY B. L. ROBINSON AND J. M. GREENMAN AT THE HERBARIUM OF HARVARD UNIVERSITY, OCTOBER, 1897.

Present name of plant, followed by data on accompanying labels. Bracketed notes added during identification.	*Treatment of plant in Pursh's Flora, whenever specifically mentioned. Bracketed notes added during identification.*
Anemone Canadensis L. (*A. Pennsylvanica* L.). Prairies; in the camp near the old Maha village, August 17, 1804.[1]	
Anemone quinquefolia L. On the waters of the Kooskooskee, June 15, 1806. [Flowering stem with involucre].	
Clematis Douglasii Hook. [No label; a single flower, but well identifiable].	[= with scarcely a doubt *C. hirsutissima* Pursh, Fl. 385, being the only species ascribed to Lewis' herbarium]. On the plains of the Columbia River. ♃. May, v. s. in Herb. Lewis.

[1] Pursh describes *Anemone tenella* Fl., 386, "from the banks of the Missouri, Mr. Lewis,—May." *A. tenella* is regarded by Hooker as synonymous with *A. dichotoma* L., which Dr. Robinson refers to *A. Canadensis* L. *A. dichotoma* is not noted in the *Flora* as being from "Lewis." It is possible this specimen is the type of his *tenella*.

Delphinium Menziesii DC.

On the Columbia, April 14, 1806. A sort of Larkspur with 3 styles. [Poor specimen].

Dentaria tenella Pursh.

Columbia near quicksands, April 1, 1806. [Complete, very slender plant].[2]

Pursh, Fl. 439. On the banks of the Columbia. ♃. Apr. v. s. in Herb. Lewis.

Erysimum asperum DC.

On the Kooskooskee, June 1, 1806. [Whole plant, in flower].[3]

E. lanceolatum Pursh, Fl. 436 (not R. Br.). On the banks of the Missouri. ♂. June, v. s.

Cleome integrifolia Torr. & Gray.

Cleome serrulata var. *roseus*, Nova species. Specimens from White River, August 29, 1806. *Cleome*. A new species. [Poor specimen].

C. serrulata Pursh, Fl. 441. On the banks of the Missouri. ⊙. Aug. v. s. in Herb. Lewis. [Leaves are slightly serrulate and name should stand].

Cleome integrifolia Torr. & Gray.

No. 43, August 25th, growth of the open prairies. Open prairies, August 25, 1804.

C. serrulata Pursh, Fl. 441. On the banks of the Missouri. ⊙. Aug. v. s. in Herb. Lewis.

[Pursh says of it: *glabra*, which is certainly true of the stem, and it may, therefore, be safely separated from the very pubescent plant *Polanisia trachysperma* T. & G. (?) with which the specimen is mixed].

Cerastium arvense L.

Plains of Columbia, April 22, 1806. [Good specimen].

C. elongatum Pursh, Fl. 321. On the plains of Columbia River, M. Lewis. ♃. April, v. s. in Herb. Lewis.[4]

[2] The specimen from which the description was evidently taken, in the herbarium of the Academy, has not the tuberous root as this has.

[3] *Erysimum asperum* DC.

Pursh has overlooked this specimen from "Rockford Camp, April 17, 1806," and describes *E. lanceolatum*, which is not distinct, from the collection of Bradbury on the Missouri.

[4] *Cerastium arvense* L.

Cerastium elongatum Pursh, I, 321, "on the plains of the Columbia River, Mr. Lewis, April." The label with specimen reads "Plains of Columbia, April 22, 1806." Modern collators give it as a synonym of *C. arvense*, but with the excellent specimen now in hand, it seems to be a good species. It is not merely hirsute, but glandular viscid in all its parts. Its remarkably long narrow leaves, very leafy nodes with short internodes, are characters which it does not share with any forms of *C. arvense* in our herbarium.

Malvastrum coccineum Gray.

A small malvaceous plant, probably a species of *Malope*. Plains of Missouri, July 20, 1806. [Good specimen].

Cristaria coccinea Pursh, Fl. 453. On dry prairies and extensive plains of Missouri. ♃. Aug. v. v., v. s. in Herb. Lewis.

Linum Lewisii Pursh.

Perennial Flax. Valleys of the Rocky Mountains, July 9, 1806. [Excellent specimen].

Pursh. Fl. 210. In the valleys of the Rocky Mountains and on the banks of the Missouri, M. Lewis, ♃. July, v. v.[5]

Claytonia lanceolata Pursh.

Headwaters of the Kooskooskee, June 27, 1806. [Good specimen].

Pursh, Fl. 175, t. 3. On the Rocky Mountains, M. Lewis. ♃. July, v. s. in Herb. Lewis.[6]

Lewisia triphylla Rob.

On the waters of the Kooskooskee within the Rocky Mountains, June 27, 1806. (*Claytonia triphylla* Wats.). [Extends range to Idaho].

Lewisia rediviva Pursh.

The Indians eat the root of this. Near Clark's River, July, 1, 1806. The calyx consists of 6 or 7 leaves, the corolla many petals and stamens . . . . capsule. [Several flowers only].

Pursh, Fl. 368. On the banks of Clark's River. ♃. July, v. s. in Herb. Lewis.

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[5] *Linum Lewisii* Pursh.

"Perennial flax. Valleys of the Rocky Mountains, July 19, 1806."

Pursh I, 210, adds to the above, "and on the Banks of the Missouri, July, Mr. Lewis. Flowers large, blue, a very good perennial, and it might probably become a useful plant if cultivated."

[6] *Claytonia perfoliata* Don.

"On the Columbia, moist ground, March 26, 1806." Pursh seems to have been in some confusion with his Claytonias. He quotes "Mr. Lewis, on the Rocky Mountains. April and May." There is another specimen labelled "Rocky Camp, April 17, 1806."

Claytonia lanceolata Pursh

"On the headwaters of the Kooskooskee, June 27, 1806." Pursh says: "On the Rocky Mountains, Mr. Lewis, June." Hooker, noting the flowers, which do not correspond with the present specimens, refers the whole as a synonym of *C. Caroliniana*, which the flowers on the picture at p. 175 of Pursh's *Flora* certainly resemble. The flowers are, however, subumbellate, and the species is certainly a good one.

Claytonia Siberica L.

"Columbia River, April 8, 1806." Pursh, describing his *C. lanceolata*, says, "in the collection of A. B. Lambert, Esq., I found a specimen collected

Montia parviflora Howell, form.

On the Columbia, in moist ground, March 26, 1806. [A very poor and indefinite specimen].

Montia parviflora Howell.

Rocky camp, April 17, 1806. [Good specimen].

Montia Sibirica Howell.

Columbia River, April 8, 1806. [Fair specimen].

Pachystima Myrsinites Raf.

Rocky Mountains, June 16, 1806.

Pachystima Myrsinites Raf.

A small shrub about 4 feet high with a small purple berry, evergreen. Near the Pacific Ocean, November 16, 1805. [Second specimen].

Ceanothus velutinus Dougl.

An evergreen; a shrub about 8 or 9 feet high. On the Rocky Mountains; waters of the Kooskooskee. [Probably not *C. sanguineus* Pursh, although that species collected by Lewis on the upper Missouri does not appear in collection.]

Claytonia perfoliata Pursh (not Don.), Fl. 176. On the Rocky Mountains, M. Lewis. ⊙. April, May, v. v. in Hort.

Claytonia alsinoides Pursh, Fl. 175. On the Columbia River, M. Lewis. ⊙. May, June, v. v. in Hort.

Ilex? myrsinites Pursh, Fl. 119. On the Rocky Mountains and near the Pacific Ocean, M. Lewis. ♄. July, August, v. s. in Herb. Lewis.[7]

Pursh, Fl. l. c.

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in the eastern parts of Siberia perfectly agreeing with the present species." He evidently had this in mind when writing of *C. lanceolata*.

Claytonia linearis Dougl.

"On the waters of the Kooskooskee within the Rocky Mountains, June 27, 1806," another wholly overlooked by Pursh.

[7] Pursh described it as an *Ilex* doubtfully, and named *Ilex? myrsinites*, and quotes it as "on the Rocky Mountains, and near the Pacific Ocean, Mr. Lewis, July and August. Rafinesque subsequently constructed the genus *Pachystima* for it. No one has been able to explain the derivation of this name. In the description of Lewis' plant, Pursh writes: "Stigma 4-lobum, crassum. Rafinesque, no doubt, wrote *Pachystigma*, and the orthography should be corrected accordingly.

Rhamnus Purshiana DC.

A shrub apparently a species of *Rhamnus.* About 12 feet high in clumps; fruit a 5-valved purple berry, which the natives eat and esteem highly. The berry depressed, globous. On the waters of the Kooskooskee, May 29, 1806.

R. alnifolia Pursh (not Michx.), Fl. 166. On the banks of the Kooskooskee, M. Lewis. ♄. May, v. s. in Herb. Lewis.

Rhus Canadensis var. **trilobata** Gray.

No. 57, October 1, 1804. First discovered in the neighborhood of the Kancez River, now very common. The growth of the little copses which appear on the steep declivities of the hills where they are sheltered from the ravages of the fire. Common on the declivity of hills; October 1, 1804.

Cissus Ampelopsis Pers.

Near Council Bluffs, Missouri, September 14, 1806. [Leaves, stem, peduncles and pedicels. Lewis' specimen not mentioned by Pursh, who gives range of species as Allegheny Mountains, Pennsylvania to Carolina].

Acer circinatum Pursh.

A very handsome species of maple. On the great rapids of Columbia, October, 1805. [Sterile, but highly characteristic and unmistakable].

Pursh, Fl. 267. On the great rapids of Columbia River, M. Lewis. ♄. v. s. s. fl.[8]

[8] *Acer circinatum* Pursh.

"A very handsome species of Maple. On the Grand Rapids of the Columbia, October, 1805." Pursh, Vol. I, 267, says: "on the Grand Rapids of the Columbia River, M. Lewis. This beautiful species has the leaves of the size of *Acer rubrum.*"

Acer macrophyllum Pursh.

A large timber tree from the grand rapids of the Columbia, April 10, 1806. [A single leaf, but readily recognizable].

Pursh, Fl. 267. On the great rapids of the Columbia River, M. Lewis. ♄. April, v. s.

Polygala alba Nutt.

A kind of Seneca snake root. On the Missouri River, August 10, 1806. [Fairly complete specimen].

Polygala Seneca var. *tenuifolia* Pursh, Fl. 750. On the Missouri, Lewis and Bradbury, v. s.

Amorpha fruticosa var. **angustifolia** Pursh.

On the great bend of the Missouri, August 27, 1806. [Good specimen in fruit].

Pursh, Fl. 466, var. γ v. s. in Herb. Lewis.

Astragalus Missouriensis Nutt.

No. 36, 18th September. The growth of the high prairies.

Astragalus Mortoni Nutt.

No. 46. The growth of the open prairies, taken 15th of September, 1804. *Astragalus* nov. spec. Open prairies, September 5, 1804. May be *A. Uralensis?* L.[9]

Lupinus argenteus Pursh.

On the Cokahlaishkit, July 7, 1806. Flowers yellowish-white. [Good specimen].

Pursh, Fl. 468. On the banks of the Kooskooskee, M. Lewis. ♃. June, July, v. s. in Herb. Lambert. Flowers small, cream coloured.

[9] *Astragalus Mortoni* Nuttall.

"The growth of the open prairie 15th September, 1804." Pursh describes *Astralagus tenellus* "on the banks of the Missouri, M. Lewis, August." From the difference in these two observations it is not clear that this specimen is the one Pursh had in view. Pursh's *A. tenellus* is referred to *A. multiflorus* by modern authors, but Pursh's description of *A. tenellus* does not accord with *A. multiflorus*. The specimens are badly eaten, but are sufficient to make it probable *A tenellus* Pursh, should be referred to *A. Mortoni* Nuttall and, perhaps, the name have priority.

Lupinus sericeus Pursh. New species.

Flowers cream colored with a small tinge of blue. On the Kooskooskee, June 5, 1806. [Tolerable specimen].

(The labels of these two specimens of *Lupinus* were confused.)

Pursh, Fl. 468. On the banks of the Kooskooskee, M. Lewis. ♃. July, v. s. in Herb. Lewis. Flowers pale purple or rose colored.

Oxytropis nana Nutt. var.

Near the head of Clark's River, July, 1806. [Differs from type in having calyx teeth longer also plant larger, leaflets longer].

O. argentata Pursh, Fl. 473. On the banks of Clark's River, M. Lewis. ♃. July, v. s. in Herb. Lewis.[10]

Petalostemon violaceus Michx.

On the Missouri, July 22, 1806. [Stem, leaves and spike of flowers].

Pursh, Fl. 461. In Tennessee, Illinois, and on the banks of the Missouri. ♃. July, September, v. v.

Petalostemon violaceus Michx.

Found September 2d ; the Indians use it as an application to fresh wounds, they bruise the leaves adding a little water and apply it. [Sterile specimen only, and accordingly doubtful].

Pursh, Fl. l. c.

Psoralea argophylla Pursh.

No. 48, No. 103, October 17, 1804. A decoction of the plant used by the Indians to wash their wounds. [Sterile, but characteristic specimen].

Pursh, Fl. 475. On the banks of the Missouri. ♃. v. s.

Psoralea tenuiflora Pursh.

Big bend of Missouri, September 21, 1804. [Stem and leaves].

Pursh, Fl. 475. On the banks of the Missouri, M. Lewis. ♃. September, v. s. in Herb. Lewis.

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[10] *Oxytropis nana* Nutt.

"Near the headwaters of Clark's River, July, 1806." Described by Pursh, Fl. p. 473, as *Oxytropis argentata*.

Trifolium megacephalum Nutt.

A species of clover near Rockford Camp, on high hills, April 17, 1806. [Specimen consists of a head on peduncle and several detached leaves].

Lupinaster macrocephalus Pursh, Fl. 479, t. 23. At the headwaters of the Missouri, M. Lewis. ♃. April, May, v. s. in Herb. Lewis.

Trifolium microcephalum Pursh.

Valley of Clark's River, July 1, 1806. [Good specimen corresponds well with later plants placed in species].

Pursh, Fl. 478. On the banks of Clark's River, M. Lewis. ♃. July, v. s. in Herb. Lewis.

Amelanchier alnifolia Nutt.

Service berry. A small bush, the narrows of Columbia River, April 15, 1806.

Pyrus sanguinea Pursh, Fl. 340, in part. In Canada and on the banks of the Columbia. ♄. April, May, v. v.[11]

Cratægus Douglasii Lindl.

Deep purple Haw. Columbia River, April 29, 1806.

C. glandulosus Pursh, Fl. 337, in part, not Willd. M. Lewis, Esq., collected it on the Rocky Mountains.[12]

Geum triflorum Pursh.

On open ground, common on the waters of the Kooskooskee, June 12, 1806. No. 2.

Geum ciliatum Pursh, Fl. 352. On the banks of the Kooskooskee. ♃. June, v. s. in Herb. Lewis.[13]

Pyrus sambucifolia Cham. & Schlecht ?

On the tops of the highest peaks and mountains, June 27,

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[11] *Amelanchier alnifolia* Nutt.

"Service berry; a small bush. The narrows of the Columbia, April 15, 1806" Pursh describes this, I, 340, as *Pyrus sanguinea*, and must have overlooked this specimen. He quotes "in Canada and on the banks of the Columbia, April, May."

[12] *Cratægus Douglasii* Lindley.

"Deep purple Haw. Columbia River, April 19, 1806." A mate to this specimen is in the Herb. Ac. Nat. Sciences, labelled by Pursh "*Cratægus glandulosa*," and described as such in *Flora*, I, 337. In the *Journal* dated Fort Clatsop, January 20, 1806. The "brown haws berries growing 18 or 20 in a clump" must refer to this species.

[13] *Geum triflorum* Pursh.

"On open ground, common on the waters of the Kooskooskee, June 12, 1806." The flowers are scarcely open. Pursh did not evidently recognize it in this condition, but drew his description from a Bradbury Missouri specimen. He probably had this specimen in mind when describing his *Geum ciliatum*.

1806, in the Rocky Mountains. [Specimen very poor, sterile, not precisely determinable].

Potentilla Anserina L.

The roots are eaten by the natives, and taste like sweet potatoes; grows in marshy ground. Fort Clatsop, March 13, 1806.

Potentilla fruticosa L.

Prairie of the Knobs; July 5, 1806. [Small but characteristic specimen].

Pursh, Fl. 355. On the banks of rivers in Canada and on the waters of the Rocky Mountains, June, August, Lewis, v. v. in Hortis, v. s. in Herb. Lewis.

Prunus demissa Nutt.

Prunus, a cherry found near the beaver bents on the Missouri, August 10, 1806. [Specimen poor and sterile].

Prunus Virginiana L.

Prunus, Choak or Pidgeon Cherry. On the waters of the Kooskooskee, 29th May, 1806. [Specimen poor and sterile].

Prunus ?

Near the base of the Rocky mounts on the west side near Collins's Creek. The shrub about 6 or 7 feet high; June 27, 1806. [Unrecognizable].

Prunus ?

A shrub about 6 feet high from the Kooskooskee, May 7, 1806. [Unrecognizable; dark purple stem, elliptic serrulate leaves].

Prunus sp.

A smaller shrub than the Choak berry, the natives count it a good fruit. On the Kooskooskee, 29th May, 1806. [Too poor for identification].[14]

Purshia tridentata DC.

A shrub common to the open prairie of the knobs, July 6, 1806. [Good specimen].

Tigarea tridentata Pursh, Fl. 333, t. 15. In the prairies of the Rocky Mountains and on the Columbia River. ♄. July, v. s. in Herb. Lewis.

Rosa Woodsii Lindl.

No. 50. October 18th. The small rose of the prairies, it rises from 12 to 14 inches high ; does not vine. Rosa, open prairies, September 5, 1804.[15]

Rubus Nutkanus var. **velutinus** Brew.

A shrub of which the natives eat the young sprout without cooking. On the Columbia, April 15, 1806.

Rubus spectabilis Pursh.

Fruit like a raspberry. Columbia, March 27, 1806. [A fairly good specimen showing stem, leaves and flowers].

Pursh, Fl. 348, t. 16. On the banks of the Columbia, M. Lewis, on the northwest coast, Menzies. ♄. April, May, v. s. in Herb. Lewis nec non Banks.[16]

Spiræa discolor Pursh.

A shrub growing much in the manner of Nine bark. On the waters of the Kooskooskee, May 29, 1806.

Pursh, Flora, 342. On the banks of the Kooskooskee. ♄. June, July, v. s. in Herb. Lewis.

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[14] *Prunus pumila* L.

Though but a single leaf is left with the branch, it is evidently the one referred to as "a smaller shrub than the 'choak' cherry. The natives account it good fruit."

[15] *Rosa Woodsii* Lindley.

"October 18, 1804. The small rose of the prairies; it rises from 12 to 14 inches, and does not vine." Only a small branch without flower. At this date they were at or near Fort Mandan. May 18th, at Chopunnish camp, they 'saw the wild roses in bloom," but this is probably one of the forms more closely related to *R. cinnamomea*.

[16] *Rubus spectabilis* Pursh.

"Fruit like a raspberry. Columbia, March 27, 1806." Pursh described and figured I, p. 348, "on the banks of the Columbia." The *Journal* of June 10th, at Chopunnish camp, notes that "purple raspberries were ripe and abundant."

Philadelphus Lewisii Pursh ?

A shrub from the Kooskooskee, May 6, 1806. A *Philadelphus?* [Sterile and too poor for certain identification].

Pursh, Fl. 329.

Philadelphus Lewisii Pursh.

On the waters of Clark's River, July 4, 1806. [Fairly good flowering specimen].

Pursh, Fl. 329. On the waters of Clark's River. ♄. July, v. s. in Herb. Lewis.

Ribes aureum Pursh.

Yellow flowering currant. Near the narrows of the Columbia River, April 16, 1806. [Very poor specimen].

Pursh, Fl. 164. On the banks of the rivers Missouri and Columbia, M. Lewis. ♄. April, v. s. in Herb. Lewis, v. v. in Hort.

Ribes aureum Pursh.

Yellow currant of the Missouri, July 29, 1805. [The thing, but from date not the type].

Pursh, Fl. 164.

Ribes Menziesii Pursh ?

Deep Purple Gooseberry. Columbia River, April 8, 1806.

Pursh, Fl. 372. [Pursh does not mention Lewis' specimen or its range].[17]

Ribes sanguineum Pursh.

Columbia, March 27, 1806.

Pursh, Fl. 164. On the Columbia River, M. Lewis. ♄. March, v. s. in Herb. Lewis.

Ribes viscosissimum Pursh.

Fruit indifferent and gummy. The heights of the Rocky Mountains, June 16, 1806.

Pursh, Fl. 163. On the Rocky Mountains in the interior of North America, M. Lewis. ♄. June, v. s. in Herb. Lewis.[18]

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[17] *Ribes Menziesii* Pursh.

"Deep purple Gooseberry. Columbia River, April 8, 1806." Specimens now wholly leafless. Pursh described his species from a specimen collected by Menzies, not perceiving, apparently, the specimen in this collection.

[18] *Ribes* sp.

In the *Meteorological Journal*, under date of March 27, 1806—"The red flowering currant is in bloom. This I take to be the same species I first saw in the Rocky Mountains. The fruit is a deep purple berry, covered with a gummy substance, and not agreeably flavored. There is another species not covered with gum, which I first found on the headwaters of the Columbia, about 12th of August last." The former is evidently *R. sanguineum*.

Clarkia pulchella Pursh.

A beautiful herbaceous plant from the Kooskooskee and Clark's River, June 1, 1806. [Fair specimen].

Pursh, Fl. 260, t. 11. On the Kooskooskee and Clark's Rivers, M. Lewis. ♂. June, v. s.

Œnothera cæspitosa Nutt.

Near the falls of the Missouri, 17th July, 1806. [Good specimen].

O. scapigera Pursh, Fl. 263. On the falls of the Missouri, M. Lewis. ♃. July, v. s.

O. cæspitosa Pursh, Fl. 735. On the banks of the Missouri, M. Lewis. ♃. June, July, v. s. specimen *imperfectum* in Herb. Lewis.

Œnothera heterantha Nutt.

In moist ground on the Squamash flats, June 14, 1806. [Good specimen].

Sedum stenopetalum Pursh.

Valley of Clark's River, July 1, 1806. On the naked rocks of the Kooskooskee, June 15, 1806.

Pursh, Fl. 324. On rocks on the banks of Clark's River and Kooskooskee. ♃. June, July, v. s. in Herb. Lewis.

Angelica, within the Rocky Mountains in moist places, June 25, 1806. The flowering one taken on September 3, 1805. [Label only].

[Probably a *Peucedanum*, poor specimen, no fruit]. A large, fusiform root which the natives prepare by baking; near the Sepulchre Rock. On the Columbia River, April 14, 1806.

Peucedanum leiocarpum Nutt.

Supposed to be a *Smyrnium*. The natives eat the tops and boil it sometimes with their soup. On the Columbia, April 15, 1806.

Smyrnium nudicaule? Pursh, Fl. 196. On the Columbia River, M. Lewis. ♃. April, May, v. s. in Herb. Lewis. The natives eat the tops of this plant and boil it in their soups, the same as we use celery. [Erroneously placed under *Ferula* and *Peucedanum nudicaule* Nutt.]

Peucedanum simplex Nutt. (or **P. triternatum** Pursh.)

A root 5 or 6 inches long eaten raw or boiled by the natives. On the Kooskooskee, May 6, 1806. [Leaves only, and species very doubtful. *P. triternatum* is said to grow on the waters of the Columbia].

Peucedanum utriculatum Nutt. ?

A great horse medicine among the natives. On the Kooskooskee, June 10, 1806. Grows on rich upland. [Specimen poor and not certainly identifiable].

Phellandrium aquaticum Pursh (not L.), Fl. 195. On the waters of the Rocky Mountains, M. Lewis. ♃. July, v. s. in Herb. Lewis. The Indians of that country use it as a medicine in the diseases of horses.

An umbelliferous plant of the root of which the Wallowallows make a kind of bread. The natives call it Shappalell. April 29, 1806. [Sterile and n o t placed ; leaves and root].[19]

[Label only].

A species of Fennel root eaten by the Indians, of an annis-seed taste ; flowers white. Columbia River, April 25, 1806.

[Unidentifiable].

An umbelliferous plant with large fusiform root which the natives bake and eat. On the Columbia, April 15, 1806.

[Unidentifiable, stems only].

An umbelliferous plant, of which the natives don't eat the root. On the Columbia, April 14, 1806.

[19] I suggested no name for this when sending the collection to Dr. Robinson, but am now inclined to regard it as *Cymopterus campestris* Nutt. There is no specimen in our herbarium to compare it with.

Cornus Canadensis L.

Root horizontal. June 16, 1806, Collins Creek.

Lonicera ciliosa Poir.

On the Kooskooskee, June 5, 1806.

Caprifolium ciliosum Pursh, Fl. 160. On the banks of the Kooskooskee, M. Lewis. ♄. June v. s. in Herb. Lewis.[20]

Lonicera ciliosa Poir.

Rocky Mountains, June 16, 1806. [Poor and sterile, but characteristic].[21]

Caprifolium ciliosum Pursh, [but not the type specimen].

Lonicera involucrata Banks.

Shrub within the Rocky Mountains, found in moist ground near branches of rivulets, July 7, 1806. No. 5 found on the waters of the Columbia, September 2, 1805. The growth of a moist situation seldom rises higher than 6 or 8 feet; puts up a number of succulent sprouts, forming a thick bush. [Stems only].

Achillea Millefolium L.

Camp on the Kooskooskee, May 20, 1806.

A. tomentosa Pursh, (not Willd.), Fl. 563. On the banks of the Kooskooskee, M. Lewis. ♃. June, v. s. in Herb. Lewis.[22]

Aplopappus spinulosus DC.

Prairies, September 15, 1804.

Amellus spinulosus Pursh, Fl. 564. In open prairies on the Missouri, M. Lewis. ♃. August, September, v. s. in Herb. Lewis.

[20] *Caprifolium ciliosum* Pursh.

[21] *Lonicera ciliosa* Poir.

"On the Kooskooskee, June 5, 1806" A flowerless branch. Pursh says: "on the banks of the Kooskooskee. M. Lewis, June; flowers of a deep yellow." In the *Journal*, reference is made to "the honeysuckle first found on the Kooskooskee, near the Chopunnish Nation, and again below the Grand Rapids," as among the plants of the Pacific coast.

[22] *Achillea Millefolium* L.

"Camp on the Kooskooskee, May 20, 1806." Described by Pursh as *A. tomentosa* Willd, "on the banks of the Kooskooskee, M. Lewis, June; flowers yellow." The specimens were evidently white, but turned yellow in drying. Pursh, Fl. II, 563, not 319, as quoted in Gray's Synoptical Flora.

Aplopappus sp.

On the Columbia, October, 1805.

Artemisia cana Pursh.

No. 55. October 2, 1804. Growth of the high bluffs.

Pursh, Fl. 521. On the Missouri, M. Lewis. ♃. September, November, v. s. in Herb. Lewis.

Artemisia cana Pursh.

On the bluffs, October 2, 1804.

Pursh, Fl. l. c.

Artemisia cana Pursh.

On the bluffs, October 1, 1804. No. 60. 1804, October 1st. Another variety of wild sage growth of high and bottom prairies.

Pursh, Fl. l. c.

Artemisia dracunculoides Pursh.

No. 52. September 15, 1804. Growth of the open plains. On the bluffs, September 15, 1804. [Good specimen].

A. Dracunculus Pursh (not L.), Fl. 521. On the Missouri, M. Lewis. ♃. August, October, v. s. in Herb. Lewis.

Artemisia frigida Willd.

No. 41 found on the bluffs the 2d of September, 1804, is the growth of open high situations. On the bluffs, September 2, 1804. [Good specimen].

Pursh, Fl. 521. On the plains of the Missouri, M. Lewis. ♃. October, November, v. s. in Herb. Lewis.

Artemisia frigida Willd.

No. 51. 1804, October 3d. Radix perennial; 3 to 8 stalks as high as the specimen; growth of the high sides of the bluffs.

Pursh, Fl. l. c.

Artemisia longifolia Nutt.

Wild sage on the bluffs, October 1, 1804. No. 53. October 3d. Flavor like the camomile, radix perennial; growth of the high bluffs.

A. integrifolia Pursh (not Willd.), Fl. 520. On the cliffs and dry savannahs of the Missouri, M. Lewis. ♃. October, v. s. in Herb. Lewis. About three feet high.

Artemisia Ludoviciana Nutt.?

Artemisia species. Columbia River, April 10, 1806. Artemisia. Rockford Camp.

Aster oblongifolius Nutt.

Big bend of the Missouri, September 21, 1804.

Aster Oreganus Nutt.

On Lewis River, October, 1805.

Balsamorrhiza sagittata Nutt.

Rocky Mountains, dry hills, July 7, 1806.

Buphthalmum sagittatum Pursh, Fl. 564. On dry barren hills in the Rocky Mountains, M. Lewis. ♃. June, July, v. s. in Herb. Lewis. The natives eat the young stems as they spring up, raw.

Balsamorrhiza sagittata Nutt.

The stem is eaten by the natives without any preparation. On the Columbia, April 14, 1806.

Buphthalmum sagittatum Pursh, l. c.

[Bidens-like composite, too poor to identify]. On Lewis's River, October, 1805.

Bigelowia graveolens Gray.

A low shrub growing in the rocky, dry hills on the Kooskooskee. May 6, 1806.

Bigelowia graveolens Gray.

No. 54, Oct. 2. Grows from 18 inches to 2½ feet, many stalks from the same root, from which they issue near the ground; the radix perennial. The goat or antelope feed on it in the winter, it is the growth of the high bluffs. High bluffs; goats feed upon; 18 inches high. Oct. 2, 1804.

Chrysocoma dracunculoides Pursh (not Lam.), Fl. 517. On high cliffs on the banks of the Missouri. M. Lewis. ♃. Oct. v. s. in Herb. Lewis.

Bigelowia graveolens var. **albicaulis** Gray.

15 Oct. 1805, on the Columbia River.

Chrysocoma nauseosa Pall. in herb. Pursh, Fl. 517. On the banks of the Missouri. M. Lewis. ♃. Oct. v. s. in Herb. Lewis.

Cnicus edulis Gray.

Carduus or Thistle-Roots, eatable. Fort Clatsop, March 13, 1806.[23]

Eriophyllum cæspitosum Dougl.

On the uplands on the Kooskooskee River. June 6, 1806.

Actinella lanata Pursh, Fl. 560. On the high lands of the Kooskooskee. M. Lewis. ♃. June, July, v. s. in Herb. Lewis.[24]

Gaillardia aristata Pursh.

Rocky Mountains, dry hills. July 7, 1806.

Pursh, Fl. 573. On dry hills on the Rocky Mountains. M. Lewis. ♂. v. s. in Herb. Lewis.

Grindelia squarrosa Dunal.

No. 40, taken on the 17th of August, 1804, at our camp near the old Maha village, and is the growth of the prairies. Anonymous balsamifera, new genus, Prairies; in the camp near the old Maha village. Aug. 17, 1804. [Good specimen].

Donia squarrosa Pursh, Fl. 559. In open prairies on the banks of the Missouri. M. Lewis. ♃. Aug., Sept., v. s. in Herb. Lewis; v. v. cult.

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[23] *Cnicus edulis* Gray.

Only a single leaf, overlooked by Pursh. "Leaves of a thistle; roots edible. Fort Clatsop, March 13, 1806. The *Journal* of January 20th says: "The root is the part used. It is nine to fifteen inches long—the size of a man's thumb, perpendicular, fusiform; when first taken from the earth, the root is white, and nearly as crisp as a carrot. In this state it is sometimes eaten without any preparation, but after it is prepared after the same process used for the pashemo-quamash, which is the most usual and best method, it becomes black, but is much improved in flavor. Its taste is exactly that of sugar, and it is indeed the sweetest vegetable employed by the Indians."

[24] *Eriophyllum cæspitosum* Douglas

Described by Pursh as *Actinella lanata*, II, 560, "on the uplands on the Kooskooskee, June 6 1806." Pursh says: "on the highlands of the Kooskooskee, M. Lewis, June and July." It resembles in habit Pursh's *Actinea*. A mate to this specimen is in the herbarium of the Academy as "*Actinea lanata*." From a number of specimens from different localities, those of Lewis differ in having the flower stalks thicken upwardly.

Gutierrezia Euthamiæ Torr. & Gray.

No. 32. Specimens of aromatic plants on which the antelope feeds; these were obtained 21st of Sept. 1805, at the upper part of the big bend of the Missouri. Upper part of the big bend of the Missouri, Sept. 21, 1804.

Solidago Sarothræ Pursh, Fl. 540. On the plains of the Missouri. M. Lewis. ♃. Sept. v. s. in Herb. Lewis.

Gutierrezia Euthamiæ Torr. & Gray.

No. 59, 1804, 19th September, the growth of high and bare prairies which produced little grass, generally mineral earth. High, bare prairies, mineral earth, with very little grass. Sept. 19, 1804.

Solidago Sarothræ Pursh, Fl. l. c.

Liatris pycnostachya Michx.

No. 35, Sept. 15th growth of the prairies. Prairies, Sept. 15, 1804.

Liatris scariosa Willd.

No. 53, 12th September, growth of high and dry prairies. High and dry prairies. Sept. 12, 1804.

[Lewis' specimen not mentioned by Pursh].

Matricaria discoidea DC.

An agreeable smell. On the Kooskooskee, June 9, 1806.

Santolina suaveolens Pursh, Fl. 520. On the banks of the Kooskooskee. M. Lewis. ⊙. June–Aug. v. v.; v. s. in Herb. Lewis.

Microseris macrochæta Gray.

Rock Camp. April 17, 1806.

Solidago rigida L.

High dry prairies. Sept. 13, 1804.

[Composite? Poor, sterile and not placed; leaves opposite, much divided into narrow segments, very pubescent]. One of the most common plants of the plains of Columbia. May 27, 1806.

Arotostaphylos Uva-ursi Spreng.

No. 33. An evergreen plant which grows on the open plains, usually; the natives smoke its leaves mixed with tobacco; called by the French *Engages* (?) *sacacommis;* obtained at Fort Mandan. Fort Mandan, open plains. Evergreen called Sacacommis, natives smoke its leaves.

Arbutus Uva-ursi Pursh (not Willd.), Fl. 283. On the plains of the Mississippi; the Indians smoke the leaves under the name of Sacacommis, and consider them of great medicinal virtue.[25]

Arbutus Menziesii Pursh.

A middle-sized tree with a remarkable smooth bark, which scales off in the manner of the birch, and red berries in clusters. Columbia River, Nov. 1, 1805.

Pursh, Fl. 282 [but does not mention Lewis' specimen].

Gaultheria Shallon Pursh.

The shallon, supposed to be a species of *Vaccinium*. On the coast of the Pacific Ocean. June 20, 1806.

Pursh, Fl. 283. On the falls of Columbia and near the western ocean. M. Lewis. ♄. May, June, v. s. in Herb. Lewis nec non Banks.[26]

[25] *Arctostaphylos Uva-ursi* Sprengel.

"An evergreen plant which grows in the open plains usually; the natives smoke its leaves mixed with tobacco. It is called by the French *Engagees sacacommis*, obtained at Fort Mandan." Pursh, Fl. 1. 283, says: "on the plains of the Mississippi the Indians smoke the leaves under the name of *sacacommis*, and consider them of great medicinal value," but does not credit Lewis. It is not clear whom he refers to as "*Engages*," but the name may have been given by the French and not by the Indians. The *Journal* speaks of a plant "known by the traders as *sacacommis*." Professor Knowlton in the notes to Coues' edition of the travels, suggests the *Arctostaphylos pungens* for this, but Lewis' label as above, settles the question. The *Journal* further says: "The natives eat the berries without any preparation. They are sometimes gathered and hung in the lodges in bags."

[26] *Gaultheria Shallon* Pursh.

Described and figured by Pursh, I, 284. "The *shallon*, supposed to be a species of *Vaccinium*, on the coast of the Pacific Ocean, January 10. 1806;" leaves and branches only. Pursh says: "on the Falls of the Columbia and near the western Ocean, M. Lewis." He further notes that he described from the more perfect specimens of Menzies. The *Journal* says: "Shallum is a favorite food of the elk It has a dark purple berry of pleasant flavor. The natives eat the berry when ripe, but seldom collect it in quantities to dry for winter use." It is generally known in these times as the Salal berry.

Vaccinium Myrtillus L.

New species. With a purple, small berry, eatable—an evergreen. Fort Clatsop, June 20, 1806.[27]

Vaccinium ovatum Pursh.

A shrub of 7 or 8 feet high, supposed to be a species of *Vaccinium ;* the berries are eaten by the natives On the Pacific Ocean. Fort Clatsop, June 27, 1806.

Pursh, Fl. 290. On the Columbia River. M. Lewis. ♄. May.[28]

Dodecatheon Meadia L.

Near the narrows of the Columbia River. April 16, 1806.[29]

Frasera thyrsiflora Hook.

In moist wet places, on the Squamash flats. June 14, 1806. [Leaf only].

Swertia fastigiata Pursh, Fl. 101. On the Missouri Flats near the Rocky Mountains. M. Lewis. ♃. July, v. s. in Herb. Lewis.

Collomia linearis Nutt.

Rockford Camp. April 17, 1806.

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[27] *Vaccinium myrtilloides* L.

This specimen is not in flower or fruit, but is so nearly a fac-simile of some forms of *Gaultheria Myrsinites*, which Pursh's *Vaccinium obtusum* has been supposed to be, that it is in all probability the type of *V. obtusum*, Fl., p. 290, though the description refers only to a specimen collected by Menzies.

[28] *Vaccinium ovatum* Pursh.

"A shrub 7 or 8 feet high, supposed to be a species of *Vaccinium.* The berries are eaten by the natives. On the Pacific Ocean. Fort Clatsop, June 27, 1806." Pursh simply says I, p. 290, "on the Columbia River, M. Lewis." The Journal notes among the berry plants esteemed by the natives "a species of huckleberry," and. referring to the huckleberry, "there are two species of shrubs first seen at the Grand Rapids of the Columbia, and since seen elsewhere. They grow in rich, dry ground." The Columbia River specimen not now in the collection was probably the one from which the description was made.

[29] *Dodecatheon Meadia* L.

"Near the narrows of the Columbia River, April 16, 1806." Pursh overlooks this; it was probably the first finding of it so far west. There might have been a specimen collected on the march up the Missouri in 1804. as in the *Journal* under date April 17th, it is noted that "violets, doves foot and cowslips are in bloom." the *Dodecatheon* being probably referred to as cowslips. If to the return from the Pacific, April 9, 1806, when they found "cowslips" again in bloom, would refer to the Columbia specimen.

Gilia aggregata Spreng.

On Hungry Creek, June 26, 1806. [Flowering stem].

Cantua aggregata Pursh, Fl. 147. On the banks of the Mississippi. M. Lewis. ♂. June, v. s .in Herb. Lewis.

Polemonium cæruleum L.

Headwaters of the Kooskooskee. June 27, 1806.

Phacelia circinata Jacq.

Root fibrous, plant from 3–4 feet high; dry situation. On the Kooskooskee, June 9, 1806. [Poor specimen].

Phacelia heterophylla Pursh, Fl. 140. On dry hills on the banks of the Kooskooskee. M. Lewis. ♂. June, July, v. s. in Herb. Lewis.[30].

Phacelia Menziesii Torr.!

Rocky Camp. April 17, 1806.

Hydrophyllum lineare Pursh, Fl. 134. On the banks of the Missouri. M. Lewis. ♃. April, v. s. in Herb. Lewis. [Specimen in Hb. Philada. Acad. showing flowers and leaves, root annual, not perennial.]

Plagiobothrys tenellus Gray.

Rocky Camp. April 17, 1806.

Krynitskia sp.?

Rocky Camp. April 17, 1806.

Nicotiana quadrivalvis Pursh.

No. 45. Specimen of the Ricara's tobacco, taken 12th of October, 1804. 12th of October, at the Ricara's town. This is the tobacco which they cultivate.

Pursh, Fl. 141. Cultivated and spontaneous on the Missouri, principally among the Mandan and Ricara nations. ⊙. July, v. v.; v. s. in Herb. Lewis nec non Nuttall. The tobacco prepared from it is excellent. The most delicate tobacco is prepared by the Indians from the dried flowers.

[30] *Phacelia circinata* Jacq. f.

Described by Pursh Fl., I, 140, as *Phacelia heterophylla*. "On the Kooskooskee, August 9, 1806; root fibrous, plant 3 to 4 feet high; dry situations." Pursh says: "on dry hills on the banks of the Kooskooskee, July, August." Only a few leaves and a portion of the flower branch have escaped the ravages of the beetles. The specimen from which Pursh took his description, evidently, is in the herbarium of the Academy of Natural Sciences, under the provisional name of *Phacelia scabiosæfolia*.

Collinsia parviflora Dougl.

Rockford Camp. April 17, 1806. [From size of corolla apparently *C. parviflora* rather than *C. violacea* as placed by Gray, yet identity is not certain].

Antirrhinum tenellum Pursh, Fl. 421. On the banks of the Missouri. M. Lewis. ⊙. July, v. v.; v. s. in Herb. Lewis.

Mimulus luteus L.

On the waters of Clark's River, July 4, 1806. [Indifferent specimens but showing stem, leaves and flowers; upper portion of the plant is not glabrous as described by Pursh, l. c., but finely and densely glandular-puberulent.

Pursh, Fl. 426. On the banks of Clark's River. M. Lewis. On the northwest coast, Pallas. ♃. July, Aug., v. s. in Herb. Lewis, nec non Lambert.

Orthocarpus tenuifolius Benth.

Valley of Clark's River, July 1, 1806. [A good specimen, showing, the root to be distinctly annual, not perennial, as described. The color of the flowers is not shown.]

Bartsia tenuifolia Pursh, Fl. 429. On the banks of Clark's River. M. Lewis. ♃. July, v. s. in Herb. Lewis.

Pedicularis Grœnlandica Retz.

On the low plains on the heath of Clark's River, July 6, 1806.

P. uncinata Willd.

[Pursh named this *P. uncinata* Willd., (Siberian) on his label, but evidently discovered his error before publication, as in his Flora he gives *P. Grœnlandica*].

Pursh, Fl. 426. In low plains of the Columbia. M. Lewis. ♃. July, v. s. in Herb. Lewis nec non Lambert.

Pedicularis scopulorum Gray. ?

On the low plains on the heath of Clark's River. July 6, 1806.

P. elata Pursh (not Willd.), Fl. 425. In the low plains, on the waters of Clark's River. M. Lewis. ♃. July, v. s. in Herb. Lewis.

[*P. elata* Pursh, not Willd., has been doubtfully referred to *P. bracteosa* Benth., but it is certainly different. It has *purple* *flowers* as described, but the calyx is not glabrous but pubescent. In all characters shown it agrees well with *P. scopulorum* Gray, notwithstanding difference in distribution and altitude.]

Pentstemon diffusus Dougl.

Camp on the Kooskooskee, May 20, 1806.

Synthyris reniformis var. **major** Hook.

On Hungry Creek, June 26, 1806. [Does not well agree with *Veronica reniformis* Pursh (ex. char.), Fl. 10, for that is said to have a creeping stem, opposite leaves and alternate peduncles, and to have been collected in boggy soil on the banks of the Missouri.]

Salvia lanceolata Willd.

Big bend of Missouri, Sept. 21, 1804. [Good specimen].

S. trichostemmoides Pursh, Fl. 19. In open plains on the Missouri River. M. Lewis. ⊙. v. s. in Herb. Lewis.

Scutellaria angustifolia Pursh.

On the Kooskooskee, June 5, 1806.

Pursh, Fl. 412. On the river Kooskooskee. M. Lewis. ♃. June, v. s. in Herb. Lewis.

Oxybaphus nyctagineus Sweet.

Open plains, Sept. 1, 1804. [Fairly complete.]

Allionia ovata Pursh, Fl. 97. On the plains of the Missouri. M. Lewis. ⊙. Aug. v. s. in Herb. Lewis.

Atriplex canescens James.

Sept. 21. Big bend of the Missouri, Sept. 21, 1804.

Calligonum canescens Pursh, Fl. 370. In the plains of the Missouri, near the big bend. ♄. July, Aug. v. s. in Herb. Lewis.

Atriplex Nuttallii Wats.

A half shrub from the high plains of Missouri, July 20, 1806.

Sarcobatus maculatus Torr.

A small branchy shrub from the plains of Missouri, July 20, 1806.

Polygonum bistortioides Pursh.

Polygonum near to *bistorte.* In moist grounds on Quamash flats, June 12, 1806. [Leaves and inflorescence].

Pursh, Fl. 271. In low grounds on the banks of the Missouri, called Quamash-flats. M. Lewis. ♃. June, v. s.

Elæagnus argentea Pursh.

Silver tree of the Missouri. From the prairie of the Knobs. July 6, 1806.

Pursh, Fl. 114. In the extensive plains on the banks of the Missouri. M. Lewis and T. Nuttall. ♄. July, v. s. in Herb. Lewis. Missouri silver tree.

Shepherdia argentea Nutt.

A. No. 39. Obtained at the mouth of the river Quicourre from which place upwards it is abundant; in the Missouri bottoms it is a pleasant twig to eat. It has much the flavor of the cranberry, and continues on the bush through the winter. This is an evergreen shrub; some plants are sent down by the barge to the care of Capt. Stoddard at St. Louis. From the mouth of the river Quicourre and from there upwards in all the Missouri bottoms. The berry pleasant, acid like cranberry, and hang on all winter; evergreen.

Hippophæ argentea Pursh, Fl. 115. On the banks of the Missouri. M. Lewis. ♄ v. s. in Herb. Lewis.

Euphorbia heterophylla L.

No. 38. 1804, Oct. 4. The growth of the high prairies or plains. High prairies and plains. Oct. 4, 1804.

E. cyathophora Pursh (not Willd.), Fl. 605. On the banks of the Mississippi. ♄. ⊙. June, July, v. v.

Euphorbia marginata Pursh.

On the Yellowstone River, July 28, 1806.

Pursh, Fl. 607. On the Yellowstone River. M. Lewis. ⊙. July, v. s. in Herb. Lewis.

Maclura aurantiaca Nutt.

[No label. Sterile specimen.]

Betula ?

Black alder of the Pacific Ocean; grows to a large size. March 26, 1806. [Specimens consist only of fragmentary sterile catkins.][31]

Quercus Garryana Dougl.

A sort of White Oak. Columbia, March 26, 1806.

Quercus macrocarpa Michx.

No. 34. The leaf of oak which is common to the prairies. 5th Sept., 1804. Common to the prairies, Sept. 5, 1804.[32]

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[31] *Alnus rubra* Bongard.

"Black Alder of the Pacific Ocean, grows to a large size: March 26, 1806." The leaves and catkins have been wholly destroyed, except a portion of one male ament and the naked branch. But there is little doubt of the accuracy of the determination. The *Journal* says of it: "The Black Alder arrives to a great size It is simple branching and diffuse – the bark is smooth and of a light color, with white spreading shoots resembling those of the beech, the leaf and fructification resemble precisely the common alder of our country. The shrubs grow separately from different roots, not in clusters like those of the United States. The Black Alder does not cast its leaves till December 1st. It is sometimes growing to the height of 60 or 70 feet, and from two to four feet in diameter."

[32] *Quercus macrocarpa* var. *depressa* Engel.

"The leaf of oak, which is common to the prairies, September 5, 1804." The *Journal* says: "September 5th, when 4½ miles from White Point Creek, the Rapid River (now Niobrara) a beautiful plain on the upper side where the Pawnees once had a village, we camped just above it (now in South Dakota in the Pinca Reservation). The place where we halted is a fine low ground with much timber, such as Red Cedar, Honey Locust, Oak, Arrowhead, Elm and Coffee Nut." On September 15th is again recorded, "our camp is in a beautiful plain (opposite what is now Brulé City) with timber scattered thinly for ¾ mile, consisting chiefly of Elm, Cottonwood, some Ash of indifferent quality, and a considerable quantity of a species of White Oak. This tree seldom rises higher than 30 feet, and branches very much. The bark is thick and of a light color. The leaves are small, deeply indented and of a light green. The cup which contains the acorn is fringed on the edges, and embraces it about one half. The acorn itself, which grows in great profusion, is of excellent flavor, and has none of the roughness which most acorns possess These acorns are now falling, and have probably attracted the large number of deer which we saw in this place, as all the animals we have seen are fond of that food." The travellers were not botanists, but a specialist could not have drawn a better description of *Quercus macrocarpa* var. *depressa*. The specimen in the collection has come through in excellent condition.

Populus monilifera Ait.

Cotton tree of the Mississippi and Missouri. Aug., 1806.

P. angulata Pursh (not Willd.), Fl. 619. It is known by the name of Mississippi Cotton Tree. [Lewis' specimen not mentioned.]

Populus trichocarpa Torr. & Gray.

Cotton tree of the Columbia River. June, 1806.

Calypso borealis Salisb.

Waters of Hungry Creek, Rocky Mountains. June 16, 1806.

Pursh, Fl. 593. On the Columbia River. M. Lewis. ♃. May, June, v. s. in Herb. Lewis.

Iris Missouriensis Nutt.

[So far as fragmentary specimen shows.] A pale blue species of Flag. Prairie of the Knobs, July 5, 1806.

Iris Sibirica Pursh (not Willd.), Fl. 30. On the banks of the Missouri. M. Lewis. ♃. July, v. v.; v. s. in Herb. Lewis.

Allium, sp.

On the waters of the Kooskooskee, Apr. 30, 1806. [Very poor sterile specimen.][33]

[Perhaps a part of] *A. angulosum* Willd. of Pursh, Fl. 223. On the banks of the Missouri. M. Lewis and Nuttall. ♃. July, v. s. in Herb. Lewis.

Brodiæa Douglasii Wats.

Hyacinth of the Columbia plains, Apr. 20, 1806. [Good specimen. Watson's synon. wrong, Proc. Am. Acad. xiv, 238. Where Pursh's *grandiflora* is placed under *laeta*].

B. grandiflora Pursh (not Smith), Fl. 223. On the plains of the Columbia and Missouri Rivers. M. Lewis. ♃. Apr., May, v. v.[34]

[33] *Allium* sp.

Pursh describes *Allium angulosum* I, p. 223, as "on the banks of the Missouri, M. Lewis, July." The specimen in this collection is so eaten that neither flowers nor roots are left. As these remains are ticketed "on the waters of the Kooskooskee, April 30, 1806," it is probably of another species overlooked by Pursh, and not *angulosum*. So far as the leaves indicate, it may be *A. reticulatum*.

[34] Described by Pursh as *Brodiæa grandiflora* Fl. I, p. 223. "Hyacinth of Colorado Plains, April 20, 1806." Pursh says: "on the plains of the Columbia and Missouri Rivers, M. Lewis, April and May. This elegant bulbous plant was called by M. Lewis rightly, Missouri Hyacinth." In the *Journal* of the expedition it is noted under date of April 16th, then at Rockfort camp, "a species of Hyacinth, a native of this place, bloomed to-day. It was not in bloom yesterday."

Calochortus elegans Pursh.

A small bulb of a pleasant flavor; eat by the natives. On the Kooskooskee, May 17, 1806. [Small specimen, 1 leaf and 1 flower. Specimen depauperate in manner of var. *nanus*, Wood, but petals obtusish and not ciliate.]

Pursh, Fl. 240. On the headwaters of the Kooskooskee. M. Lewis. ♃. May, v. s. in Herb. Lewis. The roots are eaten by the natives.

Camassia esculenta Lindl.

Near the foot of the Rocky Mountains on the Quamash flats. June 23, 1806. [Good specimen].

Phalangium Quamash Pursh, Fl. 226. On the upper part of the Missouri, near the Rocky Mountains. M. Lewis. ♃. June v. s. in Herb. Lewis.[35].

Erythronium grandiflorum Pursh.

A squamose bulb. On the waters of the Kooskooskee, June 5, 1806. [Indifferent specimen with one good flower and a poor leaf.]

Pursh, Fl. 231. On the Kooskooskee. M. Lewis. ♃; May June, v. s.

Erythronium grandiflorum var. **parviflorum** Wats.

From the plains of the Columbia near Kooskooskee River, May 8, 1806. The natives reckon the root unfit for food. [Three flowers and one leaf bearingstem. Probably the Missouri River specimen of *E. lanceolatum* Pursh, Fl. 230.]

[35] Pursh says: "on the Upper Missouri near the Rocky Mountains, M. Lewis, June. The plant is known among the natives as Quamash, and the bulbs are carefully collected by them and baked between hot stones, when they assume the appearance of baked pears, and are of an agreeable sweet taste; they form a great part of their winter stores. Though an agreeable food to Captain Lewis' party, they occasion baneful complaints if eaten in quantity." Under June 29, 1806, the *Journal* says: "the Quamash and strawberries are just beginning to bloom at the flats at the head of the Kooskooskee."

Fritillaria lanceolata Pursh.

Specimen of a liliaceous plant obtained on Brant Island, 10th of April, 1806, the root of this plant is a squamous bulb and is eaten by the natives. The Clak-clel-lar, opposite this island, call it Tel-lak-thil-pah. [Complete specimen].

Pursh, Fl. 230. On the head-waters of the Missouri and Columbia. M. Lewis. ♃. July, v. s.

Fritillaria pudica Spreng.

Plains of Columbia near the Kooskooskee, May 8, 1806. The bulb in the shape of a biscuit which the natives eat. [Complete specimen corresponding with Pursh's figure].

Lilium? pudicum Pursh, Fl. 228, t. 8. On the headwaters of the Missouri. M. Lewis. ♃. May, v. s. in Herb. Lewis.

Trillium ovatum Pursh.

Columbia River near the rapids, April 10, 1806. [Upper portion of plant].

Pursh, Fl. 245. On the rapids of the Columbia River. M. Lewis. ♃. April, v. s.

Trillium petiolatum Pursh.

Folium. The flowers brown with a fruit of brick-red. On the waters of the Kooskooskee. June 15, 1806. [Excellent specimen].

Pursh, Fl. 244. On the waters of the Kooskooskee. M. Lewis. ♃. June, v. s.

Veratrum viride Ait. or **V. Californicum** Dur.

A plant growing in wet places with a single stem and leaves clasping round one another, no flowers observed. On the Kooskooskee, June 25, 1806. [Single leaf only.]

Xerophyllum tenax Nutt.

The leaves are made use of by the natives to make baskets and other ornaments. On high land, Rocky Mountains, June 15, 1806.

Helonias tenax Pursh, Fl. 243. On high lands near the Rocky Mountains. M. Lewis. ♃. June, v. s.

Zygadenus elegans Pursh.

On the Cokalaishkit River, July 7, 1806.

Pursh, Fl. 241. On the waters of the Cokalaishkit River, near the Rocky Mountains. M. Lewis. ♃. July, v. s. in Herb. Lewis.

Aira brevifolia Pursh.

The most common grass through the plains of Columbia and near the Kooskooskee River, June 10, 1806. *Poa trivialis* L., var. [Fair specimen].

Pursh, Fl. 76. In the plains of the Missouri. M. Lewis. ♃. June, July, v. s. in Herb. Lewis. This grass is the most common in those plains.[36]

Hordeum jubatum L.

Called the golden or silken rye. On the White Bear Islands on the Missouri, July 12, 1806.

Pursh, Fl. 89. On the islands of the Missouri River. M. Lewis. ♂. July, v. s. in Herb. Lewis and Lambert.

Hordeum jubatum L.

Grass common to the open grounds near Fort Clatsop. March 13, 1806.

Pursh, Fl. l. c.

Festuca ovina L. var.

On the plains of Columbia. June 10, 1806.

Festuca duriuscula Pursh, Fl. 83? [but Lewis' specimen not mentioned].

Agropyron divergens Nees.

On the plains of the Columbia, June 10, 1806. (Determined by Prof. Scribner).

Festuca spicata Pursh, Fl. 83. On the waters of the Missouri and Columbia Rivers, June, v. s. in Herb. Lewis.

Koeleria cristata Pers.

On the plains of the Columbia, etc., June 10, 1806.

Pursh, Fl. 85. On the plains of the Columbia River. M. Lewis. ♃. July, v. s. in Herb. Lewis.

Stipa spartea Trin.

Valleys of the Missouri on the Rocky Mountain, July 8, 1806. (*Stipa comata* Trin. according to Prof. Scribner).

Stipa juncea Pursh, (not L.), Fl. 72. On the banks of the Missouri. M. Lewis. ♃. Aug. v. s. in Herb. Lewis.

[36] This seems to be the plant described by Pursh as *Aira brevifolia*, as worked out by both Dr. Robinson and myself. But Professor Scribner, whose authority on grasses cannot be disputed, decides these specimens to be *Poa tenuifolia* Nutt., *P. Buckleyana* Nash.

Zizania aquatica L.

No. 59. 8th September, the growth of moist and very wet prairies.

[Sterile specimen of a coarse grass. No label.] (Prof. Scribner writes probably *Spartina gracilis* Trin.).

Pinus ponderosa Dougl.

On the Kooskooskee. On river bottoms in rich land, west of the mountains. Oct. 1, 1805. [Leaves only].

Juniperus communis L.

No. 47. A species of Juniper common to the bluffs. Oct. 17. Common to the bluffs. Oct. 17, 1804.

Juniperus communis L. var. **alpina** Gaud.

Dwarf Juniper, Rocky Mountains, July 7, 1806.

Juniperus communis L. var. *depressa* Pursh, Fl. 646. [Lewis' specimen not mentioned].

Juniperus occidentalis Hook.

No. 58. Found 2d Oct. 1804. A species of cedar found on the bluffs, the trees of which are large, some of them 6 feet in the girth. On the bluffs, some trees 6 feet in girth. Oct. 2, 1804.

Juniperus excelsa Pursh (not Marshall von Bieb.), Fl. 647. On the banks of the waters of the Rocky Mountains. M.Lewis. ♄. May, v. s. in Herb. Lewis.

Juniperus Sabina var. β. **procumbens** Pursh.

Dwarf cedar, never more than 6 inches high, open prairies. Oct. 16, 1804. [Small sterile specimen].

Pursh, Fl. 647. Within the Rocky Mountains. M. Lewis. ♄. v. s. in Herb. Lewis. Not above 6 inches high.

Equisetum arvense L.

No. 31. Growth of the sand bank near the banks of the river, taken the 10th of Aug., 1804. Sand banks of the Missouri. Aug. 10, 1804.

Aspidium spinulosum Sw.

Polypodium species. Fort Clatsop. June 20, 1806.

Lomaria Spicant Desv.

Fort Clatsop, June 20, 1806.

Blechnum boreale Pursh (not Willd.), Fl. 669. On the northwest coast. M. Lewis. ♃. Aug. v. s. in Herb. Lewis.

Hypnum Oreganum Sull.

A species of moss from Fort Clatsop. June 20, 1806. (Identified by Mrs. Britton).

Bazzania trilobata (L.) S. F. Gray.

A moss used by the natives as a yellow dye; grows on the pines of the Rocky Mountains. July 1, 1806. (Identified by Mrs. Britton).

Egregia Menziesii (Turn.) Aresch. (**Phyllospora Menziesii**).

Fucus. From the mouth of the Columbia River on the Pacific Ocean, Nov. 17, 1805.

[Loose label with *Pyrus sambucifolius?* but date different]. No. 24. Found the 4th day of Sept., 1805. A small growth only, rising to the height of 15 feet. Moist situations it seems to prefer; it is a handsome growth.[37]

[37] *Sorbus microcarpa* Pursh.

"On the tops of the highest peaks and mountains, June 27, 1806." Completely eaten by insects, except the stem, pedicels and 2 leaflets. A label in the same sheet, in Captain Lewis' handwriting says, "found on the 4th day of September, 1805. A small growth, only rising to the height of 15 feet; moist situations it seems to prefer. It is a handsome growth."

[Label only]. The root not eaten by the natives. On the Columbia, April 14, 1806.

[Sterile and unidentified. Stem lignescent, leaves opposite, narrow, linear, fascicled in axils]. A shrub about 4 feet high. On the plains of the Columbia. May 7, 1806. Identified while the mss. was going through the press, by Prof. Heller of the University of Minnesota, as *Phlox speciosa* Pursh. See *Flora*, P. 149.

To the above detail by Dr. Robinson and Mr. Greenman, it may now be noted that this collection contains specimens of all but sixteen of Lewis's plants as described by Pursh in his Flora. Of these sixteen, seven, as marked with an asterisk, are represented already in the specimens from Lambert's herbarium, leaving but nine of the plants missing from the collection as described by Pursh. Only a few of these nine missing ones are of material importance. For all practical purposes, all the plants of Lewis and Clark's expedition are now deposited in the Academy.

***Berberis Aquifolium** Pursh.

***Berberis nervosa** Pursh.

***Ceanothus sanguineus** Pursh.

Under the provisional name of "*C. atropurpureus*."

***Psoralea esculenta** Pursh.

In the Journal of the expedition, under date of August 10th, it is noted "at the confluence of the Yellowstone with the Missouri, Captain Clark found to-day * * the men also dug up large quantities of a large and very insipid root called by the Indians Hankee, and by the 'engagés' 'white apple.' It is used by them in a dry and powdered state, but our men boiled it and ate it with their meat."

On the same sheet with *Psoralea esculenta* Pursh has fastened down a specimen of *P. hypogæa* Nutt., not noting its distinction. The initials of Professor Britton are under it with this correction: It was evidently collected on the headwaters of the Platte, where Nuttall subsequently found it.

Spiræa capitata, Fl. 342.

Described from a specimen of Menzies from the northwest coast, but of which he had said "an imperfect specimen gathered on the Columbia River" by Lewis is not in the collection, nor in the herbarium of the Academy, but is referred by Hooker to *Neillia thyrsiflora*, and frequently noted in the *Journal* of the explorers as "one of the Nine barks."

Jussiæa subacaulis. Fl., p. 304.

Torrey and Gray, and Hooker refer this to *Œnothera heterantha* Nutt. A specimen in the collection of the Academy, simply marked "from Pursh's herbarium," is *J. repens*. As Pursh was evidently well acquainted with all our Jussiæas, it seems incredible that he should have mistaken an *Œnothera* for one of this genus.

Symphoricarpos racemosus Mx.

Menziesia empetriformis Pursh.

No specimen here or in the herbarium of the Academy. Hooker supposes it to have been *Cassiope Stelleriana*, but Lewis reports his plant from the Rocky Mountains, and near the mouth of the Columbia River.

Menziesia ferruginea Sm.

"On the Columbia River, Lewis." June says Pursh.

***Erigeron compositus**, Fl. 535.

Pentstemon frutescens Lamb., Fl. 428.

***Gerardia fruticosa** Pursh.

In the herbarium of the Academy his specimen is marked "*G. suffruticosa* n. sp.," and has been placed by Dr. Gray on the sheet with *Pentstemon Menziesii* Hooker.

Mimulus Lewisii Pursh, 427.

Bartsia Gymnandra Pursh, 430.

Dr. Gray suggests that Pursh's description indicates *Synthyris rubra*.

***Diotis lanata**, Fl. 602.

Is in herbarium of the Academy under *Eurotia lanata*.

Lilium umbellatum Fl., 229.

Hooker (*Index Kewensis*) suggests this may have been *L. Philadelphicum*.

Pinus taxifolia Lamb. Fl., 640.

Pseudo-Tsuga Douglasii.

NEW AND LITTLE-KNOWN BEES FROM WASHINGTON STATE.

BY T. D. A. COCKERELL.

Halictus pacificus n. sp.

♀.—Length 10 mm., black, with ochreous pubescence, inclining to fulvous in very fresh examples, whitish in very faded ones; second, third and fourth segments of abdomen with *interrupted basal bands, ochreous in color,* of dense appressed hair, broad laterally, tapering to a point mesad; in very worn examples these bands are practically obliterated. Head ordinary, *cheeks unarmed,* antennæ wholly dark, tegulæ reddish-piceous; wings with more or less of a yellowish tint, faintly dusky toward the apex; subcostal nervure black, *other nervures, and stigma, honey color; enclosure of metathorax semilunar, strongly radiately wrinkled, bounded by a tolerably distinct rim;* legs black, small joints of tarsi ferruginous; abdomen with numerous very minute punctures, hair bands interrupted, apex with pale fuscous hair.

♂.—Differs in the usual manner from the ♀. Apical portion of clypeus yellow. Antennæ long, flagellum, except the last two joints, ferruginous beneath. Pubescence paler; nervures darker; anterior tibiæ in front, middle tibiæ at apex, hind tibiæ at both ends, and all the tarsi, yellow.

Hab.—Olympia, Wash., March 23 to July 9, numerous specimens. (T. Kincaid). Also taken by Mr. Kincaid at Seattle, May 14th, on *Rubus ursinus.*

The following table separates the females of various large Halicti allied to *pacificus:*

A. Enclosure of metathorax granular.

a. Large, with a broad face . . . . *lerouxii* Lep.

b. Smaller, with a narrower face . . . . *coriaceus* Sm.

B. Enclosure of methathorax plicate.

a. Wings clear, stigma piceous, tegulæ testaceous, *sisymbrii* Ckll.

b. Wings yellowish, stigma honey-color, rather larger species . *pacificus* Ckll.

The above four were all taken at Olympia. Three other species are allied to *coriaceus:*

1. *H. bardus* Cr., known by the clear wings and fuscous nervures.

2. *H. politus* Sm., from Mexico, with the face broader above, wings strongly yellowish.

3. *H. forbesii* Rob., having the clypeus less produced. I have examined a great number of *coriaceus* from Wash., and various specimens from New Mexico and Illinois, considered to be *forbesii*; also an Illinois *coriaceus* from Mr. Robertson. The result of this study is that I believe all belong to one somewhat variable species. The characters given by Robertson to separate the females seem not to be constant, but I have not been able to compare the males. It is to be remarked, however, that Robertson's description of the metathoracic enclosure of *forbesii*, "bearing irregular radiating rugæ, which reach the posterior margin," will hardly apply to what I have (Tr. Am. Ent. Soc., 1897, p. 163) regarded as that species, so it may be that the real *forbesii* is a valid species near *pacificus*, which I have not seen. In that case it will be separated from *pacificus* by the continuous abdominal bands, which are whitish instead of ochraceous.

The following table separates some males which are more or less similar to *pacificus*:

A. Clypeus wholly dark . . . . *sisymbrii*.
B. Clypeus partly yellow.
  a. Legs all dark, size small . . . . *angustior*.
  b. Legs partly yellow.
    i. Hind tibiæ black except ends, enclosure of metathorax plicate . . . . *pacificus*.
    ii. Hind tibiæ yellow with only a suffused dark patch.
      a. Size large, flagellum all dark, enclosure of metathorax irregularly wrinkled . . . . *lerouxii*.
      b. Size smaller, flagellum ferruginous beneath.
        1. Size larger, head and thorax black . . . . *ligatus*.
        2. Size smaller, head and thorax greenish . . *fasciatus*.

Colletes pascoensis n. sp.

♂.—Length 10 mm. or slightly over, black, with dull white pubescence having only a faint yellow or ochreous tinge. Face and thorax densely covered with long hair, *cheeks with black hair*, vertex shining but well punctured; clypeus shining, with large close sublanceolate punctures; *distance between eye and base of mandible short, the space twice as broad as long*; mandibles dark; antennæ wholly dark, reaching to tegulæ; mesothorax and scutellum shining, with large well-separated punctures; postscutellum rough and dull; base of metathorax pitted, shining, lateral faces tolerably shiny; tegulæ piceous; wings dull hyaline, noticeably pubescent, nervures and stigma piceous; stigma small, marginal cell appendiculate; legs black, first two joints of hind tarsus rather broad; pubescence of femora yellowish-white, *of tibiæ black*, of tarsi black without and pale reddish-brown within; abdomen shining, *strongly but not very closely punctured*, the hind-margins of the segments with rather thin yellowish-white hair-bands, the surface of the first two segments with long erect thin yellowish-white pubescence, *that of the remaining segments with shorter black pubescence.*

♀.—Much like that of *armata* in general appearance, but *the pubescence of the head, pleura and legs is entirely black*, contrasting with that of the thoracic dorsum, which is yellowish-white, not at all mixed with black. *The abdomen has no bands*, but is thinly clothed with rather short and inconspicuous hair, yellowish-white on the first segment, black on all the rest. The first segment has its lateral hind margins narrowly fringed with short dense white hair; the punctures on the second segment are of two sizes, large and small. Antennæ dark, the flagellum with only the faintest chocolate tinge beneath, first joint of flagellum not quite as long as the second and third together. The second recurrent nervure is less bent than usual in the genus.

Hab.—Pasco, Wash., 3 ♀, 4 ♂, May 25, 1896 (T. Kincaid). The females might be mistaken for some *Andrena* allied to *vicina*. *C. pascoensis* approaches nearest to the descriptions of *C. californica* and *C. consors*. From *consors* Cress., it differs in the pallid pubescence and the black hair as described; this relates to the ♂, the ♀ of *consors* being unknown. From *californica* Prov., it differs by the entirely black hair of the head and legs in the ♀. It may be added, that *pascoensis* is also decidedly larger than *consors or californica.*

Colletes kincaidii n. sp.

♀.—Length about 13 mm., black, with clear fulvous pubescence on head and thorax, tolerably dense, *nowhere mixed with black*, becoming whitish on the ventral surface. Head rather broad, vertex with irregularly-placed punctures of various sizes, clypeus with the punctures running into striæ, labrum with conspicuous grooves alternating with ridges, mandibles dark, space between eye and base of mandible broader than long, antennæ very short, *wholly black*; prothoracic spire short, hidden by the pubescence; mesothorax with very large and close punctures, except a large area in the middle, which is shining and impunctate; scutellum with large punctures, except the anterior border, which is impunctate; post-scutellum roughened; basal enclosure of metathorax bounded by a distinct rim, shining, with about sixteen strong ridges; lateral faces dullish, the triangle shining; tegulæ dark brown; wings hyaline, nervures and stigma black, stigma small, marginal cell appendiculate, second recurrent nervure considerably bent; *second submarginal cell extremely broad, larger than the third*; legs black, with yellowish-white, almost silvery, pubescence; pubescence on inner side of hind tarsi yellowish-white, except that *the first-three joints are tipped with shining orange fulvous*; *abdomen lanceolate,* shining; *first two segments very strongly punctured, the punctures on the second smaller and closer than on the first; remaining segments with minute inconspicuous punctures,* and a more sericeous surface; *hind margins of the segments with broad appressed white hair-bands,* all very conspicuous, that on the first more or less interrupted in the middle; some inconspicuous short black hair on the dorsum of the third to fifth segments, and on the apex.

♂.—10½ mm. long. Similar to the ♀, but more slender. Face much more narrowed below; antennæ long, *wholly black;* space between eye and base of mandible somewhat larger, but still broader than long; thoracic pubescence rather more highly colored; hair-band on first abdominal segment entire.

Hab.—Olympia, Wash., July 5, 1896, at flowers of *Potentilla palustris;* also June 30th, at flowers of lupine. A large and handsome species, but closely similar to several others.

C. inæqualis differs at once in the ♀, but the ♂ is quite like our insect, being however larger, with a longer stigma, and the face less narrowed below.

C. simulans (known only in the ♂) is smaller than *kincaidii*, and has the abdomen uniformly punctured.

C. gilensis has black hair on the thoracic dorsum. *C. compacta* has quite a different metathorax. *C. æstivalis* differs by the brown stigma, the much narrower second submarginal cell, the more parallel orbits, the much smaller punctures of the mesothorax, the very dark tegulæ the stronger punctuation of the third abdominal segment, and the pale fulvous hair on the apical segment. The *æstivalis* compared is an Illinois example fr m Mr. Robertson.

I am surprised to find, on re-examining the specimens, that the species found by Prof. Wooton on Ruidoso Creek in New Mexico, and recorded by me (An. Mag. Nat. Hist., Jan., 1897, p. 49) as *æstivalis*, is in reality *C. kincaidii.*

Habropoda floridana (Smith) var. n. **pascoensis.**

♀.—Length about 16 mm., differs from Smith's description in that the pubescence of the head is pale, mixed, however with black on the face and vertex, the wings are little darkened, and the pubescence at the sides of the end of the abdomen is shining white. The pubescence of the thorax and of the first abdominal segment is very bright orange fulvous, not at all mixed with black. The short pubescence immediately surrounding the pygidial plate is black. Tegulæ black. Pubescence of legs black; that on inner side of front tarsi orange-rufous, the brushes at the ends of the segments tipped with brilliant coppery-red. Hair on lower part of pleura black.

Hab.—Pasco, Wash., May 25, 1896, (T. Kincaid). It is just possible that this is the unknown ♀ of *H. morrisoni* Cresson. It has a superficial resemblance to *Podalirius ursinus.*

Podalirius crotchii (Cresson).

♂.—From Pasco, Wash., May 25, 1896 (T. Kincaid) agrees with Cresson's description. Hitherto the species has only been reported from California. The pubescence on the hind tarsi within is brilliant fulvous.

Podalirius syringæ n. sp.

♂.—Length about 12 mm., black, pubescence long and erect, not very dense, mouse-color; strongly mixed with black on hind two-thirds of mesothorax, and anterior margin of scutellum; black also on vertex and upper part of cheeks, mixed with black on front and more or less on sides of face; pubescence of abdomen long, thin and pale at base of first and sides of first three segments, dorsally from the third segment onward scanty and black, some pale hairs at the extreme apex; no hair-bands. Clypeus except the black anterior edge, a supraclypeal band, irregularly v-shaped lateral marks, and labrum except the anterior margin and upper lateral corners, all lemon-yellow. Mandibles and the quite long antennæ wholly black. Mesothorax dull, with numerous shallow punctures, two small impunctate central areas. Metathorax shining. Legs slender, anterior and middle trochanters, and upper half of anterior femora behind, with shining white hair; otherwise the pubescence of the femora, as of the tibiæ, is black. Tarsi with partly black and partly pale hair, that on the inner side of the first four tarsi shining ferruginous; small joints of tarsi a lively ferruginous. Tegulæ black or piceous. Wings dusky hyaline. Apex of abdomen bidentate.

Hab.—Olympia, Wash., July 3rd, at flowers of *Syringa;* also June 27th, (T. Kincaid). Nearest to *P. simillimus* (Cress.), but differs by the wholly black scape and the distribution of the pubescence.

Megachile calogaster n. sp.

♂.—Length 11–12½ mm., stoutly built, black, with pubescence varying from pale ochraceous to whitish, not dense enough on thorax to conceal the surface, some short black hair on cheeks just behind eyes, and a good deal on the middle of the mesothorax. Head ordinary; *a conspicuous patch of white hair on lower part of cheek;* face quite densely clothed with yellowish-white hair; vertex strongly punctured, as also the clypeus; antennæ wholly dark, *last joint oval and flattened;* mandibles black, elbowed without, tridentate; thorax strongly and closely punctured; *anterior coxæ with a large rather broad and blunt spire, above which is a transverse patch of the most brilliant orange-rufous pubescence;* anterior femora stout, subtrigonal, ferruginous with a black patch at base and apex within, the latter connecting with a broad black external stripe extending the whole length of the femur; under side of anterior femur with long snow-white pubescence; anterior tibia short and thick, black without, mostly ferruginous within, a large apical triangular patch without pale yellow, apex with a blunt pale yellowish tooth extending at right angles to the axis; *anterior tarsi pale yellow, tinged with ferruginous toward the end; first joint hollowed, produced at the end, but not extending as far as tip of second joint;* second and third joints broadened, and elongated at one side; anterior tarsi behind fringed with long white hair; middle and hind legs entirely black, their femora and tibiæ with scanty whitish pubescence, partly black on hind legs, their tarsi with shining orange fulvous hair; claws with the basal half ferruginous, the apical half black; tegulæ black, punctured; wings tinged with fuliginous, nervures black, marginal cell quite long and narrow; *abdomen short and convex, without any hair bands,* but having rather long thin pubescence, nowhere concealing the surface, grayish-white or pale ochreous on the first two segments, nearly all black on the rest; apex with a broad semicircular emargination; three large subapical ventral teeth.

♀.—About 14 mm. long; similar to the ♂, except in the usual sexual characters. Legs black, *with black pubescence; that on the inner side of the front and hind tarsi, and both sides of the middle tarsi, lively ferruginous;* pubescence of cheeks all black; *ventral scopa dense, black only to a slight extent at base, otherwise very brilliant orange-fulvous.*

Hab.—Olympia, Wash., June 30th, at flowers of lupine; also June 19th to July 4th (T. Kincaid). A distinct and handsome species.

Sphecodes kincaidii n. sp.

♀.—Length 12 mm., *the abdomen quite elongated with approximately parallel sides.* Head and thorax black, *abdomen entirely bright ferruginous;* head transversely oval, front dull and very coarsely rugose, clypeus subcancellate with strong punctures; pubescence of face dirty whitish; *antennæ wholly dark;* first joint of flagellum very short, broader than long; *mandibles dark,* only rufescent at the extreme tip, inner tooth short and blunt; labrum not emarginate; mesothorax nearly bare, shining, with large strong punctures; base of metathorax coarsely cancellate, enclosed by a rim; tegulæ brown; wings rather pale fulginous, nervures and stigma piceous, *stigma considerably larger than in S. dichrous,* first recurrent nervure joining second submarginal cell before its end; legs black, *hind tarsi entirely ferruginous; abdomen smooth and shining, with small sparse punctures,* first two segments appearing nearly impunctate, with a very few large punctures and more numerous very minute ones. The third segment is much more punctate than the second. Apex with some dark hair.

Hab.—Olympia, Wash., June 19, 1895 (T. Kincaid). Easily known by the large size, and the narrow elongate sparsely punctured abdomen. It is not likely, I think, that it is the unknown ♀ of *S. davisii* Rob. *S. dichrous* Sm., also occurs at Olympia.

SYNOPSIS OF THE RECENT AND TERTIARY PSAMMOBIIDÆ OF NORTH AMERICA.

BY W. H. DALL.

Family PSAMMOBIIDÆ.

Genus **PSAMMOBIA** Lamarck.

(=*Psammobia* (Lam., 1818) Bowdich, 1822; + *Gari* (pars) Schumacher, 1817; + *Haplomochlia* Gistel, 1848 (fide Mörch, 1852). Not *Psammobia* Cossman, 1886).

Type *P.* (*Tellina*) *feroënsis* Gmelin, 1792, = *T. gari* Lin., 1762, not of Lin., 1758. North European Seas.

Section Psammobia s. s.

1. **Psammobia** (sp. indet.).

880 fms. east of Tobago; U. S. Fish Commission. A worn fragment of undeterminable species.

Section Grammatomya Dall, 1897.

Wholly obliquely grooved, with no dorsal posterior area.

2. **Psammobia squamosa** Lam.

Virgin Islands (Krebs).

Subgenus **GOBRÆUS** Leach.

(= *Solen* Megerle, 1811, not Lin. 1758; + *Psammobia* Blainv., 1825, not (Lam., 1818) Bowdich, 1822; + *Sanguinolaria* Blainville, 1825, not Lamarck, 1799; + *Azor* Gray, 1851 (Brit. An., p. 51, not p. 62); + *Gobræus* (Leach MS.) Gray, 1852; + *Psammocola* sp., Blainv., 1825. Type *Psammobia vespertina* Lam. European Seas.

3. **Gobræus vaginatus** Reeve.

Charlotte Harbor, Florida (?).

4. **Gobræus circe** Mörch.

Tortola and St. Thomas, West Indies.

* * *

5. **Gobræus maximus** Deshayes.

Panama to the Gulf of California.

6. **Gobræus regularis** Carpenter.

Gulf of California.

7. **Gobræus californicus** Conrad.

Sitka to San Diego, California, also Kamtchatka (Dall) and Japan.

8. **Gobræus fucatus** Hinds.

Magdalena Bay, Lower California.

9. **Gobræus edentulus** Gabb.

60 fms., San Pedro, California.

Genus **SANGUINOLARIA** Lamarck.

(= *Sanguinolaria* Lam., 1799, not Blainv., 1825, nor Desh., 1835; + *Aulus* (sp.) Oken, 1815, not Oken, 1821; + *Lobaria* Schum., 1817, not Muller, 1776; + *Hiatula* sp. Modeer, 1793).
Type *S.* (*Solen*) *sanguinolentus* Gmelin, Antilles.

Section Sanguinolaria s. s.

1. **Sanguinolaria sanguinolenta** Gmelin.

Antilles to Brazil; Ceylon.

2. **Sanguinolaria tellinoides** A. Adams.

Gulf of California to Panama.

Section Psammotella Blainville.

(*Psammotelle* Blainv., 1826; + *Psammotella* Herrm., 1852).

3. **Sanguinolaria operculata** Gmelin.

Texas to Brazil. (Type species).

4. **Sanguinolaria hanleyi** Bertin.

Lower California to Panama.

5. **Sanguinolaria vitrea** Deshayes.

Texas to Colon.

Section Nuttallia Dall, 1897.

Inequivalve, suborbicular.

6. **Sanguinolaria nuttallii** Conrad.

Southern California and Japan. (Type species).

Genus **AMPHICHÆNA** Philippi.

(= *Amphichæna* Phil., 1847, not H. & A. Ads., 1856; + *Amphidona* Mörch, 1858). Sole species known.

1. **Amphichæna kindermannii** Phil.

Mazatlan.

Genus **HETERODONAX** Morch.

(= *Heterodonax* Mörch, 1853; + *Arcopagia* Orb., 1863, not Brown ex Leach MS., 1827).

1. **Heterodonax bimaculata** Lin.

Florida to Brazil on the Atlantic; San Diego, California, to Panama, on the Pacific Coast.

Genus **ASAPHIS** Modeer.

(= *Asaphis* Modeer, 1793; + *Capsa* Lam., 1801, not Lam., 1799; + *Capsula* Schum., 1817, not Sby., 1857; + *Psammocola* (pars) Blainv., 1825; + *Isarcha* Gistel, 1848, *fide* Mörch, 1852; + *Sanguinolaria* Desh., 1835, not Lam., 1799; + *Pliorhytis* Conrad, 1863).

Type *Asaphis* (*Venus*) *deflorata* Linn. Indo-Pacific.

1. **Asaphis coccinea** Martyn, 1784.

Charlotte Harbor, Florida, to Brazil.

(*Heteroglypta* von Martens, 1880, will form a section of *Asaphis*, characterized by divaricate sculpture. Type *Psammobia contraria* Desh., Isle Bourbon).

Genus **TAGELUS** Gray.

(= *Tagelus* Gray, 1847; + *Siliquaria* Schum., 1817, not Lam., 1801; + *Solecurtus* Orb., 1853, not of Blainv., 1825; + *Cultellus* sp., Conrad, 1845; + *Mesopleura* Conrad, 1867; + *Tagelus* Fischer, 1887; + *Psammosolen* Hupé, 1848, not Bronn, 1831).

Type *T.* (*Solen*) *gibbus* Spengler, 1794.

Section Tagelus ss.

1. **Tagelus gibbus** Spengler.

Cape Cod to Brazil, and coast of West Africa.

2. **Tagelus violascens** Carpenter.

Gulf of California to Nicaragua.

3. **Tagelus californianus** Conrad.

San Pedro, California, to Lower California.

4. **Tagelus affinis** C. B. Adams.

Sta. Barbara to Panama.

Section Mesopleura Conrad.

5. **Tagelus divisus** Spengler.

Cape Cod to Venezuela.

6. **Tagelus politus** Carpenter.

San Pedro to Panama.

7. Tagelus subteres Conrad.

Southern California to Lower California.

FOSSIL SPECIES OF THE TERTIARY.

Eocene.

Psammobia (*Gobræus*) *ozarkana* Harris. Chickasawan.

Psammobia (*Garum*) *filosa* Conrad. Claibornian.

Psammobia (*Garum*) *claibornensis* Dall. Claibornian.

Psammobia (*Gobræus*) *blainvillei* (Lea). Claibornian.

Psammobia (*Gobræus*) *hornii* (Gabb). Tejon.

Psammobia (*Gobræus*) *papyria* Conrad. Jacksonian, Vicksburgian and Chipolan.

Psammobia (*Gobræus*) *lintea* Conrad. Vicksburgian.

Miocene.

Asaphis centenaria Conrad. Chesapeake.

Pliocene.

Psammobia (*Gobræus*) *wagneri* Dall. Caloosahatchie and Waccamaw beds.

Psammobia (*Gobræus*) *edentula* (Gabb). Californian.

Tagelus gibbus Spengler. Caloosahatchie beds, and also Pleistocene of South Carolina.

Tagelus divisus Spengler. Caloosahatchie beds, and also Pleistocene of South Carolina.

The other North American fossil species referred to *Psammobia*, *Psammocola*, *Sanguinolaria*, *Solecurtus*, *Siliquaria*, etc., belong in other genera or are synonyms of the cited species.

SYNONYMS AND CORRECTIONS.

Capsa deflorata Orb. = *Asaphis coccinea* (Mart.) Mörch.

Cultellus californianus Conrad, = *Tagelus californianus.*

Cultellus caribæus Conrad, 1845, = *Macha* sp.

Cultellus subteres Conrad, = *Tagelus subteres.*

Leguminaria floridana Conrad, = *Tagelus divisus* Spgl.

Mesopleura bidentata Conrad, = *Tagelus divisus.*

Petricola centenaria Conrad, = *Asaphis centenaria.*

Psammobia affinis C. B. Adams, = *Heterodonax bimaculata.*

Psammobia biradiata C. B. Adams, = *Heterodonax bimaculata.*

Psammobia casta (Desh.) Reeve, = *Macoma cognata* C. B. Ads.

Psammobia cayennensis Lam., = *Macoma constricta.*

Psammobia cerina C. B. Adams, = *Macoma cerina.*

Psammobia constricta Lam., = *Macoma constricta.*

Psammobia declivis Turton, = *Tagelus gibbus* Spengler.

Psammobia decora Hinds, = *Sanguinolaria nuttallii* Conrad.

Psammobia lusoria Say, = *Macoma lusoria.*

Psammobia pacifica Conrad, = *Heterodonax bimaculata.*

Psammobia purpureo-maculata C. B. Adams, = *Heterodonax bimaculata.*

Psammobia rosea Deshayes, = *Sanguinolaria sanguinolenta.*

Psammobia rugosa Sby., = *Asaphis coccinea.*

Psammobia rubroradiata Cpr., (1863), = *P. californica* Conrad, (Proc. Acad. Nat. Sci. Phila., 1848, p. 121).

Psammobia tæniata Turton, = *Tagelus divisus.*

Psammocola lucinoides H. C. Lea, = *? Diplodonta* sp.

Psammocola pleiocena T. & H., = *Asaphis centenaria.*

Psammocola regia H. C. Lea, = *Asaphis centenaria.*

Psammocola rugosa Blainv., = *Asaphis coccinea.*

Sanguinolaria californiana Conrad, = *Macoma* sp.

Sanguinolaria fusca Say, = *Macoma fusca.*

Sanguinolaria miniata Gould, = *S. tellinoides* A. Ads.

Sanguinolaria ovalis (Desh.) Reeve, = *S. tellinoides* junior.

Sanguinolaria purpurea (Desh.) Reeve, = *S. tellinoides.*

Sanguinolaria rufescens Chemn., = *S. operculata* Gmel.

Siliquaria caribæa Holmes, = *Tagelus gibbus.*

Siliquaria carolinensis Conrad, = *Tagelus* sp. indet.

Siliquaria edentula Gabb, = *Psammobia edentula.*

Siliquaria equalis Conrad, = *Tagelus* sp.

Siliquaria gibba A. Adams, = *Tagelus gibbus.*

Siliquaria notata Schumacher, = *Tagelus gibbus.*

Solecurtus angulatus Sby., = *Tagelus gibbus.*

Solecurtus bidens Forbes & Hanley, = *Tagelus divisus.*

Solecurtus californianus Carpenter, = *Tagelus californianus.*

Solecurtus caribæus Blainville, = *Tagelus gibbus.*

Solecurtus centralis Sowerby, = *Tagelus gibbus.*

Solecurtus cylindricus Sowerby, = *Tagelus affinis.*

Solecurtus fragilis Conrad, = *Tagelus divisus.*

Solecurtus subteres Emmons, = *Siliquaria equalis* Conrad.

Solecurtus subteres Conrad, = *Tagelus subteres.*

Solecurtus violascens Sowerby, = *Tagelus violascens* Cpr.

Solen adansonii Bosc, = *Tagelus guineensis.*

Solen bidens Chemnitz, = *Tagelus divisus.*
Solen carpenteri Dunker, = *Tagelus divisus.*
Solen centralis Say, = *Tagelus divisus.*
Solen fragilis Pulteney, = *Tagelus divisus.*
Tellina fucata Hinds, = *Psammobia fucata.*
Tellina fucata Gould, = *Strigilla fucata.*
Tellina rufescens Chemnitz, = *Sanguinolaria operculata* Gmel.
Tellina rufescens Roemer, = *Sanguinolaria hanleyi* Bertin.
Tellina semiplanata Spengler, = *Sanguinolaria operculata* Gmelin.
Tellina vicina C. B. Adams, = *Heterodonax bimaculata.*

THE GERRHONOTUS OF THE SAN LUCAN FAUNA, LOWER CALIFORNIA, WITH DIAGNOSIS OF OTHER WEST AMERICAN SPECIES.

BY JOHN VAN DENBURGH.

A little more than two years ago, in a consideration of the reptiles of Lower California,[1] I said that "Without larger series of the other species than are at hand, the status of the *Gerrhonoti* from the 'Cape Region' of Lower California cannot be satisfactorily determined. It seems probable, however, that they are distinct from the more northern *G. scincicauda*, and are referable to the name *G. multicarinatus* Blainv." More recently[2] I have been able to examine large numbers of specimens of the four species of this genus which are known to occur in California, Oregon and Washington, and to discover more or less definite limits to their variation. I wish now to consider the status of the Lower Californian form.[3]

At first glance the lower Californian lizard bears a resemblance to *Gerrhonotus principis* of the Puget Fauna. This, however, is merely a superficial resemblance due to the comparative smoothness of these two forms, and in a less degree to their similar size and the occasional absence of complete dorsal color bands in the San Lucan species. In the number of the longitudinal rows of its dorsal scales this *Gerrhonotus* is similar to *G. palmeri* and *G. burnettii*. In other characters, however, it approaches *Gerrhonotus scincicauda*, to which I believe it is most closely related.

The following table shows the variation in the several species of those characters which seem to be of value in classification. The figures indicate the number of specimens examined.

From this table we may formulate a key which will serve to identify most specimens :

[1] Proc. Cal Acad. Sci. (2), V, 1895, p. 119.

[2] Occasional Papers, Cal. Acad. Sci., V, 1897, pp. 102–115.

[3] In making this comparison I have had twenty six specimens from San José del Cabo, Sierra El Taste, Sierra San Lazaro, Sierra Laguna and Miraflores.

	princi-pis.	*burn-ettii.*	*palmeri*	*multica-rinatus.*	*scinci-cauda.*
Dark lines along middle of ventral scales, ...				26	91
Dark lines between ventral scales, ...	17	60	2		
Ventral dark lines absent,	10	17	14		2
Azygous prefontal large, .	1	7	17	26	89
Azygous prefrontal moderate,	10	26	1		4
Azygous prefontal small, .	16	41			
A single interoccipital, .	4	8	15	26	84
Two to four interoccipitals,	23	71	1		8
No interoccipital, . .		1			1
Scale rows, $12\frac{2}{2}$, . . .					3
Scale rows, 14, . . .	19			3	87
Scale rows, $14\frac{2}{2}$, . . .	8		1	2	3
Scale rows, $15\frac{1}{2}$, . . .		5			
Scale rows, 16, . . .		71	17	20	
Scale rows, 18, . . .		1			

KEY TO SPECIES.

a.—Dark ventral lines between the longitudinal rows of scales or absent,

b.—Dorsal scales weakly keeled, in fourteen (rarely $14\frac{2}{2}$) longitudinal rows.

G. principis.

b[2].—Dorsal scales strongly keeled, in sixteen (rarely $14\frac{2}{2}$ or 18) longitudinal rows.

c.—Temporal scales smooth.

G. burnettii.

c[2].—Lower temporal scales keeled.

G. palmeri.

a[2].—Dark ventral lines along middle of longitudinal scale rows.

d.—Dorsal scales weekly keeled, in sixteen (rarely 14 or $14\frac{2}{2}$) longitudinal rows.

G. multicarinatus.

d[2].—Dorsal scales strongly keeled, in fourteen (rarely $12\frac{2}{2}$ or $14\frac{2}{2}$) longitudinal rows.

G. scincicauda.

Brief characterizations of these five species may prove useful:—

Gerrhonotus principis.

Lower temporal scales smooth; dorsal and caudal scales weakly keeled; dorsals in fourteen (or $14\frac{2}{2}$) longitudinal rows; dark ventral lines between the longitudinal rows of scales, or absent; azygous prefontal of moderate size or small; interoccipitals two or three (or 1); back without complete dark cross-bands.

Gerrhonotus burnettii.

Lower temporal scales smooth; dorsal and caudal scales strongly keeled; dorsals in sixteen (rarely $15\frac{1}{2}$ or 18) longitudinal rows; dark ventral lines between the longitudinal rows of scales, or absent; azygous prefontal usually small or of moderate size; interoccipitals two to four (rarely 1); dorsal color bands usually broken and closer than in *G. scincicauda.*

Gerrhonotus palmeri.

Temporal scales keeled; dorsal and caudal scales strongly keeled; dorsals in sixteen longitudinal rows; dark ventral lines absent (or between the longitudinal rows of scales); azygous prefrontal large; interoccipital normally single; back without complete dark cross-bands.

Gerrhonotus multicarinatus.

Lower temporal scales smooth; dorsal and caudal scales weakly keeled; dorsals in sixteen (rarely 14 or $14\frac{2}{2}$) longitudinal rows; dark lines along the middle of each of the longitudinal rows of ventral scales; azygous prefrontal large; interoccipital normally single; back with or without complete dark cross-bars.

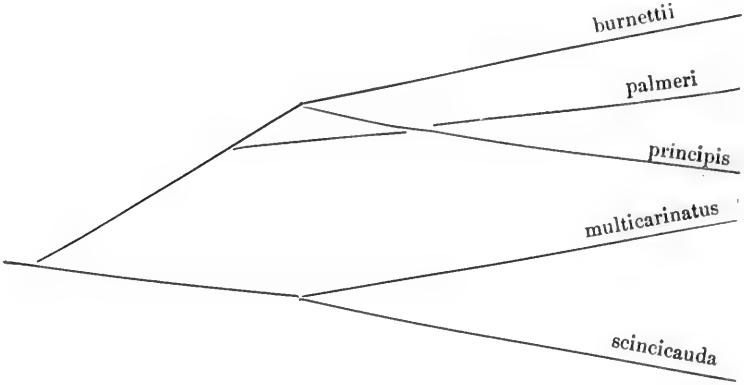
Gerrhonotus scincicauda.

Lower temporal scales smooth; dorsal and caudal scales strongly keeled; dorsals in fourteen (rarely $12\frac{2}{2}$ or $14\frac{2}{2}$) longitudinal rows; dark lines along the middle of each of the longitudinal rows of ventral scales (very rarely absent); azygous prefrontal large (rarely moderate-sized); interoccipital usually single; back usually with complete dark cross-bands.

Principis (B. & G.) finds its home in the Puget Fauna of western Washington and Oregon, and perhaps occurs in the mountains of northern California. *G. burnettii* Gray occupies a narrow strip along the coast of California from Monterey to Mendocino County. *G. palmeri* (Stejneger) is native to the western slope of the Sierra

Nevada of El Dorado, Tuolumne, Mariposa, Fresno and Tulare Counties, California, between the altitudes of 3,700 and 9,000 feet. *G. multicarinatus* (Blainville) appears to be confined to the San Lucan Fauna of Lower California. *G. scincicauda* (Skilton) has been found in northwestern Lower California, in the San Diegan, Californian and Pacific Faunæ of California, in western Oregon and in Washington, its range overlapping those of *G. burnettii*, *G. palmeri* and, probably, *G. principis*.

The probable relationship of these species may be indicated thus:—



ANATOMICAL NOTES ON CERTAIN WEST AMERICAN HELICES.

BY H. A. PILSBRY AND E. G. VANATTA.[1]

THE GENUS GLYPTOSTOMA.

This genus has very distinct conchological features, the shell recalling the typical *Zonites* in form. The jaw, radula and genitalia have been investigated and figured by W. G. Binney. From these data the senior writer placed *Glyptostoma* in the group *Belogona Euadenia* of the arrangement of Helices given in volume IX of the *Manual of Conchology*, near the genus *Epiphragmophora*. We have now examined two specimens of *G. Newberryanum*. The genital system of one is figured on Pl. I, fig. 1. The two examples dissected agree perfectly in all details, but in several points do not correspond with Binney's figures. The right eye is retracted between ♂ and ♀ branches of the genitalia. The penis is continued a short distance beyond the insertion of the vas deferens, and may be regarded as having a rudimentary epiphallus, the long retractor inserted thereon distally. There is no trace of a flagellum. Vagina long, at its apex the very long duct of the spermatheca enters. This duct is of the length of the uterus and terminates in a large globular spermatheca. No diverticulum. At the point where the sp. d. enters, an ovate sessile body is placed. This has the shining, fleshy muscular substance commonly seen in dart sacks; and we do not doubt that the organ is of that nature, although no dart was found in either of the two individuals dissected. The lumen presented several broad folds, and no distinct apical papilla. There is no trace of mucus glands. The talon is unusually long.

From these characters it appears that the genus, while probably belonging with the series of American dart-bearing Helices, is extremely isolated. The other American genera, *Epiphragmoph-*

[1] The dissections and drawings of all species noticed in this paper are by Mr. Vanatta, who is also responsible for all anatomical details of the several forms. The more general discussions relating to the systematic bearings of the facts developed are by Mr. Pilsbry.

We would here acknowledge our indebtedness to Professor W. H. Dall for alcoholic specimens of several of the forms discussed below.

ora, Lysinoe, Leptarionta, Cepolis, and *Polymita* are all more nearly allied to each other than to *Glyptostoma.*[2]

The lack of mucus glands is a degenerative feature unique in *Belogona Euadenia,* though it occurs in the *Belogona Siphonadenia.*

The high insertion of the dart sack is very unusual.

The talon is longer than in any other *Helix* known to us.

The loss of a flagellum on the penis is unique among American *Euadeniæ,* but occurs in certain Chinese forms of *Eulota* and in many other Old World groups. It is not usually a character of generic importance in Helices.

The Micrarionta group of Epiphragmophora.

Micrarionta was proposed by Mr. C. F. Ancey as a subgenus of *Helix,* based mainly, it would seem, upon the small size of the shell and reflexed lip of its type, *H. facta.* In the "Guide to the Study of Helices" the group was expanded to include the larger, simple-lipped Lower Californian Helices which Binney (following von Martens) referred to *Euparypha;* and it was shown to have well marked anatomical features unlike any other known group of Helices.

The three subgeneric groups into which our West Coast Epiphragmophoras were divided in the "Guide,"—*Micrarionta, Helminthoglypta* and *Monadenia,*—differ trenchantly in the forms of their mucus glands. In the first they are inserted by two separate ducts at the base of, rather than upon, the dart sack. In the second a single duct enters the dart sack, and splits into two bulbiferous branches above. In the third there is a single club-shaped gland. The other characters of the soft anatomy, as well as the shells, are not very unlike in the three groups.

Of the eleven species of *Micrarionta, E. intercisa* and *E. levis* are unknown anatomically. *E. Gabbi, ruficincta, intercisa, Kelletti* and *Tryoni* are known to us by W. G. Binney's figures, but several characters being unnoticed by Binney, a reëxamination of these is desirable. We have dissected *E. areolata, Pandoræ, Veitchii, Stearnsiana* and *Guadalupiana.*

E. Guadalupiana Dall, Pl. I, fig. 11 (genitalia) differs considerably from the other species examined. The flagellum is but little

[2] *Leptarionta* is hardly sufficiently known to be included in this statement. It should be stated that the shell characters of *Glyptostoma* are also notably different from any of the other genera named.

longer than the penis and epiphallus taken together. The spermatheca duct bears no diverticulum. *The dart sack is degenerate*, reduced to a small wide bud, one mucus gland arising at its right side, descending, club shaped, the other at left side, ascending and slightly sacculated; *both entirely free*, not bound to the vagina. The *right eye-retractor passes to the left* of the genital system, *not between its branches.*

The last characters may be expected to occur in *E. facta* and *ruficincta*. It is a very unusual feature. The subobsolete condition of the dart sack is unlike any allied species. The measurements are: length of penis+epiphallus 9 mm.; of flagellum 10; of spermatheca duct 15 mm.

The other forms examined have the flagellum very long, dart sack well developed, one of the mucus glands descending, spread upon the base of vagina, the other upon the dart sack, both bound down. Diverticulum developed and long except in *Stearnsiana*. In all, the spermatheca arises high, near the distal end of the vagina. The dimensions of the parts are as follows:

	Pandoræ.	*Veitchii.*	*Areolata.*	*Stearnsiana.*	
Length of penis+epiphallus	15	35	28	22	28 mm.
Length of flagellum	21	67	50	26	27 mm.
Length of spermatheca duct	$17\frac{1}{2}$	54	49	43	35 mm.
Length of diverticulum	13	43	25	0	1 mm.

Thrown into the form of an analytical key, the genital characters give these results:

a. Right eye retractor passing between ♂ and ♀ branches of genitalia; diverticulum presents one mucus gland spread upon and firmly bound to vagina below dart sack.

b. Flagellum and spermatheca duct of about equal length, *areolata.*

bb. Flagellum longer than spermatheca duct; diverticulum $\frac{3}{4}$ to $\frac{4}{5}$ length of spermatheca duct, much longer than the other branch.

c. Penis+epiphallus $\frac{3}{4}$ length of flagellum . . . *Pandoræ.*

cc. Penis+epiphallus about $\frac{1}{2}$ length of flagellum . *Veitchii.*

bbb. Flagellum shorter than spermatheca duct; diverticulum very short or wanting . . . . *Stearnsiana.*

aa. Right eye retractor not passing between branches of genitalia; mucus glands free; no diverticulum; flagellum about the same length as penis+epiphallus.

b. Dart sack degenerate, very small . . . . . *Guadalupiana.*

No further details of the genitalia are needed except such as are clearly shown in the figures; and of course some variation in the absolute dimensions of various organs is to be expected.

Details are lacking to intercalate the other species of the subgenus in the above synopsis, but from Binney's figures it seems that *E. Kelletti* and *Tryoni* fall into § *bb.* of the first division (*a.*) of this dichotomous table, and it is likely that *E. ruficincta* and *facta* group in the second division, *aa.* They differ from *E. Guadalupiana* Dall in having the dart sack well developed. The position of the eye retractor muscle is unknown. Neither of them has a diverticulum on the spermatheca duct.

E. Stearnsiana differs considerably from *areolata*, *Pandoræ*, *Veitchii* and, according to Binney's figures, *Kelletti*, in having the diverticulum short or obsolete. Two specimens were dissected, both from Coronado Islands. In one (66,091 A. N. S. P. Mus., coll. by A. W. Anthony) there is no trace of a diverticulum. In the other (69,014, from Prof. W. H. Dall) there is a very short diverticulum, about 1 mm. long, arising slightly beyond the lower fourth of the length of spermatheca duct. In this specimen the duct is 8 mm. shorter than in the other. Binney's figure shows a somewhat longer diverticulum than our No. 69,014, but it is still very short. This variation in the diverticulum is exactly paralleled in the European *Helix pomatia*.

EXPLANATION OF PLATE I.

Note.—The shells of the specimens furnishing the genitalia figured, as well as the dissections, may be found in the collection of the Academy bearing numbers corresponding to those given below.

(*Div.*, diverticulum of the spermatheca duct. *d. s.*, dart sack. *fl.*, flagellum. *m. gl. as.*, ascending mucous gland. *m. gl. des.*, descending ditto. *p.*, penis. *r. p.*, penis retractor muscle. *sp.*, spermatheca. *sp. d.*, duct of the spermatheca. *t.*, talon. *vag.*, vagina).

Fig. 1. *Glyplostoma Newberryanum* (W. G. B.). Pasadena, Cal. No. 68,997.

Fig. 2. *Epiphragmophora Veitchii* (Newc.). Cerros Is., of Lower Cal. No. 69,647.

Fig. 3. The same individual, other side of the dart sac and adjacent organs.

Fig. 4, 5. *Epiphragmophora Pandoræ Bonitosensis* Pils. Las Bonitos Is., off Lower California. No. 66,092.

Fig. 6, 7. *Epiphragmophora areolata* (Sowb.). Natividad Is. No. 69,646. In fig. 6 the opposite side of dart sack and associated organs is seen, and the spermatheca duct with its diverticulum torn free from the uterus.

Fig. 8. *Epiphragmophora Stearnsiana* (Gabb). Coronado Is. No. 69,014.

Fig. 9, 10. Another specimen from the same locality, No. 66,091, showing no trace of the diverticulum upon spermatheca duct.

Fig. 11. *Epiphragmophora Guadalupiana* Dall. Guadalupe I., off Lower Cal. No. 69,648 (Drawn to double the scale of other figures of this plate).

CONTRIBUTIONS TO A KNOWLEDGE OF THE HYMENOPTERA OF BRAZIL, NO. 4.—THYNNINÆ AND ADDITIONS.

BY WILLIAM J. FOX.

The author has withheld the publication of the present paper for some time in the hope that an opportunity would present itself for the classification of the true Mutillidæ in the collection of Mr. H. H. Smith, and thereby avoid the inconvenience of listing the Mutillidæ in more than one paper. Circumstances, however, will not permit the carrying out of such a plan, so he feels obliged to present this paper for publication, even though it deals with but a part of one family.[1]

[2]**Ælurus carbonarius** Sm. (=*Elaphroptera carbonaria* Sm.)

Four specimens. Rio de Janeiro (November).

Ælurus aethiops Klug. (=*Thynnus aethiops* Klug).

The description of this species as given by Klug will fit what I have determined as Smith's *Elaphroptera carbonaria*, as will also Klug's description of *Thynnus anthracinus*. The specimen I refer to *aethiops* is larger and heavier than *carbonarius*, and is more coarsely punctured. It is probable that *carbonarius* is the same as *anthracinus*, but the descriptions of both are so poor that nothing conclusive can be determined from them, except their faultiness. The specimen in question comes from Rio de Janeiro (November).

Ælurus nasutus Klug.

Two specimens. Rio de Janeiro (November).

Elaphroptera sp.

Two specimens (♀) of a species apparently close to *Thynnus intermedius* Klug. They are smaller than that species. Collected in September at Chapa la.

Elaphroptera decora Sm. (=*Thynnus decorus* Sm.)

One specimen.

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[1] See *Entomological News*, IX, 1, Jan., 1897, p. 14.

[2] *Ælurus carbonarius* and *Æ. aethiops* differ from typical *Ælurus* (*A. nasutus*) in the bidentate mandibles, in the third submarginal being longer than second, in the emarginate or bidentate clypeus and comparatively shorter maxillary palpi, in which joints 4–6, while much longer than the preceding ones, are still not as long as in *A. nasutus*.

Elaphroptera plagiata Sm. (=*Thynnus plagiatus* Sm.)

One specimen. Both this and *decora* were collected at Chapada (October).

Elaphroptera cribraria n. sp.

♀.—Black; legs reddish-testaceous, a curved yellow line over the base of each antenna; head large, twice as wide as broadest part of mesothorax, covered with deep, regularly separated punctures (the punctuation is almost sieve-like), covered with a rather long, pale, erect pubescence; cheeks behind eyes almost impunctate; scape shining, strongly punctured, bearing some stiff, golden hairs beneath, as do also the mandibles; mandibles falcate, when closed apparently not dentate; mesothorax above with large, sparse punctures, emarginate and depressed anteriorly in the middle, pleuræ polished; scutellum punctured; middle segment finely punctured, subconvex, not excavated or depressed; hind femora beneath, before apex, with a long tooth or spine; tibiæ and tarsi very strongly spinose; tarsal claws cleft; abdomen large, with strong, sparse punctures and long, pale pubescence beneath; second dorsal segment bearing four sharp, transverse carinæ, the first dorsal transversely sulcate at apex; sixth segment in the form of a narrow, longitudinal carina. Length 13 mm.

Rio de Janeiro (November). One specimen.

Elaphroptera brunnea n. sp.

♀.—Brown, the head in front, thorax and legs in part, and two first abdominal segments, palest, the remainder castaneous or blackish-brown; mandibles basally, a spot before and behind the eyes, sides of clypeus, fore femora internally, spot at apex of medial femora, stripe on fore tibiæ externally, and on medial tibiæ internally, yellow. Head medium, wider than thorax, finely though distinctly punctured, with sparse long hairs; occiput high and sharply margined, sparsely punctured; scape strongly punctured with some golden bristles beneath; mandibles slender, falcate, without teeth; mesothorax above with two concavities, the portion dividing them formed into a tooth-like process posteriorly; middle segment rather squarely cut off behind, the upper surface in the middle posteriorly with a tubercle or prominence; thorax is not distinctly punctured; tibiæ and tarsi strongly spinose; hind femora scarcely dentate at apex beneath; first dorsal segment of abdomen sharply truncate anteriorly, the truncation bounded posteriorly by a carina, behind which in the middle stands a small tubercle; second dorsal with three strong, transversely-parallel carinæ; remaining dorsal sparsely punctured; ventrals flat, more distinctly punctured, especially the fifth which is also rugose-striate on apical portion. Length 9 mm.

Chapada. Two specimens.

Elaphroptera pallida n. sp.

♀.—Yellowish-testaceous; spot surrounding the eye and a line extending up to the occiput on each side of front, whitish-yellow; head closely and finely punctured, sparsely so on occiput; the latter rather prominent posteriorly and subemarginate medially; scape triangular, greatly broadened apically; mesothorax bearing a longitudinal, medial fold, which is furrowed on posterior portion, and on each side of which, posteriorly, stands a horn or tooth-like process; a median fold on scutellum; middle segment indistinctly punctured, the upper surface prominent, slightly tuberculate medially and at postero lateral angles; hind femora but slightly dentate beneath at apex; tarsal claws cleft; abdomen above with sparse punctures, which become closer posteriorly, those of ventral surface stronger and closer, especially on fifth segment; first dorsal sharply truncate anteriorly, the truncated portion divided by a slender raised line and bearing some stiff, pale hairs above; second dorsal with three transverse carinæ, the first rather feeble and short, the other two very sharp; body with long, sparse, pale hairs. Length 6½ mm.

Chapada (November). One specimen.

Elaphroptera clitellata Klug. (=*Thynnus clitellatus* Klug).

A specimen from Chapada (October). The claws are cleft and the second dorsal abdominal segment bears an acute transverse carina before its apex, anterior to which the segment is rugose. The legs in the specimen before me are not yellow, but rufo-testaceous. It agrees well with Klug's figure of the species, except that the yellow of mesothorax is restricted to a small dot on each side anteriorly.

Telephoromyia punicea n. sp.

♂.—Reddish-brown, flagellum, spot enclosing ocelli, dorsulum and pleura more or less, thorax beneath, and legs, except tibiæ and tarsi, blackish; clypeus and mandibles except apex, yellowish; head closely punctured, clothed with pale, glittering pubescence; clypeus concave in middle with two strong teeth or prongs, anteriorly; mandibles rather large, terminating in a sharp point, anterior to which the inner margin is broadly enlarged and bidentate;

antennæ slightly longer than head and thorax united; joints of flagellum rounded beneath, the first two about equal in length; punctuation of thorax coarser than that of head, that of dorsulum coarsest, that on mesopleuræ closest; scutellum strongly convex; tarsal claws cleft; tibial spurs small as compared to *Ælurus carbonarius*; abdomen depressed, with distinct separated punctures and pale pubescence; pygidium large, convex, obtusely rounded at apex, coarsely rugose; last ventral segment bearing two flap-like carinæ, one on each side, between which is the subgenital plate which is sub-acute at apex; wings fuscous, with purplish reflection, stigma and costa reddish, other veins black. Length 21 mm.

One specimen. Chapada (October).

The following species of *Pepsis* have been identified by Herr Dr. R. Lucas, of Berlin, and were not included in the paper on Pompilidæ:

Pepsis aspasia Luc.

One specimen. Corumbá (April).

Pepsis Foxi Luc.

A large series of both sexes. Chapada (March, April, October).

Pepsis smaragdinula Luc.

Rio de Janeiro (November); Chapada (January, March, April). Nine ♀, five ♂ specimens.

Pepsis Schlenki Luc.

Five specimens. Chapada (January, March).

Pepsis defecta Tasch.

Several specimens.

Pepsis Pertyi var. **ruficornis** Luc.

Chapada (April). One specimen.

Pepsis centaurus Luc.

Chapada (April). One specimen.

THE SUMMER BIRDS OF SUSQUEHANNA COUNTY, PENNSYLVANIA.

BY FRANCIS R. COPE, JR.[1]

Since the publication of Dr. Dwight's paper on the "Summer Birds of the Crest of the Pennsylvania Alleghenies," (*Auk*, *IX*, April, 1892), and Mr. Stone's on the "Summer Birds of Harvey's Lake, Luzerne County, Pennsylvania," (*Proc. Acad. Nat. Sci. Phila.*, 1891, pp. 431–438)[2] no detailed account has appeared of the summer birds of the northeastern part of the State, although it has generally been supposed that the fauna of this region partook largely of the nature of the North Mountain district, with perhaps a slightly stronger tinge of the Canadian element. Indeed, on the faunal map attached to Mr. Stone's volume on the "Birds of eastern Pennsylvania and New Jersey"[3] almost the whole of Susquehanna County is included in what is known as the Canadian fauna.

The present paper, based on several years study of the birds of the county, and including only such species as have been observed during the breeding season, say from June 15th to the second week in July, shows, I think, that the fauna of Susquehanna County, although it has a strong tinge of this Canadian element, possesses it to a less marked degree than the mountainous region further south. This fact may doubtless be accounted for by the absence of any very extensive hemlock forests, such as those found around Harvey's Lake and on North Mountain.

Reference to a map will show that Susquehanna County is situated in the northeastern part of Pennsylvania, between latitude 41° 40′ and 42°. It is part of the Allegheny and Pocono plateaux, and may be described as a hilly, rocky country, interspersed with innumerable small valleys. With the exception of many small

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[1] Read before the Delaware Valley Ornithological Club at the Academy of Natural Sciences of Philadelphia.

[2] Since the above was written, a paper has been published bearing on this subject, entitled "Summer Birds of northern Elk County, Pennsylvania," by William L. Baily, (*Auk*, XIII, October, 1896).

[3] "Birds of eastern Pennsylvania and New Jersey," by Witmer Stone, published by the D. V. O. Club, Philadelphia, 1894.

lakes and ponds, the land is poorly watered, there being but few streams of any size. A spur of the Alleghenies extends through the southeastern corner, terminating in Elk Mountain, which last rises to an altitude of about 3,000 feet and is almost the only eminence in the county worthy of the name of mountain, the other hills not rising much above 2,000 feet. The vast tracts of forest, which fifty years ago covered the greater part of the county, now everywhere bear witness to the ravages of axe and fire, and are broken up into isolated patches. Among the principal forest trees may be mentioned the Beech, Maple, Hemlock, Chestnut, Birch, and Pine, the last mentioned being, perhaps, the least plentiful of the six. Of these species the Hemlock has doubtless suffered the most, being particularly prized for its bark ; nevertheless it is still found in considerable numbers interspersed among the other trees.

It is in these small, but numerous tracts of primeval forest which yet remain uncut, that we find most of the truly Canadian species. Here such northern birds as Black-throated, Blue, Canadian, Magnolia and Blackburnian Warblers, Water Thrushes, Solitary Vireos and Hermit Thrushes are all more or less common, some being abundant, but they are almost entirely confined to the deep woods, especially where there is a thick growth of hemlock. Of other Canadian species, the Junco seems to be generally confined to the open clearings and pastures bordering on woodland, and is decidedly rare, Elk Mountain being the only locality where it has been found breeding in any numbers. Even here, however, where during the latter part of June, 1894, I found upward of a dozen pairs breeding at an altitude of 2,600 feet, not a single bird was observed on a second visit, July 2, 1897. Winter Wrens are conspicuous by their absence, although there seems to be no good reason why this species should not occur plentifully, unless it be owing to the absence of any very extensive hemlock forests, as before remarked. My only reason for mentioning them in this paper is that during the first week in July, 1897, I twice heard a song in the depths of a hemlock forest near Dimock, which, although I am not familiar with the bird, I felt almost sure was the note of a Winter Wren. This would seem to point at least to the possibility of its breeding.

In the open land throughout the greater part of the county, especially in moist upland meadows, Savannah Sparrows are very common, generally breeding in small colonies ; while at Dundaff, in the southeastern portion, in open fields at an altitude of some 2,000 feet, the Bobolink is an abundant breeder, also occurring locally at many points in the central and eastern part of the county.

As to the occurrence of several species of water birds during the breeding season in Susquehanna County, I can state nothing positive, not having visited several of the more retired lakes and streams in the northwestern portion of the county, where they would be most likely to be found.

To sum up, I think it may be said that the fauna of Susquehanna County is largely Alleghenian, with a strong tinge of the Canadian, but with practically nothing of what may be regarded as belonging exclusively to the Carolinian element. To be sure, Dr. Warren (*Birds of Pennsylvania*, p. 300) mentions having taken a Hooded Warbler in the county during the summer months, while on August 10, 1895. I shot a pair of adult Prothonotary Warblers near Dimock, but these species can hardly be regarded as more than stragglers.

In the following list I have made no mention of the birds breeding, as with few exceptions all the individuals noted during the last of June and early part of July may reasonably be assumed to be summer residents and to be breeding in the locality where seen.

Such species as have not come under my personal observation or whose status as breeders may be doubtful, have been placed in brackets.

Before concluding, I desire to express my thanks to Mr. Witmer Stone, of the Academy of Natural Sciences of Philadelphia, who visited the county in June 1896 and 1897, and who has rendered valuable assistance in many ways.

[1. **Aix sponsa.** Wood Duck.

Formerly a common breeder in the more retired lakes and streams, but now decidedly rare. A pair seen during the early part of August, 1895, near a wild overgrown pond in the vicinity of Dimock only points to the probability of its breeding].

2. **Ardea herodias.** Great Blue Heron.

Rare. Scattered pairs occasionally seen along the larger streams throughout the county.

3. **Ardea virescens.** Green Heron.

Tolerably common, but like the last never found breeding in colonies, there being generally but a single pair in one locality. The birds, however, show great partiality for the old breeding grounds, and generally return to the same spot year after year.

4. Nycticorax nycticorax naevius. Black-crowned Night Heron.

This species has been observed but rarely during the breeding season, though there seems to be no reason why it should not be plentiful.

5. Philohela minor. American Woodcock.

Rather common, but yearly becoming scarcer as a breeder.

6. Bartramia longicauda. Bartramian Sandpiper.

One bird observed in an upland pasture near Dimock, June 19, 1897, and evidently breeding from its actions, is my only record for the county.

7. Actitis macularia. Spotted Sandpiper.

Common in all suitable localities.

8. Colinus virginianus. Bob-white.

Much less common now than formerly, but solitary individuals and an occasional covey are still frequently met with. During the last two years, however, there has been a noticeable increase in the numbers of this bird throughout the county.

9. Bonasa umbellus. Ruffed Grouse.

More plentiful than *C. virginianus*, but fast becoming rarer as the forests are cut away, thus depriving it of suitable breeding grounds and hiding places.

[**10. Ectopistes migratorius.** Passenger Pigeon.

A flock of four was seen July 19, 1897, in a dead chestnut tree on the edge of a strip of woodland near Dimock. Although I had a good look at the birds through my glass and feel no reasonable doubt as to the identity, I was unfortunately unable to secure any of them. This species is known to have formerly been an abundant breeder in Susquehanna County, but these are the first individuals seen for many years. This occurrence at this season of the year may possibly indicate that they still nest occasionally in the wilder parts of the county].

11. Zenaidura macroura. Mourning Dove.

This species, which may be regarded as common to the Alleghenian and Carolinian zones, though perhaps more typical of the latter, is not uncommon in some localities, although decidedly rare in others.

12. Circus hudsonius. Marsh Hawk.

The county is seemingly far too hilly and mountainous to suit the habits of this hawk, but nevertheless a pair has been seen regularly during June and July for several years past on a small marshy meadow surrounding Elk Lake, and doubtless breeds there.

13. Accipiter velox. Sharp-shinned Hawk.

Rather common, being frequently met with during the breeding season.

14. Accipiter cooperi. Cooper's Hawk.

Rare and much less common than the preceding.

15. Buteo borealis. Red-tailed Hawk.

Decidedly the most abundant hawk in the county, a few being seen almost daily.

16. Buteo lineatus. Red-shouldered Hawk.

Probably ranks next to *B. borealis* in abundance.

17. Falco sparverius. Sparrow Hawk.

Rather common.

[**18. Syrnium nebulosum.** Barred Owl.

The only record which I have of the occurrence of this owl in summer time is an adult male shot by a friend during the latter part of August, 1897. It may doubtless be regarded as a rare permanent resident].

19. Megascops asio. Screech Owl.

Common resident.

20. Bubo virginianus. Great-horned Owl.

Tolerably common resident in the deeper forests throughout the county.

21. Coccyzus erythrophthalmus. Black-billed Cuckoo.

Not uncommon, during the breeding season.

22. Ceryle alcyon. Belted Kingfisher.

Tolerably common along the banks of ponds and streams, being especially abundant at Silver Lake in the northwestern part of the county.

23. Dryobates villosus. Hairy Woodpecker.

Common throughout the wooded portions.

24. Dryobates pubescens. Downy Woodpecker.

Abundant and generally distributed, both in the woodland and in the open country.

[**25. Ceophlœus pileatus.** Pileated Woodpecker.

Personally I have never observed this species during the breeding season, but as several specimens have been taken during the early part of August, it doubtless breeds sparingly].

26. Melanerpes erythrocephalus. Red-headed Woodpecker.

Rare. A pair was observed at Dundaff, June, 1895, and a single bird near Montrose in June, 1896.

27. Colaptes auratus. Flicker.

Abundant everywhere.

28. Antrostomus vociferus. Whip-poor-will.

Very rare, having been only once or twice noted in low, secluded spots.

29. Chordeiles virginianus. Night Hawk.

Very common, collecting in large flocks during August.

30. Chætura pelagica. Chimney Swift.

Abundant, breeding throughout the county. It has, however, adapted itself to the ways of civilization and has never been observed nesting in hollow trees.

31. Trochilus colubris. Ruby-throated Humming-bird.

Common, both about houses and in the deep woods.

32. Tyrannus tyrannus. Kingbird.

Abundant and generally distributed.

33. Myiarchus crinitus. Great-crested Flycatcher.

Tolerably common throughout the county.

34. Sayornis phoebe. Phoebe.

Abundant everywhere in the open country.

35. Contopus virens. Wood Pewee.

Fully as abundant as the preceding species, but confined to orchards and woodlands.

36. Empidonax minimus. Least Flycatcher.

Very common and universally distributed during the breeding season.

37. **Otocoris alpestris praticola.** Prairie Horned Lark.

Although this species has been recorded during the breeding season by Messrs. Dwight and Parke at Athens, Bradford County, at Williamsport (Koch), and in Elk County (Baily), it has never, to my knowledge, been observed in this county until the summer of 1896, when a bird was noted July 6, in a grassy meadow near Dimock.

38. **Cyanocitta cristata.** Blue Jay.

Abundant, especially in woody situations.

39. **Corvus americanus.** American Crow.

Abundant.

40. **Dolichonyx oryzivorus.** Bobolink.

A common breeder, but decidedly local in its distribution, although isolated pairs may be found in all suitable localities throughout the county. At Dundaff, a small village in the southeastern part, at an elevation of 1,620 feet, upward of two dozen pairs were found breeding in June, 1895, while a small colony generally nests in some upland meadows near Dimock.

It may also be of interest to note that two pairs of this species were observed at Waymart, Wayne County, Pennsylvania, June 22, 1895, and four pairs near Sugarloaf Mountain on the western border of the same county, June 23, 1897.

41. **Molothrus ater.** Cowbird.

Rather common.

42. **Agelaius phoeniceus.** Red-winged Blackbird.

Locally common, breeding plentifully on the marshes of several lakes near Dimock, where I have taken fresh eggs as late as the first of July.

43. **Sturnella magna.** Meadow Lark.

Very common and generally distributed.

44. **Icterus galbula.** Baltimore Oriole.

Common about houses and generally distributed, apparently increasing in abundance.

45. **Quiscalus quiscula aeneus.** Bronzed (?) Grackle.

While on a collecting trip with Mr. Witmer Stone in the northwestern part of the county, June 22, 1897, a single Grackle was observed, presumably *Q. q. aeneus.* Unfortunately neither of us was able to secure the bird; but from its actions it was undoubtedly nesting in the neighborhood. This record seems interesting as being the first evidence, to my knowledge, of the occurrence of any species of Grackle in Susquehanna County.

46. **Carpodacus purpureus.** Purple Finch.

Not uncommon, both in the woodland and in the open country about houses, where its pretty song may be heard from April to the middle of July.

47. **Passer domesticus.** English Sparrow.

This pest, everywhere rapidly increasing in numbers, and now resident in almost every town and village of any size throughout the county, bids fair to soon drive away all the old feathered songsters from our gardens and orchards.

48. **Spinus tristis.** American Goldfinch.

Abundant everywhere.

49. **Poocætes gramineus.** Vesper Sparrow.

The most abundant and generally distributed of the sparrows during the breeding season; in fact, one of the characteristic birds of the open country.

50. **Ammodramus sandwichensis savanna.** Savannah Sparrow.

Very common and widely distributed in all suitable localities, especially in the northern and eastern portions of the county.

51. **Ammodramus savannarum passerinus.** Grasshopper Sparrow.

Common in dry uplands.

52. **Spizella socialis.** Chipping Sparrow.

Abundant.

53. **Spizella pusilla.** Field Sparrow.

Abundant in open fields and overgrown pastures.

54. **Junco hyemalis.** Slate-colored Junco.

Formerly common at Elk Mountain, from 2,000 feet up, and generally confined to open fields, but now quite rare. Its occurrence in the rest of the county is limited to two records: First, a single pair shot June 26, 1896, near Dimock, and secondly, another pair engaged in constructing a nest near the same locality, April 24, 1897. One would expect to find this species in the elevated plateau land of Ararat township, on the eastern border of the county, a locality well suited to its habits; but on a visit to this region in

June, 1897, I did not meet with a single individual, although it was found three miles to the eastward, on Sugarloaf Mountain, in Wayne County.

55. **Melospiza fasciata.** Song Sparrow.

Abundant everywhere, except in the deep woods.

56. **Melospiza georgiana.** Swamp Sparrow.

Rather common in low swampy situations.

57. **Pipilo erythrophthalmus.** Towhee.

Tolerably common in scrubby fields and clearings.

58. **Zamelodia ludoviciana.** Rose-breasted Grosbeak.

This species seems to be very rare, having only been observed once during the breeding season, when a fine male was shot June 22, 1896, in an old clearing near Dimock.

59. **Passerina cyanea.** Indigo Bird.

Abundant, especially in briar patches and clearings, where the males may be heard singing all day long.

60. **Piranga erythromelas.** Scarlet Tanager.

Very common throughout the deep woods.

61. **Petrochelidon lunifrons.** Cliff Swallow.

Common, but rather local in its distribution, and generally found breeding in colonies. It has of late years been gradually decreasing in abundance.

62. **Chelidon erythrogaster.** Barn Swallow.

More abundant and generally distributed throughout the county than the preceding species.

63. **Tachycineta bicolor.** Tree Swallow.

Rare. Scattered pairs occasionally seen in suitable localities.

64. **Ampelis cedrorum.** Cedar Bird.

Common summer resident, occurring in large flocks during June and again in September.

65. **Vireo olivaceus.** Red-eyed Vireo.

Very abundant, both in the shade trees about houses and in the deep woods.

66. **Vireo gilvus.** Warbling Vireo.

A nest with three young, collected by Mr. Stone and myself near Milford, June 22, 1897, is the only record which I have of its occurrence in Susquehanna County.

67. **Vireo flavifrons.** Yellow-throated Vireo.

Not uncommon, being frequently met with during the breeding season, especially in the deep woods.

68. **Vireo solitarius.** Blue-headed Vireo.

Common in the deep forests throughout the greater portion of the county, one or more pairs being usually met with in all the larger pieces of woodland. Two adults with young just out of the nest and not yet able to fly were observed July 8, 1896, about two miles south of Springville.

69. **Mniotilta varia.** Black and White Warbler.

Tolerably common in second growth woods and clearings.

70. **Compsothlypis americana.** Parula Warbler.

Not uncommon, and several times met with in woods where there is apparently no usnea moss. It would be interesting to know what the bird constructs its nest of in such localities.

71. **Dendroica aestiva.** Yellow Warbler.

Common throughout the open country.

72. **Dendroica caerulescens.** Black-throated Blue Warbler.

Abundant and generally distributed in the deep hemlock woods, being, perhaps, the commonest representative of its genus.

73. **Dendroica maculosa.** Magnolia Warbler.

Another very common species, almost as plentiful as the preceding, but like it confined to the deep hemlock woods.

74. **Dendroica pennsylvanica.** Chestnut-sided Warbler.

Common, but confined to the clearings and tracts of 'scrub.' A nest together with the brood of young birds was discovered June 27, 1896, in a small orchard within a few yards of the house.

75. **Dendroica blackburniæ.** Blackburnian Warbler.

Abundant wherever there is a thick growth of hemlock. It would be hard to say whether this species or *D. caerulescens* is the more plentiful, for as Dr. Dwight remarks, there are "places where both might almost be said to swarm."

76. **Dendroica virens.** Black-throated Green Warbler.

Also abundant in the deep hemlock forests, but hardly as plentiful as the preceding species.

77. **Seiurus aurocapillus.** Oven-bird.

Abundant everywhere.

78. Seiurus noveboracensis. Water Thrush.

This typical Canadian species seems to be decidedly rare, the only record for the county being one immature female shot June 26, 1896. This bird was secured in a dense swamp containing a sparse growth of rhododendron, and had evidently been out of the nest but a short time.

79. Geothlypis trichas. Maryland Yellow-throat.

Very common, but confined to clearings and open grounds, and seldom noted in the deep woods.

80. Sylvania canadensis. Canadian Warbler.

Another species belonging to the Canadian fauna, and one almost as abundant as *D. caerulescens*. It is found throughout the county, in the lower and damper portions of the deep forests, generally, but not always, where there is a thick growth of hemlock.

Personally I have never detected the Redstart (*Setophaga ruticilla*) during the breeding season in this county, but during the latter part of June, 1895, I found it to be very common in portions of Wayne County and at Lake Teedyuskung, Pike County.

81. Galeoscoptes carolinensis. Catbird.

A common species in the open country.

82. Harporhynchus rufus. Brown Thrasher.

Rather rare in the central and northern parts of the county, increasing in abundance toward the southern border. Observed only in scrubby fields and clearings.

83. Troglodytes aedon. House Wren.

Tolerably common about houses.

[**84. Troglodytes hyemalis.** Winter Wren.

Very rare. As previously remarked, the song has been detected several times during the early summer in the deep hemlock woods near Dimock, and leads me to think that it probably breeds sparingly in the wildest portions of the county].

The Brown Creeper, *Certhia familiaris americana*, although recorded by Messrs. Dwight, Baily and Stone from Sullivan, Elk and Luzerne Counties respectively, has never been observed by me in Susquehanna County during the breeding season, and if it does occur, must be regarded as a very rare summer resident.

85. Sitta carolinensis. White-breasted Nuthatch.

Very common, both in the woods and in the open country.

86. Parus atricapillus. Black-capped Chickadee.

Abundant in the woodland.

87. Turdus mustelinus. Wood Thrush.

A common species and generally confined to the deep woods. A nest containing young nearly ready to fly was discovered, however, June 18, 1895, situated in a young maple tree on the border of the woods within a few rods of the house. The female bird was exceedingly tame, allowing approach within a foot of the nest, but usually this species lacks much of the tameness and confidence which so characterizes it in the more densely populated portions of the country.

88. Turdus fuscescens. Wilson's Thrush.

Very abundant in dense, swampy woodland throughout the county. Owing to its shyness and the inaccessibility of the localities which it generally inhabits, the bird is very difficult to approach, but its presence is always betrayed by its wild bell-like notes, which may be heard at all hours of the day, but which sound the sweetest in the early morning and about sunset. It is almost impossible to imitate the song on paper, but the syllables "ta-weel'ah, ta-weel'ah, twil'ah, twil'ah," mentioned in Baird, Brewer and Ridgway's *North American Birds* (Vol. I, p. 9), convey to my ear the most accurate description of it which I have seen. After careful observation and study, I am prepared to say that this is one of the most plentiful of the *Turdidæ* in Susquehanna County, surpassing in abundance both *T. mustelinus* and *pallasii.*

89. Turdus aonalaschkæ pallasii. Hermit Thrush.

Tolerably common wherever the hemlock remains uncut, but hardly as plentiful as *T. mustelinus*, being absent in many of the localities where the latter is comparatively common. I have, on many occasions, however, observed the two species singing almost side by side, and fully agree with other observers that the song of the Hermit is considerably superior to that of the Wood Thrush, possessing as Dr. Dwight remarks, "a ringing sweetness that is only matched in part by the latter."

90. Merula migratoria. American Robin.

Common everywhere throughout the county, except in the deep woods.

91. Sialia sialis. Bluebird.

Rather common, but gradually becoming less plentiful as a summer resident. During the spring, summer and autumn of 1895, not a single individual was observed anywhere in the county, but during June and July, 1896, several broods were noted, while in 1897 the species was quite common again.

FEBRUARY 1.

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

Twenty-two persons present.

FEBRUARY 8.

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

Twenty-nine persons present.

FEBRUARY 15.

J. Cheston Morris, M. D., in the Chair.

Twenty-six persons present.

A paper entitled "Errant Frustules of Eunotia major," by T. Chalkley Palmer, was presented for publication.

FEBRUARY 22.

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

Eighty persons present.

Papers under the following titles were presented for publication:—

"A New Weasel from New Mexico," by C. M. Barker and T. D. A. Cockerell.

"On the Genus Halia of Risso," by W. H. Dall.

"Description of a new Tethys (Aplysia)," by E. J. Letson.

Under the auspices of the Anthropological Section the subject of Idiocy was discussed as follows:—

Anatomically, by William G. Spiller, M. D.

Physiologically, by Charles K. Mills, M. D.

Psychologically, by Prof. Lightner Witmer.

Educationally, by Martin W. Barr, M. D. (No abstract).

James Lane Pennypacker was elected a member.

The following were ordered to be printed:—

VOLCANIC ROCKS OF MESOZOIC AGE IN PENNSYLVANIA.

BY E. GOLDSMITH.

My petrographical and geological observations have convinced me that nearly all so called "trap" is of volcanic origin. Supporting proofs may be found in many localities near Philadelphia, such as the Haycock Mountain, New Hope and the railroad cuts north and south of Quakertown in Bucks County, Pa. The richest field of observation, however, is the hill four miles north of Pottstown, Montgomery County. The various outcrops of the volcanic rocks may there be studied to greater advantage than in the other localities.

One hundred and fifty acres of the top and side of the hill now form a public park, much of the rubbish and underbrush being, therefore, removed. A series of volcanic terraces of Mesozoic age has been thus uncovered and is, I think, worth recording. These terraces were formed by four distinct outflows of lava. The four, five or six sided columns of greenstone-basalt can be seen on the edge of each step from the first outpour. The first outflow had a range wider in extent than the others; the second was less, to all present appearances; the third eruption was decidedly less great, whilst the fourth, the top of the hill, exceeded the second and third in mass of material. The greatest difference between the levels of the various outpours is seen between the third and the fourth flow. The whole extent of these terraces is overshadowed by a grove of trees and carpeted with grass and other small plants, an illustration would, therefore, be indistinct.

A strictly scientific examination of the terraces would involve a survey, the removal of rubbish and sod down to the lava and the determination of the various levels with instruments of precision.

The terraces are situated on the western side of the park. The level forms a plateau on which a fine iron structure has been built to a height of some twenty or more feet above the trees, an observation tower, from the upper platform of which a grand view of part of the Schuylkill valley can be obtained. Near this point, in a pile of débris, the first indications of a devitrified obsidian or tachilyte were found. On a later visit I observed a slab of about three feet in length and about six inches thick imbedded in a bank of débris of similar material; many indications of the volcanic rock being scattered about. The rock is jet black, dull, very fine grained, with distinct conchoidal fracture, the edges becoming very sharp; the hardness is a little less than quartz. The per centage of silica was 57.1. Under the microscope was observed a microperlitic structure. All attempts to secure a photograph of this structure failed.

A second variety of tachilyte was found, but not so abundantly as the first. It is also deep black and very fine grained, very thin white streaks or lines being irregularly distributed through the mass. Under the microscope, the thin section showed again that the essential material consists of devitrified glass darkened by an extremely fine powder of what seemed to be magnetite. The white lines, suggestive of crystals, appeared when magnified as elongated globular forms filled with a partially crystalline substance of indistinct crystalline forms. The globules consist of subcrystalline material, filling what was originally gas pores. A section showed also the fluid structure. With very strong, light, numerous crystallites were observed.

A third variety of devitrified glass has a yellow-gray color. This tachilyte is very hard and so peculiarly splintery, sharp edged and curved, that no fragment could be secured with the hammer from which to grind a section, the lapidary having to cut the plates for the purpose. The mineral is very fine grained and even, some specimens having a yellow edge apparently of the same hardness as the general mass. Where water had affected the material there is a thin rusty coating.

With ordinary light, a thin section shows beneath the microscope, that the mass of rock is made up of largely predominating fine ash-like granules interspersed with minute fragments of crystalline material, the whole cemented together by devitrified glass.[1]

[1] About six years ago, I found a specimen of rock near Rockhill Station, in Bucks County, and determined it under the name of Felsite. It seems to me, that Felsite, Eurite, Petrosilex and Tachilyte are all the same in composition structure and origin. All these rocks seem to belong to the glassy lavas, and are, therefore, in all probability, of volcanic origin. Since the inner structure and mineral composition should decide the name of a rock, it is thought best to call this, and all three varieties, Tachilyte, because the principal mass is devitrified obsidian, as has already been suggested by several British petrographers, and, since Breithaupt's name seems to have the priority, it should, I think, be retained by geologists.

Eastward from the upper plateau of the terrace is an open area devoid of plant life. It is called by the people the "Great Ringers," Plate II, in contradistinction to the "Little Ringers," which are situated on east side of the park. The outcrop consists of rocks of various sizes, from a hand specimen to those weighing thirty tons or more. They are essentially gabbro-phonolite, as I stated in a communication made several years ago to the Academy. I then announced the mineralogical composition of these rocks to be: plagioclastic feldspar, sanidine, diallage, augite, magnetite; ferrite also was occasionally present. These rocks are very tough and close-grained. Even a thin section has a considerable cohesion and does not break in boiling in spirits of turpentine, unless the outer weathered gray crust be taken. This is brittle when thus tested.

Plate I illustrates a small section of this singular rock formation. The outcrop has precisely the appearance of what has been called an Einsturzkrater[2] or collapsed crater. The crater in its present condition is but a fraction of what it was formerly. Its former horizon can still be traced; vegetation has gradually encroached upon it and, if not prevented, will cover the entire tract which is now bare. The outlines of volcanic craters are extremely irregular everywhere, whether the walls are still standing or have fallen in. The contour may be traced, however, in either case, the rocks themselves being the guides. It can be shown that in the building up of the elevation, various phases of volcanic action must have taken place to accomplish that which ultimately resulted. It seems probable, as has been suggested, I think by Geike, and even observed by him and others, that the phonolites are formed on the upper neck of the volcano, and that the basalts are liquid lava poured out from some point along the side of the crater. Similar relations appear to have existed in the building up of the Pottstown Hill. The metallic sounds emitted from the rocks, when struck with a hammer, are of great interest to visitors, and both superstition and poetry are incited thereby. The phonolites of this locality however, lose their ringing property when broken. It seems probable that this effect is due to the production of innumerable cracks through the whole mass, just as a metallic bell or a glass jar loses the property of ringing when cracked. There are, however, some phonolites, as those occurring north of Wilmington, Delaware, and on Haycock

[2] Carl Vogt's Geologie, Band II, page 330.

Mountain, in Bucks County, Pennsylvania, which retain the metallic sound when broken.

The Little Ringers, as they are termed, are essentially the same as those described above. The outcrop, thickly covered by trees, is situated about a quarter of a mile east of the others, and may be an indication of a separate neck of a crater. The outcrop appears small because the trees have taken possession of the surroundings. There is probably more of it than can be seen at present. If not prevented, the trees will cover the Little Ringers in the course of time as certainly as nine-tenths of the whole area of the hill is now covered.

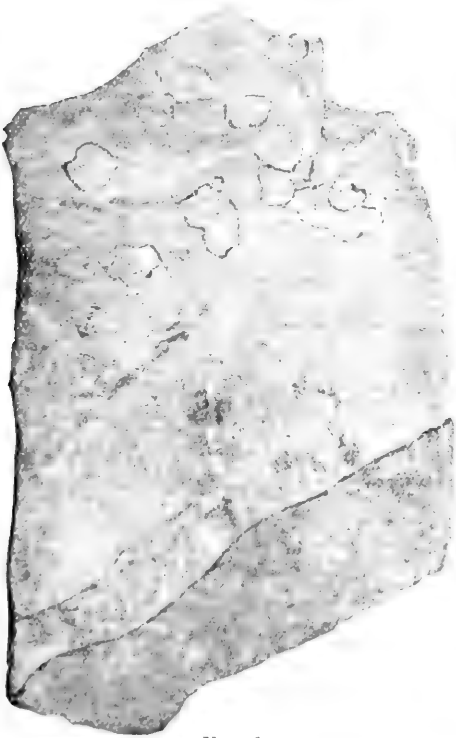

FIG. 1.
Amygdaloid showing fluidal texture.

Not far from the Railway Station on the hill, borings for water were made without result. Some of the rock fragments brought to the surface indicated a bed of amygdaloid of a pale grayish color; the thickness of the bed was not ascertained and is at present unknown. Specimens of amygdaloid are found on the surface, one of which had the almond shaped nodules of more than an inch in length and protruding from the rock nearly half an inch.

An interesting specimen of amygdaloid with an uncommon fluidal texture is represented by the figure 1. It gives a fair idea of the specimen, the lighter shade above and the darker below being sharply defined. The fluidal texture is usually observable only in thin sections under the microscope, but in this case, we have it macroscopically. When magnified the thin section showed a great many small blisters or former cavities filled with a still whiter material than the honeycombed mass in general. The lighter part of the mass contained but little magnetite, while the dark portion was filled with this iron ore. As plutonic rocks do not possess any amygdaloid texture, I have concluded that those found in the Pottstown park are of volcanic origin, that they were once a fluid lava and that the rock masses as they appear are the remnants of a collapsed crater.

Microscopic examination of thin sections gave the following result:—

The infiltrated material in the former gas cavities appeared by reflected light as white, opaque, granular masses, which could not be resolved even when magnified to about three hundred diameters into any distinct crystalline form. Nevertheless, that it possessed crystalline structure is indicated by its aspect in polarized light. I diagnose the material as feldspatic. With ordinary light and with the aid of an Abbé condenser the rock mass showed a faint green augite; the particles, very finely divided, often appeared together in groups, and these small greenish individuals having a greater refractive index than the feldspar, were, in consequence, more conspicuous than the greater mass of the rock. In polarized light the feldspar appeared to be essentially orthoclase, some sanidine being also present. This volcanic rock may be compared with the amygdaloidal basalt of Schlachenwerth, near Carlsbad, Bohemia.

A general description of the rocks on the eastern side of the hill is also of special interest. The enormous size of some of the sections of basaltic columns found there, some undoubtedly *in situ*, others removed to a lower level, is such as to cause surprise. These basalts are mostly six-sided, and as the result of weathering, somewhat rounded on their edges; some are perfectly flat and level, others are found with a concavity varying in depth, while some have been seen with a wavy surface. Some of the columns do not seem to split transversely, but stretch their bulky length some twenty feet or more along the ground. One has been named the Bullfrog by the natives. The diameters of the six-sided sections of the basalt vary. I measured some which were ten, eleven or fifteen feet across. These gigantic illustrations of mountain-making may indicate a peculiar geologic condition wherein a long continued internal heat, or possibly a slow cooling dependent upon external causes, prevented the contraction of the general mass into smaller columns such as are so often found occurring in the Tertiary and more recent periods. I confess that nowhere in my travels, either in this country or in Europe, did I observe such colossi of basaltic columns. When in their entirety they must have been giant structures in the strictest sense of the phrase. An interesting and very suggestive rock received the name of the Haystack from the owner of the place. Plate III represents the same as viewed from the southern side. As the illustration indicates, the side to the right is convex, and if one stands where he can see the convexity only, a similiarity to a haystack or the section of one may suggest itself.

On close examination I found that the inclined position of the rock was due to tilting, and that formerly it must have stood erect; it can also be shown that the rocks to the left were parts of the same, and, if the losses through erosion are also taken into account, the Haystack had, in all probability, another outline than the one which it now presents. It seems clear to me that this tall object was originally triangular in form, that it is the last remnant of a crater wall standing there almost separated from the other parts of the crater which lie to the north, northwest and west, while the southern side has entirely collapsed.

Whoever has closely observed the structure of recent volcanoes, is aware that if it were possible to make a vertical section of the crater wall, that section would necessarily be triangular in form. If it were possible to obtain it, a birds eye view would render the significance of the aspect more convincing. A photograph of the crater wall-section from the west side, Plate IV, represents it fairly well. The camera stood about half way up on the opposite slope, a position which accounts for the depression shown in the central fore ground of the picture. The part from the standing rock to the left, above, is corroded away, plant life here, as everywhere, having doubtless contributed its share toward the destruction of these rocks. The huge blocks seen in front of the tall section, are those which I believe to have been formerly united with the so-called Haystack to form the triangular part of the crater wall. Everybody who has paid the least attention to the study of rocks is acquainted with their continual disintegration, effected by heat and moisture working inward from the exposed surfaces of even the hardest and toughest rocks. The tall crater wall-section shows even now a great many cracks, especially on its convex side, and it seems evident that it will not require many years to complete its destruction. Its present inclined position will probably cause the fall of the upper part first, thus obliterating another proof of what the structure was in former times. Professor Oscar Carter said, when I showed him the object in question and pointed out its significance: "A very suggestive specimen, what else could it represent? It appears to be a last remnant of the wall of a crater." Of course, it requires some little imagination to see such a connection, but the principal emphasis is laid on the surroundings and upon the cumulative proofs of the volcanic rocks themselves.

From the Haystack a narrow winding path in a general northeasterly direction leads to an immense platform of basalt known as Table Rock. Of this no photograph was taken, in order to spare the remaining plate for the picture of the entrance to the cave. In Plate V the entrance of what the people call the cave, is plainly noticeable among the huge and partly broken rocks. The large block lying on the left shows the triangular contour of the cross cut of a crater wall in a manner sufficiently characteristic. The collapsing process and the gradual breaking up of the great masses of rock are at least partially recognizable in the illustration. To obtain a general idea of what that cave really is, however, one must ascend the debris surrounding the great wall of massive blocks, climb upward along a rustic step-walk, mount upon the top of the wall and gaze down into the cavity. The deep kettle-shaped cavity is formed by the rock masses which are more or less split in various directions, but the greater number are vertically cleft. That this is an ancient crater I have not the slightest doubt; that the formation has never been a cave in the geological sense of the word is clear from the fact that volcanic rocks never form hollow domes. It is, however, possible to creep into the cauldron from the side entrance, and boys are occasionally seen sliding or climbing down into the hollow space from above.

Volcanic craters vary a great deal in diameter; this one is small, its inside measure amounts, I think, to not much more than forty feet, and in its depth somewhat less. Since the wall rocks of this crater are cracked vertically and in the inner parts moved toward the centre, it is self-evident that the inner diameter must have been greater in the past. Here, as in other parts of the hill, the trees are doing their work steadily, breaking the larger blocks into smaller ones; the decay is continually going on, and although the entire sleeping crater is still standing where it was built by the ancient fluid lavas of the Mesozoic era, it is only a question of time when this one also will have been disrupted and obliterated like its ancient colleagues of the vicinity.

Ancient craters necessarily decay and crumble away just as any other exposure of rock will do. It is well-known to those versed in the special literature of the subject, that collapsed craters have been found and recognized in Europe, and it might reasonably be expected that in time the discovery of similar phenomena existing here would result from careful observation.

In the literature of the Second Geological Survey of Pennsylvania nothing is mentioned of the Pottstown Hill, except that Trap occurs there. But that an entire crater of Mesozoic age is still intact at that spot nobody seems to have even guessed; at least no geologist appears to have looked at it, much less to have explored or described it. That the deep cauldron is an ancient crater, I am fully convinced.

THE PETRIFACTION OF FOSSIL BONES.

BY E. GOLDSMITH.

The Port Kennedy limestone quarry, situated on the Schuylkill River, in Montgomery Co., Pa., became noted some twenty-five years ago for a deposit of fossil bones which were studied, in part, by Professors Joseph Leidy and Edw. D. Cope. Recently a fresh interest in the subject was awakened, and Mr. Mercer, the well-known archæologist, superintended some further diggings, especially in the hope of finding human remains in the fissure, the receptacle of the fossils, in the Silurian limestone.

Mr. Mercer's statement that a considerable part of those fossil bones crumbled, or, as he expressed it, "fell to a mealy powder" when touched, attracted my attention. In order to ascertain into what form and composition the bone-phosphate had been changed, I visited the locality and saw the peculiar position of the fissure filled with the moist débris derived from the overlying Mesozoic red sandstone. The mealy matter above referred to was easily found because there was more of it than solid fossil bones; although it is astonishing how many fragments of bones were in view, a sight delightful to the paleontologist.

I selected for my investigation a curved bone, apparently a transverse section of a scapula of perhaps one of the larger cats, about $\frac{5}{8}$ of an inch thick in the middle and tapering toward both ends. Clean material could easily be dug out with a knife. On drying the sample it appears as a yellowish, fine sand of even grain: Mr. Mercer's fossil bone meal. This fine grained mealy material was certainly at one time, a portion of a bone; but its composition is no longer calcium phosphate, a chemical analysis proving that phosphoric acid was almost or entirely absent. The reaction for phosphoric acid with the ammonium molybdate solution was very slight, there seemed to be but a small fraction of one per cent. of the calcium phosphate left in the specimen. It was further ascertained that this so-called bone-meal is now essentially calcium carbonate containing some magnesia. Is this material really amorphous as it appears under ordinary conditions? A slide, prepared in the ordinary way with balsam indicated beneath the microscope that nearly every particle had crystallized into a mineral. Groups of three or six crystals were recognized with a low power objective. In polarized light some of the crystals showed extinction parallel to the longer axis.

A pile of rubbish, which had been dug out of the bone-bed-fissure from which Professors Mercer and Cope had selected all that was worth having, contained some bone fragments in which the cellular structure of bone could be observed and also the gradual transition into the mealy condition or complete metamorphosis of bone phosphate into a mineral. I think a better proof could hardly be given of the gradual metamorphic change that has taken place in that locality. It seems to me that this fissure, which is V-shaped, had no outlet for the water which soaked the mixture of bones, ferruginous clay, twigs, fragments of sandstone, etc. and that the opportunity for mutual chemical dissociation was favorable to that effect. That carbon dioxide along with the water effected the change from the organic to the mineral in this case as in many others, scarcely requires demonstration. The phosphoric acid seemed to have been transposed and reunited with ferric oxide and with alumina to form vivianite and similar minerals, as indications of the presence of these species were noticed in the pile of débris near the bone deposit. In order to give some further proof of the almost complete change of the bone substance from the chemical standpoint, I endeavored to find the quantity of the carbonic acid gas volumetrically. I obtained by two measurements the average of 24.045 cubic centimeters at 0° C. temperature and 760 millimeters pressure of carbonic acid gas from 100 milligrammes of the mineral. This reduced to mass equals 47.23 per cent. It is evident that this rather high result must have a cause. Either there is another gas, or there is another oxide beside the lime. On determining the bases a large quantity of magnesia was found. The following is the result of the analysis:

CaO	30.39 per cent.
MgO	20.83 per cent.
CO_2	47.23 per cent.
Insoluble	1.79 per cent.
	100.24

The insoluble part consisted mostly of sand, a trace of lime phosphate and oxide of iron. If these small quantities of phosphoric acid, lime and oxide of iron would have been determined quantitatively, the general approximate result would not have differed much from the general result obtained. However, the differences appear when we recompute the oxides into salts such as they really are. We obtain about:

Calcium carbonate	54.27 per cent.
Magnesium carbonate	43.74 per cent.
Insoluble residue	1.79 per cent.
	99.80

From these numerical results it is plainly seen that the material is the mineral dolomite. Since bone phosphate contains generally but little magnesia, it may be assumed that this latter oxide must have been added when the transformation of the bone into the mineral took place.

Whether such a metamorphoses had ever been observed before is unknown to the writer at the present time. It was unknown to a number of chemists consulted, and, consequently, the conclusion was reached that all the possible metamorphic changes from the organic to the mineral kingdom may not have been observed.

CONTRIBUTIONS TO THE HERPETOLOGY OF SAO PAULO, BRAZIL.—I.

BY DR. H. VON IHERING.

In the State Museum under my administration, I have recently arranged and studied collections of great scientific value illustrative of the fauna of the State of Sao Paulo.

Of the collections made in Brazil by T. Natterer, the mammals and birds have been studied by the naturalist Pelzeln, of the Vienna Museum, forming an important contribution to our knowledge of the fauna of Sao Paulo. Of the other groups of vertebrates but little is known. For example, our largest fresh water fish, the *jahu*, has not been described.[1]

Concerning the reptiles and amphibians of Sao Paulo very little is known. Boettger[2] has mentioned a few species.

In the present paper I offer a list of the reptiles of Sao Paulo, excluding snakes, of which, as well as of frogs, I have lately received many species not yet determined. Of the following list two species only, *Prionodactylus* and *Heterodactylus*, are not represented in the collection of the Museum Paulista.

CROCODILIDÆ.

1. **Caiman latirostris** Daud.

CHELYDIDÆ.

2. **Hydromedusa maximiliani** Gray.
3. **Platemys spixii** D. & B.
4. **Platemys wagleri** D. & B.

This species was found at Piracicaba. The plastron is red. The species seems to be a *Platemys* and not a *Hydraspis*.

TESTUDINIDÆ.

5. **Testudo tabulata** Walb.

Called "Taboti." I have had a living example, found in the woods of this country.

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[1] I propose for this fish the name *Paulicea jahu*. A description may be found appended to this paper.

[2] *O. Boettger*, Ueber eine neue Eidechse aus Brasilien, Bericht d. Senkenb. nat. Gesellsch., Frankfurt a. M. 1875-'76, pag. 140-143 and Pl.; also *Boettger*, Katalog der Reptilien Sammlung im Museum zu Frankfurt a. M., 1893.

GECKONIDÆ.

6. **Hemidactylus mabouia** Mor.

Common at Santos, and also in the interior, as for instance at Santa Rita and Piracicaba. It is found in houses and also in the forests. It does not seem that this distribution has been effected by man's agency. In the large city of Sao Paulo I have never seen this Gecko.

IGUANIDÆ.

7. **Tropidurus hispidus** Spix.[3]

Common at Sorocaba.

8. **Enyalius catenatus** Wied.

There are two forms in Sao Paulo. One of them may be the true *catenatus* or a closely allied species, having the disposition of the spots and yellow marks somewhat irregular, not existing in all forms as seen in the figures of Spix (Plates XI and XIII). The second form, which I call variety *paulista*, has more affinity with *E. iheringi*, but the position of the nostril is nearer to the end of the snout than to the orbit, quite as in *catenatus*, to which the tibia shows analogy. A dark spot passes from the superciliary region to the upper lip. A series of alternating black spots is contained in the obscure vertebral band. Two large yellow lateral bands exist as well as in *E. iheringi*. This may be, therefore, a local variety of *iheringi*, but differs in some characters. Moreover, the dark spots of the face and of the extremities, especially of the lower legs, seem to be characteristic of *paulista*, and wanting in *iheringi*. As I had already doubts of the specific validity of *iheringi*, and as the new variety is intermediate between *iheringi* and *catenatus*, I believe that both are mere varieties of the latter.

The description above given refers to the female, the male being green without marks or spots, and not purplish as Boulenger says.

Enyalius is not at all common and it will, therefore, be impossible to obtain a sufficient representation for more conclusive studies for some time.

9. **Anisolepis grilli** Blgr.

Sao Paulo, St. Rita.

10. **Urostrophus vautieri** D. & B.

Sao Paulo, St. Rita.

[3] I have *Tr. torquatus* Wied. from Rio de Janeiro, but that species seems to be wanting in Sao Paulo.

11. **Polychrus acutirostris** Spix.

ANGUIDÆ.

12. **Ophiodes striatus** Spix.

Sao Paulo.

13. **Ophiodes intermedius** Blgr.

Santos.

14. **Diploglossus fasciatus** Gray.

Santos.

TEIIDÆ.

15. **Tupinambis teguixin** L.

This is the common "lagarto." It was by error that Boettger mentioned *T. nigropunctatus*, from Sao Paulo, as this seems to be the Amazonian form, as Boettger himself corrected.

16. **Tupinambis rufescens** Günth.

I do not know the exact habitat of our example of this species, which seems proper to the western parts of the interior. The number of ventral scales is somewhat less than in Argentine examples. The unicolored under side of the tail distinguishes this species very well from the two others.

17. **Centropyx paulensis** Bttg.

Taubaté.

18. **Ameiva surinamensis** Laur. (*Ameiva ameiva* L.).

Santa Rita.

19. **Pantodactylus schreibersii** Wiegm.

20. **Prionodactylus quadrilineatus** Bttg.

21. **Cercosaura ocellata** Wagl.

Also from the State Paraná.

22. **Placosoma cordylinum** Tsch.

Santos, Raiz da Serra, Paraná.

23. **Heterodactylus imbricatus** Spix.

Serra da Mantiqueira.

AMPHISBÆNIDÆ.

24. **Amphisbæna alba** L.

25. **Amphisbæna vermicularis** Wagl.

The number of the annuli of the body in the examples examined is: 217, 223, 224, 247. The suture of the frontals in one is longer, in two shorter than the suture between the præfrontals, and in one subequal. There are only three upper labials, only one example having four. Of course there is no reason for separating as species the southern examples distinguished by the smaller number of annuli and which only form a variety (*darwini* D. & B.) of the well known species.

It seems not at all justifiable to separate as "species" each example with a somewhat aberrant conformation of the head plates. As is the case with the anal pores (2 or 4), and the upper labials (3 or 4), the ocular also may occasionally be divided. *Amphisbæna angustifrons* Cope, and *mildei* Peters, are abnormalities of this kind of *Amph. darwini*, and not species. In one of my examples a suture in the third upper labial forms on the one side an infra-ocular.

26. **Lipidosternon microcephalum** Wagl.

Santos, Cubatad.

SCINCIDÆ.

27. **Mabuia dorsivittata** Cope.

Sao Paulo.

28. **Mabuia agilis** Raddi.

Santos.

29. **Mabuia frenata** Cope.

Piracicaba, St. Rita.

This is the provisional list of the S. Paulo species. *Hoplocercus spinosus* Fitz., mentioned by Boulenger from St. Paul, may have come from another South American St. Paulo, not of this State, as species of *Crocodilurus* and *Neusticurus*, do not occur here.

I believe it necessary to make some observations on the distribution of the Lacertilians. Our list contains 24 species of which 2 (*Centropyx* and *Prionodactylus*) as hitherto known only from Sao Paulo, may be left out of the discussion. Three of these species:—*Tupinambis teguixin*, *Ophiodes striatus*, *Amphisbæna vermicularis*, with var. *darwini* are of very broad distribution, extending from north to south Brazil and to Paraguay; eight of the species also occur in Rio Grande do Sul including *Enyalius catenatus* with its varieties, and *Anisolepis grilli* with its southern representative *A. undulatus*. The genera *Enyalius*, *Anisolepis*, *Urostrophus* and *Pantodactylus* represented in Rio Grande do Sul as well as in Sao Paulo, are not known at this time from Paraguay. It seems to be the same with

Hemidactylus, Mabuia[4] and the species of *Placosoma, Heterodactylus,* etc.

As future studies may modify these results it is sufficient here merely to touch on the problems of distribution. In general we have besides the more widely distributed forms to distinguish (1) forms of the littoral of Brazil, and (2) forms of the Paraguay valley, extending to Brazil.

I have already mentioned the former group. We can subdivide it into species developed principally to the north or to the south of the tropic of Capricorn. *Pantodactylus schreibersi* has not hitherto been found north of Sao Paulo; *Diploglossus fasciatus* is a Bahia form, which I have received from Rio Janeiro and Santos. There are many other species not represented in the interior of Sao Paulo, which extend in the coast end of Santos and further southward. Santos is situated on the ocean, S. Paulo 40 miles higher; the annual temperature of Santos, Iguape, being 21,5°, of S. Paulo 18,3° centigrade.

Thus it is quite natural that in the lowland between the ocean and the coast range, the Bahia fauna extends much farther south than in the interior. It seems probable that *Amphisbæna alba, Placosoma cordylinum*, etc. are governed by the same condition, and this will be much more evident from the numerous north Brazilian types represented in our collections from Santos and Raiz da Serra. But I can refer to another instructive instance: One of the characteristic families of the subtropical zone is that of the *Boidæ*, represented in Bahia by four species of which only *Epicrates cenchris* does not seem to reach Rio. *Eunectes murinus* is common in the interior of S. Paulo and extends to the south of St. Catharina as I have examined a skin from Laguna. It is gradually disappearing, and was once represented also in Rio Grande do Sul, as I believe *Boa constrictor*, not rare in the interior of Sao Paulo, does not occur in Rio Grande do Sul. I very much doubt the record "Buenos Ayres" in Boulenger's Catalogue. Species of *Boa* and *Eunectes* also occur in Paraguay but they are perhaps not exactly determined, and may be mere varieties of the eastern species.

I have received specimens of *Carollus caninus* L. from Rio and from Santos.

[4] This exists in St. Catharina and perhaps the north of Rio Grande do Sul, but has not hitherto been found in Rio Grande.

Another fact on which I insist is the distribution of certain forms from northern Brazil to the La Plata River, with the exclusion of the Brazilian littoral. The genus *Boa* is an example of this. *Ameiva surinamensis* does not exist in Rio Grande do Sul, but is said to live in the La Plata region, also in Bahia and in Paraguay. In Sao Paulo, however, this species is rare, and represented in the western zone only. Here we have also *Tupinambis rufescens*, extending from Mendoza to western Sao Paulo and *Mabuia frenata*, a Paraguayan species, which we have received from St. Rita and Paracicaba.

The species of *Mabuia* have an interesting distribution. As we mentioned above, the Paraguayan species *M. frenata* exists in the western parts of Sao Paulo. From Santos I have *M. agilis* Raddi, known hitherto only from Rio and north of Rio, but on the central highland we have *M. dorsivittata* Cope, extending from Rio Grande do Sul to Paraguay and to Sao Paulo. *Tropidurus torquatus* and *Polychrus acutirostris* are Brazilian species, distributed from Bahia to Sao Paulo and extending to Paraguay. It should be possible by this time, to determine analytically the various regional components of the diverse faunas.

I have elsewhere discussed these problems in distribution, having been the first to direct attention to them. In a paper on the distribution of *Ampullaria* I have mentioned, that of the species common to the Amazonian and San Francisco region, *A. canaliculata* does not occur in St. Catharina, *A. sordida* being substituted for it. Also at Rio Janeiro and in Sao Paulo there are other species of *Ampullaria.* This is only one example from a great list of species. *Glabaris riograndensis*, etc. are not represented in the River Paraná system, but are common in Rio Grande do Sul. Besides the species common to the Paraná system and to Rio Grande do Sul, there are others which reached Rio Grande and the La Plata States by the Paraguay system. This is now separated from the Amazonian system, but the faunal identity demonstrates this separation to be of very recent date.

The distribution of neither the fresh-water nor of the land faunas of Brazil can be at all understood without reference to these facts. For instance there is *Bulimus* (*Borus*) *oblongus* Müll., a form common in Rio Grande do Sul and the La Plata region, but also in Bolivia, Guiana and Venezuela. From St. Catharina to Sao Paulo and Rio where this species does not occur, *B. ovatus* Müll. is substituted for it, and north of Rio *B. cantagallanus* Rang takes its place. From Sorocaba, Ypanema, etc. I have received *B. ovatus*, but in Piracicaba and St. Rita in the western zone we have *B. oblongus*, which is evidently an immigrant from Paraguay, Bolivia, etc. with many of our other *Bulimus* and *Helix*.

The same conditions are noticed in other land shells. We find identity of species from Bahia with those of the La Plata and Rio Grande do Sul, which are absent from St. Catharina northward on the littoral.[5]

I believe finally it is time for European naturalists to take notice of these studies. It is quite an unscientific method, to continue to consider the neotropical region as a natural unity zoologically. This region in later secondary and early tertiary time was formed by coalescence of an Antarctic and a tropical element, the latter having been in mesozoic time connected with Africa. It was only with the pliocene period[6] a connection with North and Central America was formed. The ancient West Indian bridge being only during pleistocene time replaced by the present Isthmus of Panama.

We know to-day the history of the South American mammals, being able to separate the ancient endemic element from the pliocene

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[5] My various papers referring to the distribution of the Brazilian fauna and to the history of the neotropical region are as follows. The last three treat of the subject more fully:

Revision der von Spix in Brasilien gesammelten Najaden. Arch. f. Naturg. 1890, p. 117–170. Taf. IX.

On the ancient relations between New Zealand and South America. Trans. of the New Zealand Instit., Vol. XXIV, 1891, p. 431–445, (cf. Ausland, 1891, No. 18).

Die geographische Verbreitung der Flussmuscheln. "Ausland," Stuttgart, 1890, No. 48 and 49 *cf.* The New Zealand Journal of Science, 1891, p. 151.

Die geographische Verbreitung der Ampullarien in südlichen Brasilien. Nachrbl. d. Deutch. Malak. Ges., No. 5 and 6, 1891.

Anodonta und Glabaris. Zoolog. Anzeiger, No. 380–381, 1891–'92.

Ueber die Beziehungen der chilenischen und südbrasilianischen Süsswasserfauna. Verhandl. d. deutschen wissensch. Vereines zu Santiago, 1891, II. Bd., p. 143–149.

Morphologie und Systematik des Genitalapparates von Helix. Zeitschr. f. wissensch. Zool., Bd. 54, 1892, p. 386–520, Taf. 18–19 (cf. p. 489, Geograph. Verbreitung).

Das neotropisch Florengebiet und seine Geschichte. Botan. Jahrbücher. Engler. Bd. 17, 1893, p. 1-54.

Najaden von Sao Paulo und die geographische Verbreitung der Süsswasserfaunen von Südamerika. Archiv. f. Naturgesch., 1893, p. 45–140, Taf. III and IV.

Die Ameisen von Rio Grande do Sul. Berliner Entomolog. Zeitschr. Bd. 39, 1894, p. 321–446.

[6] And if in contrast to my opinion Ameghino is right, there was a connection also in the beginning of the tertiary period, followed without doubt by a long time of separation of both Americas.

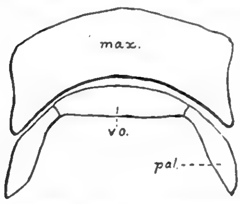
immigrants. In herpetology this is not the case, nor may we expect fossil material so abundant. Here zoogeographical data may help. Thus, I believe, no one could understand the geographical distribution of *Hyla* without supposing it a pliocene immigrant to Brazil from the north. We may be sure that *Hyla* or its allied forms will never be found in South America in the older tertiary formation. Taking *Hyla* as a northern intrusive element which passed by way of Central America to the Amazonian region and southward, we may easily understand the complete absence of these tree frogs from the Chilian forests. The Andean barrier of Chili and Peru is a very old one, and that of Ecuador a very recent one. This explains the fact hitherto not observed, that the Cordilleras are a zoological dividing line in Chile and Peru, but not in Ecuador. It seems to me quite probable that the American *Teiidæ* and *Iguanidæ* are originally from South America, and the *Solenoglyphæ*, *Boidæ*, etc. from North America.

It is not my intention to fully discuss these questions here; I would only call attention to them as new problems which we have to solve.

DESCRIPTION OF A NEW FISH FROM SAO PAULO.

PAULICEA gen. nov.

Head broader then deep, flattened, with the upper jaw little projecting beyond the lower, covered with skin, granulated behind. Occipital process reaching the dorsal plate. Dorsal spine nearly equidistant from snout and adipose fin. Pectoral spine long, broader than the dorsal spine, serrate behind. D. I–6. Caudal not deeply forked. Villiform teeth on upper jaw, palate and vomer. Palatine teeth forming with the vomerine patches a shallow band immediately behind the intermaxillary band of teeth, which is broad and scarcely or not at all narrowed in the middle.



Maxillary, vomerine and palatine teeth of *P. jahu*.

P. jahu sp. n.

A large species reaching a weight of 100 Kilo. and a length of 1.5–1.8 M. Width of head at the mouth two-thirds of its greatest width. D. I–6. A. I–10. Adipose fin equal to the anal fin. Maxillary barbel short, somewhat flattened, not longer than the head. Dirty gray with indistinct dark spots on back and sides.

There is in Sao Paulo in the rivers of the Rio Paraná system, especially in the system of the Rio Tieti, only one other fish which attains the dimensions of the Jahu; this is the *Pseudoplatystoma coruscans* Ag., called Piracampaeú. I got both at Piracicaba. The genus *Paulicea* is identical with the nameless genus No. XXXII, of C. H. and R. Eigenmann,[1] a genus which contains besides the new species here described, one Amazonian species *P. lutkeni* Steind., described as *Platystoma*.

[1] A review of the South American Nematognathi, San Francisco, 1890, p. 201.

OBSERVATIONS ON ERRANT FRUSTULES OF EUNOTIA MAJOR.

BY T. CHALKLEY PALMER.

The diatom *Eunotia major* Rab. occurs in some abundance in the uplands of Delaware Co., Pa., though appearing to flourish only in the basins of such springs as are well-shaded at all seasons. In these springs it is often present in profusion, forming masses of clean, brownish filaments attached to the sides of the pools, and by preference to submerged wood. The filaments grow to a length of ten centimeters. and vary in breadth from 0.036 mm. to 0.200 mm. in accordance with the length of their constituent cells. These filaments intertangle in such manner as to afford cover for numerous protozoa, and for such diatoms as *Surirella*, *Nitzschia*, *Pinnularia* and *Navicula*. *Eunotia lunaris* Grun. also frequently occurs in profusion in the same company.

In making a gathering of the filaments for study, it is well to begin by washing them free from all loosely adherent matters, such as sand, mica and clayey flocculence. They are then placed in a clean bottle which has been filled with water from the spring. A short exposure to diffused daylight will cause the diatoms to rise to the top, buoyed up by a multitude of oxygen bubbles entangled among them, and to free themselves from a further portion of mineral matter, which will at once subside, and may be rejected by decantation.

An examination of the gathering under the microscope will usually reveal, besides the filaments, a certain number of frustules, either isolated or in groups of two or three, moving about in a slow and erratic manner. In the course of two or three days, if all goes well, the proportion of moving cells will have increased; and from day to day, conditions permitting, the long filaments will progressively separate, until frequently the whole gathering ends by resolving itself entirely into isolated cells and short sections composed of two, four or even six cells, all in a state of lively locomotion.

Conditions favoring production of errant frustules.—The prime requisite for any extended study of the gathering is the preservation of the diatoms in a healthy condition. The best results have followed with *Eunotia major* when the clean filaments were kept in a semi-dark room, in a narrow-necked bottle filled with water from the native spring. Evaporation is slow and distilled water only is to be used in compensation. Any addition of town water is apt to be followed by a sudden and enormous increase of bacteria and a rapid decay of the diatoms. Bacteria do, in any case, gradually invade the culture and ultimately destroy it; but, with the above very simple precautions, it is quite possible to keep the gathering in good condition for a month—long enough to observe a variety of changes.

Free access of oxygen promotes the production of the motile frustules. Two approximately equal quantities of healthy filaments were selected, one of which was placed in a little vial with a narrow neck, the other in a flat glass dish; and, other conditions, as temperature, light and amount of water, being identical, at the end of a week the filaments in the dish had entirely disappeared, and the glass was found to be coated with single cells and small motile segments of the original filaments, while the bulk of those in the vial remained unseparated.

A second experiment was as follows:—Two quantities of the unseparated filaments, as nearly equal as may be, were put into precisely similar bottles. The first was at once placed in a dark corner of a poorly lighted room, the second beside it, after having been exposed to bright daylight until a mass of oxygen bubbles had formed. In the course of twenty-four hours, during nine of which all light was absent, the exposed bottle contained quantities of active motile cells, while the other afforded only a very few. This experiment, twice repeated with the same result, taken in connection with that which precedes, would indicate that we have here to do with a process the reverse of the endothermic chlorophyl reaction:—

$$CO_2 + H_2O = CH_2O + {}_2O$$

and that the chemical side of the phenomenon is that which accompanies protoplasmic motile activity in general.

This conclusion is reënforced by the observed fact that filaments of *Eunotia* in process of separation, and the resultant motile cells, give a strong carbon dioxide color-reaction in thoroughly aerated water tinted with hæmatoxylin; it is in accord with the important observation of O. Muller[1] as to the stimulating action of oxygen upon *Pinnularia*; and, finally, it is diametrically opposed to that view of

[1] Berichte der Deutsch. Botan. Gesellsch., Bd. XI, p. 571.

the nature of diatom movements held by the proponents of the "osmotic hypothesis," especially as this is set forth quite recently by W. M. Kozlowski.[2]

The stimulating action of light upon the motile activity of the errant frustules of *Eunotia* is not to be doubted, and has been observed a number of times; but, up to the present, notwithstanding that I have paid some attention to the matter, the phenomena observed are not such as are incapable of classification under the head of oxygen stimulation. No fact whatever has clearly indicated any special tendency to motion in the direction of greatest illumination, and after observing, under various conditions, the movements of thousands of these frustules, I have strong doubt as to the existence of any such tendency in *Eunotia*.

Characteristics of movements.—Students of diatom movements have, almost without exception, confined themselves to *Pinnularia* and other naviculoid forms wherein the phenomena are most striking. H. L. Smith,[3] and, more recently, O. Bütschli[4] and R. Lauterborn,[5] have been in practical agreement as to the phenomena, and to a certain extent they agree in the conclusion that motion is the result of an expulsion of a more or less fluid filament from the central nodule. O. Müller,[6] agreeing with the others as to the phenomena, looks rather, for their explanation, to currents of protoplasm which circulate along the raphe within the coleoderm, entering into and departing from the inner cell by way of the central and terminal nodules. Hauptfleisch[7] has studied forms of *Amphiprora* and *Brebissonia*, and by staining methods has apparently demonstrated in these the existence of a protoplasmic canal penetrating the raphe, through the delicate walls of which protrude exceedingly fine threads of protoplasm which act like similar organs in the rhizopods.

[2] Botanical Gazette, Vol. XXIV, p. 39. Kozlowski presents in an ingenious manner considerations supposed to point to the conclusion that in *Pinnularia* motion is due to unequal photosyntax in the two ends of the frustule, causing stronger inward currents of assimilable liquid and gas in one or the other end, this difference depending upon the unequal illumination of the two ends.

[3] Proceedings Amer. Soc. Micros., 1886.

[4] Mittheilung über die Bewegung der Diatomeen, Heidelberg, 1892.

[5] Untersuchungen über Bau, Kerntheilung und Bewegung der Diatomeen, Leipsic, 1896.

[6] Berichte der Deutsch. Botan. Gesellsch.: Bd. VII, pp. 169-180: Bd. XI, p. 571.

[7] Mittheilungen des naturwiss. Vereins für Neu-vorpommern und Rügen, Jahrg., XXVII.

Little attention having been paid to the slower movements of forms outside the Raphidieæ, it is not unusual to meet with statements implying that definite and positive motion, requiring explanation, is not observable in the case of these forms. This is a curious error. Splendid exhibitions of motile activity have long been familiar in the case of various species of *Nitzschia*, and the exceedingly striking movements of *Bacillaria paradoxa* are known to observers the world over. Certain species of *Diatoma* and *Fragilaria* exhibit motile phenomena of no doubtful kind; and of *Eunotia major*, which may stand as a type of the Fragilarieæ, the following are the observed facts:—

When a drop of water containing errant frustules is observed under an enlargement of about 200 diameters, the first movement detected will probably be that illustrated in fig. 2, Pl. VI. Certain frustules rise slowly on their ends, rotating smoothly through 180°, and fall flat upon the slide. During this manoeuvre an end remains in contact with the glass and serves as a hinge whereon the frustule turns. Occasionally, but not often, a similar revolution is accomplished at right-angles to this—in which case the long valve, instead of the narrow end, functions as a hinge. This particular movement only occurs immediately after the deposition of the diatoms upon the slide, unless at this time the cells are not in a state of activity, in which case it may be somewhat delayed. A long series of observations, extending over three years, has shown both the conditions under which this odd movement occurs, and the manifold purpose of it. It is, first, significant that only those cells that have chanced to fall upon the slide with ventral or concave girdle uppermost, as in A, fig. 2, Plate VI perform this movement. Such as have been deposited with ventral side down, as in C, begin without delay to move endwise in the direction indicated in the figure. Careful focussing shows that in most cases the frustule is, during this forward movement, tilted a trifle, so that while the anterior end remains in contact with the glass, the posterior end is free from it. This position is undoubtedly a condition precedent to successful locomotion, and there is no doubt that the attaining of this position is the purpose of the rotation. That the anterior end is in contact with the slide will be proven conclusively as we proceed; and it is, therefore, to the end of the frustule, and more especially to the ventral side of the rounded end, that search must be directed for the mechanism of this diatom's movement.

The forward movement of *Eunotia* resembles very little the smooth gliding of *Pinnularia* and *Nitzschia*. If these seem to swim, the other would appear to crawl. One corner is advanced a trifle, then the other corner, then both move forward at once. Occasionally the frustule will sidle for a moment; but generally the progression consists of a succession of impulsive jerks. The movement is accompanied by indications of very considerable stress. Comparatively large bodies, such as short filaments of *Eunotia* or small particles of sand, are pushed resolutely aside. Larger bodies, especially such as have considerable thickness, arrest the frustule for a time; but after a short interval, it is apt to turn upon its edge, with ventral girdle in contact with the obstruction, to move past in this position, and once more to resume its normal relations with the slide. At the moment of the passage of the anterior, and sometimes the posterior end of the frustule, the obstruction may be seen to move backward, as if from an impulse resembling a kick. These curious features I have observed numberless times.

If by chance the moving cell pass, as in fig. 1, Pl. VI, with a corner over the circumference of a thin piece of mica, the latter is, in many cases, caused to revolve backward in the direction indicated in the figure. This also was seen so often that the existence of something resembling pseudopodia at the corners of the frustule came to be anticipated with confidence.

Many species of motile diatoms, among them *Pinnularia* and *Nitzschia*, exhibit a sort of pendulum movement. The frustule proceeds in a straight line a certain time, comes to rest, and returns upon its path without changing the direction of its longer axis. This swing to and fro is repeated any number of times, so that anterior and posterior ends continually change places. There is little of this in the movement of *Eunotia*. I have frequently followed a frustule for half an hour without seeing it return upon its path, and on one occasion I observed a particularly active individual for two and a half hours, in which period its devious way was into all portions of the hollowed slide, and in all that time it kept one and the same end foremost. Yet there seems to be no universal necessity for this habit, since frustules are frequently observed to exhibit propulsive efforts upon solid bodies from both ends, and occasionally they do reverse their direction.

Movements in the hanging drop.—In order to study somewhat further the relations between moving *Eunotia* and the glass of the support, drops of water containing many frustules were suspended on cover-glasses and observed. The diatoms were found to separate into two portions. The first remained attached to the glass; such of them as had their dorsal or convex girdles next the glass performed the revolution before described; and these, with the others in contact with the cover, proceeded in characteristic ways, with the curious and significant difference, that as viewed from above the ventral side was now uppermost. The second portion fell to the surface of the suspended drop, where they moved as if upon a solid substratum. Midway of the drop there were none. Undoubtedly the surface of the drop possessed sufficient tension for the purposes of a crawling diatom. I have seen, in an aquarium, small snails crawling freely along the plane of contact between water and air, with broad, flat foot uppermost, applied to the surface of the liquid as if to a piece of glass.

Phenomena in carbon emulsion.—All preceding observations seeming to point to the existence of invisible organs functioning as pseudopodia, the endeavor was made to outline these by the well-known method of putting the diatoms in an emulsion of colored particles finely divided. To this end, since available India ink was found to be toxic owing to its content of camphor, a portion of carbon-black water-color was rubbed up in a drop of water until a very dark color was obtained. The emulsion showed, under medium powers, a multitude of particles exhibiting the Brownian movement. When placed in this, the errant *Eunotia* cells revealed quite clearly the existence at the corners of rounded masses of coleoderm. These were especially clear at the anterior corners. The particles of carbon approached the frustules quite closely everywhere except about the corners, and a little U-shaped line, composed of somewhat compacted particles, preceded the moving diatom. There was nowhere observable any streaming away of the particles, such as that seen by H. L. Smith and others in *Pinnularia*. Owing to the tenacity of the emulsion, and partly perhaps to the relatively raised position of the posterior end of the frustule, the clear spaces are less evident at the posterior corners.

Results of staining.—Numerous attempts were made with a variety of stains to render the coleoderm visible, the presence of which seemed to be so strongly indicated. All efforts to stain the still living coleoderm failed entirely. There was little better success in fixing with osmic acid and staining with methylene blue, methyl blue, fuchsin, etc., for the osmic acid seemed to produce, as it were, a certain shrinking of the very delicate organs. A measure of success followed the use of gentian violet followed by tannic acid, both in minute quantity. By this means the coleoderm was outlined; and especially in the case of frustules that had passed the period of their activity, and were nearly or quite dead, as shown by their contracted nucleus and bacteria-infested outline, the surface staining of the gelatinous external layer was clear. An extreme case of this is roughly shown in fig. 7, Pl. VI. Here the contents of the inner cell were apparently normal, with the exception of the nucleus, but the coleoderm was quite flaccid, loosely adherent to the frustule, and abnormally enlarged, as well as fringed with colonies of bacteria.

The stain which most quickly and surely shows the healthy coleoderm, at the same time instantly killing the diatom, is made as follows:—0·5 gram of Bismarck brown and 1.0 gram tannic acid are dissolved separately and added to a liter of distilled water. The solution remains perfectly clear, and is of a reddish-brown color. Two or three drops of this are added to a drop of water, under the cover glass, containing errant frustules of *Eunotia*. Almost before a change of tint is visible in the thin layer of water under the microscope, motion ceases, and, at the same time, at each corner of the frustules appears a little rounded mass of substance, gelatinous in appearance, and dotted with coppery or bronzy specks of most minute size. The shape of these masses, and their relation to the frustule, are indicated in figures 4 and 5, Pl. VI. The results of somewhat heavier staining with the same mixture are shown photographically by Mr. F. J. Keeley in figures 4, 5, and 6, Pl. VII.

Pursuant to the further study of these coleoderm masses, a large number of errant frustules were stained as follows: About two drops of water, containing the diatoms, were put on a cover glass and allowed some minutes to bring themselves into normal relations with the glass. Three drops of the described stain solution were added and staining was allowed to proceed half an hour. The excess of color was then removed by careful washing, dipping the cover repeatedly into a cup of water with as little friction as possible. Grübler's aqueous eosin, diluted with an equal quantity of water, was now added and allowed to act half an hour to an hour. Finally, the glass was washed and mounted in very weak formalin. The diatoms, under these circumstances, remain attached to the cover glass, as a rule with ventral side uppermost, and with coleoderm processes in the position best suited for study.

Prepared in this manner, the isolated cells and short segments of filaments present the appearance indicated by figures 3 to 5, Pl. VI. The gradual development of the foot-like organs from an intercellular plasm is shown in figure 3; and in figure 6 is shown the deterioration of these organs, which takes the form of an overproduction and liquefaction of gelatinous substance, and ends by gradually bringing to rest all the moving cells of a gathering, and entangling them in masses and threads of jelly. During this degeneration many of the cells die, but some survive with every appearance of health, though necessarily devoid of motion.

In figures 8 and 9 is shown the appearance, under 1,000 diameters, of the stained processes from the valve view and from the ventral girdle view. The outer and larger process, mainly gelatinous, shows a general mass slightly tinted only, outlined by more heavily stained grains within the substance. These grains take the eosin as do the protoplasmic granules of the inner cell. The smaller process, which seems to be somewhat shrunken by the staining with eosin (compare figures 4, 5 and 6, Pl. VII) are of a deep and nearly uniform red, and are in close apparent contact with aggregations of protoplasm within the frustule.

The small and apparently constant bead-like bodies around the circumference of the curving gelatinous masses have no perceptible thread-like connection with the more richly protoplasmic processes at the corners, and their significance is somewhat doubtful. They probably have some relation to a current of protoplasm which would seem to issue from the cell and return to it.

Structure of the frustule.—The existence of a "pseudo-nodule" on the ventral side of the valve, near the end, has long been known; but that there is a raphe at the end of the frustule has not, I believe, been stated. The photographs in Plate VII, which I owe to the kindness of Mr. F. J. Keeley, show clearly both the existence of this raphe and the presence, especially on the ventral girdle, of several channels in the silica which seem adapted to lead currents to and from this raphe and the pseudo-nodule.

The exact shape of the raphe itself, and its extent, remain to be determined; and indeed the problem presents difficulties, for the position of the raphe on the end of the frustule would necessitate sections for its study.

When a very dilute aqueous solution of gentian violet is dropped upon living and moving *Eunotia major*, and afterward washed off, certain deeply stained lines are seen in immediate contact with the silica of the ventral surface, and running down from the pseudo-nodule and the end nodule. These dark lines follow the course of the channels in the silica shown by the photographs, and would be explained by the existence of richly protoplasmic fluid. In a single case one of these lines was seen to issue, to all appearance, through the raphe and enter the coleoderm.

The above results of observation and experiment would seem to me to be conclusive proof that *Eunotia major*, and by inference other nearly related species and genera of the *Fragilarieæ*, move by the action of organs that may be called coleopodia. This conclusion, however, is far from touching the question of the means of locomotion in *Pinnularia* and its allies, and I have endeavored to indicate some of the differences of the phenomena to be explained in the two cases. It may be added in this connection that while a large *Pinnularia* in rapid motion not infrequently gives evidence of brisk internal currents such as O. Müller has described, such currents have not been observed by me in moving *Eunotia*. Under rather high powers one only sees, near the corners of the frustule, in the vicinity of the raphe, a certain internal commotion among the very small protoplasmic granules, a spasmodic movement back and forth, a weaving about. This movement differs alike from the streaming of cyclosis and the Brownian trembling, and it is traceable with difficulty, if at all, far from the corners. Nevertheless, the channelling of the frustule is of a character to indicate the existence of currents, and further observation may yet reveal them.

EXPLANATION OF PLATES.

PLATE VI. DIAGRAMMATIC.

Fig. 1.—Representation of *Eunotia major* moving across a piece of mica and revolving it in the opposite direction.

Fig. 2.—A frustule, valve view, in A resting upon its dorsal girdle, B revolving, and C reaching its normal motile position and moving in the direction of the arrow.

Fig. 3.—A short filament showing stages in the development of the coleopodia, and a free motile cell with development complete. Stained with Bismarck brown and eosin.

Fig. 4.—Valve view of motile cell, stained with Bismarck brown and eosin.

Fig. 5.—Stained cells, including a group of two.

Fig. 6.—Degeneration of the coleopodia, from overproduction of gelatinous substance, resulting in adherence. Stained as before.

Fig. 7.—Degeneration of the whole coleoderm, which is infested with bactaria in colonies. Gentian violet.

Figs. 8 and 9.—Coleopodia under higher magnification, showing differential staining by Bismarck brown and eosin.

Plate VII.

Fig. 1.—Ventral girdle view of cleaned frustule of *Eunotia major* × 925.

Fig. 2.—Optical section of the same frustule, showing the end raphe and channels leading to raphe and pseudo-nodule, × 925.

Fig. 3.—Dorsal girdle of the same frustule, × 925.

Figs. 4 and 5.—Motile frustules of *Eunotia major*, stained with Bismarck brown and tannic acid, × 315.

Fig. 6.—An enlargement of 4 (× 435).

A SMALL COLLECTION OF MAMMALS FROM NORTH-EASTERN CHINA.

BY SAMUEL N. RHOADS.

These notes are based on a collection of seventeen mammals brought to Philadelphia by Messrs. George and J. Edward Farnum, the product of a hunting trip in the Chinese and Mongolian territories northeast of Pekin with Dr. A. Donaldson Smith during May, June, July and August, 1897. By the generosity of these three gentlemen the Academy of Natural Sciences of Philadelphia comes into possession of the greater part of the collection, thus adding seven species new to its museum. An account of their trip is being prepared for the *Geographical Journal* of London.

1. Microtus (Microtus) mongolicus (Radde).[1] Mongolian Vole.

Seven specimens, Nos. 4,590 to 4,596, from along the shores of the Sungari River in Mongolia north of Petun, come near *M. arvalis* Pallas as defined by Poliakoff, Lataste and G. S. Miller, Jr. From their greater size and resemblance to Radde's plate of *mongolicus*, both as regards external and cranial characters, as well as from their geographic position, it appears best to consider them as *mongolicus*. Externally the adult specimens resemble closely in size and color very large *M. pennsylvanicus* taken at the same season (July 16th) in the vicinity of Philadelphia. The pelage of *mongolicus*, however, is more thin and coarse, indicating a habitat in a hot climate. In the skull of an old male specimen the interorbital ridges have coalesced on the frontal suture in a sharp elevated median ridge. Comparing it with *M. pennsylvanicus* of same age and sex their greatest zygomatic width is about the same, but the length of the *mongolicus* skull is about 4 millimeters greater and its interorbital elevation above the alveolus of $\underline{\text{m. 1}}$ is 2 mm. greater, showing a relative length and depth of cranium quite remarkable in the genus and nowhere approached in any American species known to me. The molar series are correspondingly long and narrow. It is a true member of the subgenus *Microtus* as defined by Miller.[2] The hind

[1] Reis. im Ost-Sibir., I, p. 194, pl. VII.

[2] N. Amer. Fauna, No. 12, 1896.

foot is 24 mm. from end of heel to end of claws; the tail 45 mm. long, these dimensions being taken from the dry specimen. No measurements for any of the specimens in the collection were recorded by the collectors.

2. Mus humiliatus M. Edwards. Pekin River Rat.

An adult female, No. 4,598, from the steep banks of a stream at Shiao Ho Tzu undoubtedly represents Milne Edwards' species described[3] from the environs of Pekin, and with whose measurements and plate it closely agrees. Edwards states that it represents *Mus rattus* in China, an unaccountable statement, perhaps a slip of the pen for *Mus decumanus*, as its external and cranial characters are very close to the short-eared, brown-backed, gray-bellied short-whiskered Norway Rat. Its short tail and small cranium, however, easily distinguish it from *decumanus*. The skull of the specimen is 37.5 mm. in occipito-nasal length and 18.5 mm. in its greatest zygomatic expanse. The nasals are relatively short, not reaching so near to the superior termini of the premaxillaries as in *decumanus* or *rattus*. The relations of this species to *Mus caraco* Pallas are seemingly close and it may yet prove that *humiliatus* is only a subspecies of *caraco*.

3. Mus sp.?

The scalp and skull of an adult, long-whiskered, long-eared and long-nosed rat, No. 4,599, taken southeast of Dolonnor apparently represent a species of slender and elegant proportions, with a skull nearly as long as in the specimen of *humiliatus* above recorded, but with a greatly diminished zygomatic width and cranial depth. These characters and the great relative length of rostrum put it in the *Mus rattus* group. Its cranium is much smaller and more slender than *M. rattus alexandrinus* and the mandibles are unusually narrow and weak for a *Mus*. The upper head is yellowish-brown, heavily lined with black, darkest around eyes. Ears brown-gray; lips white; throat yellowish-white; gray of cheeks broadly bordered inferiorly by ochraceous buff which probably extended increasingly along neck and sides of body.

4. Alactaga annulata (M. Edwards). Subsp.? Jerboa, Khin Gan.

A young female Jerboa, No. 4,597, about two-thirds grown, from all appearances should be classed under the above name. As would be expected, its immaturity is evinced by the darker pelage over the

[3] Recher. Mam., 1868–'74, p. 137.

entire upper parts as contrasted with M. Edward's figure[4] of an adult specimen. This dark coloration results from the black tips of the upper pelage being more strongly developed and the buff ground colors less intense than in the adult stage. The peculiar markings of the tail fit M. Edward's figure so well that its specific affinity to *annulatus* is very probable. On the other hand our specimen was not taken in the Mongolian desert but at an elevation of 3,550 feet in a high fertile valley, on the border of the desert in the Khin Gan Mountains. It is probably a dark race of *annulata,* as yet unnamed.[5]

5. **Tamias (Eutamias) asiaticus** (Gmelin). Asiatic Chipmunk.

Two adult specimens, No. 4,601 from Tung Ching Tzu and No. 4,602 from Sian Lang Kou, the first taken in May, the latter in June, both from the Province of Pechili along the foothills of the Khin Gan Range south and east of Dolonnor, are of interest when compared with American species of the subgenus *Eutamias.* Founded in 1880 by Trouessart as a subgenus, *Eutamias* has lately been considered by Dr. Merriam[6] as of full generic value, with *T. asiaticus* as its type, and including several species of West American chipmunks of the *townsendi*, *speciosus* and *pictus* groups.

As contrasted with typical *Tamias* of Illiger, with our eastern *striatus* as its type, *Eutamias* presents invariably a persistent second upper premolar, never found in *striatus* and its east American congeners. This feature is the only one given by Trouessart to characterize *Eutamias*, and it is worthy of mention that in his recent *Catalogus Mammalium* that author does not recognize his *Eutamias* even as a subgenus. It is, however, worthy of that rank and no more, as its generic recognition necessitates a like subdivision of *Spermophilus* into genera which, as such, are meaningless in nomenclature and only confuse where intended to elucidate the affinities of distinct but closely related groups.

The cranial characters of *T. asiaticus* do not seem to have been made the basis of comparisons by any other writer than Trouessart between the species of *Tamias* of the Old and New World.

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[4] Recher. Mam., pl. X.

[5] Radde's name, *Dipus jaculus* var. *mongolica*, in Mél. Biol. Acad. St. Pet., III, 1861, p. 680, cited by Trouessart, may be applicable to M. Edwards' species. If so it has priority over *A. annulata.*

[6] Proc. Biol. Soc. Washn., July, 1897, p. 189.

Dr. J. A. Allen makes no mention of them in his publications on the subject. The skulls of the two adult specimens secured by the Messrs. Farnum present several characters of interest. First, as to their subgeneric status, it is noteworthy that *asiaticus* not only has the well developed and persistent second premolar found in our west American species but also exhibits 6 to 8 strongly developed sulci on the pigmented face of the upper incisors, analogous to those often exhibited by *Arctomys* from the Cascade Mountains. An examination of several of our Cascade Mountain, Sierra Madre and British Columbia species of *Eutamias* exhibits the same character, and in some species, as *T. merriami, T. quadrivittatus* and *T. townsendi* it is very marked. *T. striatus* and its allies of the subgenus *Tamias* have normally smooth incisors as in *Spermophilus* and its subgenera *Ammospermophilus* and *Callospermophilus.* Dr. Allen's final separation of all American species of *Tamias* from *T. asiaticus*[6] was based solely on an examination of the *external* characters of Siberian specimens, considered in connection with the wide geographic separation of the habitats of the most boreal forms known in Eastern Asia and Western America. An English mammalogist of great note has taken occasion to deplore Dr. Allen's change of arrangement of American species as an illustration of the species-splitting which characterizes present day methods of American mammalogists. Had our critic been at the pains to inquire into the subject by personal examination of specimens he would certainly have avoided choosing such an illustration; for the specific differences between *T. asiaticus* and its nearest ally in America are, in respect of the cranium, very marked. The skull of *asiaticus* is much larger than that of the largest American *Eutamias.* It is also relatively much wider than the skull of any American species of the genus *Tamias* and the great width of the nasal bones contrasted with their shortness immediately separates *asiaticus* from any other *Tamias.* There is a distinct supraorbital process or spine in *asiaticus* caused by the more posterior reach of the normal supraorbital notch found in all other species of the genus. The skull of No. 4,602 is 40.5 mm. long; its greatest width 22.5 mm.; nasal length, 12.3 mm.; posterior breadth of nasals, 5 mm.; interorbital constriction 10.2 mm. Unfortunately no measurements of the Mongolian specimens were taken before skinning. The hind foot, measured dry, is 38 mm. in one specimen and 40 mm. in the other, indicating a species larger than *striatus.*

[6] Bull. Amer. Mus. N. H., III, p. 45.

6. **Lepus** sp. Hare.

A hare, No. 4,600, whose characters indicate a near approach to maturity, evidently belongs to a species about the size of *Lepus americanus*. It was taken on the east slope of the Khin Gan Mts., in Mongolia, at an elevation of about 4,000 feet. It is much smaller than any hare described from this region by Radde, Schrenck, Pallas and others, the hind foot measuring only 105 mm. in length. The tail and ears are relatively long, the former black above and white below. The ears are blackish-gray and ochraceous, like upper head and body, and bordered at tips with black. The belly, breast, vent and chin are pure white to bases of hairs; the lower neck, fore legs, and space between shoulders are tawny ochraceous. The skull characters show close affinity to *Lepus americanus*. It was taken July 15th, and is in full summer pelage.

7. **Gazella gutturosa mongolica** (Heude). Mongolian Gazelle.

An adult male and a yearling of the same sex, of the "Imperial Sheep" or "Houang Yang-tze" are represented by two heads in the collection. On the supposition that Heude's species *mongolica*[7] is separable from the Siberian *gutturosa* of Pallas, I adopt the above trinomial. Its separability from what Heude figures as *hillieriana* on the next plate I am inclined to doubt. In the yearling the horns are about 3 inches long and curve inward, their points touching and slightly overlapping above the occiput. The specimens were taken in the Imperial Hunting Park northeast of Dolonnor. A female of the same species, shot June 6th, contained a nearly mature fœtus.

8. **Capreolus pygargus** (Pallas), subsp.? Mongolian Roe Deer.

The skull and scalp of a fine male specimen of this animal were secured in the Imperial Hunting Park. It is placed in the above category on the authority of Sir V. Brooke[8] who considers the Manchurian Roe to be at least a small race of *pygargus*.

It is remarkable that this specimen, shot in the middle of June, is possessed of a fine set of antlers from which the velvet has not wholly disappeared around the bur.

9. **Lynx isabellinus** (Blyth). Thibetan Lynx.

A fine adult specimen of *Lynx*, No. 4,603, also taken in the Imperial Hunting Park, agrees with Blyth's description of *isabellinus*

[7] Mem. Hist. Nat. Chinois., 1894, p. 245. Pl. XXXVII.

[8] P. Z. S., 1878, pp. 917–918.

as compared with the characters of the *L. lynx* (L.) of Europe. I am unable to state an opinion as to the specific value of *isabellinus* but the fact of specific identity among the several forms of *Lynx ruffus* found across the northern continent of America, and their close resemblance to *L. lynx* of Eurasia, suggests that *isabellinus* is only an eastern race of that species, characterized by fewer and weaker spots, more naked foot pads and paler color. The specimen was killed June 17th.

NOTES ON ALASKAN WATER BIRDS.

BY ALVIN SEALE.

During the summer of 1896, it was the writer's privilege, in company with Norman B. Scofield, a fellow student at Stanford University, to make a trip into the Arctic Seas for the purpose of collecting specimens of natural history for the Leland Stanford Junior University of California.

The expedition was under the patronage of Mr. Timothy Hopkins of Menlo Park, California, to whom great credit is due for the splendid scientific equipment to which the success of the expedition is largely due.

We desire also to express our appreciation of the favors extended to us by the Pacific Steam Whaling Company of San Francisco, who furnished free transportation for the expedition, and spared no pains or expense to make our voyage pleasant as well as successful. Valuable aid was also given us by the commanders and officers of the various whaling vessels of the above company. Special service was rendered us by Captain Townsend of the bark "J. D. Peters," Captain Mason of the S. S. "Jeanie," Captain Cogan of the S. S. "Thrasher," Captain Smith of the S. S. "Narwhal," and also many others.

Our vóyage extended north to Point Barrow, Alaska, thence east to the Mackenzie River. Collections were made at various points along the coast.

URINATORIDÆ.

8. Urinator adamsii. Yellow-billed Loon.

This Loon occurs in abundance at Point Barrow during the early part of September. We are under obligations to Captain Akin of the Rescue Station for a fine specimen, a male in full breeding plumage, taken September 12th. Length 33.75 in.; bill along culmen 3.5; along gape 5; height at nostrils 1.2; width .50; tarsus 3.7; wing 14.3. Hab., western Arctic America and northeastern Asia.

11. Urinator lumme. Red-throated Loon.

The great abundance of divers forms a striking feature of bird life in Alaskan waters. The Red-throated Loon is one of the most common forms. Large bands of this species were observed at Point Barrow during the month of September. For the most part these birds were making their way to the south, usually flying high and announcing their passage by hoarse, grating cries.

In regard to this Loon, Nelson writes: "The Red-throated Loon is one of the very few birds which raises its voice in the quiet of the long Arctic night. It is abundant at Point Barrow where it is supposed to breed. It also breeds upon the Commander Islands." Hab., (Ridg.), northern portions of the northern hemisphere, breeding in Arctic regions; in North America, south in winter, nearly across the United States. One specimen, (No. 3,374, Stanford University), a male in full breeding plumage taken July 19th at Orca, Alaska, S. W.

ALCIDÆ.

12. Lunda cirrhata. Tufted Puffin.

A single individual of this species came flying past our vessel May 27th, in longitude 126° W., latitude 47° N.; this was the first specimen seen. It circled around us twice and was off again like a shot. The following day three more were observed, and from this time they became more and more abundant as we advanced to the north until about June 16th, longitude 159° 50′ W., latitude 51° 56′ N. From this date and position there was a rapid decrease in the number observed; in fact, Tufted Puffins were not met with in any great abundance north of the Aleutian Islands, their place being taken by the Horned Puffin (*Fratercula corniculata*).

In their flight past our vessel these birds would usually circle around us two or three times, turning their heads to one side and looking down at us in a comical and knowing manner, and in many ways manifesting a high degree of curiosity. Seven adult specimens of *Lunda cirrhata* are in the Stanford University collection, four of which are from Nutchuk, Alaska, July 5th; three from the Pribyloff Islands. Hab., coasts and islands of the North Pacific, from southern California to Alaska, and from Bering Strait to Japan; accidental in the Bay of Fundy and Kennebec River.

14. Fratercula corniculata. Horned Puffin.

We first observed Horned Puffins June 20th in longitude 165° 53′ W., latitude 51° 30′ N. From this position until we reached Point Hope north of Kotzebue Sound they were common. At King's Island near Port Clarence, Alaska, these birds nest in great abundance; this rookery was visited July 4th. The nests for the most part seemed to be quite high on the cliffs, and at this season were occupied by the immature birds, many of which were able to fly. The discharge of a gun caused hundreds of the adult birds to take wing and circle about us. In a very short time, however, they settled upon the cliff again, crowding upon each other and keeping up a curious guttural sound. This species is represented in the Stanford University collection by five fine specimens in breeding plumage taken on the Pribyloff Islands July, 1896. A specimen taken early in the season (June 14th) has the head and neck a deep glossy black so nearly like the coloring of the back that it was difficult to make out the usual sharp line of demarcation. Hab., coasts and islands of the North Pacific, from British Columbia to the Kurile Islands. "Abundant on all the shore line of Alaska south of the Arctic circle" (Turner).

17. Cyclorrhynchus psittaculus. Paroquet Auklet.

One specimen of this species was shot at Point Barrow, September 12th. But few of these Auklets were seen. Three specimens were taken on St. George Island, July 26th, by Messrs. Greely and Snodgrass. Hab., coasts of the North Pacific from Sitka to the Kurile Islands.

18. Simorhynchus cristatellus. Crested Auklet.

These were very abundant on the water near King's Island during the early part of July. The natives brought large numbers of these birds on board our vessel to barter. I noticed, however, that they always removed the small crest of the bird before disposing of it. Whether they retained the crest as an object of ornamentation or for some superstitious reason I was unable to learn. Three specimens[1] from the Pribyloff Islands taken in July show an interesting variation in the size of the sexes. Male: wing, $5\frac{8}{16}$ ins; tarsus, $1\frac{4}{16}$; middle toe and claw, $1\frac{12}{16}$; exposed culmen, $\frac{9}{16}$; depth of bill at nostrils, $\frac{9}{16}$; greatest width of bill at gape, $\frac{13}{16}$; head, $1\frac{12}{16}$. Female: wing, $5\frac{5}{16}$; tarsus, 1; middle toe and claw, $1\frac{9}{16}$; exposed culmen, $\frac{5}{16}$; depth of bill at nostrils, $\frac{7}{16}$; greatest width of bill at gape, $\frac{13}{16}$; head, $1\frac{12}{16}$. Hab., coasts of the North Pacific from Kadiak and the Pribyloff Islands to Kamtschatka and northern Japan. Nelson found this bird breeding in abundance on the Diomede Islands in Bering Strait. They were not seen by us north of King's Island.

[1] Nos. 3,522, 3,523, 3,553, Stanford University, Greely and Snodgrass.

20. Simorhynchus pusillus. Least Auklet.

From latitude about 60° north until we reached Bering Strait, these little birds were quite common, usually seen in pairs on the water. They were very tame and our vessel would almost run them down before they would dive or fly. A number were shot near King's Island. Three specimens, one male and two females, were taken at St. George Island July, 1897, by Messrs. Greely and Snodgrass. The male bird of this species shows a very decided increase in size over the female on the measurement of bill, tarsus and wing. Hab., coasts of the North Pacific, from Japan and southern Alaska to the Aleutian and Pribyloff Islands. Nelson found these birds abundant on the Diomede Islands in Bering Strait.

29. Cepphus columba. Pigeon Guillemot.

With the exception of a few specimens seen near King's Island, the Pigeon Guillemots were not observed until we entered the Arctic Ocean. At Icy Cape they were common on the water August 4th, their bright red legs, white wing bars and black bill making them quite conspicuous. Few were met north of this point. Hab., coast of the North Pacific, from southern California to Icy Cape, Alaska, Aleutian Islands, Kamtschatka, and northern Japan.

30. Uria troile californica. California Murre.

June 16th a solitary California Murre was observed on the water, longitude 150° W., latitude 51° 56′ N.; this was the first specimen seen. Three days later eight more of this species were observed. These birds, like the Tufted Puffin, were very curious about our vessel and would usually circle around us a number of times before going on their way. One even flew through our rigging four times, acting very much as if trying to alight on the yards. Murres were again met with June 20th, when a band of twenty-two passed us. June 22d they were quite common in longitude 164° 55′ W., latitude 52° 9′ N. Hab., Pacific coast of North America, south to Southern California. Nelson found this bird abundant on Wrangel and Herald Islands.

31. Uria lomvia arra. Pallas' Murre, "Ice Duck."

These birds were met with in great abundance after entering Bering Sea. The sailors call this murre the "Ice Duck," and its appearance in large numbers is regarded as an indication of a nearness to ice. And indeed in the present case at least, this proved to be true, for on the following day, June 27th, longitude 170° W., latitude 60° 20′ N., a large ice floe was encountered upon which these birds were very abundant; in fact, one might easily have mistaken parts of the floe for a rookery. Not only were they abundant on the floe itself, but each detached block of ice seemed to have its crew of "Ice Ducks." Off St. Lawrence Island July 1st, murres were far more abundant than any other species of bird. At East Cape, Siberia, July 26th, these birds were quite common. They were met with constantly on the American side as far north as Icy Cape. From this point on, very few were seen; none were observed to the east of Point Barrow. This species is easily distinguished by the strong heavy bill. Four specimens from Nutchuk, Alaska, have the culmen measuring 2.26 ins., 2.1, 2.2, respectively.[2] Hab., coasts and islands of Bering sea and Aleutian chain, from Kadiak to Kamtschatka. Nelson found this bird abundant on Harold and Wrangel Islands.

STERCORARIIDÆ.

36. Stercorarius pomarinus. Pomarine Jaeger.

Four of this species were seen June 20th, longitude 164° 56′, latitude 50° 56′ N. They were common at Port Clarence during the latter part of July. A fine male was taken at Icy Cape July 31st. At no time, however, were the birds in question so abundant as *S. longicaudus*. Hab., northern portions of the northern hemisphere, along sea coasts and larger inland waters, breeding far northward in America, south in winter to California, New Jersey and the Great Lakes.

37. Stercorarius parasiticus. Parasitic Jaeger.

Parasitic Jaegers were not abundant at any time. One solitary individual was seen June 28th in latitude 60° 40′ N.; two more were observed the following day. On July 1st three Parasitic Jaegers were seen off St. Lawrence Island One specimen was shot at Port Clarence July 23d. These birds were fairly common at Icy Cape. On August 3d at this place two fine adults, a male and female in black plumage, were taken (see Nos. 3,564 and 3,566 L. S. J. U.). Hab, northern portion of northern hemisphere, breeding toward Arctic regions; south in winter to New York, southern California, and even the coast of Brazil.

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[2] See Nos. 3,376, 3,422, 3,423, 3,424, L. S. J. U. Nutchuk, Alaska, July 11, 1896, A. W. Greely.

38. Sterocrarius longicaudus. Long-tailed Jaeger.

This species could be seen at almost any time from July to September. They were abundant all along the coast from Icy Cape to Herschel Island, N. W. T. They were abundant at Point Barrow and seemed to be engaged chiefly in making life sorrowful for the gulls. I noticed, however, that the big Glaucous Gull turned the tables, and was frequently seen to chase the Jaegers. One adult male was taken at Icy Cape, August 3d (No. 3,560 Stanford University). This specimen gives the following measurements: Wing, 13.5 ins.; culmen, 1.27; cere, .75; tarsus, 1.75; mid-toe and claw, 1.65. Hab., northern parts of northern hemisphere, breeding in Arctic regions, south in winter to California.

LARIDÆ.

40. Rissa tridactyla pollicaris. Pacific Kittiwake.

This beautiful bird was frequently observed in Bering Sea as far north as Icy Cape, Alaska. Like the genus *Larus*, they have the habit of following the vessel and watching for any food that may be thrown over the side. They were most abundant off St. Lawrence Island, July 1st. Two were shot at Icy Cape August 3d, (see Nos. 3,563, 3,564 L. S. J. U.). Hab., coasts and islands of Bering Sea north to Icy Cape.

40a. Rissa brevirostris. Red-legged Kittiwake.

This species was more abundant than the preceding, especially in the vicinity of the Aunamak Pass. Two specimens taken on St. George Island July 26, 1897, give the following measurements: No. 3,530 Stanford University; wing, 12.25 ins.; culmen, 1.12; depth of bill at nostrils, .45; tarsus, 1.12; mid-toe and claw, 1.76; No. 3,518 Stanford University: wing, 11.75: culmen, 1.05: depth of bill at nostrils, .45; tarsus, 1.10; mid-toe and claw, 1.70. Feet and legs, bright red, bill, greenish-yellow. Hab., coasts and islands of Bering Sea.

42. Larus glaucus. Glaucous Gull.

The big Glaucous Gulls were first observed June 29th, latitude 61° 32′ N. They were not common, however, until we reached Port Clarence, Alaska. Unlike most Gulls, this species is extremely suspicious and rarely comes within gun shot of the vessel. We found this Gull abundant from Port Clarence all along the Arctic coast to Mackenzie Bay. A southern migration of these birds was observed at Point Barrow, Alaska, September 15th; it was a cold rainy day with a strong wind blowing from the northwest. All the day, band after band of these Gulls passed the point following the coast line to the south; in one of these bands I counted forty-eight individuals, most of them adults. Hab., coasts of Arctic seas; south in winter to Long Island and California.

44. **Larus glaucescens.** Glaucous-winged Gull.

The Glaucous-winged Gulls were fairly common from the Aleutian Islands to the Bering Strait. They were seen to associate freely with the smaller Gulls, and at times would come quite near the vessel, differing in this respect from the *L. glaucus,* which so far as we could see did not associate much with the other species.

Two specimens taken at Orca Station, S. W. Alaska, give the following measurements: No. 3,425 (L. S. J. U.); wing, 17; culmen, 2.56; depth of bill through angle, .84; depth of bill through nostrils, .80; tarsus, 2.86; mid-toe with claw, 3.20; tail, 7.18: No. 3,426 (L. S. J. U.): wing, 17.5; culmen, 2.36; depth of bill at angle, .90; depth of bill at nostrils, .80; tarsus, 2.86; mid-toe and claw, 3.28; tail, 7.3. Hab., coasts of the north Pacific and Bering Sea, from Japan northwest, across through Aleutian chain, and south in winter to California.

51a. **Larus argentatus smithsonianus.** American Herring Gull.

Birds ascribed to this species came flying about our vessel near Unalaska and also near Aunamak Island. No specimens were secured. Hab., whole of North America, south in winter to Cuba and Lower California.

53. **Larus californicus.** California Gull.

No specimens were taken, but birds ascribed to this species were met with quite frequently near Aunamak Pass. Hab., western North America, chiefly in the interior, from Mexico to Alaska.

55. **Larus brachyrhynchus.** American Mew Gull.

Birds of this species were frequently observed along the Alaskan coast as far north as Icy Cape, one specimen being shot at this place July 30th. Hab., northwestern North America breeding far north; south in winter along the Pacific coast to Southern California.

62. **Xema sabinii.** Sabine's Gull.

These Gulls were first observed about ten miles off Icy Cape, Alaska, where a company of five came flying over the ice and passed our vessel. On August 8th these gulls were extremely abundant at

Point Barrow, congregating in thousands along the shore to feed upon small Cœlenterates and Crustaceans that were washed up on the sands. When we again reached Point Barrow, September 8th, these birds were in the height of their southern migration, and bands composed of from fifty to one hundred individuals were constantly passing, but this time paying little attention to the food that was still abundant along the shore. Xema Gulls were not seen at Herschel Island until August 28th. The absence of immature birds was a striking fact; almost all of these Gulls that we observed were adults. Two young, however, were shot at Point Barrow September 12th. Hab., Pacific coast of North America from Monterey, California, N. to Point Barrow, east, New York, Great Lakes, (casually to Bermudas and Peru).

71. Sterna paradisæa. Arctic Tern.

The first representative of this species was seen June 6th, longitude 141° W., latitude 52° 37′ N. The poor bird seemed to have been battling with the storm for some time and to be completely tired out; it alighted in our rigging and remained with us all day. By June 20th Terns were very common, and eight or ten could be counted from the deck of the vessel at one time. Two specimens were shot at Port Clarence, Alaska, July 8th. Terns were quite abundant at Point Barrow August 12th and at Herschel Island August 27th. Hab., circumpolar regions, south in winter to California. Another species of Tern supposed to have been *Sterna aleutica* was observed quite frequently in the Bering Sea. We were unable to obtain a specimen however.

DIOMEDEIDÆ.

82. Diomedea albatrus. Short-tailed Albatross.

The first Short-tailed Albatross was observed May 26th, about eighteen miles off Cape Flattery. Two were seen June 1st in longitude 134° 16′ W., latitude 51° 6′ N.; the day following another was observed. This completes the record of all seen during our entire voyage. These birds, unlike the Black-footed Albatross, do not follow after a vessel. Hab., North Pacific from California to Alaska.

81. Diomedea nigripes. Black-footed Albatross. "Goonie."

On May 27th, about one hundred miles northwest of Cape Flattery, these birds of the open sea were first sighted. From that time until June 21st they were always in evidence about our vessel. The last "Goonie," however, deserted us when we came in sight of the snowy mountains of the Aleutian Islands. These birds offer a never failing source of interest and instruction to the ocean traveller when the sails flap idly against the mast and the voyage stretches out to a wearisome length. As a matter of curiosity I made it a point at a certain time each day to count and note down the number of Black-footed Albatrosses that could be seen from the deck of the vessel, the position of our vessel and any peculiar hydrographic conditions. I copy the resulting table from my note book.

Date.	Longitude W.	Latitude N.	Hydrographic Conditions.	Number of Albatrosses.
May 27	126° 40′	47° 32′	Light breeze	6
May 28	———	———	Fresh breeze	8
May 29	122° 12′	47° 10′	Rough sea	7
May 30	131° 20′	47° 55′	Gale	5
May 31	133° 34′	49° 7′	Heavy sea; little wind	11
June 1	134° 16′	50° 16′	Calm	19
June 2	134° 45′	50° 44′	Becalmed	8
June 3	———	———	Fog; strong breeze	7
June 4	139° 54′	52° 9′	Calm	17
June 5	140° 11′	52° 37′	Fresh breeze	7
June 6	———	———	Rain	7
June 7	143°	51° 40′	Cold rain; strong wind	6
June 8	———	———	Rain; heavy wind	7
June 9	148° 16′	51° 28′	Warm and pleasant	8
June 10	———	———	Strong breeze	8
June 11	———	51° 30′	Slight breeze	12
June 12	———	———	Cold; calm	8
June 13	154° 41′	50° 46′	Calm	3
June 14	154° 41′	50° 46′	Slight breeze	4
June 15	158° 43′	51° 10′	Fair breeze	3
June 16	159° 58′	51° 56′	Calm; cold	3
June 17	———	———	High fog; warm	3
June 18	———	50° 42′	Fog	4
June 19	164° 56′	50° 56′	Fresh breeze	3
June 20	———	———	Fog; good breeze	2
June 21	———	———	Fog; cold	2
June 22	164° 55′	52° 9′	Becalmed	1
June 23	———	———	Becalmed	0

From the above table it would seem that in this case, at least, the Black-footed Albatross during the early month of June is found most abundant in latitudes between 50° and 52° north, and that they are seen in greater numbers about a vessel on calm days. A fine specimen of this species was taken May 11th by letting a baited hook over the side of the vessel, the hook catching merely in the horny part of the beak and dropping out when we got the bird on deck. It was utterly helpless on deck, being unable to fly unless from the water. This bird, after having his beak tied so as to restrain his vicious tendency to bite, was given the freedom of the vessel.

On one or two occasions among the birds that followed close to the stern of our vessel I noticed specimens that were marked slightly differently from the one taken. I suspect these belong to one of the other species reported from the North Pacific, but as no specimens could be taken, nothing was definitely established. Hab., North Pacific.

PROCELLARIIDÆ.

86b. Fulmarus glacialis glupischa. Pacific Fulmar.

A large flock of dark-bodied birds, in appearance very much like Pacific Fulmars, was observed some distance from the ship June 20th, latitude about 51° N. A heavy fog closing in, however, prevented us from getting a more satisfactory observation of the birds. The next day Pacific Fulmars were frequently seen quite near the vessel. On June 24th, great rafts of these birds were seen on the water in the Aunamak Pass; among these were quite a number of the white ones. Just after entering the Bering Sea we passed a great flight of Pacific Fulmars all making their way to the westward against a heavy gale of wind. They would fly a short distance, then settle upon the water and rest a moment, and then try it again. They always arose facing the wind and also sat on the water in the same position. The dark Pacific Fulmar was not seen north of Bering Strait. When in the North Pacific on our return voyage, September 25th, a large number of these Fulmars, ("bousins" they are called by the sailors), came flying about our vessel in the manner of the Black-footed Albatross, except that the Fulmars flew quite high, most of the time making a peculiar sharp cry. They followed the ship, circling around and over us almost the entire day. Hab., North Pacific to Mexico.

86c. Fulmarus glacialis rodgersii. Rodger's Fulmar.

A Rodger's Fulmar was shot June 29th latitude 61° 3′ N. Very few were seen, however, until we reached East Cape, Siberia, where they were common. On September 19th when about sixty miles west of Point Barrow, Rodger's Fulmars could be seen almost any time during the day following after our vessel, as if expecting food to be thrown over to them. They had probably learned to expect food from ships by being near the whaling vessels while they were "cutting in" or "trying out" a whale, at which time large quantities of fat and refuse are thrown over the side. Hab., Bering Sea, Arctic Ocean north to Point Barrow.

91. Puffinus creatopus. Pink-footed Shearwater.

A great flight of Pink-footed Shearwaters was observed May 26th about fifteen miles off Cape Flattery. They were passing to the north in a continuous stream. I watched from the deck of our vessel for over an hour, during which time many hundreds passed, frequently flying quite near us. Their large size, white breasts and wheeling flight were unmistakable. Our vessel interrupted their line of flight, but they simply divided, part of the stream going by on one side, and part on the other. Never for a moment did they stop the steady flow to the north. The Pink-footed Shearwaters were not met with again during our entire trip. Hab., Eastern Pacific Ocean, Cape Flattery to Chili.

95. Puffinus griseus. Dark-bodied Shearwater.

A few Dark-bodied Shearwaters were observed May 26th off Cape Flattery. They were flying north in company with the *Puffinus creatopus.* Dark-bodied Shearwaters were again observed June 22d in longitude 164° 55′ W., latitude 52° 9′ N., about sixty miles south of the Aleutian Islands. At this point we encountered and for several hours sailed parallel to a great flight of these birds. During this time thousands of individuals passed us in steady flight, all going to the westward.

Oceanodroma (?). Petrels.

Concerning Petrels I have the following entry in my note book: June 16th, longitude 159° 58′ W,, latitude 51° 56′ N. For the past two or three nights there has been a number of small bat-like birds flying about our vessel keeping up an almost constant sound of low musical notes. The sailors call them "Mother Carey's Chickens." I was not able to secure a specimen for identification. They may have been *O. furcata.*

Birds well answering the description of *O. furcata* were observed May 28th. They were flying about in the wake of our vessel, skimming gracefully over the waves and occasionally dashing through the spray as if they enjoyed the rough sea.

PHALACROCORACIDÆ.

123a. Phalacrocorax. Cormorants.

Probaby not more than two dozen Cormorants were seen during our entire voyage. No specimens were shot. Three small individuals of this genus were seen on a small island in the Aunamak Pass, which is our first northern record for "Shags." These were a small species (possibly *P. p. robustus*). Seven Cormorants of a larger species (possibly *P. urile*) were observed off Aunamak Island. A few were also seen in the vicinity of Point Hope. All the Cormorants met with seemed extremely wild, keeping well out of range of a shot gun. This is rather surprising when one considers how tame and fearless the Shags are near Monterey, California, where they are being shot at constantly.

ANATIDÆ.

154. Clangula hyemalis. Old-squaw.

Along the Arctic coast from Point Barrow eastward to the Mackenzie River, the scarcity of bird-life as compared with that of Bering Sea is quite striking. In fact, were we to disregard Old-squaws, Glaucous Gulls, and an occasional straggling band of Eider Ducks, our records for this part of the voyage would be chiefly a blank. With the exception of Eider Ducks, Old-squaws were the most abundant water fowl met with in the Arctic. At Point Barrow, September 12th, a great migration of Old-squaws was going on, thousands were passing to the south; many were shot. Their meat, however, is not considered good eating, except by the natives. Hab., northern portions of northern hemisphere, south in winter nearly across the United States.

158. Arctonetta fischeri. Spectacled Eider.

A young Spectacled Eider was taken about fifty miles off Icy Cape, Alaska, August 2d. This was the only one of the species seen.

A few skins from the heads of the adult ducks were seen in the possession of the natives at Point Barrow, where they are highly prized as articles of ornamentation. The Spectacled Eider is reported as being rarely seen on the American side, although abundant on the Siberian coast. Hab., coast of Alaska from Northern Sound to Point Barrow.

161. Somateria v-nigra. Pacific Eider.

This is the most abundant wild fowl at Point Barrow. During their spring and fall migration the very sky is clouded with their flight. They form an important article of diet for the natives and other persons stationed at Point Barrow. Hab., northeastern America, south to Great Lakes.

162. Somateria spectabilis. King Eider.

Very few King Eider were seen. One specimen was taken Aug. 7th at Point Barrow, while flying in company with the Pacific Eiders. Hab., northern portions of northern hemisphere, south in winter to Great Lakes.

164. Oidemia deglandi. White-winged Scoter.

One flock of about sixteen White-winged Scoters observed about 60 miles east of Point Barrow is our only record for this species. Hab., northern North America, south in winter to the Great Lakes.

166. Oidemia perspicillata. Surf Scoter.

A few straggling companies of Surf Scoters were seen in longitude 159° 58′ W., latitude 51° 56′ N. A great flock of these Ducks passed us June 22d when a few miles off Unalaska. They were abundant at King's Island. Hab., North America in general.

169. Chen hyperboreus. Snow Goose.

This Goose was fairly common at Herschel Island during the latter part of August, when several flocks were seen flying south. The native hunters brought in a number killed at the mouth of the Mackenzie River August 23d. Hab., western North America, breeding in Alaska.

174. Branta nigricans. Black Brant.

A number of Black Brant were brought in by the natives at Herschel Island; they do not seem to be very abundant near the island however. No live individuals of this species were seen. Hab., western Arctic America, south in winter to Lower California.

A LIST OF LAND AND SHORE BIRDS COLLECTED IN ALASKA OR ADJACENT ISLANDS IN THE SUMMER OF 1897 BY MESSRS. ARTHUR W. GREELY AND ROBERT E. SNODGRASS.[3]

222. Crymophilus fulicarius. Red Phalarope.

Four specimens from St. Paul Island, August 31st.

[3] All the above specimens are now in the museum of Natural History at Stanford University, California.

223. Phalaropus lobatus. Northern Phalarope.

Five specimens from St. Paul Island, August 17th.

236. Tringa couesi. Aleutian Sandpiper.

Five specimens, St. Paul Island, August 17th.

237. Tringa ptilocnemis. Pribyloff Sandpiper.

Six specimens, St. Paul Island, August 22d.

238. Tringa acuminata. Sharp-tailed Sandpiper.

One specimen, St. Paul Island, August 19th.

242. Tringa minutilla. Least Sandpiper.

Two specimens from Bellovski Bay, July 27th.

254. Totanus melanoleucus. Greater Yellow-legs.

One specimen from St. Paul Island, August 23d.

259. Heteractites incanus. Wandering Tattler.

Four specimens, St. Paul Island, August 22d.

302. Lagopus rupestris. Rock Ptarmigan.

One specimen.

523. Leucosticte griseonucha. Aleutian Leucosticte.

Four specimens from St. George Island, July 25th.

534a. Plectrophenax nivalis townsendi. Pribyloff Snowflake.

Four specimens, St. George Island, July 25th.

536. Calcarius lapponicus. Lapland Longspur.

Eight specimens, St. George Island, July 25th.

542. Ammodramus sandwichensis. Sandwich Sparrow.

Fourteen specimens from Amagak Island, September 15th.

557. Zonotrichia coronata. Golden-crowned Sparrow.

One specimen from Unga Island, July 22d.

582. Melospiza cinerea. Aleutian Song Sparrow.

Four specimens from Amagak Island, September 17th.

585. Passerella iliaca unalaschcensis. Fox Sparrow.

Ten specimens from Unga Island, July 21st.

723. Troglodytes alascensis. Alaskan Wren.

One specimen from Amagak Island, September 17th.

765. Saxicola oenanthe. Wheatear.

One specimen from St. Paul Island, August 29th.

LIST OF BIRDS COLLECTED AT KADIAK, ALASKA, IN 1896 BY MR. CLOUDSLEY RUTTER.

12. **Lunda cirrhata.** Tufted Puffin.

30a. **Uria troile californica.** California Murre.

129. **Merganser americanus.** American Merganser.

146. **Aytha americana.** Redhead.

301. **Lagopus lagopus.** Willow Ptarmigan.

302. **Lagopus rupestris.** Rock Ptarmigan.

352. **Haliaeetus leucocephalus.** Bald Eagle.

475. **Pica pica hudsonica.** American Magpie.

486a. **Corvus corax principalis.** Northern Raven.

ODONATA (DRAGONFLIES) FROM THE INDIAN OCEAN, AND FROM KASHMIR, COLLECTED BY DR. W. L. ABBOTT.[1]

BY PHILIP P. CALVERT, PH. D.

Dr. W. L. Abbott, of Philadelphia, made collections of Odonata in the Aldabra (Lat. 9° 25′ S., Long. 46° E.), and the Glorioso (Lat. 11° 40′ S., Long. 47° 33′ E.), and the Seychelle Islands in the Indian Ocean, and in Kashmir, which he sent to the U. S. National Museum. These, by the direction of the late Dr. C. V. Riley, were sent to me for study. Their consideration is here grouped under two heads.

I. From the Indian Ocean.

A number of papers treating of the Odonata of some of these islands lying near Madagascar already exist. As far as they are known to me they are given below, in chronological order.[2]

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[1] Based on collections of the U. S. National Museum, Washington, D. C. Researches made in the laboratories of the Academy of Natural Sciences of Philadelphia, and of the University of Pennsylvania, Philadelphia.

[2] de Selys-Longchamps, E. Névroptères. Annexe K. pp. 32–35, in Notes sur l'Ile de la Reunion par L. Maillard. Seconde Partie. Paris, Dentu, Editeur, 1862. 6 spp. Reunion (Bourbon). 19 spp. Mauritius (Ile-de-France).

Brauer, F. Neue exotische Odonaten. Verhl. k. k. Zool.-bot. Gesell. Wien., xvii, pp. 811–816, 1867. 1 n. sp. Mauritius. See on this Karsch. Ent. Nach., xx, p. 382, 1894.

Wright, E. P. Notes on the Dragonflies of the Seychelles. Ann. Mag. Nat. Hist. (4), iii, pp. 270–272. April, 1869.

de Selys Longchamps, E. List of Species and Description of a new Genus and five new species of Dragonflies (Odonata) from the Seychelles. Ann. Mag. Nat. Hist. (4) iii, pp. 272–277. April, 1869. 9 spp.

de Selys-Longchamps. E. Odonates des iles Seychelles. Ann. Soc. Ent. Belg, xii, p. 95–99. Read March 6, 1869 (see *l. c.*, p. lii). Essentially the same as the preceding.

de Selys Longchamps, E. Enumeration des Odonates de Madagascar et des Iles Comores et Mascareignes in Recherches sur la Faune de Madagascar et de ses Dépendances d'après les découvertes de François P. L. Pollen et D. C. Van Dam., 5 me Partie. 1 re livraison. Leyde, J. K. Steenhoff, editeur., 1869. 31 (?) spp. Madagascar. 7 spp. Nossi-Bé, 3 spp. Comoro Is., 21 (?) spp. Mauritius, 9 spp. Bourbon, 1 sp. Rodriguez.

de Selys-Longchamps, E. Note sur plusieurs Odonates de Madagascar et des ils Mascareignes. Revue et Mag. Zool (2) xxiii, pp. 175–183. April, 1872. Supplementary to the preceding; suppresses 1 sp. Madagascar, 1 sp. Mauritius as synonyms.

McLachlan, R. A new dragonfly of the genus *Anax* from Madagascar. Ent. Mo. Mag., xxi, pp. 250–251, 1885. 1 n. sp.

No previously published records for the Odonata of the Aldabra and Glorioso Islands appear to exist. Brief accounts of their recent visits to the former are given by Mr. T. Risely Griffith and Dr. Abbott in the Bulletin of Miscellaneous Information, Royal Gardens, Kew, 1893, p. 152 et seq., but these contain nothing as regards insects. A list of the plants collected by Dr. Abbott in the Aldabras is given in the same Bulletin, 1894, pp. 146–150. Dr. Abbott's own "Notes on the Natural History of Aldabra, Assumption and Glorioso Islands, Indian Ocean," in Proceedings U. S. National Museum, XVI, pp. 759–764, 1894, mention the *Pantala flavescens* referred to in this paper.[3]

In the present paper seven species are mentioned. Five, from the Seychelles, were already known to exist there, but some additional details on their structure or relationships are given. Two species are from the Glorioso Islands, one from Aldabra.

Subfamily AGRIONINÆ.

1. Leptocnemis bilineata Selys.

Hemicnemis bilineata Selys Ann. Soc. Ent. Belg., xii, p. 28, 1869. **Martin,** Mem. Soc. Zool. France, 1896, p. 108.

Two males, Mahé Is., Seychelles.

Kirby, W. F. A Revision of the Subfamily Libellulinæ, etc. Trans. Zool. Soc. Lond., xii, pp. 249–348. Pls. li-lvii, 1889. 1 n. sp., Madagascar, p. 317.

Karsch, F. Beschreibung einer neuen Libelluline Madagaskar's. Ent. Nach., xv, pp. 276–277, 1889. Berl. Ent. Zeit., xxxiii, p. 352, 1890. A synonym.

Karsch, F. Beitrag zur Kenntniss der Libellulinen mit vierseitiger cellula cardinalis (*Nannophya* Rambur). Ent. Nach., xv, pp. 245–263, 1889. 1 n. sp. Madagascar, p. 252.

Karsch, F. Ueber Gomphiden. Ent. Nach., xvi, pp. 370–382, 1890. Adds 1 n. sp. of Gomphinæ for Madagascar.

de Selys-Longchamps, E. Causeries Odonatologiques no. 6. Les Gomphines d'Afrique. Ann. Soc. Ent. Belg., xxxvi, pp. 86–107, 1892. Adds 2 n. spp. Madagascar, 2 n. spp. Nossi-Bé.

Calvert, P. P. Preliminary notes on some African Odonata. Trans. Am. Ent. Soc., xix, pp. 161–164, 1892 Notes on 2 spp. Seychelles.

de Selys Longchamps, E. Causeries Odonatologiques no. 7. Ann. Soc. Ent. Belg., xxxviii, pp. 163–181, 1894. Adds 1 n. sp. Gomphinæ Madagascar.

Calvert, P. P. East African Odonata. collected by Dr. W. L. Abbott. Proc. U. S. Nat. Mus. xviii, pp. 121–142, 1895 [1896]. Notes on 4 spp. Seychelles. See also Calvert. P. P. Ent. Nach., xxii, p. 215, 1896.

Martin, R. Odonates des Iles Seychelles. Mem. Soc. Zool. France, 1896, pp. 101–112. 20 spp., 5 new. Adds also 3 spp. for Madagascar.

[3] Since the above was written, Dr. A. Voeltzkow has given an account of his recent visit to Aldabra, with references to the literature of previous visits by other travellers, in Abhandlungen von der Senckenbergischen Naturforschenden Gesellschaft, xxi, l. Frankfurt, 1897.

Subfamily LIBELLULINÆ.

2. Pantala flavescens Fabricius.

Four males Glorioso Is., one of them dated Jan. 28, 1893. Four males, eight females, Aldabra Is.

3. Tramea basilaris Beauvois.

Libellula basilaris Beauvois Ins. rec. Afrique et Amer. p. 171, pl. ii, f. 1, 1805. Synonym? *Tramea Burmeisteri* Kirby, Trans. Zool. Soc. London, xii, p. 316, 1889.

One male, four females, Glorioso Is., the male and one female dated Jan. 29, 1893.

Mr. Kirby states (*l. c.*) that his *Burmeisteri* is "nearly allied to the African *T. basilaris* Beauv., in which, however (judging from the single broken specimen before me), the yellow area on the hind wings is much less extended, and the opaque spaces (of which the upper one is much more extended) is nearly black."

In all these Glorioso individuals, the yellow area on the hind wings extends from the base outward as far as the external angle of the triangle; in the male it reaches backward (caudad) to the anal 'angle,' in the females back to three-fourths of the width of the wing-base; as regards the extent of the yellow area, therefore, these individuals have, in Mr. Kirby's view, a character of *Burmeisteri* rather than of *basilaris*.

On the other hand, the upper basal band of the hind wings of *Burmeisteri* fills up "more or less of the lower basal cell and part of the wing *below* [the italics are mine] adjacent as far as the base of the triangle" (Kirby, *l. c.*). In these Glorioso females, but not in the male, the blackish-brown fills up the basilar [médian of Selys, 1896] space (= upper basal cell of Kirby), the subcostal space to the first (1 ♀) or second (3 ♀) antecubital, and parts of the supra-triangular space and of the triangle as well as the "lower basal cell and part of the wing below adjacent"; this distribution of the dark color is a character of *basilaris*. In the Glorioso male the brown on the hind wings is reddish-brown and therefore paler than in the females; it fills the "lower basal cell and part of the wing below adjacent" and extends into the triangle, and is separated from a second, wider reddish-brown band extending from the inner margin to the distal subbasal sector although not actually touching either margin or sector; this second band therefore does not "run from the base of the sector of the triangle" as in *Burmeisteri*.

I have before me also two males from Madagascar, similar to the one described above, sent to me by M. Martin as *basilaris*.

Altogether I think that the probability is that *basilaris* and *Burmeisteri* are color extremes of one and the same species.

It may be recorded here that in these Glorioso individuals the first pair of legs are blackish like the others, that the genital hamule of the male projects beyond the genital lobe, that the inferior appendage of the male is half as long as the superiors and reaches to the last denticle thereof, the superiors being longer than 9+10 but shorter than 8+9+10, and that the vulvar lamina of the female is three-fourths as long as 9, bilobed in its own apical three-fourths, and her appendages as long as 9+10.

This species has not been recorded from the Seychelles.

4. **Tramea continentalis** Selys.

Selys, Mitth. Dresdner Mus., iii, p. 299, 1878. Martin, Mem. Soc. Zool. France, 1896, p. 102.

One male, one female, Mahé Is., Seychelles.

The male is the same form so identified by M. Martin as he has sent me one of his Seychelle specimens. The female is like those he mentions in his last sentence (*l. c.*) "Certaines femelles n'ont meme qu'une petite tache marron très courte, le long de la membranule et le surplus de la tache normale est indiqué par une teinte jaune brulé très clair, presque limpide." A male in my collection from West Madagascar by Hildebrandt, formerly in the Museum für Naturkunde, Berlin, where it stood as *T. limbata* is of the same species and Mr. Kirby's description of *Tramea madagascarensis* (Trans. Zool. Soc., London, XII, p. 317, 1889) also applies here. Unfortunately even M. Martin does not give a sufficiently full statement of the distinctions between *limbata* Desjardins and *continentalis* Selys, and it is not certain that the insect I have described as *T. limbata* (Proc. U. S. Nat. Mus. xviii, p. 121; Ent. Nachr. xxii, p. 217, 1896) really is such.

In these two *continentalis*—the male has the hamule projecting considerably beyond the genital lobe, the superior appendages are almost as long as 8+9+10, the inferior appendage is almost half as long as the superiors and reaches slightly beyond their denticles; the female has the vulvar lamina seven-eighths as long as 9, bilobed in its apical three-fourths, the appendages as long as 9+10.

5. Orthetrum wrightii Selys.

Libellula wrightii Selys, Ann. Soc. Ent. Belg, xii, p. 96, 1869; Ann. Mag. Nat Hist. (4), iii, p. 272, 1869. *O. W.* Calvert, Trans. Amer. Ent. Soc., xix, p. 163, 1892; Proc. U. S. Nat. Mus., xviii, p. 134, fig. 12, 1896. Martin, Mem. Zool. Soc., France, 1896, p. 102.

Ten males, two females, Mahé Is., Seychelles.

The pale spot on the upper surface of the frons, enclosed by blue-black, is yellow in some individuals instead of olive. The front wings with 12–14 antenodals, 9–10 postnodals, the internal triangle 4-celled in one male only. Inner side of the triangle of the hind wings in the prolongation of the arculus in all.

Having recently studied the type of *O. stemmale* Burm. from Mauritius, now in the Museum of Comparative Zoology at Cambridge, Massachusetts, I have reached the conclusion that *wrightii* is but a race thereof, as the only differences I can find are the following:

	stemmale, ♂	*wrightii*, ♂ ♀
Rhinarium	darker than nasus	concolorous with nasus.
Black at the middle of the base of the labrum reaching	half-way to the free margin	to the free margin (except in one young ♂ where it reaches hardly half-way.)
Superior surfaces of second and and third femora and of first and second tibiæ	luteous	black (or reddish-brown in some immature males.)
Inferior appendage of the male compared to the superiors	one-fifth shorter	one-fourth to one-third shorter.
Total length	50 mm.	46–39 ♂, 44–41 ♀
Abdomen (length)	34 mm.	31.5–27 ♂, 31–28.5 ♀
Front wing (length)	36.5 mm.	34–29 ♂ ♀
Hind wing (length)	34.5 mm.	32–28 ♂ ♀
Pterostigma		
front wing	3.6 mm.	3.4–3. ♂ ♀
hind wing	4. mm.	

The data here given for *Wrightii* are based on the twelve individuals above cited and on eight males and three females sent me by M. Martin.

Among Dr. Abbott's specimens of this species are one male and one female, not in the least pruinose on thorax and base of abdomen, which have the frons and the labrum luteous without black except at the base of the frons.

6. Schizonyx luctifera Selys.

Zygonyx ? luctifera Selys, Ann. Soc. Ent. Belg , xii, p. 96, 1869. Martin, Mem. Soc. Zool. France, 1896, p. 103. *S. l.* Calvert. Trans. Am. Ent. Soc. xix, p. 163, 1892; Proc. U. S. Nat. Mus., xviii, p. 122, fig. 3. 1896 (Additional bibliography in this last).

Two males, Mahé Is., Seychelles. The internal triangle of the front wings is of *three* cells.

7. Diplacodes trivialis Rambur.

Libellula trivialis Ramb. Ins. Névr., p. 115, 1842.
Trithemis t. Martin, Mem. Soc. Zool., France, 1896, p. 102.

One male, two females, Mahé Is., Seychelles.

This species has been referred to *Trithemis* by recent authors, but is surely a *Diplacodes.*

II. From Kashmir.

There does not appear to be anything in print treating especially of the Odonata of Kashmir, although a number of species from this and neighboring regions have been described, chiefly by Baron de Selys, in systematic papers. The following faunal articles are useful for comparison[4].

The collection made by Dr. Abbott comprises 82 specimens of fifteen species. These are merely labelled "Kashmir" with the

[4] McLachlan, R. Scientific results of the Second Yarkand Expedition, etc. Calcutta, 1878.

Brauer, F. Verzeichniss der von Fedtschenko in Turkestan gesammelten Odonaten. Verhdl. K. K. Zool. bot. Gesell. Wien, xxx, pp. 229–232, 1880.

Kirby, W. F. On a small collection of Dragonflies from Murree and Campbellpore (N. W. India), etc. Proc. Zool. Soc. Lond., 1886, pp. 325–329.

de Selys-Longchamps, E. Odonates de l'Asie Mineure et Revision de ceux des autres parties de la Faune dite Européenne. Ann. Soc. Ent. Belg. xxxi, pp. 2–85, 1887.

de Selys-Longchamps, E. Insecta in itinere Cl. N. Przewalskii in Asia Centrali novissime lecta, XI. Horæ Soc. Ent. Ross., xxi, pp 441–447, 1887.

McLachlan, R. On two small collections of Neuroptera from Ta-chien-lu, in the Province of Szechuen, Western China, on the frontier of Thibet. Ann. Mag. Nat. Hist. (6), xii, pp. 421–436, 1894.

McLachlan, R. On Odonata from the Province of Szechuen in Western China, and from Moupin, in Eastern Thibet. Ann. Mag. Nat. Hist. (6), xvii, pp. 364–374, 1896.

elevation above or below which they were collected. The U. S. National Museum does not possess any more precise data, which is the more unfortunate as such exist for the mammals and birds collected in this region by Dr. Abbott, and may be found in the papers by Messrs. True and Richmond respectively, in the Proceedings of the U. S. National Museum, volumes XVII and XVIII.

Of the fifteen species ten are well-known as occurring in Europe and a large part of Northern and western Asia, three (*Ischnura inarmata* n. sp., *Orthetrum hyalinum*, *O. triangulare*) are Indian in their relationships, one is the cosmopolitan *Pantala flavescens* and one (*Ophiogomphus reductus* n. sp.) is allied to Palæarctic species of a Holarctic genus.

Subfamily AGRIONINÆ.

1. Lestes barbarus Fabr.

One female "below 5,000 f." It differs from European examples only by its slightly shorter pterostigma.

This species has previously been recorded from Persia and Turkestan.

2. Ischnura inarmata n. sp. Figs. 1, 2.

Two males, three females, "below 5,000 f."

Abdomen ♂ 23–22, ♀ 22. Hind wing ♂ 16–15, ♀ 16–18.

Agree in many respects with de Selys' description of *I. delicata*

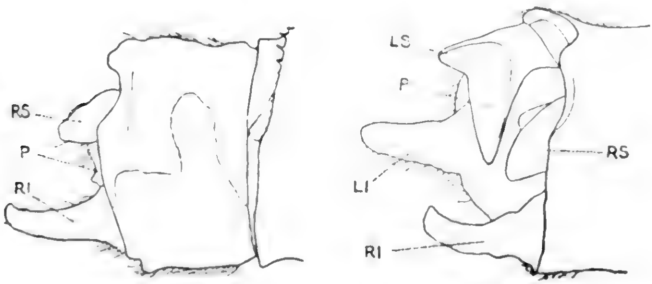


Fig. 1. Fig. 2.

Fig. 1. Profile view, right side of tenth abdominal segment and the terminal appendages of *Ischnura inarmata* n. sp. ♂ Fig. 2. The same, viewed obliquely from above and behind. RS right superior appendage, LS left superior appendage, RI right inferior appendage, LI left inferior appendage, P inferior process of the superior appendage. The irregular, curved line on the side of the tenth segment in figure 1 indicates the boundary between black above and blue below.[5] x 20.

[5] All the drawings which illustrate this paper have been made with the aid of Leitz or Zeiss lenses and the camera lucida.

(=*aurora* Brauer), (Bull. Acad. Roy. Belg. [2] xli, p. 281, 1876) but differ therefrom as follows:

♂.—Pterostigma of the front wings entirely reddish, not whitish at the outer end. Antennæ (except the first joint which is green) black. Pale postocular spots rather large, elongate. No spine near the "echancrure mesothoracique." Sides of the thorax pale green, a very fine black line on the second lateral suture. Abdominal segment 2 with a dorsal black band from base to apex; articulations between 3 and 4, 4 and 5, and 5 and 6 black, 5 with a small dorsal anteapical black spot. Dorsum of 6 orange in the basal third to fifth, dark metallic green for the remainder; of 7 entirely dark metallic green; 8 and 9 blue, unspotted, dorsum of 10 black which may be invaded by the blue of the sides at the middle of each side. The appendages blackish; superiors as described for *delicata*, inferiors pale at base, twice as long as the superiors and nearly as long as 10. Figs. 1 and 2.

♀.—Inferior side of the pterostigma as long as the costal side. Head colored as in the above described males. Dorsum of abdominal segments 1–10 dark metallic green, the articulations with narrow, yellow, transverse rings.

Subfamily ÆSCHNINÆ.

3. Anax parthenope Selys. Figs. 3 A-E.

Selys, Bull. Acad. Belg., vi (2), p. 389, 1839. Ann. Soc. Ent. Belg., **xxvii**, p. 116, 1883.

Anax bacchus Hagen, Verhdl. k. k. zool. bot. Gesell. Wien, **xvii**, p. 48, 1867.

One male, three females "below 5,000 f.", one male "5—10,000 f." Abdomen ♂ ♀ 46–49 mm., hind wing ♂ 46–49, ♀ 49–51.

Hagen described *A. bacchus* from a single female in his collection, from the Himalayas, of which he says that it "is throughout so close to *parthenope* in size, form, color and mark-

Fig. A.

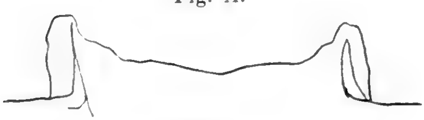


Fig. B.

Fig. C.

Fig. D.

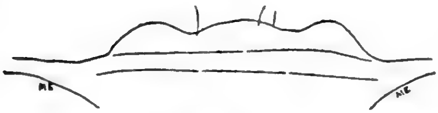


Fig. E.

Fig. 3 A–E x 25.

Hind margin of the occiput of *Anax parthenope*, ♀ showing variations in the two processes or "horns." A. Individual from Kashmir (*bacchus* Hagen), B from Kashmir, C from Indre, France, D from Yokohama showing asymmetry, E from Yokohama. ME hind margins of the eyes.

ings that I long held it for the same species." He then gives a number of differences which, he believes, distinguish the two forms.

With the more abundant material above cited before me, I find that these differences are not constant, but vary individually. Even what is apparently the most important of these, the possession by *bacchus* of a backwardly-directed, conical tooth on each side of the occiput of the female, is of this varying nature. Of the three females here quoted, one has these teeth less developed than in a female of *parthenope* from France, as figs. 3 B and C show.

The close relationship existing between the Odonate fauna of Kashmir and that of Europe, referred to in the introduction of this paper, is clearly seen from the results of a comparison of individuals of this species from France, Kashmir and Japan, as follows :

	2 ♂ 3 ♀ Kashmir 1 ♂ 2 ♀ France	32 ♂ 4 ♀ Yokohoma
Humeral and second lateral thoracic sutures	with a narrow black line for their entire length.	with some discontinuous black marks.
Sides of the first abdominal segment inferiorly	with a quadrate dark brown spot reaching from the base to the middle of the segment.	with a small round, blackish dot near the middle of the segment.

Membranule on all four wings	uniformly pale gray.	white at base, cinereous in apical half (front wings) or three-fourths (hind wings.)
Hind margin of the occiput of the female	with two acute, or moderately acute, processes (figs. 3 A-C.)	with two blunt, rounded tubercles (figs. 3 D, E.)

That is, in the only constant characters which I could find distinguishing the Kashmir from Japanese individuals, the former agreed in all cases with French examples. I have not been able to find any constant characters to separate the French from the Kashmir examples.

Mr. McLachlan (1878) has recorded this species from Srinagar.

Subfamily GOMPHINÆ.

4. Ophiogomphus reductus n. sp. Figs. 4, 5, 6 7.

Two males, three females, "5—10,000 f."

Differs from *O. serpentinus* Charp. as follows:

♂ ♀.—No black mark or line on the suture between frons and nasus, or on the nasus; prothorax yellowish green, a transverse band between anterior and middle lobes and either side of the posterior lobe blackish; the two median black bands on the thoracic dorsum wanting; the narrow antehumeral black stripe isolated, touching neither the anterior mesothoracic border below nor the antealar sinus above, or almost entirely wanting in one female; no dark spot behind the posterior legs; the dorsal yellow spot on 3–7 rounded, not pointed, at its hind end, on 8–9 occupying almost the entire length of the segment.

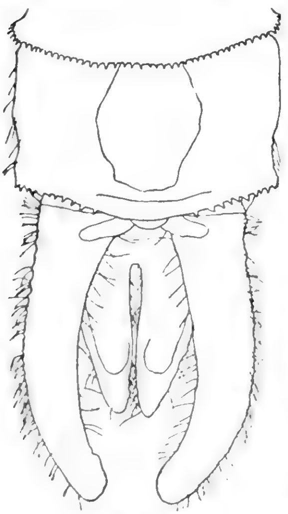


Fig. 4.

Dorsal view of the tenth abdominal segment and the terminal appendages of *Ophiogomphus reductus* n. sp ♂. x 15.

♂.—Superior appendages (2.5 mm.) longer than the 9th (2 mm.), and consequently still longer than the 10th (1.75 mm.) abdominal segment, diverging from each other in their basal half, converging in their apical half in a regular curve, curved also downward in the apical half. Inferior appendage about one-third shorter; viewed in profile it is directed somewhat upward and the superior margin is biemarginated in two places, viz. immediately behind the base and immediately in front of the apex; both emarginations have curved outlines and the anteapical is the smaller of the two; the tip of the appendage is slender and curved upward. The genitalia of the second segment are very similar to those of *serpentinus,* especially as regards the penis, as figured in Monog. Gomph., pl. 5, f. 2.

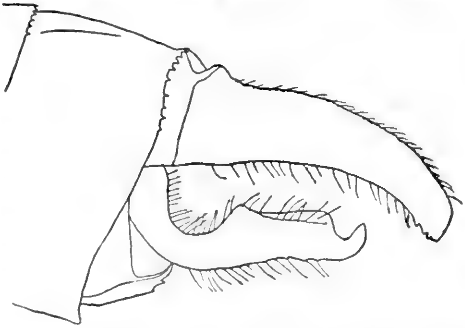


Fig. 5.
Profile view, left side of the terminal abdominal appendages of *Ophiogomphus reductus* n. sp. ♂ x 15.

Anal triangle of the hind wings 4-celled.

♀. The two "horns" of the occiput are much shorter, in one female the right horn is absent and the left is represented merely by two black denticles. Second and third tarsal joints superiorly (externally) more or less yellowish. These females consequently, as far as the coloration of the abdomen and of the tarsi is concerned, resemble the female from southern Russia described on p. 81, Monog. Gomph. Dimensions.—Abdomen ♂ 37.5 mm., ♀ 37–39. Hind wing ♂ 33–34, ♀ 35–37.

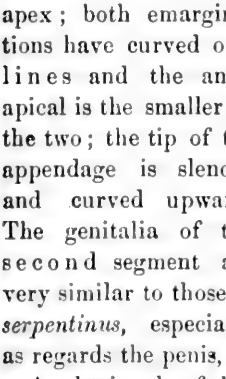


Fig. 6.
Ventral view of the inferior abdominal appendage of *Ophiogomphus reductus* n. sp. ♂ x 15.

From *spinicornis* Selys (Bull. Acad. Roy. Belg.–2–xlvi, p. 437, 1878) described from a single female, from the mountains north of Pekin, these females differ by the absence of a black line on the fronto-nasal suture, the predominant color of the vertex blackish, the "horns" of the occiput bearing denticles as in *serpentinus*, not a single short spine, the absence of the black median dorsal thoracic stripes, the isolated position of the black antehumeral stripe.

From *O. assimilis* Schneider (Selys in Monogr. Gomph., p. 81, 1857), from Asia Minor, known from two males, these males differ by the entirely yellow lips and nasus, the rear of the head mostly yellow as in *serpentinus*, the absence of the median and the isolated position of the antehumeral stripes on the thoracic dorsum; a mere black line only, no band, on the second lateral thoracic suture, no intermediate band; the dorsal yellow spots on 3–6 longer and rounded at their hind ends.

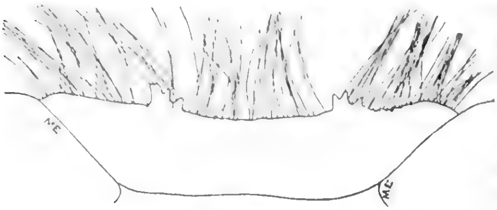


Fig. 7.

Occiput of *Ophiogomphus reductus* n. sp. ♀ to show its two processes ("horns"). ME margins of the eyes. x 25.

Subfamily CORDULEGASTERINÆ.

5. Cordulegaster bidentatus Selys.

Selys, Ann. Soc. Ent. France (2) i, p. 109, 1843. Ann. Soc. Ent. Belg., xxxi, p. 34, 1887.

One male, "below 5,000 f.", agrees with *bidentatus* in its appendages (very nearly), in the number of cells (three) in the anal triangle, and in those color differences which distinguish *bidentatus* from *insignis*. It differs from *bidentatus* in having an apical inferior yellow spot on abdominal segment 1, and a twin apical yellow spot on the dorsum of 4–6, a yellow spot on each side of the apex of 7–9, and a basal yellow spot on each side of 10; all the yellow spots on the abdomen are larger than in *bidentatus*. Abdomen 55 mm., hind wing 46. The most eastern record for *bidentatus* hitherto appears to be Asia Minor.

Subfamily LIBELLULINÆ.

6. Pantala flavescens Fabricius.

Two females, "below 5,000 f."

7. Libellula quadrimaculata L.

Four males, four females "below 5,000 f."

Only in three of these, all females, does the black basal spot of the hind wings extend into the triangle, and even in these three it does not completely fill the triangle. These females and one male may be referred to the variety *prenubila*, although the brown cloud below the pterostigma is in no case intense. One of these females is also interesting in that it approaches *basilinea* McLach. (Ann. Mag.

Nat. Hist. [6] xiii, p. 430, 1894), as on the front wings a dark-brown streak occurs in the submedian space from the cross-vein almost to the distal end, and there is a small, separate brown spot in the same space on the basal side of the same cross-vein ; in the subcostal space of the same wings there are, between some of the antecubitals, small pale brown spots in the midst of the yellow of the anterior margin. This yellow extends to the pterostigma in all but two males. The ventral abdominal spots of *basilinea* are not present.

Recorded from Turkestan (Brauer), Persia and Yarkand (Selys).

8. Orthetrum cancellatum L.

Five males, nine females, "below 5,000 f."

Recorded from the eastern side of the Caspian and from Persia (Selys).

9. Orthetrum brunneum Fonsc.

Five males, three females, "below 5000 f."; two females "5–10,000 f." Not distinguishable from European specimens, with which I have carefully compared them, and certainly different from *gracile* (Albarda) Selys and *Ramburii* Selys. One female has the discoidal triangle of both hind wings crossed by one vein, but I can find nothing to indicate that it is of a different species.

Abdomen ♂ 27–28, ♀ 27–28. Hind wing ♂ 34–35, ♀ 34–35.

Recorded from Turkestan (Brauer) and Persia (Selys).

10. Orthetrum hyalinum Kirby (?)

O. h. Kirby, Proc. Zool. Soc. Lond., 1886, p. 326, pl. xxxiii, figs. 5, 6.

One female, "below 5,000 f.," is probably this species, although it is larger (total length 38 mm., abdomen 25, hind wing 29, alar expanse 62), and the thorax is pale olive instead of reddish-brown, which may not, however, indicate more than that this individual is more immature.

11. Orthetrum triangulare Selys.

Libella t. Selys, Mittheil. zool. Mus. Dresden, iii, p. 314, 1878.

Two males, "below 5,000 f." agree with the very brief diagnosis. Their size is rather large; abdomen 31.5, hind wing 38 mm.

12. Crocothemis erythræa Brullé.

Six males, five females "5–10,000 f."; six males, five females "below 5,000 f." Abdomen ♂ 21–23.5, ♀ 21–22 mm., hind wing ♂ 25–27.5, ♀ 25–29. In seven males and eight females, and on one side only of one male and one female, the sectors of the triangle are a little separated at their origin.

Previously known from Turkestan (Selys).

13. Sympetrum (or Diplax) vulgatum L.

One male, " 5–10,000 f.", has the black longitudinal line on each side of the third abdominal segment, the basal line of the frons prolonged inferiorly in front of the eyes, hamules as described by Baron de Selys (Ann. Soc. Ent. Belg., xxxi, p. 10). It is of the typical form of *vulgatum* and not of the race *decolorata* Selys.

14. Sympetrum (Diplax) Fonscolombii Selys.

One male, two females " 5–10,000 f." ; one female " below 5,000 f." In the male, which is semi-adult, the yellow on the base of the hind wings reaches out in the submedian space almost to the triangle and more than half way back toward the hind margin. In the females the extent of this yellow is smaller and like that of European examples.

Previously known from Turkestan, and Murree in N. W. India. Mr. C. C. Adams and Prof. M. J. Elrod have sent me both sexes from the plateau of the Nilgiris, 7,500 ft., taken in August and September, 1896.

15. Sympetrum (Diplax) meridionale Selys.

One female, " below 5,000 f." There is a greater extension of yellowish coloring over the bases of the wings than is usual in European individuals of this species, but the other characters agree. Baron de Selys refers to this species a female from " les montagnes de l'Inde." (Ann. Soc. Ent. Belg., xxviii, p. 36, 1884).

MARCH 1.

MR. CHARLES MORRIS in the Chair.

Twenty-eight persons present.

A paper entitled "The Muscidae collected by Dr. Donaldson Smith in Somali Land," by Garry de N. Hough, M. D., was presented for publication.

MARCH 8.

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

Twenty-one persons present.

A paper entitled "A new Grasshopper Mouse from New Mexico," by Samuel N. Rhoads, was presented for publication.

MARCH 15.

MR. CHARLES MORRIS, in the Chair.

Twenty-seven persons present.

A paper entitled, "Notes on the Fossil Walrus of Eastern North America," by Samuel N. Rhoads, was presented for publication.

The death of William M. Singerly, a member, was announced.

MARCH 22.

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

Eighty persons present.

The death of Thomas McKean, a member, was announced.

MR. WITMER STONE made a communication on the breeding-habits of some birds of Eastern Pennsylvania, illustrated by beautiful lantern views taken by Messrs William L. Whitaker and William L. Baily. (No abstract).

MARCH 29.

MR. CHARLES MORRIS, in the Chair.

Twelve persons present.

Papers under the following titles were presented for publication:—

"Birds observed in Central California in the summer of 1893," by John Van Denburgh.

"Revision of the North American Slugs: Binneya, Hemphillia, Hesperarion, Prophysaon and Anadenulus," by Henry A. Pilsbry and E. G. Vanatta.

Mr. Carroll Smyth was elected a member.

The following were ordered to be printed:—

DIPTERA COLLECTED BY DR. A. DONALDSON SMITH IN SOMALILAND, EASTERN AFRICA.

BY CHAS. W. JOHNSON.

The Diptera described and listed in this and the following paper by Dr. Garry de N. Hough, were collected by Dr. Smith on his expedition through Somaliland from Berbera to Lake Rudolf, thence southeast to the coast.[1] All of the specimens have been presented to the Academy of Natural Sciences of Philadelphia by Dr. Smith.

In studying this material I have had to depend entirely on descriptions, and one important paper I have been unable to consult, so that a few species have had to be set aside for the present. For any error, therefore, that may occur in their identification, I wish to beg kind indulgence. I also wish to express my sincere thanks to Dr. Hough for his kindness in working up the Muscidæ.

CULICIDÆ.

Culex sp.

Two specimens, Sheikh Husein, Oct. 7th. Too imperfect for determination.

STRATIOMYIDÆ.

Sternobrithes tumidus Loew.

Sternobrithes tumidus Loew, Oefers. Kongl. Akad. Forhand., 264, 1856.

One specimen, Sheikh Husein, October 3, 1894.

TABANIDÆ.

Pangonia obesa Walker.

Pangonia obesa Walker. Insecta Saund. I, 14.

Five specimens ♀ collected at Sheikh Husein, Sept. 20, 1894, agree with Walker's description.

Pangonia appendiculata Macquart.

Pangonia appendiculata Macq. Dipt. Exot. I, 97, Pl. 13, fig. 2.
? *Pangonia varicolor* Wied. Auss. Zweifl., I, 100.

One specimen (♂), Abula, November 25, 1884.

Chrysops stigmaticalis Loew.

Chrysops stigmaticalis Loew. Dipt.-Faun. Ind-Afri. (101), 29, 1860; Oefers. Kongl. Akad. Forhand., 338, 1857.

One specimen (♀), Sheik Mahomet, November 9, 1894.

[1] See Dr. Smith's article and maps, in *The Geographical Journal* for August and September, 1896.

Tabanus biguttatus Wiedemann.

Tabanus biguttatus Wied. Auss. Zweifl., II, 623, 20.
Tabanus tripunctifera Walk. Zool., VIII, Append. XCV; List, etc., pt. V, 227.
Tabanus cerebes Walk. List, etc , pt. I, 149.
Tabanus noctis Walk. Insecta Saund. I, 42.
Tabanus cilipes Macq. Dipt. Exot., I, 1, 120.

One specimen (♀), Mt. Kulol, August 27, 1895. This seems to be a widely distributed and variable species. The male has two white spots on the third and fourth segments of the abdomen. I am indebted in part to Mr. E. E. Austen of the British Museum for the above synonymy.

Tabanus maculatissimus Macquart.

Tabanus maculatissimus Macq. Dipt. Exot, I, 1, 121, Tab. 17, f. 2; Walker List, etc., V, 227.

One specimen, Sheikh Husein, October 15, 1894.

Hæmatopota albihirta Karsh.

Hæmatopota albihirta Karsh, Berl. Ent. Zeit., 1887, 371, Taf. IV, fig. 4.

One specimen, December 12, 1894.

Hæmatopota maculiplena Karsh.

Hæmatopota maculiplena Karsh, Berl. Ent. Zeit., 1887, 371, Tab. IV, fig. 5.

Two specimens, El Dere, March 22, 1895. The specimens are badly broken, but agree well with the description of this species.

ASILIDÆ.

Hoplistomera serripes Fabr.

Laphria serripes Fabr. Syst. Antl., 159, 16.
Laphria maculipennis Macq. Hist. Nat. Dipt., I, 285, 22.
Hoplistomera serripes Macq. Dipt. Exot, I, 2, 60.

One specimen, near Lake Stefanie, June 5, 1895.

Laxenecera zonata Loew.

Laphria zonata Lœw. Bericht des Konigl. Preuss. Akad. d. Wissensch. zu Berl. 1852, 659.
Laxenecera zonata Loew. Karsch, Berl. Ent. Zeit., XXXI, 374, 1887.

Four specimens, Sheikh Husein, September 29–30, 1894.

Laxenecera sp.

One specimen, Sheikh Mahomed, November 6, 1894.

BOMBYCIDÆ.

Exoprosopa suffusa Klug.

Anthrax suffusa Klug. Ehrenberg, Sym. Phys. (Ins. Afr. Boreal. et Asia occident.). 12, Tab. XXX, fig. 2, 1832.

Two specimens, Sheikh Hausin, September 23–28, 1894. This species is beautifully figured in the work referred to. It is not the

Anthrax suffusa Walker, (List, etc., pt. II, 251), described without habitat. As it is undoubtedly an *Exoprosopa*, the two names can remain. It is allied to *Anthrax vespertilioni* Meig.

Eurycarenus laticeps Loew.

Bombylius laticeps Loew, Bericht. der Konigl. Preuss. Akad. d. Wissensch. Berl., 659, 1852; Peters, Natur. Reise nach Mossambique, Insect., 14, 1862. *Eurycarenus laticeps* Loew.

One specimen, Shiekh Husein, September 26, 1894. The venation is exactly like that figured by Loew, but the pile is more or less rubbed from the abdomen.

Bombylius sp.

One specimen, December 3, 1894. Too much injured to determine.

SYRPHIDÆ.

Melanostoma annulipes Macquart.

Syrphus annulipes Macq. Dipt. Exot, II, pt. 2, 102, pl. 17, fig. 4, 1842; Bigot, Ann. Soc. Ent. Fr., VII, 3 ser. 436, pl. 12, fig. 5, 1859.

Eleven specimens, Sheikh Husein, Sept. 29th, Oct. 7th, and Ginneer Nov. 14th.

Syrphus sp.

Two specimens, Sheikh Husein, September 29th, and October 8, 1894.

Asarkina sp.

One specimen, Sheikh Husein, September 20, 1894.

Rhingia cærulescens Loew.

Rhingia cærulescens Loew. Dipt. Fauna Sud-Afri. (101) 29, 1860; Oefers. Kongl. Akad. Forhand., 377, 14, 1857.

Three specimens, Sheikh Husein, September 29th, and October 1, 1894.

MEGATRIGON n. gen.

Head hemispherical, slightly wider than the thorax, front and vertex of nearly uniform width, *the three ocelli widely separated, the two upper ones being situated on the vertical orbits near the angles of the eyes, the three being widely equidistant, eyes hairy*, occiput prominent, third joint of the antennæ ovate as long as the first and second taken together, arista inserted near the base and slightly longer than the third joint. Thorax as wide as long, anterior margin straight, posterior portion rounded. Scutellum but slightly arched and of a nearly equal width. Abdomen convex, oblong, slightly tapering, about twice the length of the thorax.

Posterior femora greatly thickened, *outer portion on the under side, armed with two ridges having teeth-like projections* (Fig. 1) in the groove between these ridges, the tibia lies when the fly is at rest, posterior tibiæ arcuated and the outer half thickened, first joint of the posterior tarsi dilated and as long as all the other joints. Wings as shown in Fig. 2. Type *M. sexfasciatus.*

Megatrigon sexfasciatus n. sp.

♀.—Length 9 mm. Face, front and vertex granulose, (except a narrow longitudinal space on the front,) black, shining, with long whitish pile on the face and front yellowish on the vertex, mouth parts reddish, the two upper ocelli showing a red metallic lustre in certain light; posterior and inferior orbits with a dense yellow pubescence, eyes sparsely covered with white hairs. Antennæ and aristæ black, base of the aristæ and second joint of the antennæ reddish. Thorax black, shining, granulose, with yellowish-white pile, humeri reddish, a dense yellow pubescence forms three dorsal stripes, and a continuous margin extending from the anterior end of the outer dorsal stripes, the latter only reach the suture, while the middle stripe almost reaches the posterior margin, pleuræ with a dense yellowish pubescence and long whitish pile, posterior angle reddish with bright yellow pile, scutellum black with a yellow posterior margin and long yellowish-white pile. Abdomen convex, black, granulose, with sparse yellowish-white pile and six transverse bands of dense yellowish pubescence arranged as follows: An arcuate band on the second segment extends from the posterior angles to the middle where it is very narrowly interrupted; third, with a basal and a slightly arcuated middle band; fourth with a basal, middle, and posterior band, the middle one slightly curved, lateral margins of the third and fourth segments yellow, posterior part of the first segments shining and the posterior margin of the fifth yellow. Venter concave, brown with dense grayish pubescence and sparse white pile, lateral margins blackish. Femora black, with long whitish hairs, coxæ brown, anterior and middle tibiæ and tarsi red covered with yellowish hairs, under side of the tibiæ near the outer end with a brownish band. Groove on the under side of the outer portion of the posterior femur into which the basal half of the tibia

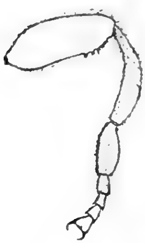


Fig. 1.

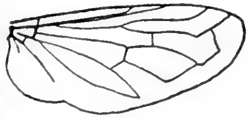


Fig. 2.

lies when at rest, shining, ridges with five teeth-like projections, posterior tibiæ black, pile yellowish, base of the tibiæ and tarsi red. Wing hyaline, with a slight tinge of brown, veins dark brown. Alulæ and halteres bright yellow.

One specimen, Sheikh Husein, October 10, 1894.

ACROCERIDÆ.

Pterodontia Smithi n. sp.

Length 10 mm. Head black, with yellow and brownish pile. Antennæ yellow. Thorax yellow thickly cover with long yellowish pile, a dorsal stripe about the width of the head extends to nearly opposite the base of the wings where it expands into a large discoidal spot occupying the entire dorsal portion, a spot on the antealar protuberance, lower portion of the pleuræ and the sternum, black. Scutellum yellow with brown and yellowish pile and a round central black spot. Abdomen tricolor, with brown and yellowish pile; the irregular black dorsal stripe and the dark and light yellow transverse bands that extend on either side and divide the segments into two equal parts may be described as follows: The first segment is covered by the scutellum and visible only on the side, is black with a lateral and posterior margin of light yellow; second, the black of the dorsal stripe occupies fully one-half of the anterior and nearly one-third of the posterior half of the segment, between the anterior portion of the central stripes and the subtriangular black markings at the anterior angles, is a small dark yellow spot representing the first dark yellow band, the light yellow posterior band extending on each side of the central marking is narrowly contracted at the lateral margin; third, anterior half of the central stripe the same width as the posterior half of that on the preceding segment, posterior half contracted to about one-third that of the anterior portion, the black lateral markings at the anterior angles quadrate, the lateral portions of the light yellow band but slightly contracted; fourth, the anterior portion of the central stripe somewhat narrower at the anterior margin than at the middle or anterior margin of the light yellow band, posterior half one-third the width of the anterior portion and not quite or very narrowly touching the posterior edge of the segment, lateral markings quadrate, light yellow band less contracted than on the third segment; fifth segment similar to the fourth, except that the central stripe does not reach the posterior margin, in one specimen the central and lateral markings are narrowly connected, thus dividing the dark and light yellow bands; sixth segment black with a yellow spot at the posterior angles, in one specimen the latter character is wanting. Venter yellowish, first and sixth segments brownish, in one specimen the base of all the other segments is slightly tinged with brown. Legs yellow with yellow pile, coxæ and the under side of the femora more or less tinged with brown, tips of the claws black. Wings hyaline, veins yellow.

Two specimens, Crorgora, September 13, 1894. This species is readily distinguished from those already described by its lateral quadrate abdominal markings.

ANTHOMYIDÆ.

Phorbia fusiceps Zett.

One specimen, Sheikh Mahomed, November 11, 1894.

Anthomyia abyssinica Jænnick.

Anthomyia abyssinica Jænnick. Neues Exot. Dipt., Abhandl. d. Senckenb. Ges., VI, 372.

Two specimens, Sheikh Husein, October 3rd; Sheikh Mahomed, November 10, 1894.

Authomyia sp.

Three specimens, Sheikh Husein, October 3, 1894.

Anthomyia sp.

One specimen, Sheikh Husein, October 3, 1894.

Caricea marginipennis n. sp.

Length 3 mm. Front, vertex and occiput bluish-gray, face and a ridge surrounding the base of the antennæ yellow, two slightly arcuate black lines extend from the vertical angles near the eyes, to the yellow ridge above the antennæ, space between the two lines less bluish, on each of the vertical and frontal orbits are three minute black points; antennæ yellow. Thorax bluish-gray with two rows of four minute black points from each of which rises a small bristle, there are also numerous smaller ones on the side of the dorsum and on the pleuræ, scutellum bluish-gray with two black bristles. Abdomen of the same color with two small black dots on the third, fourth and fifth segments. Legs yellow. Wings with a brownish tinge, and a wide whitish-hyaline posterior margin commencing near the second longitudinal vein.

Two specimens, Sheikh Mahomed, October 11, and Ginea, November 14, 1894.

Anaphalantus politus n. sp.

Length 3½ mm. Front and vertex black, with whitish bloom, frontal orbits with silvery pubescence each with three shining black spots, the upper one at the junction of the front and vertex; face light yellow, palpi yellow, proboscis black, occiput black, shining; antennæ, first and second joint and arista yellow, third joint blackish, and longer than the first and second taken together. Thorax black with a hoary bloom which is more dense on the pleuræ and also forms a wide dorsal stripe, dorsum with numerous black bristles, humeri shining, scutellum black with two lateral and two very long apical bristles. Abdomen black, disc and a narrow dorsal line on the last segment hoary, the lateral portion of the segments shining black, venter hoary. Legs yellow with black hairs, outer half of the anterior tibiæ and the first joint of the tarsi black, with long dense black hairs, tips of the posterior femora brownish. Wings hyaline, iridescent in certain lights, veins yellow.

One specimen, Sheikh Husein, October 3, 1894.

This species may be distinguished from *Anaphalantus pennatus* Loew, by the third joint of the antennæ being black, and the outer half of the tibiæ only, being black.

TRYPETIDÆ.

Trypeta angusta Loew.

Trypeta angusta Loew, Berl. Entom. Zeit., 1861, 271, Taf. II, fig. 9.

One specimen, Sheikh Husein, October 11, 1894.

SEPSIDÆ.

Sepsis costalis n. sp.

Length 5 mm. Face and cheeks brown; front, vertex and occiput black. Antennæ reddish-brown, proboscis black. Thorax and abdomen black, opaque. Legs entirely black. Wings hyaline, except the costal cell which is entirely black.

Two specimens, Sheikh Husein, October 3, 1894.

Sepsis sp.

Two specimens, Sheikh Husein, October 3rd; Ginea, November 14, 1894.

DIOPSIDÆ.

Diopsis somaliensis n. sp.

Length 7 mm. Head red, shining, with very sparse white hairs, mouth parts and lateral prolongations that form the eye-stalks, brownish, the enlarged portion that forms the base of the eye, dark brown, antennæ reddish, aristæ brown.

Fig. 3.

Thorax black with a very short white pubescence, scutellum black, spines yellowish, tips of the spines brown, halters light yellow. Abdomen black, shining, hypopygium reddish, venter brownish, legs dark yellow, anterior tibiæ and all except the basal joint of the anterior tarsi brownish. Wings hyaline slightly tinged with brown, veins black, a black ocellate spot above and a ⊳ shaped marking below, near the tip of the third longitudinal vein as shown in Fig. 3.

Two specimens, near Lake Abaya, May 9, 1895.

OSCINIDÆ.

Elachiptera femorata n. sp.

Length 3 mm. Head brownish, lower portion of the face and front more or less yellowish, orbits in certain lights are silvery, the ocellar triangle shining, the lower portion greatly attenuate and almost reaching the base of the antennæ, under side of the antennæ red, upper side and setæ dark brown. Thorax brown, with three black stripes and covered with a grayish pubescence, which also forms a short prominent line in the center of the anterior portion of the black dorsal stripe, pleuræ brownish, scutellum blackish. Abdomen black, with a narrow yellowish-white posterior margin to all the segments, venter brownish. Femora and tibiæ reddish, tarsi yellow, posterior femora somewhat thickened. Wings hyaline, veins dark-brown.

Three specimens, Ginea, November 14th, and Sheikh Mahomed, October 11, 1894.

Chlorops sp.

One specimen, Sheikh Husein, October 3, 1894.

HIPPOBOSCIDÆ.

Hippobosca camelina (Savg.) Leach.

Hipposca camelina Savigny mss. Leach, Eprob. Ins., Wern. Mem., II, 556. Tab. XXVII, figs. 11–14, 1817; Rondani, Ann. Mus. Civ. Storia Nat. Genova, XII, 165, 1878.

One specimen, Berbera, July 5, 1894.

Ornithomyia nigricans Leach.

Ornithomyia nigricans Leach. Eprob. Ins. Wern. Mem., II, 10. Tab. XXVII, figs. 7–10, 1817; Wied. Auss. Zw., 11, 609, 3; v. d. Wulp, Dipt. Sum. Exp. 57, 1; v Röder, Entom. Nachr., XIX, 236, 29.

Two specimens, Dada, November 21, 1894. These specimens agree with the description.

THE MUSCIDÆ COLLECTED BY DR. A. DONALDSON SMITH IN SOMALI LAND.

BY GARRY DE N. HOUGH, M. D.

One cannot offer for publication a paper on Muscidæ in which species are described as new without a certain amount of misgiving. So many descriptions of Muscidæ have been published that I fear I may have overlooked some, and that I may have added to the already too long list of synonyms. I can only say that I have conscientiously tried to avoid this. My descriptions are long, but the resemblances between the Muscidæ are so close, that it is essential to describe new species at length if they are ever to be recognized by subsequent students. If any of the species described as new are already known, I shall be very glad to be informed of it and to publish the synonymy.

Considerable space has been given to the bristles of the head, and, as I have felt obliged to introduce some new names, my descriptions must be prefaced by a few remarks on these bristles.

Bristles of the Head.—The central feature of the muscid face is the frontal suture, which, taken as a whole, has the shape of an inverted U, the arms making with one another more or less of an angle.

If we draw a line across the face tangent to the convexity of this suture, then the part of the face dorsad of this line and between the eyes is the *front.* The front is distinctly divided into three parts, a median (the frontal *vitta*), and two lateral (the *geno vertical* plates). The boundary lines between the vitta and the geno-vertical plates are marked by rows of bristles (usually one row on each side of the vitta), which are inserted in a dorso-ventral line from a point on a level with the anterior ocellus to the ventral border of the front. These are the *frontal bristles.* They are in two groups which I call the *ascending frontal* and the *trans-frontal.* The *ascending* frontal, from one to four in number, are the most dorsad of the frontal bristles. If more than one is present, the most dorsad is the largest, and each succeeding one is smaller (usually much smaller) than its dorsal neighbor. They are curved dorsad, caudad and more or less laterad, and are parallel to one another.

The *trans-frontal* vary in number in different species, in the two sexes of the same species and even in different individuals of the same sex. In the female they are directed mesad and cephalad across the frontal vitta and more or less of them may decussate with their fellows of the opposite side. In the male they are generally more numerous than in the corresponding female, and they are directed cephalad with (usually) a curve dorsad or ventrad. As in the female they may decussate, but as a rule they do not.

Each geno-vertical plate is continued over the vertex to the occipital surface in the form of a little ridge. This ridge is bounded laterad by a suture which begins at the dorso-mesal angle of the eye, runs to the vertex, over the vertex to the occipital surface of the head, and then in a ventro-mesal direction as far as the great central foramen. About half way between the vertex and the great foramen the little ridge bifurcates. The lateral branch continues in about the same direction as the main ridge, while the mesal branch runs more or less directly mesad and joins its fellow of the opposite side; thus by these two little ridges and their mesal branches a triangular area is marked out at the dorso-central part of the occiput. At the very beginning of each of these little ridges just mentioned, right on the vertex, stands a bristle which is called the *inner vertical*, and down a little way on each ridge just before it bifurcates stands another which I propose to call the *occipito-central.* Both of these bristles are present in every species that I have so far had the opportunity of examining. They vary in size in different species and in the two sexes of the same species. The inner vertical project dorsad with more or less of a curve caudad and mesad, so that they sometimes decussate a little and are almost always convergent. The amount of convergence varies even in individuals of the same species and sex. The occipito-central project dorsad and mesad sometimes with a curve, sometimes without a curve, sometimes decussating a little with one another, sometimes apparently decussating with a bristle called the post-vertical, which will be described later.

On the vertex, just laterad the beginning of the little ridge and the inner vertical bristle, stands a bristle which is called the *outer vertical.* This bristle varies much in size in different species and in the two sexes of the same species. It is larger in the female than in the male, and is absent in the males of some species although present in their females.

A little caudad, ventrad and laterad of the outer vertical, on the occipital surface of the head, there is sometimes a small bristle which curves dorsad, mesad and a trifle cephalad, apparently decussating with the outer vertical. I call this the *occipito-lateral.*

Parallel to and at a variable distance caudad from the occipital margin of the eye, is a row of bristles called the *cilia of the posterior orbit.* They begin dorsad very near the outer vertical bristle but distinctly caudad of it and also very near but cephalad of the occipito-lateral. The members of the dorsal part of this row are commonly larger and more perfectly aligned than the members of the members of the ventral portion, and there is much difference in their size and correctness of alignment in different species as well as in the distance to which they can be traced ventrad as a distinct row. Frequently there are one or more rows of exceedingly small bristles intercalated between the cilia of the posterior orbit and the occipital margin of the eye. The posterior orbit is the space between the cilia of the posterior orbit and the occipital margin of the eye; it is usually narrower in the male than in the female, and may be absent.

I spoke above of a triangular area marked out at the dorso-central part of the occipital surface of the head by the two little ridges and their mesal branches. This triangle and the more or less distinct eminence on which the ocelli are situated, are continuous with one another over the vertex and form a differentiated portion which is occupied by a group of bristles which may be called the ocellar group. Among them we must distinguish the *greater ocellar* (ocellar pair of Baron Osten-Sacken), and the *lesser ocellar.*

The greater ocellar is a pair of bristles usually easily distinguishable by their larger size, which are inserted between the anterior and posterior ocelli. They vary in size, direction and curvature in different species and in the two sexes of the same species, and in different individuals (especially males) of the same species. They are generally parallel to the lesser ocellar bristles and sometimes differ from the latter in size by a very small amount.

The lesser ocellar are more numerous, from three to twelve pairs, and are usually inserted in two parallel lines (sometimes in four) which begin very close to the insertion of the greater ocellar and extend caudad a variable distance, sometimes about half way to an imaginary line joining the insertions of the inner vertical bristles, sometimes beyond this line to the occipital surface of the head.

Usually the most caudal pair of lesser ocellar is somewhat larger than the rest, sometimes much larger, and it has received the special name *post-vertical* pair. When it is much larger and at the same time is separated by quite a space from the next pair (as in the females of *Myospila*, *Muscina* and *Graphomyia*) the post-vertical really seem to be an independent pair of bristles, but when (as in *Musca* and *Morellia*) they are hardly distinguishable in size, are as near the next pair as that pair is to the next in the series, and still more when we find similar bristles even caudad of the post-verticals themselves it is clear that they belong to the lesser ocellar series.

In some species we can see, in the middle of the frontal vitta, a more or less distinctly differentiated dorso-ventral stripe. The ventral end of this stripe is not much above the ventral end of the frontal vitta itself. Dorsad it broadens out and then divides into two branches, one of which passes on each side of the ocellar eminence to the vertex. Inserted on the vitta some little distance below the anterior ocellus and close to this stripe (over which they decussate) we find in some species a pair of rather small bristles which I call the *preocellar*.

Bristles which are inserted on the geno-vertical plate are called *orbital*.

On each side of the face at the ventral end of the arm of the frontal suture, begins what is called the *transverse impression* of the face. This is at first a rather broad shallow depression. It passes almost horizontally laterad (becoming narrower as it proceeds) ventrad of the eye, and can be readily traced as far as the ventro-caudal angle of the eye where it usually seems to end. Sometimes, however, it can be seen to be continuous with a suture of the occiput which runs from the latero-ventral angle of the great foramen toward and sometimes to the ventro-caudal angle of the eye.

That part of the side of the face which is dorsad the transverse impression, laterad of the arm of the frontal suture and mesad of the eye is called by the German authors the wange. For this, I suggest the word gena, for reasons which will appear later. The gena is continuous dorsad with the geno-vertical plate.

Ventrad of the transverse impression and ventrad of the eye, extending ventrad to the edge of the mouth opening, cephalad to the vibrissal ridge, and continuing caudad on the occiput to the great foramen, is the part which the German authors call the Backe. For this I suggest the word *bucca*.

In English we have but one word "cheek" for the two German words Wange aud Backe. The Wange is dorsad of the Backe. In Latin the word "gena" refers rather to the upper part of the cheek, the word "bucca" to the lower part. For these reasons and because the words bucca and Backe are so nearly alike, it has seemed to me wise to translate Wange by gena and Backe by bucca. The bucca is sometimes clearly defined, cephalad, from the vibrissal ridge by a distinct steep edge (I have never been able to see a suture here), at other times it is not so defined and the line of separation is an imaginary one, more or less clearly indicated by differences in the characters of the hairs and bristles of the bucca and the vibrissal ridge. That portion of the bucca which is on the occipital surface is bounded by distinct sutures. The whole bucca is hairy or bristly, the hairs and bristles varying in number and size in different species.

Mesad of the arms of the frontal suture, constituting the lateral boundaries of the facial fossa, are two distinct ridges, one on each side of the face. These are the *vibrissal ridges*, so-called because on them the stout bristles called *vibrissae* are inserted. They were called the *facialia* by Desvoidy, by Walker and by Baron Osten-Sacken, but the term used by Professor Brauer, "*Vibrissenleisten*," meaning vibrissal ridges, is so much more appropriate, that I prefer to sacrifice priority to good sense. If we follow the vibrissal ridge dorsad we find that it diminishes in width and gradually disappears from view under the gena. If we follow it ventrad we find that it gradually increases in width, being largest at a point called the *vibrissal angle*, where the largest of the *vibrissæ* is inserted. The position of the vibrissal angle with relation to the edge of the mouth-opening is not the same in all genera, being sometimes very close to it and sometimes rather remote. In all the genera to be considered in this paper, however, except *Pollenia* and *Paracompsomyia*, the two are very close together. Dorsad of the vibrissal angle we usually find one or more vibrissæ which are much smaller than the one inserted at the angle. Dorsad of the smaller vibrissæ the ridge is usually more or less thickly beset with minute bristles as far as or beyond the ventral end of the arm of the frontal suture. Ventrad of the angle there are usually a few vibrissæ.

The bristles of the legs require also a few words of introduction. These bristles have not as yet received the study that they deserve in the Muscidæ. I believe there is a typical arrangement of these

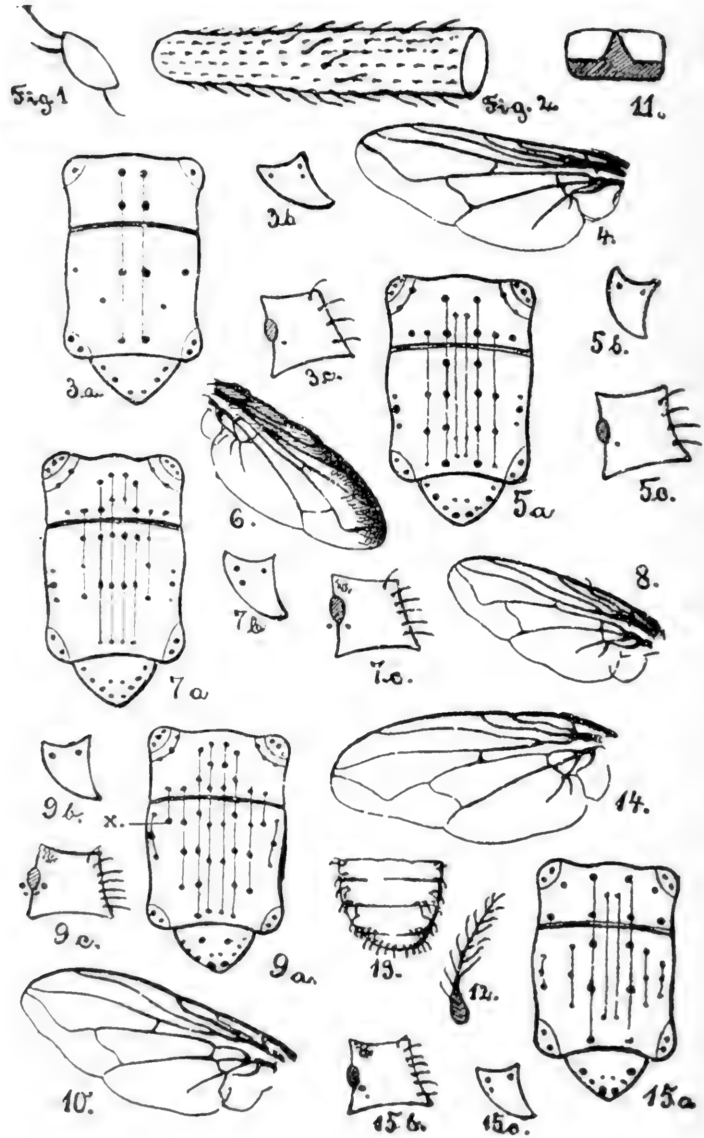


Fig. 1
Fig. 2
11.
3a
3b
3c
4.
5a
5b.
5c.
6.
7a
7b
7c.
8.
9a.
9b.
9c.
x.
10.
12.
13.
14.
15a
15b.
15c.

I.

bristles subject, of course, to great variation but easily recognizable. When the limbs of a Muscid are in their natural position it will at once be seen that so far as the fore and hind legs are concerned, one surface is turned toward the median line of the body and one away from it; these are the mesal and lateral surfaces respectively. The lateral surfaces are provided with stouter and more numerous bristles as would be expected if, as is supposed, the function of the bristles is a protective one. The terms flexor and extensor need no explanation. The anterior femur in cross section has the shape I, 1, and its bristles (at least the prominent ones) are in three rows, each of which extends from base to apex. Two of these rows are near the extensor border, the one nearest that border being made up of larger bristles than the other; the third row is very near the flexor border; all three are on the lateral surface. The hind femur is shaped very like the fore femur, and has on its lateral surface an extensor row and a flexor row of bristles, corresponding to the row nearest the extensor border and the flexor row of the lateral surface of the fore femur; the mesal surface has also a flexor row, but its members are smaller and less numerous than those of the flexor row of the lateral surface. The middle femur is much less flattened than the others, and in its natural position its surfaces are anterior and posterior flexor and extensor; it has an anterior flexor and posterior flexor row of bristles and also an anterior median and a posterior median row. As a rule the median rows are incomplete, i. e., do not extend all the way from base to apex. The anterior commonly ends half way from base to apex, the most apical members of the row being the largest, the posterior often begins about half way from base to apex, and extends thence to the apex, its apical members being also the largest, and usually the apical three or four form a transverse group of considerable prominence. The tibiæ are, in cross section, almost triangular with a very well marked extensor border and with flexor, mesal and lateral (middle tibia with flexor, anterior and posterior) surfaces. The same difference in size and number of bristles that was noted in the case of the mesal and lateral surfaces of the fore and hind femora is noticeable in the corresponding tibiæ, but is not so pronounced. Each of these surfaces has, ordinarily, a flexor and extensor row of bristles. The middle tibia has also flexor and extensor rows of bristles on its anterior and posterior surfaces, and it has, in some genera, a prominent bristle on the flexor surface which does not occur (as far as my observation extends) on either of the other tibiæ, Very often the surfaces of the tibiæ have other rows besides the flexor and extensor, such are usually made up of minute bristles, except for the terminal subapical member, but sometimes one or more of the members are largely developed and in consequence an oblique row of large bristles may appear on the tibia as in I, 2.

The apical bristles of the tibiæ are remarkably constant in number, arrangement and relative size.

Although the number of specimens collected by Dr. Smith in the group Muscidæ (sens. strict.) is quite small, only thirty-eight, nevertheless the collection is very interesting, including eleven genera, of which three are new, and thirteen species of which seven are new.

Genus GLOSSINA.

Glossina longipennis Corti.

Two females taken August 19, 1894, and August 24, 1894. They agree perfectly with Corti's description, except that there are no brown spots on the abdomen.

Genus IDIA.

Idia lunata Wied.

Three females taken September 29, 1894, October 2, 1894, and November 10, 1894.

Genus COSMINA.

Cosmina sp.?

Female, taken November 10, 1894. Too imperfect to identify or describe.

Genus MUSCA.

Musca domestica L.

Female specimen, taken October 11, 1894. This is a variety with color and markings of abdomen somewhat like the male. The ground color is a dull reddish-brown, on each of the first three segments there is a narrow, median, cephalo-caudal black stripe; the whole of the ventral surface of all segments and the cephalic half of the dorsal surface of the first segment are rather more yellow than the remainder of the dorsal surface. In color of abdomen the specimen reminds me of a female specimen sent me by Dr. Wm. A. Nason, in which the abdomen had the color and markings of the male. Structurally the specimen is identical with *domestica* although it has, to be sure, five dorso-central bristles behind the suture, but this number occurs occasionally in otherwise normal specimens both of *domestica* and *corvina*.

Musca corvina Fabr.

One male taken September 10, 1894.

Musca biseta nov. sp.

One male and four females, all taken March 10, 1894. Very much like *domestica*, from which it differs as follows:

Male.—Front about one-half as wide as in specimens of *domestica* with the same width of head. Dorsum of first abdominal segment entirely black.

Female.—Front of same width as that of specimens of *domestica* with same width of head, but the frontal vitta is decidedly narrower and its lateral borders less curved.

Both Sexes.—Smaller than the average sized *domestica*. Geno-vertical plates, genæ, buccæ and vibrissal ridges silvery white, with scarcely a trace of the yellowish tinge which so often predominates in *domestica*. Only *two dorso-central* bristles in front of the suture. Bristles of the extenso-lateral row of the hind tibia equal or almost equal. No prominent bristle in the extenso-mesal row of the hind tibia.

Genus MORELLIA.

Morellia podagrica Loew.

Two males and one female taken March 10, 1894, and April 10, 1894. Agree perfectly with, but are smaller than, my European specimens of this species.

Genus PSEUDOPYRELLIA.

Pseudopyrellia sp.?

One male and one female taken March 10, 1894. This is a new species. The specimens are too imperfect to describe fully. The antennal arista has longer, more numerous and more delicate hairs than *cornicina* (American and European specimens), and the female has on the thorax, in front of the suture, a broad, median, cephalo-caudal hoary stripe which fades out before the suture is reached. The distinctness and brilliancy of this stripe vary with the incidence of light. Of 100 American female specimens of *cornicina* examined not one has this stripe. The front of the male is much narrower than in *cornicina*.

Pseudopyrellia nuda nov. sp.

Four females taken March 10, 1894, and September 29, 1894. Length about 8 mm., of a brilliant metallic violet color, varying to bronzy-green. Remarkably few and delicate macrochætæ.

Width of head about 2.4 mm., of front about 0.7 mm. Vitta occupies about one-third of the front. The genæ and the ventral quarter or fifth of the geno-vertical plates are silvery-white or dead black, according to the incidence of the light, the remainder of the geno-vertical plates, the ocellar prominence and the dorsal half of the posterior orbit are metallic violet or green; the ventral half of the posterior orbit is silvery white, dead black or with metallic reflections according to the incidence of the light; the buccæ are dead black or metallic violet according to the incidence of the light; the vibrissal ridges are black with slight metallic reflections; the frontal vitta is dead black. The bristles of the vertex are as in *cornicina;* the hairs of the geno-vertical plates (there are no orbital bristles) are as in *cornicina,* but much less numerous; the bristles of the vibrissal ridges are yellowish-brown and arranged as in *cornicina;* the buccæ are sparsely beset with delicate yellowish-brown hairs. Palpi black or dark brown, dilated at the apices; proboscis black or dark brown, with some metallic reflections. Antenna, 2d joint 0.2 mm., 3d joint 0.6 mm.; color brown, 3d joint lighter than 2d. The whole thorax and abdomen has a finely punctate appearance and is remarkably free from macrochætæ, although quite as thickly clothed with fine hairs as is usual in the Muscidæ.

Bristles of thorax.—I, 3a, 3b, 3c. *Humeral,* 1. *Dorso-central,* 4, 2 in front and 2 behind the suture, the posterior is of good size, the rest are minute. *Intra-alar,* 1, very small. *Supra-alar,* 1, very small. *Post alar,* 2, as usual, of good size. *Notopleural,* 2, as usual, of good size. *Scutellar,* apical and two marginal, of good size. Tegulæ hyaline; Halteres pale yellow.

Legs.—Femora black or very dark brown, with some metallic reflections. Tibiæ and tarsi black or very dark brown; bristles of legs much smaller and less numerous than usual in the Muscidæ.

Fore Leg.—Femur.—Only one extenso-lateral row of bristles, and this is made up of fewer and smaller bristles than usual. Bristles of flexo-lateral row smaller and much fewer than usual. *Tibia.*—No prominent bristles except the preapical of extensor border.

Middle Leg.—Femur.—The usual rows are present, but the individual bristles are small, and there are but few of them. The only respectable sized bristle of the femur is the preapical of the posterior surface. *Tibia.*—Anterior surface no bristles at all. *Posterior surface.*—One prominent bristle at the middle of the tibia and a varying number of other much smaller bristles. *Flexor surface.*—

One large bristle, about twice as large as the largest of the posterior surface, at the junction of the third and apical fourths, inserted close to the edge of the posterior surface.

Hind Leg.—Femur.—The usual rows present but of fewer and smaller bristles than usual. *Tibia.*—No prominent bristles save one very delicate flexo-lateral.

Genus POLLENIA.

I might consider the species to be here described as the type of a new genus in deference to the views of Professor Brauer as I understand them. He gives as one of the characters of *Pollenia:* "two orbital bristles in the female." These specimens have from four to six orbital bristles of large size inserted in a dorso-ventral line roughly parallel to the insertions of the trans-frontal bristles and laterad these large orbitals and parallel to them another row of very small bristles. I am sure that the number of large orbital bristles may vary in individuals of the same species and, therefore, am personally of the opinion that their number is not always a character of generic value, e. g., in our common species of *Morellia* the number of large orbital bristles varies from two to seven, frequently differing on the two sides of the same specimen. Such being the case, it seems to me that I must include this species in *Pollenia* since it presents all the characters of that genus except the one mentioned. The woolly hair is present only on the caudal border of the mesopleura, caudad the row of bristles which protect the root of the wing, a condition often met with in our common *P. rudis* if the specimen is not fresh. The specimens look as if they had been wet.

Pollenia virido-cana nov. sp.

Three females taken September 5, 1895. Length about 7.5 mm.; width of head about 2.2 mm., of front about 0.75, of frontal vitta about 0.25 mm. Looking at the head directly from in front, the height of the eye is 1.3 mm., of the bucca 0.4 mm. The highest point of the vertex is a little higher (about 0.1 mm) than the highest point of the eye. The third antennal joint is twice as long as the second.

The general color of the fly is a dirty greenish-white or gray. On close examination it is seen that the ground color of the thorax and abdomen is a metallic green, but that this is more or less concealed by a thick, whitish, hoary coating. In some lights there seem to be two dorso-central bands on the thorax which are free from this coating. The anterior femora are of the same colors as the thorax, the middle and posterior femora are dark brown, with here and there suggestions of the green color and hoary coating. The tibiæ and tarsi are a very dark brown. Tegulæ milky white. Halteres brownish. The genæ, geno-vertical plates, ocellar triangle, posterior orbits, buccæ and vibrissal ridges are dirty white with the usual silky lustre, varying according to the incidence of the light to a pale brown. Frontal vitta pale brown. Antennæ: second joint pale brown, third joint darker brown with hoary coating.

Bristles of Head.—Inner vertical, outer vertical, greater ocellar, and ciliæ of posterior orbit as in *P. rudis*. Lesser ocellar less numerous than in *rudis*, only three or two pairs. Ascending frontal, one, large. Transfrontal six to eight, mostly decussate over the narrow vitta. Orbital: a row of four to six large bristles, the insertions of which are roughly parallel to the insertions of the transfrontals; a second row laterad the large ones and parallel to them composed of very small bristles. Genæ bare. Buccæ with a series of stout bristles along the edge of the mouth opening and with the remainder of their surface sparsely beset with very fine hairs. Vibrissal ridges with a very few hairs dorsad the principal vibrissa extending little or not at all dorsad the ventral end of the arm of the frontal suture.

Bristles of Thorax, I, 5a, 5b, 5c. *Humeral*, 3. *Post-humeral*, 2. *Dorso central*, 6, two in front of and four behind the suture. *Acrostichals* very small, one anterior and two posterior to the suture. *Intra-alar*, 4, one in front of and three behind the suture; the most posterior is very small and a little mesad the line of the others. *Supra-alar*, 3, of which, as usual, the middle one is much the largest. *Post-alar*, 2, as usual. *Notopleural*, 2, as usual.

Scutellar.—A small bristle of the jugum, an apical, two marginal and a rather small discal.

Bristles of Abdomen.—As usual in Muscidæ (sens. strict.).

The macrochaetæ of the head and thorax and nearly all the minute bristles and hairs of the thorax and abdomen appear to be inserted at the centres of little black disc-shaped spots.

Bristles of the Legs.—Too imperfect to be described. The only especially noteworthy feature that can be made out is a long, stout bristle at the middle of the anterior surface of the middle femur. This represents, apparently, the anterior median row of bristles of the middle femur that is so universally present in the Muscidæ (sens. strict.) and is so well developed in *P. rudis*.

Genus LUCILIA.

Lucilia spinicosta nov. sp.

One male and one female, taken March 10, 1894. Length: about 5.5 mm. (male) and 6.0 mm. (female). Width of head: male 2.0 mm. female 2.2 mm. Width of front: male 0.1 mm. at narrowest part, females 0.8 mm., vitta of female 0.5 mm. Third antennal joint twice as long as the second.

Color.—The usual metallic green of Luciliæ with some hoary reflections. Legs yellowish-brown, femora much darker than tibiæ and tarsi. Tegulæ: inferior dark smoky brown almost black, superior hyaline. Halteres yellowish. Genæ, geno-vertical plate, posterior orbit, buccæ and vibrissal ridges silvery-white. Antennæ: second joint and base of third yellowish-brown, remainder of third chestnut-brown. Palpi yellowish-brown. Wings hyaline, slightly stained with yellowish-brown toward the costal border.

On the costal border of the wing, basad of but very close to the end of the auxiliary vein, is a good sized spine. On both the upper and under surfaces of the wing the third longitudinal vein bears a number of minute spines, those beneath are four or five in number and much more delicate than those above, those above are ten or twelve in number and extend nearly to the small cross vein.

Bristles of the Head.—As usual in Luciliæ.

Bristles of the Thorax.—I, 7a, 7b, 7c. *Humeral*, 3. *Post humeral*, 2. *Dorso-central*, 5, 2 in front and 3 behind the suture. *Intra alar*, 4, one in front and 3 behind the suture. *Acrostichal*, 5, 2 in front and 3 behind the suture. *Presutural, notopleural, supra alar* and *post alar* as usual. *Scutellar*, apical, 3 marginal and one discal. Sternopleura and mesopleura as usual in Luciliæ.

Bristles of Abdomen.—On hind border of second segment a number of small appressed bristles. On hind border of third segment about twelve to fourteen larger and less appressed bristles. On the fourth segment about twelve not at all appressed quite good sized bristles both marginal and discal. In the male these bristles are larger than in the female.

Bristles of the Legs.—*Fore Leg.*—Femur: as usual but dorsal lateral extensor row has only about six members. Tibia: in the lateral extensor row there is in the male, but not in the female, a little basad the junction of middle and apical thirds one rather prominent bristle; in the lateral flexor row there is one large bristle at the junction of the apical and middle thirds; in the mesal extensor row there are no prominent bristles; in the mesal flexor row there are about four prominent bristles and these are larger in female than in the male.

Middle Leg.—Femur: as usual. Tibia: the anterior surface, a little apicad the middle, has one large bristle; the posterior surface has two rather smaller, one at the middle and one near the apical end of the basal third; flexor surface has one at about the junction of the middle and apical thirds.

Hind Leg.—Femur: as usual. Tibia: the lateral extensor row has from three to five prominent bristles and the mesal extensor row two, of which one is very near the middle and the other in the basal quarter; no prominent bristles in either flexor row.

Genus **PAROCHROMYIA**.

The species to be here described would find its place in the table of Brauer and Bergenstamm[1] between *Ochromyia* and *Zonochroa.*

The eyes of the male are very close together but not in contact and the male has no transfrontal bristles above the middle point between the base of the antennæ and the vertex. Both sexes have ocellar bristles. Both sexes have abdominal marochætæ at the sides of each segment, on the hind margin of the third segment (appressed and delicate), and on the fourth; the male also has some on the hind margin of the second but they are more delicate than those of the third. The female has one fair sized orbital bristle at the upper part of the geno-vertical plate and, extending ventrad from this, a series of very delicate, minute bristles or hairs which extend along the whole of the geno-vertical plate and on the gena about half way to the end of the arm of the frontal suture.

In Girschner's system I should place this species among the Calliphorinæ with the description of which it agrees[2] except that it has three posterior intra-alar bristles. The sterno-pleural bristles have the arrangement 1–1. I can not make out the arrangement of the second ventral segment.

Parochromyia varia nov. sp.

Three males and three females, taken March 10, 1894, Nov. 17, 1894, Sept. 3, 1895. A pale yellowish-brown fly about 6.5 to 7.5 mm. long. The wings are notably broad and extend a little beyond the apex of the abdomen.

[1] Vorarbeiten zu einer Monogr., etc., Pars III, p. 90, (178).

[2] Separat-Abdruck aus der Illustrirten Wochenschrift für Entomologie, Vol. I, 1896, p. 14.

Head.—The antennæ, buccæ, genæ, vibrissal ridges, facial fossa and ventral third to half of the geno-vertical plate are all pale yellowish-brown. The remainder of the geno-vertical plate is bluish gray. The frontal vitta is brown with a slight reddish tinge. The posterior orbit differs in the two sexes. In the female it is about 0.1 mm. wide, bluish-gray dorsally and shading off ventrally to pale yellow; in the male it is narrower, entirely absent along the dorsal third or half of the eye and entirely yellow. In the female the front occupies about one-third of the width of the head and is mostly made up of the frontal vitta the geno-vertical plate being very narrow.

Bristles of the head.—Female:—Seven to nine transfrontal of good size and a few small intercalary, sometimes the larger ones decussate and sometimes not, they extend a little ventrad the insertion of the antennæ. Ascending frontal, one. Orbital as mentioned in the generic description. Greater ocellar, of good size, divergent. Lesser ocellar, several pairs all parallel to the greater; one very small pair is situated ventrad the greater, there are several small pairs dorsad the greater and one pair at the dorsal border of the ocellar triangle is half to three quarters the size of the greater. Inner vertical and outer vertical, inserted as usual, equal; only a little larger than the ascending frontal, larger than the greater ocellar. Post vertical small, erect, parallel to one another, inserted on the occipito-vertical border a trifle caudad the line of the inner verticals. Occipito-central, very small and delicate, inserted very close to the occipito-vertical edge. Occipito-lateral not present. Ciliæ of posterior orbit rather sparse but well aligned, extending ventrad to the caudo-ventral angle of the eye. Bucca: vertical diameter as seen from in front nearly one half that of eye; along edge of mouth-opening a series of large stout bristles, the remainder sparsely beset with minute hairs. Vibrissal ridges: a few minute bristles dorsad the principal vibrissa extending to a point a very little dorsad the ventral end of the arm of the frontal suture.

Male:—Transfrontal, as mentioned in the generic description, about seven in number. Inner vertical good sized. Outer vertical absent as is usual in male Muscidæ. Greater ocellar much smaller than in the female (the usual thing in Muscidæ). Lesser ocellar, quite numerous, some of them almost equal to the greater. Post vertical as in the female. Occipito-central (doubled in one specimen), ciliæ of posterior orbit, bucca and vibrissal ridges as in female.

Antenna.—Third joint about twice as long as the second. Arista longer than second and third joints together, its hairs rather few (about eight above and six below). The exact shade of color varies in different specimens, being sometimes darker and sometimes lighter; in one female the third joint is almost a chestnut-brown. Proboscis and palpi yellowish-brown.

Thorax.—Color, varying shades of yellowish-brown, darker on the dorsum. On the dorsum, bands of dark brown or bluish-gray, varying much in width in different specimens (in one male none at all). A dark spot on the middle of the scutellum in all the females and in one male.

Bristles of the Thorax, I, 9a, 9b, 9c. *Humeral*, 3. *Posthumeral*, 3, outermost on a level ventrad the presutural. *Dorso-central*, 6, two in front and four behind the suture. *Intra-alar*, 4, one in front and three behind the suture. *Acrostichal*, 6, three in front and three behind the suture. *Presutural*, notopleural, supra-alar and post-alar as usual. *Post-sutural*, I venture to apply this name to a bristle, present in all the specimens of this species, which I have not been able to find in any other Muscids that I have seen. It is situated caudad the transverse suture of the thorax, a little mesad and caudad the anterior supra-alar, and laterad the intra-alar No. 3 (I number the intra alars, dorso-centrals and acrostichals from the caudal end of the thorax cephalad, thus the intra-alar nearest the scutellum is No. 1).

Scutellar.—Apical, three marginal, jugal, two discal of which the anterior is considerably the larger.

Abdomen.—Color: Principally yellowish-brown; of varying shade in different specimens. There are also some very dark brown, almost black, markings as follows: on the first segment a very narrow band on the hind margin; on second segment a broader band and a median mark, (I, 11) the width of the band and the size of the mark varying considerably; third segment like second, but the band broader and the mark larger, so that in some specimens almost the whole segment is dark brown or black: fourth segment entirely black or dark brown.

Bristles.—There are bristles on the hind borders of the first three segments. Toward and at the sides of the segments the bristles are larger than toward the middle. All are more or less appressed. Those toward the middle can hardly be called macrochaetae until we reach the third segment. On the fourth there are some discal as well as marginal macrochaetae, and they are none of them appressed.

Legs.—Color: Yellowish-brown. Bristles: Fore-leg, femur, as usual. Tibia, lateral flexor row has one large bristle at the junction of the middle and apical thirds, mesal extensor row has from four to six rather small bristles about equal and equi-distant, extending from very near the base to very near the apex. *Middle leg:* Femur, as usual, but the anterior median row is represented by only one bristle of good size which is situated just at the middle of the femur. On the whole, the bristles of this femur are rather few. Tibia: Anterior surface, one large bristle at junction of apical and middle thirds; posterior surface two, rather smaller at junction of basal and middle, and middle and apical thirds respectively; flexor surface one, rather small at junction of apical and middle thirds. *Hind leg:* Femur, as usual. Tibia, mesal extensor row has usually two prominent but not very large bristles situated respectively at the junction of the basal and middle, and middle and apical thirds (sometimes the former is absent); lateral extensor row has a considerable but varying number of unequal but almost equidistant bristles extending from base to apex; lateral flexor row is represented by only one bristle situated at the junction of the apical and middle thirds.

Genus SOMALIA.

There is but a single specimen, and that a female of the species on which I found this new genus, but the characters are so pronounced that I have no hesitation in so doing. In the table of Brauer & Bergenstamm[3] this genus would fall in the group with *Dasyphora*, except that it has but one large orbital bristle. It differs, however, from *Dasyphora* in several points: (1) the sterno-pleural bristles have the arrangement 2–1, instead of 1–3; (2) there is a row of bristles on the hypo-pleura; (3) the third joint of the antenna is much shorter as compared with the second; (4) the outline of the arista as a whole is much narrower, and its hairs are less closely set; (5) the eyes are only minutely hairy with a magnification of twenty diameters; (6) the post-vertical bristles are very small, while in *Dasyphora* they are large.

In Girschner's classification the new genus stands far away from *Dasyphora* in the 6th or 7th group of his Tachinidæ.

Somalia enigmatica nov. sp.

One female, taken October 11, 1894.

[3] Vorarb. zu Monog. Musc. Schiz., Part III, p. 90 et seq.

Length about 8.0 mm. Width of head 2.5 mm., of front 0.9 mm. (vitta 0.5 mm., geno-vertical plates each 0.2 mm.). Looked at squarely from in front the dorso-ventral diameter of the head is 2.3 mm., the vertex extends 0.1 mm. dorsad the eyes, the dorso-ventral diameter of the eye is 1.5 mm., of the bucca 0.7 mm. Third antennal joint about 1½ times as long as the second. General color pale olive-green with a hoary coating, legs a yellowish-brown, except that the third, fourth and fifth tarsal joints and the apical part of the second are black. On the thorax, in front of the suture, are two narrow bands, one on each side, between the acrostichal and dorso-central bristles, which have no hoary coating; these bands broaden cephalad and unite at the cephalic border of the thorax. On the second, third and fourth abdominal segments there is a narrow, median, cephalo-caudal dark brown stripe not represented in the diagram, I, 13, which shows also the arrangement of the abdominal bristles.

Head.—Color: Genae, geno-vertical plate, facial fossa, vibrissal ridges, posterior orbits and ocellar prominence silvery; vitta dark brown; bucca olive; transverse impression of the face yellowish-brown with silvery coating. Second joint of antennæ yellowish-brown, third joint darker with a hoary coating. Palpi yellowish-brown. Proboscis black.

Bristles: Trans-frontal, about eight, of which the ventral four or five are of good size and inserted close together, the rest small and scattered. Ascending frontal, one, large. Orbitals, one large at about the junction of the dorsal and middle thirds of the front and one exceedingly minute a little dorsad the large one, no others at all. The bristles at the vertex are somewhat injured, and I can only say that the inner vertical, outer vertical, greater and lesser ocellar, post-vertical (very small), and ciliae of the posterior orbit are present; nothing unusual can be made out in regard to them in this specimen. Genæ naked. Buccæ distinctly separated from the vibrissal ridges; parallel to the edge of the mouth-opening and a little distance from it is a row of coarse bristles; near the cephalic end of the bucca about as far dorsad the large bristles of the mouth-edge as they are from the mouth edge itself, are two stout bristles about equal in size to those of the mouth edge; the rest of the bucca is rather sparsely beset with minute bristles and hairs. Vibrissal ridges: The principal vibrissa and the vibrissal angle are close to the edge of the mouth opening; dorsad the principal vibrissa there are only a few minute bristles not extending as far as the ventral end of the arm of the frontal suture; ventrad the principal vibrissa are four lesser vibrissæ inserted along the edge of the mouth opening as far as the cephalic end of the bucca.

Thorax.—Color, as mentioned above. Halteres yellow. Tegulæ hyaline, milky white toward the edges.

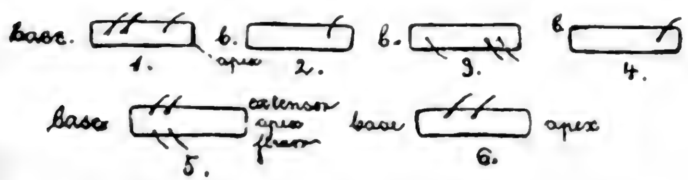
Bristles, I, 15a, 15b, 15c. *Humeral*, 2. *Posthumeral*, 1, on a level dorsad the presutural. *Dorso-central*, 5, two in front and three behind the suture. *Intra-alar*, 3, none in front of the suture. *Acrostichal*, 2, one in front and one behind the suture, both small. Presutural, notopleural, supraalar and postalar as usual. *Scutellar:* apical, two submarginal and one small discal or subapical.

Mesopleural. At the dorso-cephalic angle is a group of little hairs, among which two are more prominent than the rest, and perhaps deserve to be called bristles, an arrangement recalling the prominent bristle in this situation which is so constant in the genera *Morellia*, *Muscinia*, *Musca*, *Myospila* and their allies. As usual, there is a large bristle just ventrad the prostigma, a little ventrad and caudad this bristle is another, much smaller but decidedly prominent, which I have not found in any other Muscid.

Sternopleural. Two in front and one behind. *Pteropleural* and *hypopleural* present.

Wing. Venation shown in the figure. On the third longitudinal vein are about ten little spines quite regularly distrlbuted from the base to near the small cross vein. There is a costal spine just basad the end of the auxiliary vein.

Ventral surface of abdomen. No ventral membrane; second ventral segment overlaps the edges of the corresponding dorsal, all the other ventral segments are overlapped by the corresponding dorsal.



II.

Bristles of the Legs.—Anterior femur as usual. Anterior tibia: lateral flexor row has one large bristle at the junction of the middle and apical thirds; mesal extensor row has three prominent bristles as arranged in II, 1. Middle femur has one large bristle at the middle of the anterior surface, a few bristles in the flexor row of each surface, and on the posterior surface a subapical transverse group of three. Middle tibia has one on the anterior, II, 2, three on the posterior, II, 3, and one on the flexor, II, 4, surface. Posterior femur as usual. Posterior tibia has four on the lateral surface (two flexor and two extensor, II, 5), and two on the mesal surface II, 6.

Genus **PARACOMPSOMYIA**.

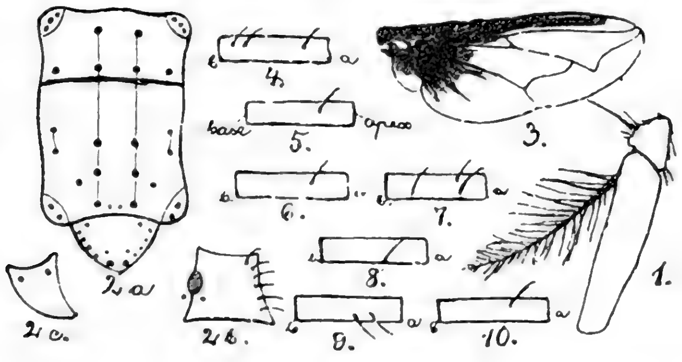
Very close to *Compsomyia*. In the table of genera of Brauer and Bergenstamm it would fall with *Compsomyia* from which it differs as follows: wings not hyaline but, toward base and costa, black or very dark brown; thorax without longitudinal black stripes; the vibrissal angles are not as far dorsad the mouth edge as in *Compsomyia*; there are no vibrissæ ventrad the principal vibrissa; the orbital bristles are much smaller than in *Compsomyia* and are directed laterad instead of ventrad; the sterno pleural bristles are 1–1 instead of 2–1.

Paracompsomyia nigripennis nov. sp.

Four females, taken August 23, 1894. Large metallic blue, violet or green flies with yellow heads, black legs and with the costal border and basal half of the wings black or very dark brown. Length of body 11 to 12 mm., of wing 10 mm. Width of head 5 mm.; of front 1.7 mm. at base of antennæ, 1.8 mm. at vertex; frontal vitta 1 mm. at widest point, 0.7 mm. at base of antennæ. Looked at squarely from in front the dorso-ventral diameter of the head (height) is 4.2 mm., the vertex extends 0.2 mm. dorsad the dorsal border of the eyes, the dorso-ventral diameter of the eye is 2.5 mm., of the bucca 1.5 mm. The second antennal joint is 0.3 mm. long, the third is 1.1 mm.

Head.—Color:—dorsal two-thirds of geno-vertical plate is polished ferruginous, the ventral third as also the genæ, buccæ, vibrissal ridges and facial fossa are a paler, yellowish-brown with a thin hoary coating. Vitta ferruginous. Antennæ yellowish-brown. Ocellar prominence and an adjoining triangular area of varying size at the dorsal part of the occiput ferruginous to yellowish-brown varying in different specimens. Posterior orbit silvery. Palpi yellow. Proboscis dark brown to black.

Bristles.—Inner vertical and outer vertical of good size, inserted as usual. Post vertical very small, inserted a little caudad the line of the inner verticals. Occipito-central replaced by a number of minute bristles. Ciliæ of posterior orbit as usual, well aligned, rather small. Greater ocellar very small, divergent, pointing almost directly laterad. Lesser ocellar exceedingly minute, numerous, in four to six rows, occupying nearly the whole of the ocellar prominence and extending caudad to or nearly to the line of the inner verticals. Ascending frontal, one, parallel to the outer vertical, inserted on a level with the greater ocellar some distance laterad the line of insertion of the transfrontals half way between that line and the lateral border of the geno-vertical plate. Transfrontals ten to twelve, small, non deccusate. Orbitals two, very small (0.2 to 0.3 mm. long), curved laterad instead of ventrad as usual, inserted



III.

Humeral, 3. *Dorso-central*, 5, 2 in front of and 3 behind the suture. *Intra-alar*, 1. *Supra-alar*, 2. *Acrostichal*, 1, posterior. *Presutural*, *notopleural* and *postalar* as usual. *Scutellar*: Apical, four marginal and two discal as figured.

about at the middle (dorso-ventrally) of the geno-vertical plate and 0.3 or 0.4 mm. (dorso-ventrally) from each other; besides these two orbitals the geno-vertical plate is quite thickly clothed with very minute hairs or bristles which toward the vertex are black and toward the genæ are whitish or colorless. Genæ, clothed like the geno-vertical plates with exceedingly delicate and minute whitish hairs. Buccæ clothed like the genæ, but toward the occiput the hairs are much longer than elsewhere (as much as 0.2 mm.). Vibrissal ridges almost straight, only very slightly convex laterad;

vibrissal angle and principal vibrissa a little above the mouth edge but not as high as in *Compsomyia macellaria* or in *Pollenia*; the principal vibrissa is very small for the size of the fly; there are no other vibrissæ but the ridges are clothed nearly their whole length with exceedingly minute whitish hairs.

The arista is about as long as the third antennal joint and is densely plumose with fine hairs. Its rhachis is yellow toward the base while its apical part and the hairs appear black.

Thorax.—Color.—Metallic blue, violet or green with hoary coating. The hoary coating is much thicker in front of than behind the suture. The prostigma is very large and is white. Halteres yellowish. Tegulæ white with smoky brown or black border of very varying width.

Bristles.—There is a row of bristles on the hypopleura and some bristles on the pteropleura.

Abdomen.—Color.—Metallic blue, violet or green with a hoary coating which is thickest toward the sides and on the ventral surface. The first segment and the caudal borders of the second and third are not hoary. The fourth segment is quite thickly covered with whitish hairs. There are no abdominal macrochætæ. The second ventral plate overlaps the corresponding dorsal plates a very little, the other ventral plates are overlapped by the corresponding dorsal plates.

Bristles of the Legs.—Femora as usual in the Muscidæ. Tibiæ: anterior tibia has on the mesal surface in the extensor row three prominent bristles III, 4, and on the lateral surface in the flexor row one III, 5; middle tibia has on the anterior surface one III, 6 on the posterior surface three III, 7, and on the flexor surface one III, 8; hind tibia has on the lateral surface in the flexor row two III, 9, and on the mesal surface, in the extensor row, one III, 10.

Explanation of Figures.

I.

1. Cross section of anterior femur of a Muscid.
2. Formation of an oblique row of bristles on the tibia.
3a. Bristles of thorax of *Pseudopyrellia nuda* nov. sp.
3b. Bristles of sternopleura of *Pseudopyrellia nuda* nov. sp.
3c. Bristles of mesopleura of *Pseudopyrellia nuda* nov. sp.
4. Wing of *Pseudopyrellia nuda* nov. sp.
5a. Bristles of thorax of *Pollenia virido-cana* nov. sp.
5b. Sternopleura of *Pollenia virido-cana* nov. sp.
5c. Mesopleura of *Pollenia virido-cana* nov. sp.

6. Wing of *Pollenia virido-cana* nov. sp.
7a. Bristles of thorax of *Lucilia spinicosta* nov. sp.
7b. Sternopleura of *Lucilia spinicosta* nov. sp.
7c. Mesopleura of *Lucilia spinicosta* nov. sp.
8. Wing of *Lucilia spinicosta* nov. sp.
9a. Bristles of thorax of *Parochromyia varia* nov. sp.
9b. Sternopleura of *Parochromyia varia* nov. sp.
9c. Mesopleura of *Parochromyia varia* nov. sp.
10. Wing of *Parochromyia varia* nov. sp.
11. Marking of abdominal segment of *Parochromyia varia.*
12. Arista of *Somalia enigmatica* nov. sp.
13. Abdomen of *Somalia enigmatica* nov. sp.
14. Wing of *Somalia enigmatica* nov. sp.
15a. Bristles of thorax of *Somalia enigmatica* nov. sp.
15b. Mesopleura of *Somalia enigmatica* nov. sp.
15c. Sternopleura of *Somalia enigmatica* nov. sp.

II.

Diagrams of positions of bristles of tibiæ of *Somalia enigmatica.*
1. Anterior tibia; mesal surface, extensor row.
2. Middle tibia; anterior surface.
3. Middle tibia; posterior surface.
4. Middle tibia; flexor surface.
5. Posterior tibia; lateral surface.
6. Posterior tibia; mesal surface.

III.

1. Antenna of *Paracompsomyia nigripennis* nov. sp.

2a, 2b, 2c. Thorax, mesopleura and sternopleura of same.

3. Wing of same.

4 to 10 positions of bristles of tibiæ of same.

A NEW WEASEL FROM NEW MEXICO.

BY C. M. BARBER AND T. D. A. COCKERELL.

Putorius frenatus subsp. **neomexicanus** n. subsp.

Similar to *P. frenatus*, but paler in color; white markings on head more extensive, the white patch between the eyes large, quadrangular, and confluent with the stripes between eye and ear.

Color.—Upper parts, including legs and body from shoulders to tail, entirely of a uniform pale yellowish ochre, a sort of dilute coffee color, but warmer; feet decidedly pallid, but not white. Tail the color of the back, but rather more tinged with reddish, the apical 50 mm. black. Under parts, including breast and throat, uniform light yellowish-ochreous, a tint like that of the back but somewhat paler. Head brownish-black; a large quadrangular creamy-white patch between the eyes, slightly broadest behind, about one-fifth longer than its greatest breadth, narrowly confluent with broad white bands between the eye and ear, which latter extend downward and backward, fading gradually into the ochreous color of the under parts. Face in front of median white patch slightly speckled with whitish. Long bristles of upper lip, some black and some white; a variable amount of white on upper lip; no black behind angles of mouth. Hair of ears brown-black, but white hairs from the lateral bands invade the lower anterior parts, overlapping the aperture. The black of the head fades into brown behind the plane of the ears, and shows here a small whitish mark; the area behind the lower part of the ears is strongly suffused with blackish, contrasting with the yellowish-white immediately below.

Cranial characters.—Compared with Merriam's figure of the skull of *frenatus* (N. A. Weasels, Pl. III, f. 1), the skull of *neomexicanus* is similar, but the frontal region is less narrowed anteriorly and slightly more convex; and the zyomatic processes seem less produced in a lateral direction; the occipital condyles are more produced behind.

Total length of skull 54 mm.; greatest breadth 32; interorbital breadth 14½; foramen magnum to plane of last molars 34 mm.

Measurements (of type specimen in flesh).—Length 500 mm., tail 205, hind feet 50.

Hab.—The Mesilla Valley of New Mexico, near the Rio Grande, alt. about 3,800 ft.

The type specimen was shot in the grass on the shore of Armstrong's Lake, Mesilla, Feb. 1, 1898, by Mr. A. C. Tyson. It is an old male; the teeth are somewhat worn and one or two are gone. It had eaten some small rodent, which from the foot found in the stomach seems to be *Onychomys arcticeps* Rhoads. A second specimen, also a male, was given to us by Mr. C. Barnes, who obtained it from Mr. J. J. Roese. It was killed by a dog in Mesilla Park, and was, unfortunately, much decomposed when it reached our hands. It agrees with the typical specimen, except that the throat is whiter and there is a little more white on the upper lip. Mr. Roese reports that he recently saw four specimens together in a road, early in the morning; this, with the development of the sexual organs, leads us to believe that this (beginning of February and end of January) is the mating season.

A specimen without any history, in alcohol, is in the collection of the New Mexico Agricultural College. It approaches true *frenatus* more than our examples, having a spot behind the angle of the mouth, and the white median patch of the head confluent only on one side with the lateral band. The discovery of *P. frenatus neomexicanus* extends the range of the *frenatus* series many hundreds of miles to the north, and into the Upper Sonoran Zone. One of us, after reading Dr. Merriam's account of the North American weasels, prophesied that there would be a new type found in the Mesilla Valley, and such proves to be the case, the characters of our animal, while surely of no more than subspecific value, being quite distinct.

ON THE GENUS HALIA OF RISSO.

BY WM. H. DALL.

The systematic position of the genus *Halia*, a curious deep water gastropod discovered in the last century, has long been contested. Lamarck (who knew it only by the shell) put it among the land-shells like *Achatina*, Martyn referred it to the whelks (*Buccinidæ*), Jay and Sacco classified it in the vicinity of *Struthiolaria*, and Sowerby near *Purpura*. Fischer, in 1858, was the first to examine it anatomically and concluded that it was one of the *Toxifera*, related to *Pleurotoma*. The paper was one of his earliest and rather crude; though it added materially to our knowledge, the conclusions were not altogether satisfactory to students of molluscan anatomy. Nevertheless his view has been accepted so late as 1896 by M. Cossmann, one of the leading paleontologists of France. In 1885 Poirier, of the Paris Museum, was lucky enough to obtain a specimen, a female, like that of Fischer, dredged in fifty fathoms at the mouth of the Gambia River. His discussion of the dissection[1] added very considerably to our acquaintance with the macroscopic anatomy and that of the nervous system. He was, however, little less unfortunate than Fischer in his examination of the most important systematic character, the radula, and reported an extraordinary duplication of the œsophagus, such as is quite unknown elsewhere in mollusks, and which would require the most conclusive confirmation to receive credence from anatomists. Poirier reverted to the opinion of Martyn that *Halia* is Buccinoid, which being interpreted into systematic language, means that he recognized in it the characteristics of a rhachiglossate Prosobranch, which is essentially correct. The true relations of this remarkable form were first recognized by Kobelt in a later publication[2] which has unfortunately remained unfinished and has attracted no attention from anatomists. In view of the fact that the early errors have obtained such a wide currency and that, even in Fischer's Manual, the characters of the nearest allied form are incorrectly

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[1] Bull. Malac. Soc. de France, July, 1885, pp. 17–50, pl. II–IV.

[2] Inconographie der schalentragenden europ. Meeresconchylien, II, p. 6.

given, it seems worth while to restate the latest and most trustworthy conclusions.

Each tooth of *Halia* is shaped much like a "wish-bone," the prongs forming an arched divergent base and the central projecting portion at the junction, the cusp. The attached bases of the arch are turned up a little and indistinctly notched on the edges; the main part of the arch is free and very prominent. When the cover glass of the microscopic slide is pressed down upon the radula the pillars of the arch break away from the cusp at their junction, which led Poirier to regard them as a separate series of lateral teeth on each side, and Fischer, not noticing Troschel's explanation of this part of one of his figures, has been led into the same error in regard to the analogous radula of *Volutomitra.* Poirier took the notched bases of the broken off lateral portions of the single tooth as the distal ends or cusps of his supposed laterals, directly reversing their true position. There is only a single row of teeth.

The position of *Halia* is unquestionably among the *Volutacea.* The radula of *Scaphella Turneri* as figured by Gray, is almost identical, and that of *Volutomitra gronlandica* is closely similar. *Halia* wants the siphonal appendage of the typical Volutes and so does *Volutomitra.* Both *Scaphella* and *Volutomitra* are without opercula, like *Halia.* The external form of the foot and head is essentially similar in all three. The texture of the shell of *Halia*, and also its color and color-pattern, are essentially identical with those of *Scaphella (Aurinia) dubia* Brod., which has the pillar and plaits degenerate. The process of degeneration, aided by the more ample whorls of *Halia*, has completed the effacement of the plaits and the enfeeblement of the pillar or central axis of the shell. The specimen of *Halia* at my disposal for study is somewhat worn at the apex, but the form of the nucleus indicates that, like *Scaphella* and *Volutomitra*, its nepionic shell was membranous, and has left a rough scar on the surface of the initial shelly coil, a view confirmed by Cossmann's figure of the nucleus of a fossil species. In *Aurinia* the degenerate radula is edentulous, but the type, which began in the Eocene, and has retained its color pattern and general characters ever since, is abundant in the Pliocene, and may readily have thrown off the aberrant *Halia* at that period from which it is known to date.

Halia was erected into a family by Kobelt, but it can hardly be said to possess family characteristics, its essential features being negative and due to degeneration from the normal type of the group to which it belongs. The characters of the latter, however, fully justify us in separating, from the operculate *Volutidæ* with their calcareous nepionic shell and Buccinoid dentition, the family *Scaphellidæ*, destitute of an operculum, with a membranous nepionic shell and the peculiar dentition above described. This latter group will include *Caricella, Scaphella, Cymbiola, Eopsephæa, Aurinia, Halia, Volutomitra* and their allies.

The recent *Halia* has been dredged along the eastern margin of the Atlantic from the Bay of Biscay to Senegal. The genus is represented in the Pliocene of Italy by one or two forms which have received distinct specific names. The type was first named by Meuschen in the Museum Gronovianum in 1778, and was erected into a separate genus by Risso in 1826.

DESCRIPTION OF A NEW TETHYS (APLYSIA).

BY E. J. LETSON.

Tethys Pilsbryi n. sp. Plate VIII.

Length 11½ cm., body elongated, flabby, plump, enlarged behind. Mouth encircled by wide lips and large buccal appendages. Rhinophores (posterior tentacles,) stout, short conic, slit at the extremities; eyes small, black, placed before the rhinophores. Anterior ends of pleuropodial lobes well separated, posterior ends joined behind, mantle large, median perforation very small, surrounded by radial striæ (visible only under a lens). Right margin of mantle, folded over about half its width, and largely adnate; posteriorly not forming an excurrent siphon; gill considerably exposed. Genital opening under forward right border of mantle, surmounted by a fleshy prominence. Opening of opaline gland large, single, about 13 mill. back of the genital pore, and well under the gill. Gills foliated in regular branches. External integument smooth; with a few inconspicuous scattered warts; olive colored, with some clouding of black on the reflexed mantle and sometimes also near the tail; shell normal.

Silam, North Coast of Yucatan, (Heilprin).

This differs from all other known species in having the mantle folded back upon itself and adnate except near the edge.

A NEW GRASSHOPPER MOUSE FROM NEW MEXICO.

BY SAMUEL N. RHOADS.

Among the ten species and races of short-tailed mice of the genus *Onychomys* known to inhabit the United States we find a surprisingly small amount of color variation, or of difference in size and external proportions, from the type of the genus, *O. leucogaster*, from Dakota. The short, nearly unicolor, blunt tail, rounded, microtine ears, dense, silky pelage and buffy gray colors are more or less characteristic of all the species ranging from the Saskatchewan to the Mexican boundary.

A careful study of their cranial characters is thus necessary in determining their relationships.

A specimen of *Onychomys* in superficial appearance almost identical with *leucogaster*, was recently forwarded to the writer from Mesilla, Dona Ana Co., New Mexico, by Mr. T. D. A. Cockerell, for identification. Four specimens of *Onychomys* from Clapham, Union Co., New Mexico, prove to be identical with the Mesilla specimen and on comparison with their nearest geographical allies, *leucogaster, brevicaudus* and *longipes* prove to belong to a distinct and undescribed species. It may be known by the following diagnosis:—

Onychomys arcticeps sp. nov. Long-Nosed Grasshopper Mouse.

"*Onychomys leucogaster* subsp. ?"; Allen, Bull. Amer. Mus. N. H., 1893, p. 74. "*Onychomys leucogaster brevicauda*"; Allen, ibid, 1896, p. 253.

Type No. 1,529, ad. ♂, col. of S. N. Rhoads, taken by E. E. Thompson at Clapham, Union Co., New Mexico, Nov. 7th, 1893.

General characters.—About the size of *leucogaster*, with slightly longer tail and ears, deeper fulvous (less gray) coloration above, narrower cranium, and long, slender rostrum.

Color.—Above uniform ochraceous buff,[1] heavily lined with blackish, lightest along sides, blackest on top of head and around eyes. A blackish oval spot on upper, outer margins of ears. Tail white, with an ill-defined, narrow stripe of blackish-buff on superior proximal two-thirds. Color of sides at the white margin and on lower rump and thighs deeper ochraceous buff. Lower parts tawny white as contrasted with the clear, pure white of *leucogaster*.

[1] Ridgway's Nomen. of Colors, Pl. V, No. 10.

Cranial characters.—Skull viewed from above (contrasted with *leucogaster*), long and narrow, the brain case high, compressed, elongate, ovate; the rostrum much narrowed and the nasals slender and projecting decidedly beyond the anterior tips of the premaxillaries. No distinct supraorbital bead as contrasted with *longipes* from Texas. Palate ending posteriorly with a convex edge as in *torridus*, as contrasted with the strongly developed median spine of *leucogaster*.

Measurements (of type).—Total length 150 mm.; tail vertebræ, 45; hind foot, 21; ear, from crown (dry), 11. Average of four topotypes, in same order as above: 152—46—22. Skull: total length, 28.6; nasal length, 11.3; zygomatic expansion; 14.7; mastoid expansion, 12; interorbital constriction, 4.7; length of mandible 15.3.

NOTES ON THE FOSSIL WALRUS OF EASTERN NORTH AMERICA.

BY SAMUEL N. RHOADS.

In the eleventh volume of the *Transactions* of the American Philosophical Society,[1] Dr. Joseph Leidy describes and figures two specimens of fossil walrus obtained on the coast of New Jersey, and discusses the relationships of the recent and fossil forms of Atlantic walrus. In his opinion there is no foundation for a distinction between the existing species and the so-called *Trichechus virginianus* of DeKay,[2] based on a fossil walrus skull from Accomac County, Virginia.

In the eighth volume of the *Journal* of the Academy of Natural Sciences of Philadelphia, published twenty years subsequent to his paper in the *Transactions* of the Philosophical Society above referred to, Dr. Leidy describes a walrus tusk from the phosphate beds of Ashley River, South Carolina. This specimen he compares with the tusks of a large skull in the museum of the Academy from Nova Scotia, and concludes that the characters of the South Carolina specimen are not of sufficient value to determine whether it pertained to a species distinct from the living one. The specimen from Nova Scotia, thus casually referred to by Dr. Leidy, is yet in the museum of the Academy, and is by far the most complete fossilized cranium of an adult animal of which we have any record.

Before passing to a further consideration of the specimens described by Leidy, it should be stated that Dr. J. A. Allen, in his Memoir of the Pinnipeds[3] also records[4] a skeleton of a fossil walrus "with tusks over five inches long" in the quaternary clays of Portland, Maine. Dr. Allen does not seem to have examined any fossil specimens of walrus, nor does he venture an opinion as to the specific value of the so-called fossil species. From his full quotations of Leidy, however, it is evident that Dr. Allen was inclined to coincide with the determinations of so eminent an authority.

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[1] New Series, pp. 83–86, pl. 4, and 5.

[2] Nat. Hist. N. York, Zool., I, p. 56, pl. 19, fig. 1, a, b.

[3] U. S. Geol. Surv., Misc. Pub, XII, 1880.

[4] See also Amer. Nat., Sept., 1878, p. 633.

With the specimen from Nova Scotia above alluded to is a memorandum, evidently penned by the sender and donor of the specimen. It reads:—" Office of School Commissioners, 48 George Street [Halifax], 187[1]. Skull of a walrus (*Trichecus rosmarus*) Sable Island, Nova Scotia. The walrus is now extinct in Nova Scotia. It was last seen alive on Sable Island sand beaches. There must have been a considerable number on the island, as a great many of their skulls have been thrown up on the beaches at intervals after heavy gales. The specimen sent was found some two years since, and as none have been found since then, I am inclined to think it the last of the series. You will observe that the tusks are partly fossilized.—J. R. W[illis]." This specimen is recorded in the *Proceedings* of the Academy for 1871, and classified among recent vertebrate material. This fact and the tenor of Dr. Leidy's remarks regarding it show that he did not consider it a fossil. This is remarkable, as the specimen is of precisely the same nature in color, texture and specific gravity as the larger fossil specimen which Leidy described and figured in the *Philosophical Transactions*, and which came from the beach at Long Branch, New Jersey. Undoubtedly the Sable Island specimen is of the same age and derivation from an ancient raised sea beach stratum as were the two specimens obtained on the shores of New Jersey, the skeleton from the quaternary clays of Portland, Maine, and the type of DeKay's *Trichechus virginianus* from the sea beach of Accomac County, Virginia. For this reason all of these fossil specimens are taken in the following study as typical of the supposed fossil species of Atlantic walrus as compared with the animal now existing on our North Atlantic Coasts of America.

Of the four fossil specimens mentioned, three are now in the custody of the Academy of Natural Sciences, the one from Sable Island and the more perfect of the two New Jersey specimens figured by Dr. Leidy, being the property of the Academy. The third specimen is the anterior half of the cranium from Long Branch, loaned to Dr. Leidy by Prof. Geo. Cook, and figured in the *Transactions* of the Philosophical Society. It was recently purchased from Prof. Ward of Rochester, N. Y., by the New Jersey Geological Survey for its museum at Trenton, and through the courtesy of Prof. J. C. Smock, was loaned to Mr. Lewis Woolman, of Philadelphia, for use in this connection. It is to the efforts of Mr. Woolman and his scientific interest in the work of the Survey, as well as his devotion to original research in the Academy of Natural Sciences that the facts contained in this paper are now made accessible. Mr. Woolman's attempt to locate DeKay's type of *T. virginianus* resulted in the discovery that this specimen was destroyed by fire with the other objects of natural history in the museum of the old New York Lyceum of Natural History, now known as the New York Academy of Sciences.

The loss of this specimen, together with the inadequate description of its characters and the crude nature of DeKay's figure of it make the use of the name *virginianus* for an extinct species of walrus questionable, even in the event of proof that the other fossil specimens represent a different species from that now existing. However, if the characters of these latter can be shown to indicate such a state of affairs and at the same time show no radical differences from what we know of the type of *virginianus*, it is eminently proper that that name should be applied to them, and the extinct walrus of the glacial period be so distinguished from *Rosmarus rosmarus*.

As Leidy has already shown, DeKay's brief diagnosis of *virginianus*[5] is equally applicable to *Rosmarus rosmarus*, and had he not figured the specimen, we would now, on account of the loss of the type, be forced to make *virginianas* a probable synonym of *rosmarus*. The fact, however, that the type was a fossil and was figured, and that it, in all probability, represented the same species as the fossil skulls from New Jersey and Sable Island, makes the name as tenable as ever for a possible species of fossil walrus.

The characters of all the fossil specimens show conclusively their closer affinity to *rosmarus* than to *obesus* of the Pacific Ocean, except in the relative size of the molars. In this respect they approach more nearly the Pacific species as represented in the skull of an old male from Alaska, in which the molars are very large and rounded. The canine tusks of the fossil specimens are characteristic of the rather short, heavy, decurved and spreading form seen in *rosmarus*. In respect of the ratio of the extreme facial width across the maxillaries to the greatest occipital width, it is noticeable that the fossil specimens come much nearer to *obesus*, in which the differences between these dimensions are much less than in *rosmarus*. In the fossil specimen from Nova Scotia the maxillary expansion is 203 mm., and the paroccipital expansion (adding 10 mm. for wear)

[5] It reads: "Cheek teeth with obliquely truncate crowns, not ridged; the second smaller than the first."

is 278 mm. In a very old male specimen of *obesus* from Alaska these measurements are respectively 220 mm. and 295 mm. In a somewhat younger but adult west Greenland specimen of *rosmarus* these dimensions are 195 mm. and 295 mm. Viewed anteriorly, the facial outline of the fossil specimens, especially in the oldest New Jersey example, shows affinity with the *rosmarus* type in the relatively greater ratio of width to height, and in the Sable Island skull the median projection of the premaxillaries extends considerably beyond the anterior plane of the maxillaries into a blunt, beak-like process.

In the very old recent Alaskan specimen the premaxillaries are on a plane with the maxillaries at this point, and their median suture recedes behind them at its antero-inferior border in a sort of hare-lip conformation.

The three fossil specimens are remarkable for the great relative size of the nasal bones. The New Jersey specimen now belonging to the Geological Survey of that State is much wider across the maxillaries than the widest recent or fossil walrus skull in the custody of the Academy, and is from a very old individual. While we would expect a corresponding width of the nasal bones, these are, nevertheless, correspondingly long, also, presenting an area nearly twice as great as in the largest recent walrus skulls in the collection. The smaller New Jersey specimen, belonging to the Academy, also has a correspondingly large nasal area. The nasal sutures in the process of fossilization become sufficiently well-defined, even in the oldest specimens, to determine their area. In the larger New Jersey specimen the greatest nasal length is 98 mm., and the greatest width 80 mm. In the smaller one these dimensions are 96 mm. and 81 mm. In the largest Greenland specimen they are 72 mm. and 65 mm., and in the largest Alaskan specimen 72 mm. and 64 mm.

Turning now to the upper maxillary dentition, a comparison between the fossil and recent specimens of aged individuals shows the following marked differences in the permanent teeth.[6]

In recent *rosmarus* of nearly the same size as the smaller New Jersey fossil specimen and 25 mm. shorter in basilar length than the Nova Scotia fossil, all the grinding teeth average about one-half the dimensions of the fossil specimens, and making allowance for

[6] I adopt the dental formula of Dr. Allen's Monograph of the Pinnipeds, page 57.

the difference in age they are more than one-third smaller. In the fossil specimens the permanent incisor exceeds the grinders both in triturating area and in alveolar depth and calibre. In *rosmarus* and *obesus* this tooth is much smaller than $\frac{m.2}{}$. The posterior molar ($\frac{m.3}{}$) in the fossil skulls (excepting the one belonging to the New Jersey Geological Survey),[7] is a deeply rooted tooth of nearly the same calibre and triturating area as $\frac{m.2}{}$. In both *rosmarus* and *obesus* it is the smallest and shallowest rooted of the permanent dentition and is sometimes wanting in aged specimens.

Another marked character which is peculiar to the two fossil specimens belonging to the collection of the Academy, and in some degree to the specimen of the Geological Survey, is the remarkable median depression of the maxillæ at the incisive foramina, and the constriction of the inter-incisor space. In the Sable Island example the depth of the incisive foramina below the crown of $\frac{m.1}{}$ is 64 mm. and the distance between the alveoli of the permanent incisors is only 17 mm. In the Long Branch skull it is about the same. In the recent Greenland specimen these measurements are 41 mm. and 30 mm., and in the Alaskan specimen 50 mm. and 30 mm.

While the foregoing comparisons were made with an amount of material far more comprehensive than that accessible to Dr. Leidy, and supplemented by the valuable diagnoses, figures and tables of measurements given by Dr. J. A. Allen, the author regrets that a larger series of adult crania of our living species of walrus was not available. Premising, however, that the recent skulls used in this comparison are typical in essential characters of *rosmarus* and *obesus*, and that the fossil skulls, including the type of *virginianus*, all represent a period of Pleistocene Age, the writer concludes that the weight of evidence favors the separation of the fossil and recent species of Atlantic walrus under the following diagnoses:

Rosmarus rosmarus (Linnæus). Recent Atlantic Walrus.

Phoca rosmarus Linnæus; Syst. Nat., 1758, p. 38.
Rosmarus rosmarus Rhoads; Amer. Nat., 1894, p. 523.

Characters.—Ratio of greatest anterior maxillary width to the paroccipital expansion, as 2 to 3; permanent upper incisor much smaller than $\frac{m.2}{}$; $\frac{m.3}{}$ smallest, shallow-rooted, in old adults sometimes absent; superior grinders relatively weak, the opposing rows separated by a wide incisive diastema twice the width of the largest

[7] In this the posterior molars have fallen out, the alveoli showing them to have been of large calibre but quite shallow.

molar; roof of mouth gently, evenly rounded, shallow between the grinders; incisive foramina small, not indented, their distance below the alveolus of $^{m.\,1}$ only equalling the distance between the two opposing permanent incisors; nasals small, short, rectangular.

Rosmarus virginianus (DeKay). Fossil Atlantic Walrus.

Trichechus virginianus DeKay; Nat. Hist. N. York, I, p. 56, pl. 19, fig. 1, a, b.

Characters.—Ratio of greatest anterior maxillary width to paroccipital expansion, as 2 to $2\frac{3}{4}$; permanent upper incisor as large as $\underline{^{m.\,2}}$; $^{m.\,3}$ larger than $^{m.\,1}$, nearly as large as permanent incisor, deeply rooted, persistent; superior grinders massive, crowded, the opposing rows separated by a narrow incisive diastema about as wide as the largest molar: root of mouth deeply furrowed between the grinders; incisive foramina large, acutely indented; their depth below the alveolus of $^{m.\,1}$ being twice as great as the space between the two opposing permanent incisors; nasals large, relatively long, becoming much wider anteriorly.

It should be understood that the above diagnosis of the fossil walrus rests chiefly on the Sable Island specimen, and the finer skull belonging to the Academy from New Jersey which Leidy figured on plates 4 and 5 of volume XI of the *Philosophical Transactions.* Both these skulls evidently belonged to very old males. In some respects, as in the relative sizes of the teeth to each other, the other New Jersey specimen and the plate of DeKay's *virginianus* agree in their closer approach to the existing walrus. Owing to their fragmentary condition, as compared with the Sable Island and Long Branch specimen, and the fact that the latter two agree exactly in all the characters enumerated, it is best to consider these as typical of the fossil animal. As DeKay's type is destroyed and his diagnosis and plate of little value, I would recommend that if the characters pointed out in this paper as distinguishing the fossil from the recent Atlantic walrus are sufficiently confirmed by other specimens to warrant their separation, that DeKay's name be retained. The evidence in favor of DeKay's fossil being the same as *rosmarus* and the other fossil specimens a distinct species, to which the name *virginianus* cannot apply, is too flimsy to merit attention.

APRIL 5.

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

Seventeen persons present.

The death of Oliver A. Judson, M. D., a member, was announced.

APRIL 12.

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

Twenty-six persons present.

PROF. PILSBRY made a communication on the natural history of slugs. (No abstract.)

APRIL 19.

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

Nineteen persons present.

The Function of the Radula.—MR. H. A. PILSBRY spoke of a radula of the gastropod *Nerita peloronta* exhibited by Mr. Keely, mentioning its great length compared to that of the animal, and the large number of similar teeth at the margins. The modifications found by Fischer in the radula of *Neritopsis* and by the speaker in that of *Orthomesus* and the Helicidæ indicate that specialization in the Rhipidoglossa and Pulmonata has proceeded from the median line of the radula outward, the outer teeth being the last to be modified, and therefore of value as indicating the ancestral condition; this mode of modification being probably the result of the greater functional activity of the median portion in feeding, due to the rounded shape of the subradular cartilage.

MR. CALVERT stated that the position of the radula in squids recently dissected by him seemed to preclude the use of that organ as a rasp, as described for snails.

MR. PILSBRY replied that he had not observed any cephalopod feeding, but supposed that the radula here acted as an aid to deglutition, crowding the fragments, taken in the beak, down the œsophagus.

DR. CHAPMAN observed that he had often observed squids eating fish, and the beaks alone were used to bite the prey. He further alluded to the impossibility of keeping squids in aquaria owing to their incessant activity. They constantly dart against the glass and soon die from the mutilation ensuing.

April 26.

The President, Samuel G. Dixon, M. D., in the Chair.

Twenty-six persons present.

A paper entitled "Materials toward a Natural Classification of the Cylindrelloid Snails," by Henry A. Pilsbry and E. G. Vanatta, was presented for publication.

Rock Inscriptions in Kauai, Hawaiian Islands.—Dr. Benjamin Sharp exhibited a specimen of coquina received from Mr. J. K. Farley of Kauai. He had visited Mr. Farley in 1893 with the hope of seeing some rock inscriptions usually covered with sand. An effort to uncover the rocks and expose the inscriptions had then been unsuccessful, although the bed rock had been reached at a depth of six feet. The following letter, accompanied by drawings of the inscriptions, has recently been received:—

Koloa, Kauai, Hawaiian Islands, July 13th, 1897.

Dr. Benj. Sharp,

Dear Sir:—When you were here in October, 1893, I promised you that I would send you any new information that I might obtain regarding the figures cut into the sandstone[1] ledge at Keoneloa, also diagrams of them if I ever saw them again.

On June 15th a native fisherman told me that the drawings were exposed to view at low tide. I went to Keoneloa June 16th, 17th, 18th, 19th and 21st, and send you herewith, in another package, the result of the visits. On the last date I could do nothing but try cutting the rock with a hatchet and an old native stone adze, as a high surf was fast covering the ledge again with sand.

With a hatchet one could, I think, make a four foot figure in about two hours, steady work; with the adze it would take at least six times as long, and use up a number of such tools. Most of the figures look as if they had been cut with a semi-pointed implement like a rounded cold chisel. With the corner of the stone adze I was able to make about the same kind of a cut. A whirling motion that I noticed the waves as they ran off the rock gave to the sand, lodged it in the cuts and this may have worn the cutting into the sort of rounded pockets noticed.

I had a talk, June 17th, with an old native woman named Kauila, who has lived near Keoneloa for many years. She said:— "I first saw the pictures when I was about thirteen years old (that was in 1848). I went to see them with my school-teacher and his other scholars and two Roman Catholic priests. My teacher's name was Alexandro, a Frenchman. He was the first Roman

[1]The rock is coquina, not sandstone.

Catholic priest in Koloa and built the Roman Catholic Mission buildings. We saw *all* the picture rocks exposed; you have only seen a part of them to-day. The priest went home with me from Keoneloa and talked with my father, Walewale, and with my grandfather, and also with a number of other old natives (in those days there were many old people in the land) about the drawings. They had all seen the pictures but had never heard who cut them, or why they were done. The oldest folks said that their fathers and grandfathers had told them that the pictures had always been there."

The sand-hills to the west of Keoneloa are said to have been old battle-fields. They were certainly used as burial grounds as we know.[2]

Fugitives from the Oahu wars are said to have landed at Keoneloa and to have been killed and buried in these sand-hills by Koloa natives.

Alexander, in his "Brief History of the Hawaiian People," Chap. 15, says "About the end of the 13th century, Kalaunuiohua, a warlike and ambitious *Moi* (King) of Hawaii, undertook to subdue the whole group . . . he defeated the leading chiefs of Maui, Molokai and Oahu. . . . he set sail for Kauai . . . and landed near Koloa, where he was met by Kukona, at the head of the warriors of Kauai, and was totally defeated, his fleet being taken, his army destroyed. It was about this time that a vessel called 'Mamala' in the tradition, arrived at Kahului, in Maui. The captain and crew are said to have been foreigners of light complexion, with bright eyes, who intermarried with the natives and became progenitors of a light colored stock. As there were no Europeans in the Pacific Ocean in the 13th century, it is most probable, as Judge Fornander has suggested, that these foreigners were the crew of some Japanese junk, driven out of its course by a typhoon, and drifted to these shores, as has twice happened in recent times. Also, about the year 1527–28, Spaniards, a man and his sister, were saved from a wreck on Hawaii . . . they intermarried with the natives and became the progenitors of certain well-known families of chiefs, such as that of Kaikeowa, former Governor of Kauai."

Jarvis, in his history of the islands, says, "Cook found in the possession of the natives of Kauai two pieces of iron, one a portion of a hoop, and the other appeared to be part of the blade of a broadsword." "The knowledge and use of iron was generally known."

Kauila's story would take us back to the early part of the 17th century, without a tradition of the workers.

The cross and the flag (?)[3] make me think that foreigners may have had a hand in the work, or may have given the natives, if they did the work, a knowledge of those emblems. Were it not for them one might think that the pictures were done by a party of

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[2] We obtained, when with Mr. Farley, a number of bones and one complete skeleton.

[3] Referring to the drawing sent with the letter.

North-west Indians, who could, I believe, easily, in their large canoes, sail or drift down to the islands with the currents, in a shorter time than a Japanese junk could. One can usually see half a dozen N. W. drift logs on the beach at Keoneloa. On the beaches of Niihau, some fifty miles away, hundreds of logs and Red Wood posts have been picked up a few months after freshets on the Pacific coast of the U. S. and B. C., had washed out the logging dams of the saw mills.

The last figure on my diagram, I take it, was made to represent a woman in parturition.

P. S. Since writing the foregoing, I have seen Dr. Emerson of this place. He tells me that eight or nine years ago, he saw on the beach at Honaunau, Kona, Hawaii, somewhat similar drawings, cut into lava rock. Honaunau is not far from Keei, the place at which the Spanish man and woman are said to have landed in about 1527–28. The natives of Hawaii know nothing of the workers. Dr. Emerson says: Kackeoewa came from a Hawaiian family. My "cross" may be a totem.

Mr. Wm. W. Jefferis was appointed Curator of the William S. Vaux Collections for the current year.

The following were appointed the Committee on the Hayden Memorial Award for 1898:—Messrs Persifor Frazer, Angelo Heilprin, Theodore D. Rand, Benjamin Smith Lyman, and Jos. P. Lesley.

The following were ordered to be printed:—

BIRDS OBSERVED IN CENTRAL CALIFORNIA IN THE SUMMER OF 1893.

BY JOHN VANDENBURGH.

It was my good fortune in the summer of 1893 to be one of a party of five who, during the weeks from June 21st to July 27th, fairly lived in the saddle, riding nearly eight hundred miles through the Coast Range, interior valleys and Sierra Nevada of California. The other members of the party were Dr. Charles H. Gilbert, Dr. W. W. Thoburn and Professor C. B. Wing of Leland Stanford Junior University, and the Rev. Mr. Briggs, then of San Francisco.

The main object of the expedition was the gathering of material which would throw light upon certain problems connected with the fish fauna of the streams in the vicinity of Mt. Whitney, but all forms of vertebrate life received more or less attention. My time was devoted chiefly to the birds and reptiles, the latter, perhaps, receiving the major share. Owing to the rapid rate at which it was necessary to travel, opportunities for collecting were not of the best, but the ornithological observations made, are presented in the hope that they may be of interest from the fact that most of the birds were in their breeding ranges and, in many instances, in localities seldom visited by the ornithologist.

Our route lay in Santa Clara County from Los Gatos and Palo Alto to Saratoga, and thence to Boulder Creek in Santa Cruz County; June 21st, Santa Cruz; June 22d, Soquel, Aptos and Watsonville; June 23d, San Juan, Hollister and Tres Pinos; June 24th, up the valley of the San Benito River to San Benito, Hernandez, Hepsadan Mountain and Erie; June 26-29, across a divide to the Los Gatos Creek, June 29th, and then down this stream and through Pleasant Valley to Huron, June 30th. From Huron we crossed the San Joaquin Valley, by way of Lemoore, Armona and Hanford, to Visalia, July 1-3d. From Visalia we went to Three Rivers and then up the east fork of the Kaweak River to Cain's Flat, Weishar Mill and Mineral King, July 4–6th. Crossing Farewell Gap, we spent a day in Shotgun Cañon close to Little Kern River, and then went on to Trout Meadows and the south fork of Kern River, reaching Little Kern River Lake July 12th and Soda Springs or Big

Kern River Lake one day later. Our trail then lead us up Whitney Creek to its headwaters, across to Cottonwood Creek and thus down to Owen's Lake and Lone Pine, July 14–16th. From Lone Pine we returned to San Francisco by way of Independence (July 17th), Big Pine (July 18th), Round Valley (July 19th), McGee's (July 20th), Troy's near Mono Lake (July 21st), Mono Pass and Dana Creek (July 22d), Yosemite Valley (July 23d), Crocker's (July 24th), Buena Vista (July 25th), and Stockton (July 26th).

1. Colymbus nigricollis californicus. Eared Grebe.

The Eared Grebe was seen only in Owen's Valley, where a single pair were feeding in a small lake near Lone Pine, July 16, 1893.

2. Podilymbus podiceps. Pied-billed Grebe.

A pair of this species inhabited a pond near Watsonville, where we camped, June 23d.

3. Ardea herodias. Great Blue Heron.

This heron was observed at Watsonville, June 23d. It was common along the San Benito River, June 29th, and several were hunting in the alfalfa fields of Pleasant Valley, June 30th.

4. Ardea virescens. Green Heron.

The Green Heron was not uncommon along the San Benito River from Tres Pinos to San Benito, June 24–27th. One was observed on the east fork of the Kaweah River, July 5th.

5. Fulica americana. American Coot.

Two Coots were playing in Little Kern River Lake early in the morning of July 13th. In Owen's Valley a number were seen on a small lake near Lone Pine, July 16th.

6. Actitis macularia. Spotted Sandpiper.

This loud voiced wader was seen at Kern River Lake, July 13th and 14th.

7. Ægialitis vocifera. Killdeer.

The Killdeer was observed near Watsonville, June 24th; at Tres Pinos, where it was very abundant along the San Benito Creek, June 25th, and along the Los Gatos Creek and in Pleasant Valley, June 30th. In the San Joaquin Valley, this bird was the almost constant accompaniment of water, July 1–4th. In Owen's Valley, many were seen along the streams and irrigation ditches between Lone Pine and Bishop, July 16–19th.

8. Oreortyx pictus plumiferus. Plumed Partridge.

A large covey was observed near Mineral King, July 7th. Several were seen near Shotgun Cañon, July 11th, and a pair with half grown young were flushed between Trout Meadows and Kern River Lakes, July 12th. A single adult male was seen at Crocker's, July 25th.

9. Callipepla californica. California Quail.

This quail was heard constantly between Saratoga and Boulder, June 21st.

10. Callipepla californica vallicola. Valley Quail.

Valley Quail were very abundant along the east fork of the Kaweak River, July 4–5th.

11. Dendragapus obscurus fuliginosus. Sooty Grouse.

The Sooty Grouse was well represented at an altitude of about 8,000 feet near Mineral King. Here they were heard at all times of the day, and a female was seen with her covey of young, then about the size of Valley Quail, July 7th. Several were observed by Dr. Gilbert at the head of Shotgun Cañon, July 10th.

12. Zenaidura macroura. Mourning Dove.

This species was first observed at Watsonville, where it was common in the grain fields. After leaving Watsonville, it was with us constantly to San Juan, Hollister, Tres Pinos, up the valley of San Benito Creek, across into that of the Los Gatos, thence down Pleasant Valley to Huron, across the San Joaquin Valley to Visalia, and up the east fork of the Kaweak River to Cain's Flat, at the lower limit of pines, June 24th, July 5th. Doves were very abundant in Owen's Valley, from Lone Pine to Bishop, July 16th–19th.

13. Pseudogryphus californianus. California Vulture.

A single individual of this species was seen sitting on a fence-post near the road between Big Pine and Bishop Creek in Owen's Valley, July 19th.

14. Cathartes aura. Turkey Vulture.

Buzzards were noted at Aptos, Watsonville, San Juan, Hollister, Tres Pinos, San Benito, Hernandez, Visalia, Three Rivers and Cain's Flat. East of the Sierra Nevada several were seen in Owen's Valley, and a dead one was found in Long Valley.

15. Circus hudsonius. Marsh Hawk.

A hawk of this species was seen near Big Pine, Owen's Valley, July 19th.

16. Accipiter velox. Sharp-shinned Hawk (?).

A bird thought to be of this species was seen near San Benito, June 27th.

17. Buteo borealis calurus. Western Red-tailed Hawk.

Several Western Red-tails were sailing high in the air near Aptos, June 23d. The species was next seen at Tres Pinos, June 26th, but was not again observed until the party reached Dana Creek, above the Yosemite Valley, where one was shot July 23d.

18. Aquila chrysaetos. Golden Eagle.

The only eagle seen flew from the ground near an irrigation ditch to a large oak, near Visalia, July 3d.

19. Falco sparverius deserticolus. Desert Sparrow Hawk.

This species was first met at Soquel, where a single individual was seen June 23d. Others were observed near San Juan and Tres Pinos, June 24th. On June 27th one was seen near San Benito, feeding four young which had recently left the nest.

20. Glaucidum gnoma californicum. California Pigmy Owl.

A Pigmy Owl was brought to me at Boulder by some boys who had shot it as it flew about their camp among the redwoods at noon June 22d.

21. Speotyto cunicularia hypogæa. Burrowing Owl.

A number of Burrowing Owls were seen near San Juan, June 24th. In Pleasant Valley and between there and Huron this species was very common, and often whole families of them could be seen on or near the mounds which contained their nesting burrows. June 30th, several were seen at various points in the San Joaquin Valley.

22. Geococcyx californianus. Road-runner.

A Road-runner shot by Dr. Thoburn near Big Pine, July 18th, was the only one observed.

23. Ceryle alcyon. Belted Kingfisher.

One Kingfisher was seen near Tres Pinos, June 26th.

24. Dryobates pubescens gairdnerii. Gairdner's Woodpecker.

This Woodpecker was very abundant along the San Benito Creek, June 25th to 28th.

25. Dryobates nuttallii. Nuttall's Woodpecker.

Nuttall's Woodpecker was observed only on the east fork of the Kaweah River near Cain's Flat, July 5th.

26. Xenopicus albolarvatus. White-headed Woodpecker.

The White-headed Woodpecker was very common among the pines between Weishar Mill and Mineral King, July 7th.

27. Sphyrapicus ruber. Red-breasted Sapsucker.

Several "Red-headed Woodpeckers" were busy in the pines at Kern River Lakes, July 13th.

28. Sphyrapicus thyroideus. Williamson's Sapsucker.

This bird was quite common among the pines and sequoias near Weishar Mill, July 7th. Several were seen near Kern River Lakes, July 12th to 14th.

29. Ceophlœus pileatus. Pileated Woodpecker.

A bird of this species was noted at Weishar Mill, July 6th.

30. Melanerpes formicivorus bairdi. California Woodpecker.

This showy bird was usually seen in flocks of from three to a dozen individuals. It was noted among the redwoods at Boulder, June 21st, and in the oaks near Watsonville, San Juan, Tres Pinos and San Benito, June 23d to 27th. In the San Joaquin Valley it was common—particularly so near Visalia, July 3d—but ascended the east fork of the Kaweah only to Cain's Flat.

31. Melanerpes torquatus. Lewis' Woodpecker.

Many Lewis' Woodpeckers were circling in the air along San Benito Creek between Tres Pinos and Hepsadan Mt., June 25th–29th.

32. Colaptes cafer. Red-shafted Flicker.

A Flicker was noted at Watsonville, June 23d; another was seen near San Juan, June 24th, and several were observed in San Benito Valley, June 27th–29th. In the high Sierras three were seen in Shotgun Cañon, July 10th.

33. Phalaenoptilus nuttallii californicus. California Poorwill.

Several Poorwills were heard in the foot hills near Tres Pinos throughout the moonlit night of June 25th.

34. Chordeiles virginianus henryi ? Western Night Hawk.

While all Night Hawks seen were flying so high as to prevent their capture, it seems probable that two, seen near Tres Pinos, June 25th, and also several observed at Kern River Lakes, July 13th, were of this form.

35. Chordeiles texensis ? Texan Night Hawk.

A number of Night Hawks seen at Big Pine, Owen's Valley, July 18th, were referred to this species.

36. Chætura vauxii. Vaux's Swift.

Five Vaux's Swifts were seen with a flock of Violet-green Swallows near Boulder, June 21st. It is probable that they were breeding in hollow redwoods.

37. Trochilus alexandri. Black-chinned Humming-bird.

This Humming-bird was noted only near Lone Pine, where several were observed July 16th.

38. Calypte anna. Anna's Humming-bird.

Near Watsonville this fine bird frequented the blossoms of the buckeye, June 24th. Several were seen near San Benito, June 26th–27th.

39. Selasphorus rufus. Rufous Humming-bird.

Two individuals of this little species were observed near Mineral King, July 7th. They were flying about a clump of low bushes at an altitude of about 7,500 feet.

40. Tyrannus verticalis. Arkansas Kingbird.

The western Kingbird was very common in the vicinity of San Juan, Hollister and Tres Pinos, June 25th. At Tres Pinos a pair had a nest which contained four young nearly ready to fly. The species was observed in the valley of the San Benito as far up as Erie.

In the San Joaquin Valley this bird was very abundant, and several nests had been built upon the crossbars of telegraph poles. It was noted near the east fork of the Kaweah, but disappeared a short distance above Cain's Flat, July 6th.

In Owen's Valley several were noted near Lone Pine and Independence, July 16th–17th.

41. Myiarchus cinerascens. Ash-throated Flycatcher.

The Ash-throat was quite common in the Coast Range between Saratoga and Boulder, June 21st. It was observed in the hills near Watsonville, June 23d, and at the headwaters of the San Benito Creek, June 29th.

42. Sayornis saya. Say's Phoebe.

A pair of Say's Phoebes had a nest in a barn in Round Valley, which contained two large young, July 19th.

43. **Sayornis nigricans.** Black Phoebe.

The Black Phoebe was not uncommon at Boulder, June 21st, Watsonville, San Juan and Hollister, June 24th, Tres Pinos June 25th, and San Benito, June 27th. Several were observed along the east fork of the Kaweah, July 4th.

44. **Contopus richardsonii.** Western Wood Pewee.

The Western Wood Pewee was common along the streams near Saratoga and Congress Springs, June 21st, but was not again met except on the east fork of the Kaweah River, where several were observed July 5th.

45. **Pica nuttallii.** Yellow-billed Magpie.

The Yellow-billed Magpie was common at Visalia, July 3d.

46. **Cyanocitta stelleri frontalis.** Blue-fronted Jay.

This Jay was very common in the Coast Range between Saratoga and Boulder, June 21st. It was again noted shortly after entering the coniferous woods on the east fork of the Kaweah, July 6th; was very common at Weishar Mill, and ranged up almost to Mineral King, July 7th.

47. **Aphelocoma californica.** California Jay.

The California Jay was found in the Coast Range between Saratoga and Boulder, June 21st. It was common along the San Benito Creek from Tres Pinos to its source, June 15th–29th, and was again observed at Visalia and along the east fork of the Kaweah to the lower limit of pines.

48. **Corvus americanus.** Crow.

Crows were abundant near San Benito, June 27th, and several small flocks were seen in Pleasant Valley, June 30th. They were very numerous between Visalia and Three Rivers, July 3d.

49. **Nucifraga columbiana.** Clark's Nutcracker.

A noisy troop of Clark's Crows was observed almost at the top of Farewell Gap, July 8th. The species was again seen near the head waters of the south fork of the Kern River, July 15th.

50. **Agelaius phœniceus.** Red-winged Blackbird.

Red-wings were many near Watsonville, June 24th. A few were seen at Trout Meadows, July 12th, and several near Lone Pine, July 17th.

51. Sturnella magna neglecta. Western Meadow Lark.

This Meadow Lark was abundant in the fields near Watsonville, San Juan, Hollister and Tres Pinos, June 23d to 26th, and in almost all parts of the San Joaquin Valley where any low vegetation grew July 1st to 4th.

52. Icterus bullocki. Bullock's Oriole.

Bullock's Oriole was observed near the following places: San Juan and Hollister, June 24th; Tres Pinos, where a pair had a nest which contained large young, June 25th; San Benito, June 27th; Erie, June 29th; Los Gatos Creek, June 30th; Lemoore, July 1st; Visalia, July 4th; east fork of the Kaweah River, July 5th; and Yosemite Valley, July 24th.

53. Scolecophagus cyanocephalus. Brewer's Blackbird.

Brewer's Blackbird was noted near the following places: Saratoga, June 21st; Watsonville, June 23d; San Juan, June 24th; Hollister, June 24th; Tres Pinos, June 26th; San Benito, June 27th; Lemoore, July 1st; and Trout Meadows, July 12th.

54. Carpodacus purpureus californicus. California Purple Finch.

The California Purple Finch was not uncommon in the Coast Range near Boulder, June 21st. Three were seen near Watsonville, June 23d.

55. Carpodacus cassini. Cassin's Purple Finch.

Cassin's Finch was first seen a mile or two below Mineral King, on the east fork of the Kaweah, July 7th. They were much more numerous in Shotgun Cañon, July 8th to 10th.

56. Carpodacus mexicanus frontalis. House Finch.

The "Redhead" was found near Watsonville, San Juan, and Hollister, June 24. It was plentifully distributed in San Benito Valley from Tres Pinos up to the divide. A pair had a nest in a tin can hung in the porch of a farm house on the east fork of the Kaweah River, which contained two young birds, July 4th.

57. Leucosticte tephrocotis. Gray-crowned Leucosticte.

Farewell Gap was filled with snow on July 8th, and here several small flocks of Gray-crowned Finches were busily feeding on small flies and grubs. A single bird of this species was seen in Mono Pass, July 22d.

58. Spinus tristis. American Goldfinch.

The American Goldfinch was observed only near Watsonville, June 23. It is abundant near Monterey in May and June, where it is associated with *S. psaltria, S. lawrencei, S. pinus, Carpodacus purpureus californicus* and *C. mexicanus frontalis.*

59. Spinus psaltria. Green-backed Goldfinch.

"Wild Canaries" were many between Santa Cruz and San Benito, June 22d to 27th. Others were noted at the headwaters of the San Benito Creek, June 29th.

60. Spinus lawrencei. Lawrence's Goldfinch.

Several Lawrence's Goldfinches were seen near San Benito, June 26th. The species was not observed elsewhere.

61. Chondestes grammacus strigatus. Western Lark Finch.

The "Field Sparrow" was very common in the grain fields near Watsonville, San Juan, Tres Pinos and San Benito, June 23d to 27th. It was seen also at Armona, in the San Joaquin Valley, July 1st.

62. Zonotrichia leucophrys. White-crowned Sparrow.

The White-crowned Sparrow breeds commonly near Weishar Mill and extends its range up the east fork of the Kaweah to an altitude of about 10,500 feet. Here several were heard singing where more than half the ground was covered with snow, July 8th. A nest, found near the source of Owen's River, contained four young, apparently just hatched, July 21st.

63. Spizella socialis arizonæ. Western Chipping Sparrow.

Chipping Sparrows were quite common in San Benito Valley, June 26th to 29th.

64. Junco hyemalis thurberi. Thurber's Junco.

Thurber's Junco was everywhere throughout the timbered regions near Mineral King, July 7th, Shotgun Cañon, July 9th–11th, Kern River Lakes, July 13–14th, and Little Yosemite, July 23d. Near Weishar Mill a nest was found which contained three small, young, July 7th, while one near Kern River Lakes contained four nearly fresh eggs, July 14th.

65. Junco hyemalis pinosus. Point Pinos Junco.

This Junco, described from Monterey, was found breeding abundantly in the Coast Range from the vicinity of Saratoga to Boulder, June 21st. At Boulder it was even more common than at Monterey in May.

66. Amphispiza belli nevadensis. Sage Sparrow.

Several birds of this species were shot near Big Pine, Owen's Valley, July 18th.

67. Melospiza fasciata samuelis. Samuel's Song Sparrow.

This bird was common near Saratoga, June 21st.

68. Melospiza fasciata heermanni. Heermann's Song Sparrow.

A few were found at Lone Pine, July 17th.

69. Passerella iliaca megarhyncha. Thick-billed Sparrow.

The Thick-billed Sparrow was observed only between Shotgun Cañon and Trout Meadows, July 11th.

70. Pipilo maculatus oregonus. Oregon Towhee.

This species was constantly present in the Coast Range between Saratoga and Boulder. Many of the specimens approach *P. m. megalonyx.*

71. Pipilo fuscus crissalis. Californian Towhee.

The California Towhee was rarely out of sight between Saratoga and Santa Cruz, June 21st–22d. Several were seen near Watsonville, June 23d, Hollister, June 24th, San Benito, June 26th, and Erie, June 29th.

72. Habia melanocephala. Black-headed Grosbeak.

This Grosbeak enlivened the woods between Saratoga and Boulder, June 21st. It was again observed at Aptos, June 23d, and was abundant in San Benito Valley, June 25th–29th One was seen in Yosemite Valley, July 24th.

73. Guiraca cærulea eurhyncha. Western Blue Grosbeak.

The Western Blue Grosbeak was first observed near Lemoore in the San Joaquin Valley, July 1st. In Owen's Valley it was common near Independence, July 18th.

74. Passerina amœna. Lazuli Bunting.

The Lazuli Buntings were singing along the road between Saratoga and Boulder, June 21st. Several were observed near Watsonville, June 24th, between San Juan and Hollister, June 24th, and in San Benito Valley, June 26th–29th. In Owen's Valley the species was seen a number of times near Lone Pine, July 16th–17th. One was found in Yosemite Valley, July 24th.

75. Piranga ludoviciana. Western Tanager.

The Western Tanager was observed on the east fork of the Kaweah River from Cain's Flat to near Mineral King, July 6th–7th. It was common in Shotgun Cañon, July 9th–11th.

76. Petrochelidon lunifrons. Cliff Swallow.

Cliff Swallows were plentiful in the region around Soquel, Aptos, Watsonville, San Juan, Hollister, Tres Pinos, San Benito and Erie, June 23d–29th. A colony had about a hundred nests fastened to the side of a cliff near San Benito. Ten of these nests were examined June 26th. One held three fresh eggs, two each contained three adult birds, the others were empty.

In Owen's Valley this species was very abundant at Lone Pine, July 17th, at Independence, July 18th, at Big Pine, July 19th, and near Bishop, July 20th.

77. Chelidon erythrogaster. Barn Swallow.

The Barn Swallow was rare near Tres Pinos, June 26th. It was not again met until Owen's Valley was reached, where it was found associated with *P. lunifrons* at all points visited. Two young, which had just left the nest, were sitting on a rafter in a barn at Big Pine, July 18th. A nest near Bishop contained fresh eggs, July 19th.

78. Tachycineta thalassina. Violet-green Swallow.

Several Violet-green Swallows were flying with the swifts at Boulder, June 21st, and a few were seen in San Benito Valley, June 26th–28th.

79. Phainopepla nitens. Phainopepla.

A bird of this species was seen in the Valley of the Los Gatos Creek, June 30th. Several "White-winged Blackbirds" were observed on the east fork of the Kaweah, a short distance above Three Rivers, July 4th.

80. Lanius ludovicianus gambeli. California Shrike. (?)

A Shrike was seen at Watsonville, June 23d, and others at Hollister and Tres Pinos, June 24th. A number were in the lower part of San Benito Valley, June 26th–27th, and in the San Joaquin Valley near Huron and Armona, July 1st.

81. Vireo gilvus. Warbling Vireo.

The Warbling Vireo was encountered only in San Benito Valley, where it was not uncommon, June 27th–28th.

82. Helminthophila celata lutescens. Lutescent Warbler.

This warbler was singing everywhere in the Coast Range near Boulder, June 21st, but was not again observed until near Mineral King, where several were feeding at an altitude of 7,400 feet, July 7th.

83. Dendroica aestiva. Yellow Warbler.

Several Yellow Warblers were playing in the bushes near Saratoga, June 21st. One was noted at Watsonville, June 23d, and the species was well represented in the San Benito Valley, June 26th–28th.

84. Dendroica occidentalis. Hermit Warbler.

A single male of this species was seen among the willows at Mineral King, July 8th.

85. Clinclus mexicanus. Ousel.

Two Ousels were flirting on a raft of logs under a bridge in the town of Boulder, June 22d. One was observed near Mineral King, July 7th, standing upon a rock in the middle of the east fork of the Kaweah River, which at this point is a mass of foaming rapids. Soon it started up the stream but quickly dived under the water to reappear a few moments later some distance below its starting point. This performance was repeated several times. An adult and two full grown young were secured on the Little Kern River at the foot of Shotgun Cañon, July 10th.

86. Oroscoptes montanus. Sage Thrasher.

The only Sage Thrasher observed was hanging with its neck pierced by a barb of a wire fence in Round Valley, July 19th.

87. Mimus polyglottos. Mockingbird.

Mockingbirds were living in the gardens at Lemoore, July 1st. Several were heard near Visalia, July 3d.

88. Harporhynchus redivivus. California Thrasher.

The "Mountain Mockingbird" was numerous in the Coast Range between Saratoga and Boulder, June 21st. Several were observed in the foothills near Watsonville, June 23d.

89. Harporhynchus lecontei. LeConte's Thrasher.

One was noted between Independence and Big Pine, July 18th.

90. Thryothorus bewickii spilurus. Vigor's Wren.

This Wren was frequently heard in the Coast Range north of Boulder, June 21st.

91. Certhia familiaris occidentalis. California Creeper.

Two Creepers were busily examining the trunk of a redwood near Boulder, June 22d. Several were seen at Weishar Mill (altitude 6,720 feet), July 7th. One was shot at Kern River Lakes, July 14th.

92. Parus inornatus. Plain Tit.

This bird was seen only in the Coast Range north of Boulder, where it was generally distributed, June 21st.

93. Parus rufescens neglectus. California Chickadee.

Troops of Chickadees scolded as I rode through the Coast Range between Saratoga and Boulder. One was seen near Watsonville, June 23d.

94. Chamæa fasciata. Wren Tit.

This little bird was rarely silent in the chaparral of the Coast Range north of Boulder, June 21st. Others heard near Watsonville and San Benito were probably of this form.

95. Chamæa fasciata henshawi. Pallid Wren Tit.

Wren Tits, which were heard, but not obtained, at Cain's Flat on the east fork of the Kaweah, July 5th, were doubtless of this pale race.

96. Psaltriparus minimus californicus. California Bush Tit.

This Bush Tit was very abundant in the Coast Range near Boulder, June 21st, and also near San Benito, June 27th–28th. Several flocks were seen near the east fork of the Kaweah a few miles above Three Rivers, July 4th.

97. Regulus satrapa olivaceus. Western Golden-crowned Kinglet.

A Golden-crowned Kinglet flitted about in the pines near the trail between Shotgun Cañon and Trout Meadows, July 11th.

98. Turdus ustulatus. Russet-backed Thrush.

This species was in full song near Boulder, June 21st. Several were noted near Aptos, June 23d.

99. Merula migratoria propinqua. Western Robin.

Robins were first met among the pines along the east fork of the Kaweah, at an altitude of about 6,000 feet, July 6th. They were common in Shotgun Cañon and at Trout Meadows, July 10th–11th. Several were observed at Kern River Lakes, July 12th–14th.

100. Sialia mexicana occidentalis. Western Bluebird.

A few birds of this species were observed near Boulder, June 21st, one at Watsonville, June 23d, and others in San Benito Valley, June 26th–29th.

101. Sialia arctica. Mountain Bluebird.

Mountain Bluebirds were often seen in Shotgun Cañon, July 10th, but were not observed elsewhere.

REVISION OF THE NORTH AMERICAN SLUGS: BINNEYA, HEMPHILLIA, HESPERARION, PROPHYSAON AND ANADENULUS.

BY HENRY A. PILSBRY AND E. G. VANATTA.

In a former essay[1] we undertook a revision of the Arionid genera *Ariolimax* and *Aphallarion.* In the present paper the remaining American genera of *Arionidæ* are similarly treated.

Profiting by a criticism from one[2] whom all limacologists acknowledge as master, we have extended our anatomical observations to the pallial organs, muscle system, etc., with interesting and we believe important results.

The genera of Arionidæ, often scattered even by the great malacologists among Helicid or Limacid groups, now fall into orderly sequence; and in the flood of light disclosed by comparative study of the myology, the phylogeny and approximately final classification of the various groups is seen clearly outlined before us.

Trivial and unsatisfactory as are the external features of slugs, the details of their internal morphology are wonderfully varied. Everywhere there are important characters; and those who starve their souls on a mere study of the genitalia and oral armature miss the best part of the feast.

Believing with Cope that all the facts of morphology should be taken into account in systematic classification—that "system" is, in fact, an epitome of the total structure, as well as, with certain distortions, a phylogeny of organisms, we have freely used characters from all organs in which we found differentiation, in the construction of our scheme of family, subfamily and generic classification.

We must again gratefully acknowledge our indebtedness to various friends and correspondents for material received, and especially to Messrs. P. B. Randolph, J. G. Malone and Fred. L. Button. Slugs have also been received from J. G. Cooper, T. D. A. Cockerell, E. H. Ashmun, Wm. H. Dall, W. G. Binney and others; and the series in our collection from Henry Hemphill has also been of great service.

[1] Proc. Acad. Nat. Sci. Phila., 1896, pp. 339–350, pl. xii–xiv.

[2] Dr. H. Simroth, in Zoologisches Centralblatt, IV. No. 6, March, 1897.

Our observations may be grouped under four captions: I, Notes on the comparative anatomy of *Arionidæ*;[3] II, Classification; III, Descriptions of the genera and species, and IV, Brief directions for collecting and preparing slugs.

I. Anatomy of Arionidæ.

General external features.—Slugs of the family Arionidæ vary in external form from the typical *Limax* shape, to forms with a conspicuous dorsal hump. The mantle is generally oval, situated anteriorly on the body, and completely closed over the shell, but in the humped forms it is more posterior and larger, extending some distance in front of the shell, which is more or less exposed. The breathing pore is in its right side near the edge, connected therewith by a gutter. The mantle is adnate at the sides and behind, but free for some distance in front. The foot always has longitudinal "pedal furrows" above its lateral edges, defining a vertically grooved band or "foot margin." The pedal furrows meet at the tail, at which point there is often a "caudal gland," pit or slit developed. The surface sculpture of the integument of the foot is varied in the several genera and species. In *Ariolimax* there are close parallel grooves above, becoming oblique and more spaced at the sides, and with less conspicuous grooves at right angles to these, uniting them. In *Hemphillia*, *Binneya* and *Anadenus* there is a dorsal groove running back from the mantle, with oblique grooves branching from it on each side. In *Prophysaon* the surface is divided into a reticulation of long diamond shaped meshes by pigmented grooves, each mesh being further subdivided. One species, *P. cœruleum*, is an exception, having longitudinal grooves as in *Ariolimax* or *Arion*.

The sole is distinctly divided into three longitudinal tracts separated by grooves in *Anadenulus*. In some other genera (*Ariolimacinæ*) there is an indistinct tripartite division, while in others (*Prophysaon*, *Hemphillia*, etc.), this is not recognizable.

Shell.—The shell varies in form from a moderately well developed spiral (*Binneya*) or a convex plate (*Hemphillia*) exposed entirely or in part by an orifice in the mantle, to a nearly flat, wholly internal plate as in most of the other genera. In some forms of *Prophy-*

[3] The elementary character of a portion of this paper scarcely calls for apology in view of the fact that the study of slugs in America is still in an embryonic condition. While in Europe there are many expert observers, we have probably not more than four or five men in America who have given especial attention to them.

saon and *Arion* this plate is largely cuticular, the calcareous layer being represented only by scattered, angular, granules. In all cases the shell-cavity in the mantle is small, not much larger than the enclosed shell. This contrasts strongly with the allied family *Philomycidæ*, which has an enormously extended, empty shell sack.

General internal topography.—In most genera of completely limaciform external contour, the body from head to tail is excavated into one general body cavity (see these Proceedings for 1896, Pl. XIII, fig. 1), in which the digestive system lies extended, with the genitalia lying parallel with or across it, the liver or liver and ovotestis extending into the tail. In genera with a dorsal hump (*Binneya* and *Hemphillia*) that portion of the foot behind the posterior end of the hump is not excavated, but solid as in *Helix* and other spiral-shelled genera. The liver and ovotestis lie in the posterior portion of the cavity of the hump, into which the viscera are crowded upward and forward. Along the floor of the body cavity, extending from below the mouth a variable distance backward, lies the suboral gland (P. A. N. S., 1896, Pl. XIII, f. 1), which in some genera is deeply imbedded in the muscular tissue of the sole, in others lies lightly attached thereto.[4] In *Ariolimax* and its immediate allies the genital system including the ovotestis, is crowded forward into the anterior half of the animal's length; in *Prophysaon* and most other genera it lies stretched out at greater length, and the albumen gland and ovotestis are decidedly posterior. Other peculiarities in the arrangement of the organs are noticed below.

Alimentary tract.—The buccal body in *Arionidæ* is short, as in allied families of snails. The jaw varies from thin and flexible to strong, is of the ordinary arched form, and is always sculptured anteriorly. The usual sculpture consists of numerous flattened ribs denticulating the cutting margin; but in *Prophysaon fasciatum* the structure is rather a series of narrow, hardly overlapping or imbricating plaits, much as in some species of the genus *Flammulina* of the *Endodontidæ*. In *P. humile* the plaits seem quite lost in a general, close, vertical striation, as in *Pyramidula*, also a genus of *Endodontidæ*.

The radula resembles that of the *Endodontidæ*. The central teeth are tricuspid, ectocones small. Lateral teeth bicuspid, passing

[4] This gland, the function of which is to secrete mucus to lubricate the sole in crawling, was erroneously interpreted as a buccal retractor muscle by Binney, Man. Amer. Land Shells, p. 98, second paragraph from top.

gradually into the marginal series by shortening of the basal-plates. Marginals bicuspid, with occasionally a tooth with the ectocone bifid. In the *Ariolimacinæ* the inner cusps of the outer lateral and inner marginal teeth are much lengthened and oblique, the ectocones much reduced, simulating the pseudo-zonitoid teeth of *Flammulina. Arion* also shows this tendency to a much less degree. In the other genera the cusps of these teeth are short or of moderate length.

All Arionidæ have four longitudinal folds of the intestine,[5] as usual in slugs generally; the main divergence being in the comparative length of the folds and the degree of their torsion. The folds are designated by the initial G with exponents 1, 2, 3, 4, as in Pl. XI, fig. 29. The anterior loop between G^2 and G^3 is caught up by the cephalic artery immediately upon its emergence from the diaphragm (Pl. XIV, figs. 66, 70, 72). In *Arion* the posterior loop between G^1 and G^2, forming the lower end of the stomach, lies posterior to all other intestine folds;[6] but in all the other American genera the loop formed by G^3 and G^4 lies behind the stomach.

In *Ariolimax*, *Aphallarion* and *Hesperarion* (Pl. XI, fig. 33) the gut is long and spirally wound. In *Prophysaon* (Pl. XI, figs. 28–30, 32, 34), *Anadenulus* (fig. 35), *Hemphillia* (fig. 36) and *Binneya* (fig. 31) it is much less twisted spirally. In the latter two genera the posterior loop formed by G^3 and G^4 is very short, on account of the crowding forward of the viscera into the dorsal hump.

In *Prophysaon*, *Anadenulus*, *Hemphillia* and *Binneya* there is no differentiation of the first fold into crop and stomach, such as occurs in *Ariolimax*, etc.

Reproductive organs.—In the *Arionidæ* there are two main types of genital organs. In the more primitive and normal type there is a well developed penis provided with a retractor muscle, and in every way homologous with the same organ in the Helices and pulmonate snails generally. This may be seen in *Ariolimax*, *Hesperarion* (Pl. XII, figs. 44, 47), *Binneya*, *Hemphillia*, and the Himalayan genus *Anadenus*. In the slugs, as well as in many other snails, the terminal portion of the vas deferens is noticeably enlarged, often considerably swollen for a distance above its insertion in the penis (see Pl. XII, fig. 49, *epi.*, *Hemphillia*; and these Proceedings, 1896, Pl. XIV, fig. 14, *epi.*, *Ariolimax*). This enlarged tract has

[5] In *Aphallarion* there is a short loop interposed between the second and third long folds, making six folds. See P. A. N. S., 1896, pl. 13, f. 4.

[6] P. A. N. S., 1896, Pl. 13, f. 3.

been called the "epiphallus." In the other type, to which *Arion*, *Geomalacus*, *Prophysaon* and *Aphallarion* belong, the penis has been lost through degeneration, and the vas deferens enters the atrium directly, its lower course being enlarged or modified in various ways (Pl. XIII, all figs.) as described above, into an epiphallus.[7] The epiphallus is not evertible, has no retractor, and does not have the function of a penis. In it the sperm is lodged in packets or "spermatophores." These, in *Hesperarion* and *Prophysaon*, are oblong, narrow capsules of chitinous texture, with a long, slender filament at one end (Pl. XII, fig. 43). They may occasionally be found in the spermatheca (Pl. XII, fig. 48, where the outlines of several are faintly visible through the wall). In genera with this type of genitalia the vagina and lower portion of the free oviduct are introvertible, and assume the function of the penis, being provided with a retractor or retractors; and in some genera, such as *Arion*, the spermatheca duct also has a retractor muscle. In forms having the spermatheca duct inserted directly upon the atrium, there is, of course, no vagina, and the free lower portion of oviduct alone acts as penis.[8] The peculiar enlargement of the epiphallus in *Prophy-*

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[7] The term epiphallus was originally proposed some years ago by the senior author of this paper for the structure as commonly found in such *Helicidæ* as the West Indian *Caracolus* and *Pleurodonte* species, and in most of the larger East Indian and Australian forms, in which it occurs associated with a well-developed penis, as in *Hesperarion*, etc. It is strictly synonymous with Simroth's term "*Patronenstrecke*." Mr. Collinge (Proc. Zool Soc. Lond., 1897, p. 447) proposes to substitute "sperm-duct" for what we term epiphallus, and restrict the latter name to "the terminal portion of the vas deferens above the sperm-duct." There is, of course, no objection to the substitution of an English name for the Greek compound, but since the term epiphallus has already been used in extensive and numerous works in America, England and Germany, it seems a little revolutionary to completely alter its significance. If Mr. Collinge wants a term for the vas deferens above the epiphallus, he had better, to avoid confusion, invent a new one; though what he wants it for is not quite apparent

[8] *Arion* is a case in point, *cf.* Collinge, Proc. Zool. Soc. Lond., 1897, p. 447. *Geomalacus* also is similar. In *Prophysaon* and *Aphallarion* however, it is the vagina proper which performs both its usual function and that of an evertible penis. We consider Mr. Collinge's statement (*l. c.*) that "Messrs. Pilsbry and Vanatta have suggested the term * * * vagina for what I term free-oviduct" as an inadequate representation of our position, due, no doubt to our inadvertent enumeration of *Arion* as one of the genera in which the vagina functions as a penis We use the term "vagina" for the passage below the union of the spermatheca duct with the free oviduct proper (see Pl. XIII, fig. 57, *vag.*), considering such usage justified by its functions. The term "free oviduct" will naturally be retained for the passage from the apex of the vagina (when present) to the point of approximation of the vas deferens. Morphologically, the vagina may be regarded as an elongated portion of the atrium.

saon is not hollow like a penis, but has a small duct only, the walls being solid and muscular.

The remaining organs do not differ from their usual structure in Aulacopod pulmonates, although the position of the ovotestis is varied in the several genera.

Muscles.—Only the muscles lying free in the body cavity, not those composing the external walls or sole, will be considered herein, the latter being morphologically similar in *Arionidæ* to the other land snails.

The free muscles belong to two groups: (1) retractors of the buccal mass, eye-peduncles and tentacles, and (2) retractors of the generative organs.

The buccal and tentacle retractors, with the foot retractor or retractors in ordinary spiral-shelled snails converge and are attached posteriorly or proximally to the columella of the shell. In Limacid or Arionid slugs the degenerate shell no longer serves as a support for these muscles, which are inserted at or near the posterior margin of the diaphragm, or floor of the lung; this position approximating pretty closely to the posterior or former columellar margin of the vestigial shell. In the more primitive genera, *Binneya, Hemphillia, Ariolimax*, etc., the retractors still converge to a point near the middle of the back margin of the lung, under the posterior edge of the shell (Pl. XIV, figs. 65, 66, 67, 69, 71). In the more divergent genera *Arion* (Pl. XIV, fig. 72) and *Prophysaon* (Pl. XIV, fig. 70), the eye and tentacle retractors have moved from the middle to the outer posterior angles of the diaphragm. The convergent retractors of *Ariolimax* and its allies are a heritage from the spiral-shelled ancestors of the family, although the utility of the convergence is no longer present; while the parallel retractors of *Arion*, etc., are a later modification which resulted in a straight backward pull of each retractor, independent of the others, and possibly brought about mechanically by the tendency toward separation of the grouped proximal insertions by strains on the converging muscles from their separated distal terminations. Another muscle more or less closely associated with the buccal and tentacle retractor system, is found in *Ariolimax, Hemphillia* and allied genera (Pl. XIV, figs. 65, 66, 69). This is a band passing from near the proximal insertions of buccal and eye retractors forward across the diaphragm to an insertion in the top or right side of the head. It has been termed the "retensor" by Simroth, who observed it in *Ariolimax Californicus*, and supposed it to be an aid to the extension of the penis. We scarcely endorse this view of its function, after observing it in several other genera in which it is not inserted near the atrium, but in the integument of the head or back above. It may aid in withdrawing the head beneath the mantle. Morphologically this muscle is regarded by Simroth as a slip detached from the body-wall. In this, again, we are compelled to dissent. We regard it as a *retractor pedis*, the anterior insertion of which has moved from the sole to the side or upper integument. Pending further investigation into its physiologic function and morphologic equivalency, we continue to use Simroth's name "retensor" for this muscle.

The retractors of the genitalia are far less constant in form, number and position than those of the buccal mass and eyes. Their proximal insertions here, as in the spiral snails, are on the diaphragm or lung floor. The chief muscles of this system are the penis retractor (Pl. XIV, figs. 66, 71 *r. p.*), which is almost invariably inserted on the left side of the diaphragm, and the oviduct retractors (Pl. XIV, fig. 67, *vag. r.*), which may be inserted either upon the diaphragm or at its posterior border. The latter are well developed only in those genera in which the oviduct or vagina has assumed the function of a penis. In *Arion* and *Geomalacus* the spermatheca duct also has a retractor. The several retractors of the female organs are quite inconstant in position and number (being often increased by splitting). They are not homologous with the penis retractor, but have been developed *de novo* in the genera requiring them.

Another muscle deserving mention is a short band uniting the swollen epiphallus to its peduncle, in the genus *Prophysaon* (Pl. XIII, fig. 57, *musc.*). This muscle so conceals the true structure of base of the epiphallus that no former authors with the exception of Simroth, have correctly described or represented it.

Pallial region.—Underlying[9] the retractor muscle system is seen a thin but dense membrane perforated only by the aorta and the rectum. This is the "diaphragm" separating the body cavity from that of the lung (indicated in outline in the figures on Pl. XV). Removing the diaphragm, the inner surface of the lung is exposed, densely reticulated with blood vessels (Pl. XV, fig. 73). The breathing pore or pulmonary aperture (Pl. XV, fig. 77, *p. a.*) is situated at

[9] The slug being pinned back downward in the dissecting pan. In the natural position of the animal it overlies the muscles.

the middle of the right margin of the lung cavity in some genera (*Ariolimax*, *Aphallarion*, *Hesperarion*), at the right anterior angle in others (*Arion*, *Prophysaon*). The rectum lies along the right side, posteriorly, and opens at the breathing pore (Pl. XV, figs. 73, etc., *r*). Lying in the lung cavity, and often almost filling it, is the kidney (Pl. XV, figs. 76, 77, 80, etc., *k*). It is rounded or squarish in shape, thick, and attached by its upper side[10] to the roof of the lung cavity around the heart and toward its posterior side. The kidney appears variously striated or shows branching ducts (as in Pl. XV, fig. 74). Its secretion is voided through a slender duct the (secondary ureter, Pl. XV, *u. r*) emerging posteriorly toward the right side, running parallel to the rectum, and opening near the edge of the breathing pore. The characters of the ureter are insufficiently shown in the figures. Behind the middle of the kidney there is an excavation perforating it, occupied by the heart (Pl. XV, *a. v.*). In some genera both chambers of the heart are exposed below; in others only the ventricle. Only in *Aphallarion* are both auricle and ventricle concealed by a thin outer layer of the kidney. We have occasionally observed a portion of the kidney protruded tongue-like from the breathing pore in drowned specimens of large species. The morphology of these organs is not greatly varied among the genera of Arionidæ, and need not be farther considered here. In defining the *families* of Pulmonata, these organs give characters of great value.

II. CLASSIFICATION.

The generic characters of slugs in general, and of Arionidæ in particular, as given in the standard manuals and faunal monographs, are of the most superficial character. With a single conspicuous, exception,[11] we do not know of any writer who has given evidence of much insight into or comprehension of the meaning of the varied internal structure of slugs, or who has even suggested a phylogenetic arrangement ot the genera of Arionidæ.

The complete classification of this and related families cannot be presented here without unduly extending the limits of this paper by including information upon the Old World genera; but so far as the Arionidæ are concerned, the essential outlines may be gathered

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[10] Or, as the preparation lies, its lower side.

[11] Need we mention the brilliant author of Die Nachtschnecken der Portugesisch-Azorischen Fauna?

from the table below, as all of the subfamilies are represented by American genera.

Analytical key to subfamilies and genera.

I. Retractor muscles of pharynx and tentacles converging backward, their posterior insertions contiguous, inserted at the posterior edge of the diaphragm.

a. Tail solid, the viscera crowded forward and elevated into a dorsal hump or visceral dome; shell partly or wholly exposed; penis present, with retractor muscle; ovo-testis posterior in the body-cavity; intestine short and simply folded; an accessory "retensor" muscle developed.

Subfamily BINNEYINÆ.

b. Shell exposed, spiral, *Vitrina*-shaped, with differentiated, lirate or costulate nepionic whorl; mantle with small lobes on each side of the breathing orifice; sole distinctly tripartite; genitalia with accessory organs, the penis retractor inserted on the diaphragm; retensor muscle short, slender, toward the right side; buccal retractor shortly bifurcate anteriorly.

BINNEYA.

b′. Shell partially exposed, a flat or convex, non-spiral plate; no lobes on the large mantle; sole not in the least tripartite; genitalia without accessory organs, the penis retractor muscle inserted on the "retensor," which is strong, wide, and to the left of the buccal retractor, the latter not bifurcate anteriorly,

HEMPHILLIA.

a′. True slugs, the foot excavated throughout, the body-cavity (and viscera) extending to the tail; shell small, flat, not spiral, wholly buried; ovo-testis anterior to the posterior loop of intestine; intestine long, spirally twisted; inner cusps of outer lateral and inner marginal teeth much lengthened; pharynx retractor deeply bifurcate anteriorly.

Subfamily ARIOLIMACINÆ.

b. A well-developed "retensor" muscle present; genitalia with no appendicula, the ovo-testis anterior in position; tail with a "plug" in the caudal pore. Large slugs.

c. No penis nor penis retractor muscle, the vagina assuming its function; a small epiphallus; right eye retractor not passing between male and female branches of genitalia, APHALLARION.

c'. Penis large, introverted apically, with well-developed retractor muscle; right eye retractor involved between male and female branches of genitalia, ARIOLIMAX.

b'. No retensor muscle; an appendicula on the atrium; penis simple, with apical papilla and a well-developed retractor muscle; caudal pore an open pit; foot-margin wide. Slugs of moderate size, HESPERARION.

II. Retractor muscles of pharynx and tentacles running parallel, the latter inserted proximally at the outer posterior angles of the diaphragm; (in American genera the penis and its retractor muscle wanting, the free oviduct or the vagina assuming its function); epiphallus variously modified. True slugs, with completely buried shell plate or vestige, and visceral cavity extending into the tail.

Subfamily ARIONINÆ.

a. Retractor muscle of the pharynx inserted proximally decidedly behind the posterior edge of the diaphragm; intestine long and strongly twisted spirally, the stomach, or posterior loop formed by G^1 and G^2, lying behind the loop formed by G^3 and G^4; kidney ring-like, exposing both chambers of the heart from below.

b. Epiphallus slender, tapering distally, not abruptly bent or constricted near the atrium; spermatheca duct inserted upon the atrium; free oviduct functional as a penis; ovo-testis extending behind the intestine; external integument longitudinally rugose; sole more or less visibly tripartite; a mucous gland at the tail; breathing pore decidedly anterior to middle of mantle, the genital orifice below it, ARION.

a'. Retractor of the pharynx inserted at the posterior edge of the diaphragm; intestine shorter, not much twisted spirally, the stomach, or posterior loop formed by G^1 and G^2, lying far anterior to the posterior loop formed by G^3 and G^4; external genital orifice anterior, near right tentacle.

b. Sole not in the least tripartite; posterior portion of the tail peculiarly modified and capable of self-amputation; kidney with a large excavation exposing both chambers of the heart; epiphallus more or less swollen, suddenly constricted and bent near its insertion in the atrium, with which it communicates by a short pedicel which is bound to the swollen portion of epiphallus by a muscular band; vagina functional as a penis; ovo-testis lying in front of the posterior loop of the gut, PROPHYSAON.

b'. Sole tripartite, the narrow median field defined by longitudinal grooves; tail normal; kidney covering the auricle (seen from below); genitalia unknown, ANADENULUS.

III. DESCRIPTIONS OF GENERA AND SPECIES.

Genus **BINNEYA** J. G. Cooper, 1863.

Binneya Cooper, Proc. Cal. Acad. Sci., III, p. 62.

Xanthonyx Crosse & Fischer, Journ. de Conchyl., XV, 1867, p. 223; Moll. Terr. et Fluv. Mex., I, p. 192. Strebel & Pfeffer, Beitrag zur Kenntniss der Fauna Mexikanischer Land- und Süsswasser Conchylien, Theil IV, p. 26 (1880).

Somewhat slug-like, with elevated, subspiral visceral hump and external shell, subcentral on the back; mantle broadly produced beyond the shell, not reflexed over it at edges; breathing pore submedian or behind middle of right margin of mantle, a small rounded left and somewhat larger right cervical mantle lobe on each side of it; genital orifice behind the right tentacle; foot radially grooved and reticulate above, the foot-margin narrow; pedal grooves deep, without a tail pore; sole tripartite, the areas separated by longitudinal grooves; shell Vitrina-shaped, with the first (nepionic) whorl distinctly demarked from the following, and strongly sculptured.

Viscera elevated into the dorsal hump, the body cavity not extending back of it into the tail, which is solid.

Jaw arcuate, with numerous ribs denticulating the basal margin.

Radula with 28–1–28 to 31–1–31 teeth (in *B. notabilis*), 32–1–32 (in *B. cordovanus*), the rachidian teeth tricuspid, laterals bicuspid, the ectocones small; marginal teeth bicuspid, the inner cusps moderately long, sometimes bifid.

Intestinal tract (Pl. XI, fig. 31) short; anterior loop formed by G^2 and G^3 somewhat twisted, posterior loop of G^3 and G^4 straight and very short. Liver occupying posterior portion of dorsal hump and spire of shell.

Genital system with well-developed penis continued beyond insertion of retractor in a short epiphallus. Spermatheca with a long duct or one of quite moderate length; an appendicula near the base of vagina or penis, and, according to Pfeffer, two long-stalked, globose, netted vaginal accessory appendages.

Muscle system (Pl. XIV, fig. 65) Ariolimacine. Buccal and eye retractors converging posteriorly, contiguous at their proximal insertions. A "retensor" arises from the roof of visceral cavity slightly anterior to proximal insertion of retractors, and extends anteriorly to the right side near the lower edge of mantle, where it is inserted in the integument. Penis retractor inserted in the left posterior region of the visceral dome.

Distribution, Santa Barbara Island, off California, Guadalupe Island, off Lower California (*B. notabilis*), and States of Vera Cruz and Chiapas, Mexico (*B. Salleana, Cordovana, Sumichrasti, Chiapensis*).

The chief differences between *Binneya* and *Xanthonyx* seem to be that in *Binneya* the nepionic shell is spirally lirate, in *Xanthonyx* radially plicate; in *Xanthonyx* there is a small caudal horn, in *Binneya* none; and there are certain discrepancies in the details of genitalia as described by Binney, Crosse and Fischer, and Strebel and Pfeffer. These may, perhaps, be in part merely specific variations, and in part errors of observation. On account of the sexually immature condition of our specimens we unfortunately cannot verify the published accounts. The description of the anatomy of *Xanthonyx Salleanus* given by Strebel and Pfeffer seems to be worthy of confidence.

Binneya agrees with *Hemphillia* in the solid tail, the viscera being crowded forward into the dorsal hump; in the exposed shell, short and simple gut; the general arrangement of muscles, especially the possession of a "retensor"; in the well developed penis, and general system of external reticulation. It differs from *Hemphillia* mainly in the better developed spiral shell, the differently placed retensor muscle and penis retractor, the presence of an appendicula, and the distinctly tripartite sole. That the two genera are closely allied is so obvious as to justify the supposition that *Hemphillia* descended from a slug very similar to the existing *Binneya*.

Cryptostrakon W. G. B. is probably allied to *Binneya*, but the muscles, genitalia and alimentary canal are unknown, and the types though in alcohol, have been dried.

B. notabilis J. G. Cooper. Pl. XIV, figs. 63, 64, 65; Pl. XVI, figs. 87, 88.

Binneya notabilis J. G. Coop., Proc. Cal. Acad. Sci., III, p. 62, figs. 15, in text. Tryon, Amer. Journ. Conch., II, p. 244, pl. 3, f. 4 (copied from Cooper). W. G. Binney, Land and Fresh-water Shells of N. A., I, p. 68, f. 112. Terr. Moll., V, p. 245, f. 141–143; pl. V, f. K (teeth), pl. xi, f. B (genitalia). Man. Amer. Land Shells, p. 108, f. 71–74. Fourth Supplement to Terr. Moll. V, p. 184, pl. 1, f. 9 (shell).

Alcoholic specimens measure about 10 mm. long to double that length; color buff-gray with rather large black dots mainly scattered along the radial grooves of the foot and in a line above the pedal grooves, the mantle maculated with black. Surface with rather coarse radial grooves and sparse reticulation; a fine groove median on tail above, not extending to the end; foot margin narrow, closely and evenly crenate; sole unicolored grayish, rugose and distinctly tripartite.

Jaw (Pl. XVI, fig. 87) and dentition (Pl. XVI, fig. 88) described above.

Digestive and muscular anatomy described above. Our specimens were sexually immature, so that the description of genitalia is taken from Binney, Crosse, Fischer, Strebel and Pfeffer.

Distribution: Santa Barbara Island, off California; Guadalupe Island, off Lower California.

Genus HEMPHILLIA Bland & Binney, 1872.

Hemphillia Bland & Binney, Ann. Lyc. N. H. of N. Y., X, p. 208 (1872), type *H. glandulosa* B. & B.

Slug-like, with the mantle conspicuously elevated (in alcoholic specimens) into a nonspiral visceral hump; the shell a slightly convex, non-spiral plate partially exposed, its edges buried in the mantle, which is very broadly produced beyond the shell on all sides. Breathing pore behind the middle of right margin of mantle. Genital orifice behind the right tentacle. Foot radially grooved and reticulate above, the foot margin wide, conspicuous; pedal furrows deep, meeting in a mucous pore at the tail, or without tail gland. Sole not in the least tripartite.

Viscera elevated into the dorsal hump, the body-cavity not extending back of it into the tail, which is solid.

Jaw low, wide, with about 14 low wide ribs with shallow intervals.

Radula with tricuspid central, bicuspid lateral and marginal teeth, the inner cusp (mesocone) of the latter long.

Intestinal tract short, crowded forward, but little twisted; G^4 angularly bent, forming a sort of fifth fold (Pl. XI, fig. 36).

Genital system with well developed penis containing penis-papilla, the retractor terminal; passing into an epiphallus. Spermatheca on a short duct, inserted in atrium; ovotestis at posterior end of visceral cavity, immediately under hind end of shell.

Muscle system Ariolimacine, the eye and buccal retractors converging posteriorly, contiguous at their proximal insertions; buccal retractor spreading where it enters buccal mass, not bifurcate. A broad "retensor" muscle arises at the posterior margin of diaphragm just left of the retractor insertions, and runs forward as far as the front insertion of the mantle (Pl. XIV, fig. 69, *ret.*). Penis retractor inserted proximally on the ventral face of the retensor. Right eye retractor passing between male and female branches of the genitalia.

Lung radially striate rather than reticulate. Kidney a broad squarish leaf, free for the greater part, adnate dorsally around the heart, (Pl. XV, fig. 78).

Distribution: Oregon, Washington and western Idaho.

Hemphillia shares with all *Ariolimacinæ* the primitive arrangement of the retractor system. Like all of this subfamily except *Hesperarion* it possesses that anomalous muscle called by Simroth the "retensor," which we hold to be a modified *retractor pedis*.

Apart from these important characteristics of the musculature, there are profound differences from *Ariolimax* and its allies: the viscera are crowded forward and upward into a visceral hump under the mantle, behind which the foot is solid, as in the spiral-shelled snails; the shell is comparatively large and imbedded only at the edges in the mantle, which exposes a considerable part of it; and the intestinal tract, while fundamentally of the same type, is considerably shortened and simplified.

In all of these departures from the normal slug structure, *Hemphillia* is akin to *Binneya;* but it is a more advanced evolution-product, in that it has lost the spiral torsion of the visceral mass and shell, still retained by *Binneya* as a reminiscence of long past ancestors.

Among the secondary characters separating *Hemphillia* from *Binneya* may be mentioned the tripartite sole, narrow foot margin, and small mantle lobes of *Binneya*, the other genus having no division of the sole, no mantle lobes and a wide foot margin. Internally, *Binneya* has an appendicula, the penis retractor is inserted on the lung floor, and the retensor muscle is weak, while in *Hemphillia* there is no appendicula and the penis retractor is inserted on the surface of the very broad and strong retensor. The digestive tract is considerably alike in the two genera.

Key to species of Hemphillia.

a. Mantle papillose; tail acutely keeled above, terminating in a fleshy horn which overhangs the caudal pore; pedal furrows scarcely rising at their union behind. Penis with a bifid internal process inserted at the apex of the cavity; spermatheca globular, on a comparatively slender duct; penis retractor muscle inserted upon the epiphallus, ... *H. glandulosa.*

a'. Mantle slightly rugose, not papillose; no horn at tail, pedal grooves abruptly rising behind, meeting over the tail. Penis with a simple fleshy process inserted at the base of the cavity; spermatheca small with a very stout duct; penis retractor muscle apical on penis, ... *H. camelus.*

H. glandulosa Bland & Binney. Pl. IX, figs. 1, 2; Pl. XII, figs. 49, 50.

Hemphillia glandulosa Bland & Binney, Ann. Lyc. Nat. Hist. of N. Y., X, p. 209, pl. ix, f. 1, 3 (exterior), 5 (shell), 15–17 (teeth). Terr. Moll., V, p. 248, f. 144–146, pl. v, f. J (teeth), pl. xii, f. J, K (genitalia)?. Man Amer. Land Shells, p. 111, f. 75–77 (78?). Supplement to T. M., V, pl. iii, f. H (?). Third Supplement, p. 211, pl. iv, f. D. Pilsbry & Vanatta, Nautilus XI, p. 44.

Color in alcohol blackish above, or yellowish with black spots; the edge of mantle, sides of foot below mantle, foot-margin and sole yellowish; shell yellow. Mantle extension densely papillose in front of the shell and at sides. Breathing pore median on the right side. Genital orifice near right tentacle, a groove running from it toward the breathing pore. Foot obliquely grooved and rather coarsely reticulated, pinched up into a high, acute keel posteriorly, this keel declining and terminating in a prominent horn-like process at the end. Foot-margin rather wide, vertically grooved as usual. Pedal furrows scarcely rising at the tail, meeting in a caudal pore immediately below the "horn." Sole transversely wrinkled, the wrinkles bent backward mesially, as in *Prophysaon*. Length 10 to 13 mm.

Shell convex, with yellow cuticle, thin calcareous layer and posterior nucleus.

Genitalia (Pl. XII, figs. 49, 50) with the penis enormously swollen, its lumen filled by a bifid, fleshy, imperforate, corrugated body attached to one side above; epiphallus moderately stout, longer than the penis, bearing the retractor muscle near its base. Spermatheca globular, large, borne on a duct of its own length, inserted upon the atrium.

Type locality, Astoria, Oregon (Hemphill); also in Washington at Chehalis; and according to Binney, Olympia and Gray's Harbor.

Part of several of the references given above apply to *H. camelus*, Mr. Binney having included that species in *glandulosa*. The latter is herein restricted to slugs with papillose mantle and caudal horn, as originally indicated by Bland and Binney.

Besides the conpsicuous external differences noticed under *H. camelus*, the two species differ markedly in the genitalia. In *H. glandulosa* the fleshy process in the penis is bifid and attached to the side at the apex of the cavity. In *H. camelus* the process is simple and attached basally. The position of the penis-retractor and the shape of the spermatheca and its duct differ in the two forms.

H. camelus Pilsbry & Vanatta. Pl. IX, figs. 3, 4; Pl. XII, figs. 41, 42; Pl. XVI, fig. 85.

Hemphillia camelus Pilsbry & Vanatta, Nautilus, XI, p. 44 (August, 1897).

Color in alcohol pale grayish-buff, closely speckled and maculated with blackish on the mantle and tail, more sparsely and lightly so on the anterior half of the foot, the sole without dark markings. On the mantle the spots form two more or less distinct longitudinal bands. Surface of the mantle somewhat rugose, not papillate; breathing pore behind the middle. Genital opening near right tentacle. Foot with a short dorsal groove behind mantle, obliquely descending grooves with sparse reticulation on the sides of tail, and coarse reticulation below mantle laterally; the head longitudinally closely grooved and reticulate; sole as in *H. glandulosa;* tail somewhat keeled above near the end, without any appearance of a caudal "horn." Foot-margin wide, grooved vertically; pedal furrows abruptly and conspicuously rising at the tail, with no noticeable caudal pore at their union, at least in alcoholic examples, but in one specimen there seems to be a transverse slit under the pedal groove, with a vertical gutter below it, T-shaped. In another, nothing of this appears. Length about 28 mm.

Genitalia (Pl. XII, fig. 41, 42) with a very large penis, its cavity filled by a large, transversely corrugated, solid, fleshy body attached at the base of the penis, and a small tongue-like body arising close to the entrance of the epiphallus (fig. 42). The latter is longer than in *H. glandulosa*, and the retractor muscle is inserted at its root. Spermatheca small, its duct very stout, inserted upon the atrium.

Shell slightly convex, long-oval, with clear yellow cuticle, thin calcareous layer, and posterior nucleus; the surface lightly marked with growth lines. Length 8, width 5 mm.

Jaw low, wide, with about 14 low, broad ribs separated by narrow intervals. Radula: Marginals with rather long inner cusps (Pl. XVI, fig. 85).

Old Mission, Idaho (Henry Hemphill).

This species has a proportionally smaller shell than *H. glandulosa*, a longer, less compressed and less carinated tail, with no trace of a caudal horn and no perceptible caudal gland; the mantle is not papillose, the pedal furrows rise abruptly at the tail, uniting over it, and the genitalia differ in important respects, as noticed under the description of *H. glandulosa*.

Genus **ARIOLIMAX** Morch, 1860.

Ariolimax Mörch, Malak. Blätter, VI, p. 110. Pilsbry & Vanatta, Proc. Acad. N. S. Phila., 1896, p. 342.

To the generic characters described and implied in our former paper, the following may be added:

Tail gland (Pl. XV, fig. 81) a peculiar triangular mass of tissue, in alcoholic specimens deeply fissured transversely.

Muscle system (Pl. XIV, fig. 66, *A. columbianus*) having the buccal and eye retractors converging posteriorly, their proximal insertions contiguous at the posterior edge of the diaphragm. Buccal retractor very deeply bifurcate. An accessory muscle, the "retensor," arises with the retractor group, to the left of the median line, and passing forward is inserted in the integument of the neck, on the right side or above.

Lung (Pl. XV, fig. 73, *A. columbianus*, the kidney removed) and kidney (Pl. XV, fig. 74, *A. columbianus*) as usual in *Arionidæ*. Auricle concealed by kidney, ventricle (fig. 73, 74, *v*) exposed.

Subsequent studies support the conclusion reached in our former paper, that *Ariolimax* is more closely allied to *Aphallarion* than to any other known genus.

Genus **APHALLARION** Pilsbry & Vanatta, 1896.

Aphallarion P. & V., Proc. Acad. N. S. Phila., 1896, p. 348.

Tail pore as in *Ariolimax*.

Muscle system (Pl. XIV, fig. 67) substantially like *Ariolimax* in arrangement of the buccal and eye retractors, except that the right eye retractor is not involved between the ♂ and ♀ branches of genitalia; "retensor" inserted nearer the median line anteriorly. Penis retractor wanting, but several vaginal retractors (fig. 67, *vag. r.*) arise from the diaphragm.

Pallial region as in *Ariolimax*, except that the kidney is larger, and both auricle and ventricle are concealed therein (Pl. XV, fig. 76).

Aphallarion is intimately related to *Ariolimax*, from which it differs in the absence of a penis and its retractor, in having the right eye retractor free from and to the left of the genitalia, and in having both chambers of the heart embedded in the kidney. No other genus is nearly allied.

To our former account it may be added that Mr. Wetherby informs us that his *Ariolimax Hecoxi* from Santa Cruz is specifically the same as our *A. Buttoni*. As he remembers the genital system, it corresponded with that of our species. Since *A. Hecoxi* was not described, this will in no way affect nomenclature, but is of interest as removing a doubtful species from slug literature, and extending the geographic range of *Aphallarion*.

Genus **HESPERARION** Simroth, 1891.

Hesperarion Simroth, Malak. Blätter (n. F.) XI, Heft 2, p. 109. Type *Ariolimax niger* Coop.

Slugs with the usual small, anterior, shield-like mantle, completely buried, non-spiral shell plate, and long body-cavity excavated to end of tail. Breathing pore somewhat behind middle of right mantle edge. Genital orifice distant from tentacle, below the anterior margin of mantle. Foot with longitudinal grooves, becoming oblique on the sides, the foot margin moderate, pedal furrows deep, meeting in a very conspicuous, subtriangular, posteriorly guttered tail pit. Sole rather indistinctly tripartite, the areas not defined by longitudinal grooves. Jaw with coarse ribs.

Radula with the usual tricuspid central and bicuspid lateral teeth, ectocones small; marginals with very long, oblique cusps, the ectocone minute or vestigial.

Intestinal tract (Pl. XI, fig. 33) much as in *Ariolimax*. G^1 indistinctly divided into crop and stomach, making a half revolution; G^2 describing a complete revolution in the opposite direction, G^3 another, reversed, and G^4 still another revolution parallel to G^2. Posterior loop formed by G^3 and G^4 lying behind that formed by G^1 and G^2, as in *Ariolimacinæ* generally.

Genital system (Pl. XII, figs. 44–48) having a well developed penis with terminal retractor and epiphallus, lumen with plicate walls (fig. 45), and a large apical penis papilla (figs. 45, 46). Atrium bearing a vermiform appendicula with swollen base (fig. 44 *ap*; fig. 47, *ap*). Spermatheca borne on a short, basally swollen duct. Spermatophores (fig. 43, x 1½) chitinous, elongate, with flagellum-like extension at one end. Ovotestis separated from albumen gland, lying on the right side under G^3, to the right of posterior end of stomach (Pl. XI, fig. 33, *ot.*).

Muscle system (Pl. XIV, fig. 71) Ariolimacine in having the retractors converging posteriorly, their proximal insertions contiguous; buccal retractor deeply bifurcate. No "retensor." Penis retractor short, broad, inserted in the left anterior portion of the lung floor or diaphragm (fig. 71, *r. p.*).

Lung as usual; kidney very large (Pl. XV, fig. 77, *k*). Only the ventricle exposed.

Distribution: Middle portion of California, in the counties lying near and below San Francisco Bay, west of the Sierra Nevada.

Externally *Hesperarion* is like *Ariolimax* and *Aphallarion* except in the structure of the caudal pore, which is a deep, open pit in this genus, while in the others it is filled by a mass of spongy tissue. The jaw, teeth, intestine, pallial region and musculature of the three genera are practically identical in their main features, except that *Hesperarion* totally lacks a "retensor" muscle.

In the genitalia are found further important differences. The ovotestis is not packed adjacent to the albumen gland anteriorly, as in *Ariolimax* and *Aphallarion*, but is carried back to a more posterior position among the hind loops of the intestine, and surrounded by the liver (Pl. XI, fig. 33, *ot.*). The penis, externally similiar to that of *Ariolimax*, is of the usual simple structure, not invaginated, and the atrium bears an enigmatic organ of unknown function, our ignorance of which is veiled behind the term "appendicula."[12] This is wanting in other *Arionidæ* with the exception of *Binneya*, the most primitive genus of the family.

The species of *Hesperarion* are dimorphic, like *Ariolimax columbianus*, having a spotted and an immaculate form.

[12] This convenient term was first used by Dr. von Ihering in his "Morphologie und Systematik des Genitalapparates von Helix." The appendicula inserted low on the vagina or on the atrium is not homologous with the elongated sack found in *Panda*, *Strophocheilus*, etc., associated with the spermatheca. The latter probably serves the purpose of an accessory spermatheca.

H. niger (J. G. Cooper). Pl. IX, figs. 5, 6; Pl. XI, fig. 33; Pl. XII, figs. 43–48; Pl. XIV, fig. 71.

Ariolimax niger J. G. Cooper, Proc. Acad. Nat. Sci. Phila., 1872, p. 147, pl. 3, f. B, 1–4. W. G. Binney, Terr. Moll. V, p. 234, f. 133 (caudal pore); pl. v, f. D, F, (teeth); pl. xii, f. F (genitalia); Man. Amer. Land Shells, p. 100, f. 64; Terr. Moll. v. Third Supplement, Bull. M. C. Z., XIX, no. 4, p. 212, pl. v, f. A, I, C, D (external aspect and caudal pore). Cockerell, Ann. Mag. N. H. (6), vi, p. 278, 279.

Hesperarion niger Simroth, Malak. Blätter (n. F.), xi, p. 109–119, pl. 1, f. 7–14.

Ariolimax Andersoni J. G. Coop.?, W. G. Binney, Ann. Lyc. Nat. Hist. N. Y., xi, p. 182, pl. xii, f. 9 (genitalia), pl. xviii, f. G (teeth); Terrestr. Moll. V, p. 235, f. 135, 136, pl. xii, f. E (genitalia), pl. v, f. G (teeth). Man. Amer. Land Shells, p. 132, f. 66, 67. Second Suppl. T. M. V, p. 43. Third Suppl. p. 212, pl. v, f. F. Not *Arion Andersoni* J. G Cooper.

Exterior: Upper surface (in alcoholic specimens) smoky brown-black above, slightly lighter gray-black laterally, unicolored or dappled with black ragged spots; sole gray-black, with black spots scattered along the inner edge of the lateral areas. Integument obliquely longitudinally grooved, not much reticulated. Mantle with the lung pore submedian; genital orifice some distance behind the right tentacle, caudal pore conspicuously large and deep, with a cleft extending to the tail; sole indistinctly tripartite. Length (in alcohol) 30–45 mm.

The genitalia in two individuals dissected show considerable variation. In one, (Pl. XII, fig. 44), the penis is large nearly its entire length, constricted at base; this being from a maculated individual like Pl. IX, figs. 5, 6, from Santa Clara, Cal. In the other, a typical *niger* in coloring, the penis is slender below, swollen above (Pl. XII, fig. 47). We hope to receive further specimens and ascertain the limits and significance of variation in these organs.

In one specimen (Mus. no. 71,078) there were thirteen spermatophores (Pl. XII, fig. 43) in the spermatheca.

Jaw with eleven wide ribs.

Radula agreeing with *Ariolimax* in the long, oblique cusps of the marginal teeth.

Cooper's types were from the neighborhood of San Francisco Bay. Specimens are before us from Bolinas, Haywards, Santa Clara, Stevens' Creek Canyon, Santa Cruz range, 900 feet altitude, and near San José. Binney gives the localities Santa Rosa, Healdsburg, Sonoma Co.; and for the synonymous *Ariolimax Andersoni*, mountains of Alameda Co. The general range, therefore, covers the Coast and Bay counties from Sonoma to Santa Cruz.

Professor Cockerell defines a color-form *maculatus* as follows: "This much resembles *A. hemphilli* var. *maculatus*, but is larger and stouter, and has the lateral areas of the sole marbled as in *niger*. Two specimens were received from Dr. Cooper, who found them at Haywards, Cal." The maculated form is shown in our figures. It seems more abundant than the spotless slug, but in our series it is difficult to separate the two, as some which appear spotless often show a few maculæ on close examination.

H. Hemphilli (W. G. Binney).

Ariolimax Hemphilli W. G. Binney, Ann. Lyc. Nat. Hist. N. Y., XI, p. 181, pl. xii, f. 7 (genitalia), pl. xviii, f. H (teeth) (1875); Terrestr. Moll., V, p. 235, f. 134, pl. v, f. H (teeth), pl. xii, f. G (genitalia); Man. Amer. Land Shells, p. 102, f. 65. Third Suppl. Terr. Moll., v, p. 212, pl. v, f. G. Cockerell, Ann. Mag. N. H. (6), vi, p. 278.

Ariolimax Hemphilli var. *maculatus* Ckll. in Binney, Third Supplement to Terr. Moll., V, p. 212, pl. v, f. B.

Since its first publication in 1875, nothing material has been added to our knowledge of this species. Its generic position is uncertain. The desirability of procuring additional specimens in order to place the form upon a better basis will be evident. The type locality is Niles Station, Alameda Co., California.

Professor Cockerell's color-form *maculatus* has been figured in Binney's Third Supplement, but not before described. "Small spotted *hemphilli* found by Dr. Cooper at Haywards. When alive, as I learn from Dr. Cooper, they are reddish, the spotted variety of *niger* being gray; in alcohol, both appear gray. They agree with *hemphilli* W. G. B. in the genitalia, and differ also from *niger* in their more slender form and immaculate sole of foot. Indeed, comparing them with typical *niger*, they appear fundamentally distinct in every way, but the var. *maculatus* of *niger* is strangely intermediate—just what one might expect a *niger* × *hemphilli* hybrid to be." (Ckll. *ms.*).

Genus **ARION** Férussac.

Conspicuous in the European fauna for the number of species and individuals, and for the large size and frequently brilliant coloring of some forms, this genus is represented in America by one or two species introduced from Europe and still very local in distribution. They have not yet exhibited the tendency to spread characteristic of the introduced *Limaces*.

Arion hortensis Fér. Pl. XV, figs. 79, 82, 83; Pl. XIV, fig. 72.

Numerous specimens of this species were collected in March and April, 1896 near or in a greenhouse in Seattle, Washington, by Mr.

P. B. Randolph. A specimen much contracted in alcohol is here figured, with the retractor system and pallial organs. As preserved they measure 15 to 20 mm. in length; ground-color above dirty whitish, with a conspicuous blackish stripe along each side of mantle and of the foot behind it, the back with a broad median bluish or slate-black band, tapering posteriorly, often only faintly indicated; sole light yellow.

In other specimens from Poughkeepsie, N. Y., the region between the longitudinal black bands on mantle and sides is speckled and maculated with black.

As this species is an immigrant from Europe, where it is well known and has been repeatedly investigated anatomically, we omit a detailed description and synonymy. The coarsely, longitudinally rugose integument, anterior position of the breathing orifice, and posterior position of the genital orifice, below the other, readily distinguish *Arion* from all native American slugs.

Arion sp.

W. G. Binney describes a slug referred by him to *Arion fuscus* Müller, from Boston, Mass. Mr. Cockerell considers it likely that the figure in Terrestrial Mollusks, Pl. LXIV, fig. 1, (copied in Man. Amer. L. Shells, fig. 502) represents *A. subfuscus*. Whether more than one species of *Arion* occurs in America will remain doubtful until further examination of the Bostonian slug can be made.

Genus **PROPHYSAON** Bland & Binney, 1873.

Prophysaon Bland & Binney, Ann. Lyc. Nat. Hist. N. Y., X, 1873, p. 293; type *P. hemphilli* B. & B. Cockerell, Ann. Mag. N. H. (6), VI, p. 277–279, and Nautilus XI, p. 77 (key to species).—W. J. Raymond, Nautilus, IV, p. 6 (mutilation of tail).

Phenacarion Cockerell, Nautilus III, p. 127 (March, 1890), type *Arion foliolatus* Gld. The Conchologist II, p. 118.

Slugs with anterior shield-like mantle in which the flat, non-spiral shell is completely buried, the breathing pore in front of the middle of its right margin; genital orifice behind and near right tentacle. Foot reticulated, the areolæ subdivided (except in *cœruleum*); the coloration in two or three longitudinal bands on mantle or mantle and foot, or monochromatic. Foot-margin wide, pedal furrows deep, with no noticeable caudal pore (or only a small slit, in *P. foliolatum*, hardly or not visible in alcoholic specimens). Sole not in the least tripartite. Tail usually showing an oblique constriction at from the posterior third to sixth of the animal's length, marking the place where self-amputation takes place.

Body cavity extending into the foot, but frequently not to its end; genital system and gut lying side by side and extending about the same distance backward (Pl. XI, fig. 34, *P. fasciatum*).

Jaw weak, flexible; flatly ribbed, plaited or striate. Rachidian teeth tricuspid, laterals bicuspid, the ectocones small; marginals formed by shortening of the basal-plates, bicuspid, the mesocone moderate or short, ectocone small, occasionally bifid.

Intestinal tract (Pl. XI, figs. 28, *P. Andersoni*; fig. 30, *P. cœruleum*, fig. 32, *P. foliolatum*, and fig. 34, *P. fasciatum*) with four well developed sigmoid folds; no division of G^1 into crop and stomach; anterior loop formed by G^2 and G^3 twisted one-half revolution; posterior loop of G^3 and G^4 long, extending far behind stomach, and twisted less than a complete revolution.

Genital system (Pl. XII, figs. 37–40, and Pl. XIII, all figs.) not crowded forward; no penis nor retractor; epiphallus either very stout, cylindrical and fleshy, with minute perforation, or more slender, long and tapering distally; in either case suddenly narrowing near the atrium to a minute duct, which enters the atrium by a short tapering peduncle, in close contact with which the enlarged epiphallus is held by a muscle (seen in fig. 57 of Pl. XIII, *musc.*, and fig. 39 of Pl. XII). Duct of spermatheca short; spermatophores as in *Hesperarion*. Ovotestis (Pl. XI, fig. 34) lying anterior to the posterior loop of gut, between its upper and lower folds, adjacent to the albumen gland.

Muscle system (Pl. XIV, fig. 70) with the eye retractors inserted at the outer posterior angles of the diaphragm, as in *Arion*; buccal retractor inserted at the posterior edge of diaphragm to the right of the middle, bifurcate distally. Right eye retractor passing between branches of genitalia.

Pallial region (Pl. XV, fig. 80) much as in *Arion*; breathing pore, anus and nephridial orifice at the right anterior angle of the pallial cavity; kidney ring-like, excavated to show both chambers of the heart; other features as usual in the family.

Distribution: Middle California to British Columbia, eastward in Idaho to the Cœur d'Alène Mts.

Prophysaon stands rather isolated in the *Arioninæ*. The only native American genus approaching it is *Anadenulus*, but this differs in several important particulars to be mentioned below. The Palæarctic *Arion* is like *Prophysaon* in the pallial region, but differs markedly in (1) the removal of the buccal retractor insertion backward from the diaphragm edge, (2) the complex twisting of the gut and the posterior position of the stomach (see these Proceedings, 1896, pl. 13, f. 3); (3) the simpler form of the epiphallus, and well developed retractor muscles of vagina and spermatheca, and (4) the normally constructed tail. There are various other minor differences; but upon the whole, the American genus is less divergent than the European from the primitive forms of the family in its musculature, more divergent in the tail structure and epiphallus. In *Arion*, shell reduction has progressed rather further, at least in the typical forms. *Geomalacus*, a lateral branch from the *Arion* stem, is even more remote from the American genus. The Himalayan genus *Anadenus* (with which Fischer unites *Prophysaon* as a subgenus), differs conspicuously in possessing a well developed penis with retractor, and externally in the extreme narrowness of the foot margin and the tripartite sole.

The self-amputation of the tail in *Prophysaon* has been described by Henry Hemphill[13] and W. J. Raymond;[14] while Simroth has noticed and figured the appearance of the tail in alcoholic specimens before amputation.

Mr. Raymond writes as follows: "In August, 1888, I collected on one occasion about a dozen examples of *Prophysaon Andersoni* J. G. Cp., near the San José reservoir, above Lexington, Santa Clara County. While taking measurements of the living specimens, before putting them into alcohol, I noticed in several a contraction about two-thirds of the length from the head. This appeared as an indented line completely encircling the body. Upon handling the slugs to examine this phenomenon more closely, the line became deeper and in the case of two of the specimens the tail dropped off, almost as readily as the ray of the so-called 'brittle' starfish."

Nearly all full grown alcoholic specimens of *P. Andersoni, foliolatum* and *cœruleum* show a well defined impressed line around the tail, or occasionally the tail has actually been amputated, as in the specimen of the last-named species figured on Plate IX, figs. 7 to 11. Dissection shows that the body cavity does not extend beyond the point of excision, or but little beyond; the remainder of the tail being occupied by very spongy vesicular connective tissue.

We have not seen *Prophysaon* alive, and observations are still lacking upon some interesting points which could probably be sup-

[13] Nautilus III, p. 126, footnote; Fourth Supplement to Terr. Moll. V, p. 182.

[14] Nautilus IV, p. 7.

plied by keeping slugs in captivity. Does regeneration of the lost member take place, and if so, is the renewed tail structurally like the amputated one, or does loss of the tail result eventually in death? What animals persecute *Prophysaon?* Observations upon these questions might go a long way toward explaining the present utility of tail amputation, though they may not indicate the mode of its origin. Without knowledge of the final consquences of amputation to the slug, or what its natural enemies are, speculation upon tail excision is idle. In an analogous case now well known, that of *Helicarion* in the Philippine Islands, Semper[15] states that every species he examined "possessed the singular property, which many lizards have—particularly the Geckos—of shedding their tail when they are seized somewhat roughly at a little way behind the shell. This they do by whisking the tail up and down with extraordinary rapidity, almost convulsively, till it drops off; if the creature is held by the tail, it immediately falls to the ground, where it easily hides among the leaves. If it is laid flat on the hand, the rapid wagging movement is strong enough to raise the body with a spring into the air, so that it falls over on to the ground. These snails at first constantly escaped me and my collectors in this way, and not unfrequently we had nothing but the tail left in our hands. According to Guilding's observations the same peculiarity of parting with the hinder prolongation of the foot characterizes the West Indian snail *Stenopus.* I ascertained by further investigation that in a free state of nature such self-mutilation not unfrequently occurs, for about a hundred specimens of *Helicarion gutta*, which is extremely common in the north-east of Luzon, I found, perhaps, ten individuals that had shed their tails, or, to speak more accurately, the hinder end of the foot, and had the stumps partly healed, or the foot to some extent grown again. Now, this hinder portion of the foot is the most conspicuous part of the snail's body, and it may be supposed that it is, in most cases, the part first seized by the reptiles or birds that prey upon them; but, startled by the escape of the body, they would soon learn to recognize, by the form of the tail, those species which were capable, by this self-amputation, of depriving them of the larger and probably the only valuable portion of the prey. In this way the species of the genus *Helicarion* can escape the pursuit of their enemies better than they otherwise could on account of their exposed mode of life."

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[15] Animal Life, Chapter XII.

Whether Semper's plausible supposition be held to sufficiently explain the self-mutilation of *Helicarion* or not, it seems to us that the slowness of the process of amputation in *Prophysaon* precludes the idea that it is a means of escape from birds, which, in any case, are as likely to seize the slug by the head or middle as by the tail. If molluscan foes are in question, the time consumed in amputation is of less moment; and it might be worth while to imprison *Prophysaon* with *Circinaria* (*alias Selenites* and *Macrocyclis*), which is the most rapacious snail of the West Coast. The suggestion is offered for what it may be worth; and the whole subject referred to the enterprising and enthusiastic naturalists of the West for observation and experiment.

The species of *Prophysaon* fall into three very distinct groups, two of them containing but one species each, the other including *P. Andersoni* Coop. (*plus Hemphilli* B. & B., *Pacificum* and *flavum* Ckll.), and *P. foliolatum* Gld. (including *Phenacarion Hemphilli* W. G. B.). As the synonymy indicates, these two species are excessively variable. In the case of *Andersoni* a great extent of territory is inhabited by the several forms and typical form of the species, and much more extensive series than we have yet seen must be brought together before a final decision upon the limits of variation, and the definable subspecies if any exist, can be made. Our study of them is based wholly upon alcoholic slugs, gathered from localities hundreds of miles apart; and it is to be expected that richer collections may modify, and certainly will amplify, the conclusions reached.

Our general results so far as synonymy is concerned, do not differ radically from those attained by Professor Cockerell, whose synopsis of the species is given below.[16]

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[16] "(1). Epiphallus stout, sausage-shaped. A pale dorsal stripe.
- a. Ochreous species, ... *P. Pacificum* (incl. *flavum*).
- b. Grayish species, ... *P. Andersoni* (incl. *Hemphilli*).

"(2). Epiphallus banana shaped, but tapering at the end. No pale dorsal stripe, . . *P cæruleum* (Epiphallus rather slender, flattish, tapering, somewhat curved. Shell 2 mm. long, narrow, white, shiny).

"(3) Epiphallus slender, gradually tapering to a point. Body with a blackish dorsal band.
- a. Jaw ribbed, ... *P. fasciatum.*
- b. Jaw only striate, . . . *P. humile.* (Until more material of *humile* is seen, it cannot be made sure that the jaw-character is a specific one.)"

For some further details of Professor Cockerell's views, see *Nautilus*, Nov. 1897, pp. 77–79. The "banana" or "sausage" shape of the epiphallus we find to be a variable character, not constant specifically.

Key to species of Prophysaon (alcoholic specimens).

a. Surface with coarse diamond-meshed reticulation, the meshes finely subdivided; mantle banded or spotted; foot-margin moderate or wide.

b. Mantle free about two-thirds of the distance back to breathing orifice (Pl. X, fig. 17). Epiphallus stout, cylindrical, bluntly rounded at both ends; vas deferens extremely long, convoluted in a snarl; usually a pale dorsal line on the tail; jaw coarsely ribbed.

c. Outer lateral and inner marginal teeth with blunt and rather short cusps. Length 50–80 mm. (in alcohol), the posterior third or more being marked off by an oblique constriction and subject to self-amputation, ... *P. foliolatum.*

c'. Outer lateral and inner marginal teeeth with long, acutely pointed cusps. Length 25–35 mm. (in alcohol), the posterior part subject to amputation shorter, ... *P. Andersoni.*

b'. Mantle free as far back as the breathing orifice (Pl. X, fig. 27). Epiphallus slender, gradually tapering distally; vas deferens not elongated; back with a wide red or pale area enclosing a darker median band, and bounded on each side by dark lateral bands, or entire slug dusky; jaw closely, finely plaited or striated,

P. humile and var. *fasciatum.*

a'. Surface longitudinally closely grooved above, obliquely and less closely so at the sides, the grooves occasionally joined by short transverse lines; foot-margin very narrow, *P. cœruleum.*

P. Andersoni (J. G. Cooper). Pl. X, figs. 18–22; Pl. XI, fig. 28, 29, Pl. XIII, figs. 59–62; Pl. XVI, figs. 92, 93.

Arion ? Andersonii J. G. Cooper, Proc. Acad. Nat. Sci., Phila., 1872, p. 148, pl. 3, f. F, 1–5.

Not "*Prophysaon Andersoni* J. G. Cooper," W G. Binney, Second Supplement to T. M., V, p. 42 (= *P. fasciatum*).

Prophysaon Andersoni J. G. Cooper, W. G. Binney, Third Supplement to Terr. Moll., V, p. 208, pl. iii, f. 1, pl. vii, f. C; pl. i, f. 3 (dentition), pl. ix, f. I, J (surface reticulation). Fourth Supplement, p. 179.

Prophysaon Andersoni J. G. Cooper, Proc. Amer. Philos. Soc., 1879, p. 288. Cockerell, Ann. Mag. N. H. (6), VI, p. 278; Nautilus XI, p. 77, 78 (includes *P. Hemphilli*). Raymond, Nautilus IV, p. 6.

Prophysaon Andersoni var. *marmoratum* Ckll., The Conchologist II, p. 72.

P. Andersoni var. *suffusum* Ckll., The Conchologist II, p. 118.

Prophysaon Hemphilli Bland & Binn., Ann. Lyc. N. H. of N. Y., X, p. 295, pl. xiii, exclusive of fig. 5 (external view, shell, jaw, teeth, digestive system and genitalia). W. G. Binney, Terrestr. Moll., V, p. 238, f. 137, 138, 139, pl. v, f. 1 (teeth), pl. xii, f. H (genitalia), "specimens from Mendocino County" excluded. Man. Amer. Land Shells, p. 105, f. 68, 69, 70. Third Supplement to T. M., V, p. 208, pl vii, f. D. Simroth, Nova Acta Acad. Cæs. Leop.-Carol. Germ. Nat. Cur., LVI, 1891, p. 362, pl. 7, f. 5–8 (full account of anatomy). Taylor, The Ottawa Naturalist III, p. 90.

Prophysaon pacificum Cockerell, Nautilus III, p. 111 (Feb., 1890); V, p. 31; XI, p. 77 (includes *flavum*). W. G. Binney, Third Supplement to T. M. V, p. 210, pl. vii, f. B. F. H.

Prophysaon flavum Cockerell, Nautilus III, p. 111. Ann. Mag. N. H. (6), VI, p. 278, 279, as var. of *pacificum*. W. G. Binney, Third Suppl., p. 210, pl. vii, f. K.

Prophysaon Andersonii var. *pallidum* Ckll., Nautilus V, p. 31.

Length in alcohol 25–35 mm. Upper surface buff-gray or whitish flesh colored, with irregular blackish diamond venation and sometimes suffused with purplish-black, showing a pale dorsal line; the mantle yellowish, with two curved lateral black stripes, with or without scattered marbling; sole pale buff or dirty white; foot-margin pale; below and anterior to mantle whitish. Integument with rather coarse diamond venation, the areolæ subdivided into minute polygonal granules.

Shell oval, with moderately consistent calcareous layer.

Genitalia (Pl. XIII, figs. 59, 60, 61): Epiphallus cylindric, straight or sometimes curved, with an abrupt basal constriction, kink and peduncle secured by a short muscle, as described above. Vas deferens very long, its length measured from end to the abrupt bend at the atrium being about 7 times the length of the epiphallus; thrown into a complicated snarl. Spermatheca globose or oval, on a rather slender duct. Vagina long. Free oviduct short. Ovotestis showing externally a compact mass of rounded follicles. Right eye retractor passing between branches of genitalia.

Measurements of several specimens are as follows: *a* (Mus. no. 69,010, Oakland, Cal.), length of swollen epiphallus 9 mm.; length of extended vas deferens, from apex of the epiphallus to base of same 64 mm.; *b* (same locality), epiphallus 5, v. d. 36 mm.; *c* (Portland, Ore.) epiphallus 5.5, v. d. 37 mm.

Jaw (Pl. XVI, fig. 92, specimen from San Juan I.) arcuate with about 15 well-defined ribs, denticulating the basal margin.

Radula with 44–1–44 teeth; rachidian tricuspid, laterals bicuspid, the ectocones quite small; marginals with moderately long, pointed mesocones and minute ectocones (Pl. XVI, fig. 93, two outer lateral, and a group of marginal teeth).

Alcoholic *P. Andersoni* varies in general tone from a smoky lead color above to reddish with black marbling or suffusion, mantle light dirty buff, or yellow, variously marked. Very rarely the two curved black stripes on the mantle are wanting, and occasional specimens fail to show the pale dorsal line, which in others is very conspicuous. We fail, however, to find internal characters permitting the division of our series into several species; and while it is possible that some of the named forms may be geographic subspecies, we are disposed to regard them rather as local variations of but slight rank and uncertain diagnosis. Large series from many localities must be collected and compared to define the subspecies, if any exist.

It differs chiefly from *P. foliolatum* in being smaller, with very much shorter "amputateable" tail segment, and in dentition.

Simroth found a very long, smooth, vermiform spermatophore in *P. Andersoni.*

Santa Clara Co. (Ehrhorn, Raymond) around San Francisco Bay (Cooper, Button, *et al.*), California; Portland (Malone), Forest Grove and Astoria (Hemphill), Oregon; Kalama, Chehalis, Port Townsend and San Juan Island (Hemphill), Washington; Vancouver Island (Wickham, Taylor); Old Mission, Lake Cœur d'Alêne, Idaho (Hemphill).

There is considerable variation in the shape and size of the epiphallus, even among specimens of similar size and external appearance, collected at the same time at one locality. Thus, in one specimen of a small series from San Juan Island, the epiphallus is 4½ mm. long, and straight (fig. 61); while in another it measures 7 mm. and is curved (fig. 59). The extremes in a larger series from Oakland, Cal., are: shortest, 5 mm. long, straight; longest 8 mm. long, curved. After vainly trying to correlate the variations of the epiphallus with other characters, with a view to defining two or more species, we are compelled to conclude that they are largely individual, possibly to some extent functional, but that these variations are not in any sense characteristic of races or species. Of course the observations were made upon sexually mature individuals.[17]

Of the several forms included in the above synonymy, it is now generally admitted that *P. Hemphilli* is a synonym of *P. Andersoni.* Professor Cockerell[18] has stated his opinion that *P. flavum*, described

[17] Mr. Cockerell's division of *Prophysaon* into forms with the epiphallus "sausage-shaped" and those with it "banana-shaped" is therefore not a specific criterion according to our observations.

[18] Nautilus, XI, p. 77, Nov., 1897.

from Gray's Harbor, Washington, is to be included in *P. pacificum.* There are all possible intergradations between the ochreous and grayish forms in *P. Andersoni* and *P. foliolatum.*

In *P. pacificum* we fail to see any specific characters. The coloration agrees well with specimens of undoubted *P. Andersoni* from Washington, and neither the measurements nor the dentition offer differential characters, so far as we can see. The types were collected by Mr. Wickham, near Victoria, Vancouver Island.

P. foliolatum (Gould). Pl. X, figs. 15, 16, 17; Pl. XI, fig. 32; Pl. XIII, figs. 55, 56, 57, 58; Pl. XIV, fig. 70; Pl. XV, fig. 80; Pl. XVI, figs. 90, 98.

Arion foliolatus Gould, Moll. U. S. Expl. Exped., p. 2, Pl. I, f. 2a, b (1852); Binney, Terr. Moll., II, p. 30, Pl. 66, f. 2 (1851). Copied by subsequent writers. W. G. Binney, Second Supplement to Terr. Moll., V, p. 206, Pl. viii, f. A, B, Pl. ix, f. B, C, D.

Phenacarion foliolatus Ckll., Nautilus., iii, p. 127 (March, 1890); Ann. Mag. N. H. (6), VI, pp. 278, 279; W. G. Binney, Fourth Supplement, p. 181.

Arion foliatus W. G. Binney, Proc. Acad. Nat. Sci. Phila., 1858, p. 197.

Arion foliolatus var. *Hemphilli* W. G. Binney, Third Supplement, T. M. V, p. 208, Pl. viii, f. C; ix, f. H (genitalia). Cockerell, Nautilus, III, p. 126 (March, 1890).

Phenacarion Hemphilli W. G. Binney, Fourth Supplement to T. M. V, p. 183 (not *Prophysaon Hemphilli* Bld. & Binn.).

Length (in alcohol) 50–80 mm. Rather slender, the posterior third (or more) often distinctly more attenuated, defined by an oblique groove. Mantle oblong, its length contained $2\frac{2}{3}$ to $3\frac{1}{6}$ times in the total length of body, the breathing orifice decidedly in front of the middle. Foot margin rather wide; wrinkles of the sole corresponding to vertical grooves of the foot margin, bending backward and meeting in the middle; pedal groove deep, with no noticeable caudal pore.

Colors variable: (1) Back clear reddish-fawn with a lighter dorsal band, sometimes obsolete, the mantle with the usual two curved black lateral stripes, with or without scattered maculæ; becoming paler, light yellowish on the sides and sole; or (2) back reddish, suffused with black, mantle bands long, often with a third median band and scattered maculæ, foot with the principal veins of the reticulation black-pigmented, as are alternate grooves of the foot margin; sides paler, gray; sole yellowish.

Surface with deeper oblique grooves connected by short longitudinal grooves to form a roughly diamond-shaped reticulation, the meshes of which are minutely subdivided.

Shell very delicate, membranous, with a thin and incoherent layer of calcareous granules.

Jaw (Pl. XVI, fig. 98) strong, opaque, with 8–14 wide flattened ribs.

Radula with 44–1–44 teeth. Centrals tricuspid, laterals bicuspid, the ectocones small. Marginals formed by shortening of the basal-plates, having the mesocone short, ectocone simple or on some teeth bifid (Pl. XVI, fig. 90).

Epiphallus stout, cylindric, curved, with the usual constriction, peduncle and muscle at base. Vas deferens extremely long, elaborately twisted and tangled. Vagina long, the spermatheca duct about as long as the spermatheca. Albumen gland very large, long and tongue-shaped. Ovo-testis a very compact mass showing externally only the rounded-polygonal ends of the closely packed follicles. In two typical individuals from Seattle (Mus. no. 71,072) the measurements are: *a* (fig. 55), length of swollen epiphallus 12.5 mm., of extended vas deferens from summit of epiphallus to base of same 92 mm.; of albumen gland 28 mm.; length of animal 80 mm. *b* (fig. 57), length of epiphallus 14 mm.; of vas deferens 114 mm. The ratio of length of epiphallus to that of vas deferens as measured above is about 1 : 7½ or 8. The original of fig. 58 is a small specimen, perhaps not fully adult.

Type locality, Discovery Harbor, Puget Sound (Pickering). Also occurs at Olympia (Hemphill), Seattle (Hemphill, Randolph), and doubtless throughout the Puget Sound region generally.

P. foliolatum is very closely allied to *P. Andersoni* Coop. It is larger, more elongated, with the solid portion of the tail, or that subject to amputation, longer in proportion than in *Andersoni.* In living specimens a mucous pore is visible at the tail, but this is not noticeable externally in alcoholic examples. The light dorsal line is occasionally indistinguishable.

The jaw forms probably intergrade with *P. Andersoni;* but the teeth differ quite perceptibly in the shorter, blunter cusps of the outer laterals and inner marginals. This is one of the best specific characters.

The form described by Binney as *Phenacarion Hemphilli* does not seem to offer sufficiently tangible points of difference from *foliolatum* to stand as a species, even were the name not preoccupied. It is said to be "more slender and more pointed at the tail than *foliolatus.* The body is a bright yellow with bluish-black reticulations. The edge of the foot and the foot itself are almost black. Shield irregularly mottled with fuscous. The body also is irregularly mottled with fuscous, and has one broad fuscous band down the center of the back, spreading as it joins the mantle, with a narrower band on each side of the body. It loses its color on being placed in spirits, becoming a uniform dull slate color. Mantle lengthened oval. Shell-plate represented by a group of calcareous grains concealed in the mantle; it is impossible to remove it as one shell-plate. A decided caudal pore." The jaw and dentition are as in *foliolatum.* Genitalia much as in *foliolatum*, but Binney found the albumen gland to be much shorter, less tongue-shaped and brown-tipped. The epiphallus tapers distally, instead of contracting abruptly.

Localities: Gray's Harbor and Chehalis, Washington.

The only characters of importance are the dorsal band, which seems to be similar to *P. fasciatum*, and the tapering epiphallus, also a character of that species, if not, in this case, an indication of sexual immaturity. Mr. Cockerell considers it a synonym of *foliolatum;* and, as we have seen no authentic specimen, and the name is, in any case, preoccupied, we consider it best to leave the form as a synonym of *foliolatum*, pending further information.

In a series from Cascade Springs, on the Columbia River near the Government locks, collected in October, 1897 by Mr. J. G. Malone, (Pl. XIII, fig. 54) the epiphallus is shorter, not curved, the vas deferens also much shorter. The spermatheca is subglobular. Measurements: length of epiphallus 8.6 mm.; of extended vas deferens from apex of the epiphallus to the abrupt curve at base of same, 42 mm.; of albumen gland 13 mm.; length of animal 50 mm. As measured above, the epiphallus is about one-fifth the length of the vas deferens. In typical *foliolatum* it is about one-eighth, in *Andersoni* one-seventh. These specimens are (in alcohol) less vermiform than typical *foliolatum*, with paler color, back including shield, reddish, fading on the sides; mantle striped as usual, but blackish stripes defining the dorsal pale stripe either very faint or lacking, so that in some individuals no pale dorsal line is visible.

The jaw in this form (Pl. XVI, fig. 89) resembles that of *P. Andersoni* in the numerous ribs. Radula with long, pointed mesocones on outer lateral and inner marginal teeth, as in *P. Andersoni.* In typical *P. foliolatus* the corresponding teeth are shorter and blunter.

This will probably prove to be a distinct subspecies, and referable to *P. Andersoni* rather than to *foliolatum.*

P. humile Cockerell. Pl. XVI, fig. 97.

Prophysaon humile Cockerell, Nautilus, iii, p. 112 (February 1890), Ann. Mag. N. H. (6), VI, p. 277, 279. W. G. Binney, Third Suppl., p. 211, Pl. VII, figs. E, G, L, M.

We do not consider *P. humile*[19] specifically distinct from *fasciatum*. The coloration, genitalia and teeth are practically identical, and the character of the jaw (Pl. XVI, fig. 97) does not seem to be constant. Several specimens selected at random from our series of *fasciatum* from Seattle have a jaw neither plaited or ribbed, but densely, irregularly striated. We cannot find any other differences between these specimens and the ordinary *fasciatum* with flat-ribbed or plaited jaw. The name *humile* has precedence over *fasciatum* and if the two forms prove to be, as we think, specifically identical, *fasciatum* will be reduced to varietal rank.

P. fasciatum Cockerell. Pl. X, figs. 23-27; Pl. XI, fig. 34; Pl. XII, figs. 37-40; Pl. XVI, figs. 91, 94-96.

Prophysaon fasciatum Cockerell in Binney, Third Supplement to Terr. Moll., V, p. 209, pl. vii, f. A (May, 1890). W. G. Binney, Fourth Supplement, p. 180, Cockerell, Ann. Mag. N. H. (6), VI, p. 278, 279.

Prophysaon Hemphilli, "specimen from Mendocino County," W. G. Binney, Terr. Moll., V, p. 239, pl. xii, f. I.

Prophysaon Andersoni J. G. C., W. G. Binney, Second Supplement, p. 42.

Prophysaon fasciatum var. *obscurum* Ckll. The Conchologist II, p. 119 (Chehalis, Wash.)

Length (in alcohol) 25–35 mm., rarely as much as 50 mm. General form and surface reticulation as in *P. Andersoni*. Color extremely variable: (1) Whitish-buff, (2) bluish-gray, or (3) red on the back, gray-buff at the sides, always with two conspicuous black stripes (well- or ill-developed) along the sides behind the mantle, defining a wide, wedge-shaped light dorsal area, which encloses a

[19] The original description is as follows: "*Prophysaon humile* Cockerell—Length (in alcohol) 16½ mill. Body above and mantle smoke-color, obscured by bands. Mantle wrinkled, and having a broad dorsal and two lateral blackish bands, reducing the ground-color to two obscure pale subdorsal bands. Length of mantle 7 mill., breadth 5½ mill. Respiratory orifice 2¾ mill. from anterior border. Body subcylindrical, somewhat tapering, rather blunt at end. Distance from posterior end of mantle to end of body 8 mill. Back with a blackish band reaching a little more than half its length, and lateral darker blackish bands reaching its whole length. Reticulations distinct, "foliated." Sole strongly transversely striate-grooved, but not differentiated into tracts. Jaw pale, strongly striate, moderately curved, not ribbed. Lingual membrane long and narrow. Teeth about 35-1-35. Centrals tricuspid, laterals bicuspid, marginals with a large point, and one (sometimes two) small outer points. Liver pale chocolate.

Found by Mr. A. F. Wickham under the bark of rotten logs in the woods around Lake Cœur d'Alene, Idaho, 1889.

In its reticulations and general characters this species resembles *P. Andersoni*, of which it is possibly a variety."

similarly shaped dark stripe running backward from the mantle, sometimes well-defined, sometimes faint. Mantle buff or red, with two curved lateral black bands (sometimes obsolete) and scattered black maculation or marbling. Shell rectangularly oblong, 2 or 3 mm. long.

Epiphallus slender, long, and tapering distally, having an abrupt kink at base, secured by a short muscle, as usual in the genus. *Vas deferens neither lengthened nor convoluted.* Vagina apparently functional as a penis. Spermatheca globose or oval, on a short, stout duct which is directly continued into the vagina. Free oviduct short and slender. Ovo-testis a rather loose bunch of oval follicles (fig. 38). Albumen gland unusually hard and brittle. The right eye retractor passes between the branches of genitalia.

In one specimen (Pl. XII, fig. 37) there seems to be a glandular enlargement of one side of the base of the epiphallus with a small tubercle on the other side. This may be pathologic.

Jaw (Pl. XVI, figs. 94–96) arcuate with a slight median projection below, covered with flat, narrow, crowded ribs separated by very narrow, shallow intervals, or with flat, slightly imbricated plaits (or merely densely, irregularly striated vertically in form *humile*, see above.)

Radula with 35–1–35 teeth. Centrals tricuspid; laterals lacking the entocone; marginals formed by union of ectocone with mesocone and shortening of the basal-plate. The cusps are short throughout. The change from laterals to marginals is so gradual that it is practically impossible to draw a line between them. On some outer marginals the ectocone is bifid. The figure shows a central with one lateral and a group of three inner marginals.

Well and constantly distinguished from *P. Andersoni* and *foliolatum* externally by the wide, light dorsal area enclosing a darker median stripe, and bounded laterally by blackish bands. Internally, the slender, tapering epiphallus and short vas deferens are even more characteristic. The scarlet color of the back, noticed by Cockerell in some specimens, is not accidental, but of common occurrence.

In form the species varies (in alcohol) from a long, vermiform shape to about the contour of *P. Andersoni.*

The body-cavity extends nearly to the end of the tail. Self-excision of the tail occurs, but the amputated portion is short, as in *P. Andersoni,* and the great majority of individuals we have seen show no oblique constriction of the tail.

P. coeruleum Cockerell. Pl. IX, figs. 7–11; Pl. XI, fig. 30; Pl. XIII, figs. 51–53; Pl. XVI, fig. 86.

Prophysaon coeruleum Cockerell, Nautilus, iii, p. 112. Ann. Mag. N. H. (6), VI, p. 278. W. G. Binney, Third Suppl. T. M. V, p. 209, Pl. vii, f. I, J.

P. coeruleum var. *dubium* Ckll., *l. c.*; W. G. Binney, *l. c.*

Length (in alcohol) about 15 mm.; color blue or slate-blue (sometimes brown), somewhat paler at the sides. Back with close, deep longitudinal grooves, which, on the sides, become oblique and more spaced, and more anteriorly they radiate vertically below the mantle; transverse grooves uniting the longitudinals comparatively few and shallow. Foot-margin very narrow, a second narrow well-defined sub-margin above it. Tail without caudal pore, frequently self-amputated and leaving a conspicuous longitudinal slit (Pl. IX, fig. 7, and figs. 9–11, the excised portion).[20]

Genitalia (Pl. XIII, fig. 51–53) somewhat as in *P. Andersoni*. The epiphallus is short; in one of the original specimens from Olympia (Pl. XIII, figs. 52, 53) very short, truncated at the ends; in another specimen from Seattle (Pl. XIII, fig. 51) it is oblong; vas deferens tangled, but shorter than in *Andersoni*. Spermatheca globular, on a rather slender duct, which is short in the Olympian specimen, longer in that from Seattle.

Radula about as in *P. fasciatum*; the cusps of outer lateral and inner marginal teeth rather short; marginals quite wide (Pl. XVI, fig. 86).

Type locality, Olympia, Washington (Hemphill). In addition to part of Hemphill's original lot, we have received it from Seattle (P. B. Randolph) and Portland, Oregon (J. G. Malone). Mr. Randolph writes that "it occurs solitary in dark fir woods under damp logs. Color in life a brighter shade of blue. They do not bear handling."

"*P. cœruleum* is an exceedingly distinct species, distinguished at once by its color and the character of its reticulations." In the latter respect, the species differs from all others of the genus, and re-

[20] The original description from larger specimens than we have seen, is as follows: "Length in (alcohol) 22½ mill., in motion 43 mill. Body and mantle clear blue-gray, paler at sides, sole white. Mantle finely granulated, broad, without markings. Length of mantle 7 mill., breadth 5 mill. Respiratory orifice 2½ mill. from anterior border. Body subcylindrical, tapering, pointed. (In one specimen eaten off at the end.) Distance from posterior end of mantle to end of body 10¾ mill. The reticulations take the form of longitudinal equidistant lines, occasionally joined by transverse lines, or coalescing. Sole not differentiated into tracts. Jaw pale, strongly ribbed. Liver white. Mr. Binney sends me colored drawings of the living animal; the neck is long and white, or very pale."

sembles *Ariolimax*. The very narrow foot-margin, with an unusually distinct border above, is another distinguishing feature.

Most of the specimens we have seen have lost the end of the tail by self-amputation, as shown in the figures. When perfect the tail is pointed, with no perceptible mucous pore; the longitudinal grooves of the back become irregular near the end of the tail. The color of Portland and Seattle specimens is distinctly blue, but some of the original lot from Olympia, collected about eight years ago, have become brown. Mr. Cockerell thus describes a variegated form which he refers to *cæruleum* as a variety :—

"*Prophysaon cæruleum* var. *dubium*. Length (in alcohol) 8 mill. Length of mantle, 4 mill. Distance from posterior end of mantle to end of body 3½ mill. Mantle broad, with four bands composed of coalesced black marbling, very irregular in shape, and running together anteriorly. Body dark, tapering. Sole pale, its edges gray. Liver white. With the *P. cæruleum* is a small dark slug, probably a variety of it, but differing as described above. It will easily be distinguished by its blackish color and the peculiar markings on the mantle."

There are, in some specimens, very close, fine, superficial impressed vertical lines crossing the deeper oblique grooves.

Genus **ANADENULUS** Cockerell, 1890.

Anadenulus Ckll., Ann. Mag. N. H. (6), VI, p. 279 (Oct., 1890).

Slugs with the minute, non-spiral shell plate wholly buried; the mantle small, rounded and anterior, with breathing pore median on the right side. Genital orifice below right tentacle. Foot reticulate, somewhat keeled posteriorly, the foot-margin moderate, pedal grooves rising slightly at tail, with no caudal pore there; sole distinctly tripartite, the areas separated by longitudinal grooves, middle field narrower than side fields (Pl. IX, fig. 12).

Body-cavity extending the entire length. Jaw with about 20 wide, flat ribs (Binney). Radula with 20–1–20 teeth, about as in *Prophysaon* in form.

Intestinal tract (Pl. XI, fig. 35) much as in *Prophysaon*; posterior loop formed by G^3 and G^4 extending far behind that formed by G^1 and G^2, slightly twisted posteriorly, the folds elsewhere hardly twisted.

Genital system unknown.

Muscle system (Pl. XIV, fig. 68) as in *Prophysaon*. Eye retractors inserted at the two posterior angles of the diaphragm, the buccal retractor at the posterior margin somewhat to the right of the median line, shortly bifurcate distally.

Pallial region (Pl. XV, fig. 75). Kidney large, rounded nearly filling the lung cavity. Ventricle exposed.

Distribution: San Diego Co., California.

No adequate discussion of the affinities of *Anadenulus* can be entered upon until well-preserved specimens are collected permitting an examination of the genitalia. Present information indicates its proximity to *Prophysaon*, with which *Anadenulus* agrees in the digestive tract and musculature. But the voluminous kidney, exposing only the ventricle, the conspicuously tripartite sole, and the apparent absence of that peculiar structure of the tail which distinguishes *Prophysaon*, are all important characters indicating the distinctness of the two genera.

Turning to Old World genera, we find *Arion* differing in its tail gland, posteriorly prolonged buccal retractor and complexly twisted intestine. *Geomalacus* shows the same with still other differences; and in *Anadenus* the foot margin is very much narrower, the sole not divided by longitudinal grooves, and the intestine is long and spirally twisted.

A. Cockerelli (Hemphill). Pl. IX, figs. 12, 13, 14; Pl. XI, fig. 35; Pl. XIV, fig. 68; Pl. XV, fig. 75.

Anadenus Cockerelli Hemphill, Nautilus, IV, p. 2 (May, 1890), W. G. Binney, Fourth Supplement to Terr. Moll., V, p. 178, Pl. i, f. 1; Pl, iii, f. 5 (dentition).

Anadenulus Cockerelli Cockerell, Ann. Mag. N. H. (6), VI, p. 278, 279 (Oct., 1890).

Alcoholic specimens have the foot blackish, with a short, light stripe behind the mantle above, the sides below mantle and the head pale; mantle small, short, black with two festooned longitudinal yellowish stripes.

Length 9–13½ mm.

Cuyamaca Mts., San Diego Co., California (Hemphill).

IV. BRIEF DIRECTIONS FOR COLLECTING, PRESERVING AND EXAMINING SLUGS.[21]

In the Northern States the best time for collecting slugs is in early spring. From February to July, most well grown specimens

[21] As many of our American conchologists have not collected or studied slugs especially, we have thought it not superfluous to append the following notes on collecting slugs, with rough directions for their examination. It will readily be understood that if the slug to be examined is of very small size, or it is necessary to obtain all the data from one or two specimens, more or less radical modifications of these instructions must be made.

taken will prove to have the reproductive organs fully developed. Autumn and late summer are a somewhat less favorable time, because the young of the year have then attained the full growth of the species, while upon opening them the genitalia are found undeveloped. Still, autumn specimens should be collected. Always date each "catch" and keep it separate.[22]

The best preservative for slugs (and other land mollusks) is alcohol. Of other preservatives, formalin (formaldehyde) is perhaps the best; but it is, on the whole, a very unsatisfactory substitute, rendering the tissues tough and slippery, difficult to dissect, and generally destroying calcareous organs in time. Formalin specimens are, moreover, inferior to alcoholic for histological study. Upon the whole, then, formalin should only be used as a permanent preservative for large slugs, if at all, and then in a three or four p. c. solution. It should be added, however, that when travelling with limited means of conveyance, it is often convenient to use formalin on account of the economy of carrying it in the commercial strength, to be diluted as occasion arises. *Never crowd snails in formalin;* the bulk of the solution should exceed that of the snails six or eight times.

After collecting slugs they should be drowned by placing in a vessel of water with a lid laid on (not a cork pushed in) to exclude air. Generally twelve hours is a sufficient time, but this depends upon the slugs and the temperature. In hot weather less time is required. Test them by taking one out, touching it with alcohol, and if no retraction takes place they are ready to be transferred to 25% alcohol;[23] leave in this about twelve hours, then transfer to 50%, and after twenty-four hours or more to about 75%, in which they may be permanently kept.

If formalin is used, the slugs may be placed in the 3 or 4% solution when drowned, and changed to fresh solution after a few days, the first being thrown away. Formalin specimens may at any time be transferred to alcohol, or it may be used with a small per cent. of alcohol.

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[22] Of course, for economy of space and alcohol, all the lots of one species may be kept in one jar, each in a separate vial or piece of cheese-cloth.

[23] Of course, in field work the exact proportion is not vital. In general, it is best to use a mixture of three parts of water to one of alcohol at first, then a half and half mixture, and then the permanent strength. The first and second mixtures may be kept and used repeatedly, occasionally adding a little alcohol to keep up the strength.

To dissect slugs use a small pan, say 4x6x1½ inches, with a layer of blackened wax on the bottom. Only a pair of fine scissors, a pair of fine-pointed tweezers, a small scalpel and a supply of fine pins, with, of course, the small lens usually carried by naturalists, is necessary. Cut the outer integument across the head and along the left side, pin sole down in the pan, with water enough to cover, open by turning the dorsal integument to the right, and cut the rectum where it enters the back. The digestive tract may then be studied by picking away the liver, and, with ordinary care, the genitalia may be removed and isolated by cutting out a small area around the genital orifice. After observing its insertion, the penis retractor may be cut.

If specimens are abundant, use another for the examination of the muscles and pallial organs. Open by cutting just above the foot groove all around the body; remove the sole, pin back downward in the dissecting pan and remove the digestive and genital systems, care being taken to break no muscles. The whole retractor system will then be seen, and after study the muscles may be cut and the diaphragm carefully removed, disclosing the kidney, heart and lung, as seen in the figures on Plate XV.

Use a large slug to begin with, such as *Limax maximus*, the *Ariolimaces* or *Aphallarion*, and no difficulty not readily overcome will be encountered.

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DESCRIPTION OF PLATES.

Plate IX.

Figs. 1, 2. *Hemphillia glandulosa* Bld. & Binn. Dorsal outline and lateral aspect of a specimen from Astoria, Oregon (Hemphill, coll.), Mus. no. 71,161. *m*, mantle; *sh*, exposed surface of shell.

Figs. 3, 4. *Hemphillia camelus* Pils. & Van. Lateral and dorsal aspects of the type specimen. Old Mission, Idaho. Mus. no. 63,926.

Figs. 5, 6. *Hesperarion niger* (J. G. Coop.). Ventral and lateral aspects of a maculated individual. Santa Clara, Cal. Mus. no. 71,198.

Figs. 7, 8. *Prophysaon cœruleum* Ckll. Dorsal and lateral aspects of a specimen which has lost its tail by self-amputation. Olympia, Washington. Mus. no. 63,913.

Figs. 9, 10, 11. *Prophysaon cœruleum* Ckll. Lateral, anterior and dorsal aspects of the self-amputated tail of a specimen from Seattle, Washington. No. 71,074.

Figs. 12, 13, 14. *Anadenulus Cockerelli* (Hemph.). Ventral, lateral and dorsal aspects of one of the original specimens, from Julian City, San Diego Co., California. Mus. no. 63,895.

Plate X.

Figs. 15, 16. *Prophysaon foliolatus* (Gld.). Lateral and dorsal views of a typical specimen from Seattle, Washington. Mus. no. 71,072.

Fig. 17. *Prophysaon foliolatus* (Gld.) Same specimen, the mantle turned backward to show position of its anterior insertion.

Figs. 18, 19. *Prophysaon Andersoni* (J. G. Coop.). Oakland, California. Mus. no. 69,010a.

Figs. 20, 21, 22. *Prophysaon Andersoni* (J. G. Coop.), San Juan Island, Washington. Mus. no. 63,912.

Figs. 23, 24. *Prophysaon fasciatum* Ckll. Seattle, Washington. Collected in March or April, 1896. Mus. no. 68,025.

Figs. 25, 26. *Prophysaon fasciatum* Ckll. Lateral views of two individuals from Seattle, Washington.

Fig. 27. *Prophysaon fasciatum* Ckll. Same individual as fig. 26, with mantle turned backward to show position of its anterior insertion.

Plate XI.

[All figures represent the digestive tract viewed from above. *A. gl.*, albumen gland; *B. d.*, bile duct; *B. m.*, buccal mass; G^{1-4}, first, second, third and fourth folds of the gut; *Gen. or.*, external genital orifice; *L*, liver; *o. t.*, ovo-testis; *sp.*, spermatheca; *T*, tail; *ut.*, uterus; *vag.* vagina.]

Fig. 28. *Prophysaon Andersoni* (Coop.). Oakland, Cal. Mus. no. 69,010*a*.

Fig. 29. *Prophysaon Andersoni* (Coop.). California. Mus no, 71,071. Received from W. G. Binney as *P. Hemphilli* B. & B.

Fig. 30. *Prophysaon cæruleum* Ckll.

Fig. 31. *Binneya notabilis* Cooper. Guadalupe Island. Mus. no. 71,923.

Fig. 32. *Prophysaon foliolatum* (Gld.). Seattle, Wash.

Fig. 33. *Hesperarion niger* (Cooper). California. Mus. no. 71,-078. *o. t.*, ovo-testis; *L*, liver, *T*, tail.

Fig. 34. *Prophysaon fasciatum* Ckll. Seattle, Wash. Mus. no. 68,026. Salivary glands and anterior portion of liver removed, genitalia and digestive tract *in situ*.

Fig. 35. *Anadenulus Cockerelli* (Hemphill). One of the original lot.

Fig. 36. *Hemphillia camelus* Pils. & Van. Old Mission, Idaho. Mus. no. 63,926. *o. t.*, ovo-testis.

Plate XII.

[*Epi.*, epiphallus; *p. p.*, penis papilla; *r. p.* penis retractor; *v. d.*, vas deferens].

Fig. 37. *Prophysaon fasciatum* Ckll. Seattle, Wash. Mus. no. 68,026*a*. Perhaps abnormal.

Fig. 38. *Prophysaon fasciatum* Ckll. Same locality. Ovo-testis.

Fig. 39. *Prophysaon fasciatum* Ckll. Same locality. Mus. no. 68,025.

Fig. 40. Same specimen, atrium and base of the epiphallus, the binding muscle removed.

Fig. 41. *Hemphillia camelus* Pils. & Van. Type specimen. Mus. no. 63,926.

Fig. 42. The same, penis opened.

Fig. 43. *Hesperarion niger* (Cooper). Spermatophore.

Fig. 44. *Hesperarion niger* (Cooper). Santa Clara, Cal., collected Nov. or Dec., 1896.

Fig. 45. *Hesperarion niger* (Cooper). Mus. no. 71,078. Apex of penis opened.

Fig. 46. The same, side view of penis-papilla.

Fig. 47. *Hesperarion niger* (Cooper). Mus. no. 71,077.

Fig. 48. The same. Spermatheca.

Fig. 49. *Hemphillia granduloss* B. & B. Apex of penis opened, showing papilla.

Fig. 50. *Hemphillia glandulosa* B. & B. Lower portion of genital system. Astoria, Oregon.

Plate XIII.

[*f. ov.*, free oviduct; *musc.*, muscle connecting atrium and epiphallus; *sp.*, *sp. d.*, spermatheca and its duct; *vag.*, vagina; *ped.*, peduncle of the epiphallus.]

Fig. 51. *Prophysaon coeruleum* Ckll. Seattle, Washington.
Figs. 52, 53. *Prophysaon coeruleum* Ckll. Olympia, Washington. The pedicel of epiphallus is seen in fig. 53.
Fig. 54. *Prophysaon Andersoni* (?) var. Cascade Springs, Washington. Mus. no. 71,647.
Fig. 55. *Prophysaon foliolatum* (Gld.). Seattle, Washington. Mus. no. 71,072. Typical form.
Fig. 56. The same. Median transverse section of the epiphallus.
Fig. 57. *Prophysaon foliolatum* (Gld.). Another specimen from the same locality.
Fig. 58. The same, a smaller specimen not mature.
Fig. 59. *Prophysaon Andersoni* (Cooper). Oakland, Cal. Mus. no. 69,010.
Fig. 60. *Prophysaon Andersoni* (Cooper). California. Mus. No. 71,071. Received from W. G. Binney as *P. Hemphilli* B. & B.
Fig. 61. *Prophysaon Andersoni* (Cooper). Oakland, Cal. Mus. no. 69,010.
Fig. 62. *Prophysaon Andersoni* (Cooper). Spermatophore.

Plate XIV.

[The retractor muscle systems are all represented as seen from beneath. *ao*, aorta; *c. a.*, cephalic artery; *e. r.*, eye retractor; *G*, intestine; *l. t. r.*, left tentacle and eye retractor; *ovid. r.*, retractor of the oviduct; *p*, penis; *ph. r*, pharynx or buccal retractor; *ret.*, retensor muscle; *r. p.*, penis retractor; *r. s.*, radula sack; *r. t. r.*, right tentacle retractor; *sp. r*, retractor of the spermatheca; *t. r*, tentacle retractor; *vag.*, vagina; *vag. r.*, vaginal retractor; *v. a*, visceral artery.]
Figs. 63, 64, 65. *Binneya notabilis* Cooper. Guadalupe Island. Ventral and lateral aspects of an alcoholic specimen, and the retractor system.
Fig. 66. *Ariolimax Columbianus* (Gld.).
Fig. 67. *Aphallarion Buttoni* Pils. & Van.
Fig. 68. *Anadenulus Cockerelli* (Hemph.).
Fig. 69. *Hemphillia camelus* Pils. & Van. Mus. no. 63,926.
Fig. 70. *Prophysaon foliolatum* (Gld.). Mus. no. 71,073.
Fig. 71. *Hesperarion niger* (Cooper). Mus. no. 71,078.
Fig. 72. *Arion hortensis* Fér. Seattle, Wash. Mus. no. 68,023.

Plate XV.

[Pallial organs, seen from below, the diaphragm removed. *a*, auricle; *ao*, aorta; *k*, kidney; *l*, lung; *p. a.*, pulmonary or breathing aperture; *ph. r.*, pharynx or buccal retractor muscle; *p. v*, pulmonary vein; *r*, G^4, rectum; *r. t. r*, right tentacle retractor; *ur*, secondary ureter; *v*, ventricle.]
Fig. 73. *Ariolimax Columbianus* (Gld.). Maculated specimen from near Oakland, California. Pallial region from below, with pulmonary net work of the lung roof.

Fig. 74. The same, showing main ramifications of excretory canals in kidney.
Fig. 75. *Anadenulus Cockerellii* (Hemp.).
Fig. 76. *Aphallarion Buttoni* Pils. & Van.
Fig. 77. *Hesperarion niger* (J. G. Coop.). Mus. no. 71,078.
Fig. 78. *Hemphillia camelus* Pils. & Van.
Fig. 79. *Arion hortensis* Fér. Specimen from Seattle, Wash. Mus. no. 68,023.
Fig. 80. *Prophysaon foliolatum* (Gld.). Specimen from Seattle. Wash. Mus. no. 71,073.
Fig. 81. *Ariolimax columbianus* (Gld.) End of tail, lateral view.
Figs. 82, 83. *Arion hortensis* Fér. Seattle, Washington.
Fig. 84. *Hesperarion niger* (Coop.). Oblique view of end of tail, showing pore.

Plate XVI.

Fig. 85. *Hemphillia camelus* Pils. & Van. Central, first lateral, and three marginal teeth.
Fig. 86. *Prophysaon cœruleum* Ckll. Group of outermost marginal teeth.
Fig. 87. *Binneya notabilis* Coop. Jaw.
Fig. 88. *Binneya notabilis* Coop. Teeth.
Fig. 89. *Prophysaon Andersoni* (Coop.), var.? Mus. no. 71,647. Cascade Springs, Washington.
Fig. 90. *Prophysaon foliolatum* (Gld.). Typical form. Central, first lateral, and group of marginal teeth.
Fig. 91. *Prophysaon fasciatum* Ckll. Central, first lateral and group of marginal teeth.
Fig. 92. *Prophysaon Andersoni* (Coop.). Jaw. San Juan Island. Mus. no. 63,912.
Fig. 93. Outer marginal and lateral teeth of same individual.
Fig. 94. *Prophysaon fasciatum* Ckll. Jaw. Mus. no. 68,026. Seattle, Washington.
Fig. 95. Much magnified portion from median part of another similar jaw of the same species.
Fig. 96. More enlarged basal margin of same.
Fig. 97. *Prophysaon humile* Ckll. Much magnified portion of the basal margin of a striated jaw. Seattle, Washington.
Fig. 98. *Prophysaon foliolatum* (Gld.). Jaw. Mus. no. 71,072. Seattle, Washington.

May 3.

The President, Samuel G. Dixon, M. D., in the Chair.

Fifty-three persons present.

Papers under the following titles were presented for publication:—

"Notes on Mr. Meehan's paper on the Plants of Lewis and Clark's Expedition across the Continent, 1804–06." By Dr. Elliott Coues.

"List of Bats collected by Dr. W. S. Abbott in Siam." By Gerrit S. Miller, Jr.

May 10.

The President, Samuel G. Dixon, M. D., in the Chair.

Twenty-six persons present.

Papers under the following titles were presented for publication:—

"Certain Aboriginal Mounds of the South Carolina Coast." By Clarence B. Moore.

"Certain Aboriginal Mounds of the Savannah River." By Clarence B. Moore.

"Certain Aboriginal Mounds of the Altamaha River." By Clarence B. Moore.

"Recent Acquisitions." By Clarence B. Moore.

"Environmental and Sexual Dimorphism in Crepidula." By E. G. Conklin.

May 17.

Mr. Charles P. Perot in the Chair.

Thirty-six persons present.

Papers under the following titles were presented for publication:—

"Descriptions of five New Phyllostome Bats." By Gerritt S. Miller, Jr.

"Chitons collected by Dr. Harold Heath at Pacific Grove, near Monterey, Cal." By H. A. Pilsbry.

"Some New Species of Diatoms." By C. S. Boyer.

The deaths of Theodore Wernwag, May 1st, and of J. Waln Vaux, May 16th, members were announced.

May 24.

The President, Samuel G. Dixon, M. D., in the Chair.

Forty persons present.

Mr. Charles Morris read a paper on the antiquity of Man from the standpoint of evolution. (No abstract).

May 31.

The President, Samuel G. Dixon, M. D., in the Chair.

Twenty-one persons present.

A paper entitled "Botanical Observations on the Mexican Flora, especially on the Flora of the Valley of Mexico." By J. W. Harshberger, M. D., was presented for publication.

Papers under the following titles were accepted for publication in the Journal:—

"Certain Aboriginal Mounds of the South Carolina Coast." By Clarence B. Moore.

"Certain Aboriginal Mounds of the Savannah River." By Clarence B. Moore.

"Certain Aboriginal Mounds of the Altamaha River." By Clarence B. Moore.

"Recent Acquisitions." By Clarence B. Moore.

The following were ordered to be printed:—

MATERIALS TOWARD A NATURAL CLASSIFICATION OF THE CYLINDRELLOID SNAILS.

BY HENRY A. PILSBRY AND E. G. VANATTA.

While recording some recent additions to the North American landsnail fauna with the intention of revising the "Check List" of United States land mollusks published in these *Proceedings* for 1889, the attention of the senior author was recalled to the rejection of the generic name *Cylindrella* by Messrs. Harris and Burrows in 1891, and their substitution of a new name for the group. Upon compiling a list of the generic and subgeneric names which have been applied to species of "Cylindrella," it became obvious that a thorough taxonomic revision was urgently needed. In order to ascertain which of the numerous names should be retained as valid, to place these upon a solid basis, and to reduce the remainder to synonyms, it was found necessary to supplement a review of the literature of the group by an examination of the snails themselves, especially with reference to the radulæ, and the internal characters of the shells, revealed by a study of sections cut to expose the internal columella or axis. This detailed examination has been made chiefly by the junior author of this paper.

The characters of the radula have been utilized as a basis for classification by Crosse and Fischer in 1870, their paper marking an epoch in the taxonomic history of this family. W. G. Binney has added to our knowledge of this subject upon the lines laid down by the French writers; and later, Strebel and Pfeffer, in their suggestive and original series of papers upon the Mexican fauna, have made important contributions toward a rational classification of the group. There are many other writings bearing upon the nomenclature of the Cylindrellas, but no others of importance for original facts or views concerning their phylogeny or structure, aside from mere species work.

The external conchologic characters of the Cylindrellas are well known by the writings of Pfeiffer, Poey and others, but the modifications of the internal armature have been far less fully elucidated. A portion of Pfeiffer's descriptions mention briefly the internal structure, and some of the plates of the *Novitates Conchologicæ* and *Malakozoologische Blätter* represent it; and Arango, in his *Contribucion a la Fauna Malacologica Cubana,* notes the internal structure of the Cuban species. Most of these observations, however, are not sufficiently detailed or exact to meet the requirements of the case, now that a classification is based largely upon internal structure; and our own work is therefore founded wholly upon the study of a series of sections including nearly every species in the collection of the Academy.

Without entering into any elaborate exposé or criticism of the work of former authors upon the Cylindrellas, attention should be directed to the contention of Crosse & Fischer[1] and later of Fischer[2] that the series should be distributed between two family groups, the *Cylindrellidæ* and the *Pupidæ,* a conclusion based wholly upon the structure of the teeth and jaws; the first family having greatly modified teeth and plaited jaw, the second having normal dentition and solid jaw.

That this splitting of the Cylindrellas into two is an unnatural division, seems to us to be proven by the following considerations: (1) The discovery of completely Cylindrelloid shells (*Epirobia*) with the "normal" type of teeth. (2) The presence of transition stages in the teeth in the genus *Holospira,* and (3) the recent demonstration by the senior author of this paper[3] of the rapid changes undergone by the teeth of some genera under the stress of changed habits, without corresponding changes in the rest of the anatomy, as seen in *Papuina, Polymita,* etc. (4) The general law of change in the structure of the jaw, as illustrated in the families *Endodontidæ* and *Helicidæ,* must now be recognized as largely discounting the old value placed upon that organ as a factor in systematic malacology; and in any family of snails we may expect to find both the more primitive plaited and the later solid type of jaw. The final reason for rejecting the idea that any of the group under consideration are *Pupidæ,* is that none of them, so far as known, possess the extremely characteristic complication of the male genital organs found in *Pupa, Buliminus, Clausilia,* and their immediate allies, and which constitute one of the most important characters of the family *Pupidæ.*

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[1] Journ. de Conchyl., 1870.

[2] Manuel de Conchyliologie.

[3] Manual of Conchology (2), IX, introduction and portions relating to arboreal Helices.

Our further observations upon the family may be grouped under five heads :—

I. Names applied to generic and minor groups of Cylindrelloid snails.

II. Key to the genera and subgenera.

III. Classified lists of the species with zoo-geographic and other notes.

IV. Brief sketch of other genera of the family.

V. Provisional phylogenetic diagram and table of geographic distribution.

I. CHRONOLOGICAL LIST OF NAMES APPLIED TO CYLINDRELLOID SNAILS.

(Exclusive of those pertaining to *Lia*, *Macroceramus*, *Holospira*, and other generally recognized genera).

1822 (or earlier). COCHLODINA Férussac, Tableau Systematique, etc., p. 24, 61.

Under *Helix*, Férussac establishes a "Quatorzième sous-genre. Cochlodine, *Cochlodina* nobis." The subgeneric definition applies better to *Clausilia* than to the other forms included by Férussac in the group; and, indeed, seems to be based wholly upon that genus. The species of *Cochlodina* are classified as follows :—

*Shell dextral.

† Aperture without teeth or laminæ.

1. Peristome not continuous.

Premier groupe. Les Pupoides, *Pupoides*.

493 *carinata* Gmel. [=*Macroceramus lineatus* Brug.].
494 *nebulosa* nobis. [*nomen nudum*].
495 *ignifera* nobis. [*nomen nudum*].

2. Peristome continuous.

Deuxième groupe. Les Trachèloides, *Tracheloides*.

496 *sloanii* nobis. [*nomen nudum*].
497 *draparnaldi* nobis. [*nomen nudum*].
498 *petiveriana* nobis. [probably=*C. eximia* Pfr.].
499 *blainvilliana* nobis. [*nomen nudum*].
500 *cylindrus* Chemn. [=*Cylindrella*].
501 *rosata* nobis. [*nomen nudum*].
502 *truncata* Dillw. [Undeterminable ?=*Megalomastoma*].
503 *fasciata* Lam. [Undeterminable ?=*Megalomastoma*].

504 *tortuosa* Chemn. [= *Tortulosa tortuosa*, an oriental operculate).
505 *gracilicollis* nobis. [*nomen nudum*].
506 *perplicata* nobis. [*nomen nudum*].
507 *collaris* nobis. [= *Cylindrella*].
508 *subula* nobis. [*nomen nudum*].
509 *antiperversa* nobis. [*nomen nudum*].

†† Aperture armed with large folds or long teeth.

510 *gargantua* nobis [*nomen nudum* = *Odontostomus*].

** Shell sinistral.

1. Aperture without laminæ.

Troisième groupe. Les Anomales, *Anomales; Pupa* Drap.

511 *perversa* L. [= *Balea*].
512 *chemnitziana* nobis. [*Cylindrella elongata* Chemn.].

2. Aperture armed (with laminæ or an elastic operculum).

Quatrième groupe. Les Clausilies, *Clausiliæ;* genre *clausilie* Drap.

[Includes the species of *Clausilia*, with some *nomina nuda* perhaps pertaining to other groups].

It will be seen that *Cochlodina* is a miscellaneous group, including species of at least six modern genera, all of which have since been named. Under these circumstances it had better be left as a synonym of *Clausilia*, as the diagnosis precludes its use for any of the other groups included.

1828. Brachypus Guilding, Zool. Journal, III, p. 167. Proposed for *B. costatus* Gldg. Preoccupied in *Aves* by Swainson, 1824, and in *Diptera* by Meigen in the same year.

1837. Urocoptis Beck, Index Moll., p. 83. Species, *petiverana* Fér., *blainvilliana* Fér., *cylindrus* Ch., Dw. and Wood; *rosata* Fér., *glandula* B., *abbreviata B.*, *coarctata B.*, List H., XXI, 17; *truncatula* Lam. (*Clausilia*), *gracilicollis* Fér.

J. E. Gray, in Proc. Zool. Soc. Lond., 1847, p. 177, selects "*Turbo*" *cylindrus* as type. This would make the group equivalent to *Thaumasia* Alb. a later name. Von Martens, in Die Heliceen, 1860, names *decollata* Nyst as type. This species belongs to Crosse and Fischer's later group *Eucalodium;* and as it does not appear in Beck's original list of species, must be rejected from the group. *Urocoptis* is the earliest tenable name for any genus of the family.

1837. Brachypodella Beck, Index Moll., p. 89. Proposed for *perplicata* Fér., *collaris* Lam., *subula* Fér., *antiperversa* Fér.

1837. Apoma Beck, Index Moll., p. 89. For *elongata* Chemn. (*chemnitziana* Fér.). Gray, 1847, and Mörch, 1852, retain the name for this species.

1840. Cylindrella Pfeiffer, Archiv für Naturg., p. 41. For the following species:

Gracilicollis Fér. [a *Brachypodella*] *collaris* Lam. [a *Brachypodella*] *antiperversa* Desh. [a *Brachypodella*], *subula* Desh. [type of the later group *Mychostoma* Alb.], *perplicata* Fér. [a *Brachypodella*], *chemnitziana* Desh. [type species of the earlier group *Apoma* Beck], *elegans* Pfr. [type of the later group *Gongylostoma* Alb.], *crispula* Pfr. [a species of the later group *Gongylostoma*], ? *torticollis* (Oliv.) Lam. [=*Clausilia* of the section *Bitorquata* Bttg.].

Another *Cylindrella*, in *Conidæ*, was proposed in 1840 by Swainson (Malacology, p. 311), and still again, for the group now generally known as *Cylichna* (*t. c.* p. 326. See Man. of Conch., XV, p. 287). It is now, so far as we know, impossible to decide whether Pfeiffer's group was published prior to Swainson's or *vice versa*. Cossmann has proposed to substitute the term *Distæctria* (*q. v.*) for *Cylindrella* Pfr. As *Cylindrella* is later than both *Urocoptis* and *Brachypodella*, and the same name was used in the same year for two other groups, we reject it from the nomenclature of this family.

1840. Siphonostoma Swainson, Treatise on Malacol., pp. 168, 333. For *costata* Gldg. and *fasciata* (Encycl. Meth., pl. 461, f. 17). Name preoccupied by Voigt in Vermes, 1836 ; also used in Rotifera, 1832.

1847. Brachypodisca Agassiz, Nomenclator Zool., Index Universalis, p. 51. An emendation, upon etymological grounds, of *Brachypodella* Beck.

1850. Thaumasia Albers, Die Heliceen, p. 207. Proposed for *decollata* Nyst, *liebmanni* Pfr., *gruneri* Dkr., *cylindrus* Chemn., *sanguinea* Pfr., *brevis* Pfr., *binneyana* Pfr.

The two first species belong to *Eucalodium*, the rest to the Jamaican and Haytien group of large *Cylindrellas*. Name preoccupied by Perty in Arachnida, 1830. *Spartina* (*q. v.*) has been proposed as a substitute, but it is superfluous, as the group is a synonym of *Urocoptis* Beck, 1837.

1850. Mychostoma Albers, Die Heliceen, p. 207. Proposed for *subula* Fér., *collaris* Fér., *gracilicollis* Pfr., *hanleyana* Pfr., *pallida* Guild., *seminuda* Adams.

In the second edition of Die Heliceen, 1860, p. 37, von Martens selects *C. subula* as type.

1850. GONGYLOSTOMA Albers, Die Hel., p. 208. Proposed for *sowerbyana* Pfr., *humboldtiana* Pfr., *rosea* Pfr., *variegata* Pfr., *elegans* Pfr., *crispula* Pfr., *sagraiana* Pfr., *porrecta* Gould, *philippiana* Pfr.

From this list of species, von Martens selected *elegans* as the type, in Die Heliceen, 1860, p. 38.

1850. CASTA Albers, Die Heliceen, p. 208, proposed for *elongata* Ch. and *gracilis* Wood, the former selected as type by von Martens, 1860. This group is absolutely equivalent to *Apoma* Beck, 1837.

1852. STROPHINA Mörch., Catal. Yoldi, p. 35. Proposed for *laterradii* Grat. only.

1853. TRACHELIA Pfr., Monogr. Hel. Viv., III, p. 564. Proposed for *marmorata* Shutt., *volubilis* Morel., *porrecta* Gld., *gracillima* Poey, *speluncæ* Pfr., *subtilis* Morel., *gouldiana* Pfr., *rugeli*, Shutt., *riisei* Pfr., *cinerea* Pfr., *morini* Morel., *philippiana* Pfr., *scalarina* Shutt.

These are mainly slender *Brachypodella* species. Name preoccupied by Scopoli in Aves, 1777, by Serv. in Coleoptera, 1834, and by Westwood in Coleoptera, 1839. It is, therefore, rejected from molluscan nomenclature.

1870. CALLONIA Crosse & Fischer, Journal de Conch., 1870, p. 18. Based upon one species, *Cyl. elliotti* Poey.

1880. EPIROBIA Strebel & Pfeiffer, Beitr. zur Kenntniss der Fauna Mex. Land- und Süsswasser-Conch., Theil IV, pp. 77, 85. Proposed for *Cylindrella berendti*, *polygyra*, *morini* (not of Morelet), *apiostoma*.

This is a valid genus, well distinguished by the dentition and hollow axis.

1891. DISTÆCTRIA Cossmann in Harris and Burrows, Eoc. and Oligoc. Beds Paris Basin, pp. 100, 114. Proposed as a substitute for *Cylindrella* Pfr., no reason being given for the change. By reference to the list of species originally assigned to *Cylindrella*, it will be seen that long before the year 1891, every one was amply provided with generic names, *Gongylostoma* Alb. and *Brachypodella* Beck including all of them. The name *Distæctria*, therefore, falls as a synonym. Being of even date with *Spartina* Harr. & Burr. (*q. v.*), it might possibly dispute supremacy with that term as a generic name for "*Cylindrella*" *parisiensis* Desh.; but it is obvious that that species (which, in our opinion, is not a Cylindrella nor a member of the same family), does not require both a generic and subgeneric name.

1891. SPARTINA Harris & Burrows, The Eocene and Oligocene Beds of the Paris Basin, pp. 100, 113 (Sept. 23, 1891). Proposed as a substitute for *Thaumasia* Alb., 1850 (not Perty, 1830–1834).

As *Thaumasia* is based partly on species of *Eucalodium* (Crosse & Fischer, 1868), and partly on species of *Urocoptis* (Beck, 1837), the name *Spartina* falls as a synonym under these groups, unless, indeed, it be retained for the Paris Basin Eocene species described by Deshayes as "*Cylindrella*" *parisiensis*, which is the only species mentioned under *Spartina* by Harris and Burrows. See under *Distæctria.*

II. ANALYTICAL KEY TO CYLINDRELLOID GENERA AND THEIR SUBDIVISIONS.

(Exclusive of the generally recognized genera *Lia*, *Macroceramus*, *Eucalodium*, etc.).

I. Axis of the shell a solid, not perforated, column; teeth of the radula very peculiar, the centrals very narrow, laterals with gouge-shaped cusps.

- *a.* Radula with large posterior cusps (ectocones) upon all of the side teeth, which are of similar form, gradually becoming smaller from the inner to the outer edge of radula, generally with no abrupt break in size between lateral and marginal teeth; rows slanting, "*en chevron*" (Pl. XVII, fig. 5). Genus UROCOPTIS Beck.
  - *b.* Axis slender and simple, without spiral laminæ or other processes. Subgenus UROCOPTIS.
    - *c.* Shell large, stout and fusiform; axis straight. Section *Urocoptis* s. s.
    - c^1. Shell small, thin and fusiform; axis straight. Section *Cochlodinella* P. & V.
    - c^2. Shell small, pillar-shaped; axis sigmoid below. Section *Spirostemma* P. & V.
  - b^1. Axis with a single, strong, smooth spiral lamina, median in each whorl. Subgenus ARANGIA P. & V.
  - b^2. Axis with two series of hooks curving toward each other, or with a series of oblique nodes or ribs. Subgenus IDIOSTEMMA P. & V.
  - b^3. Axis with a single stout spiral fold crenulated at the edge. Section *Maceo* P. & V.
  - b^4. Axis with one or several spiral laminæ, the lower of

which is cut into teeth or crenulated, *at least in the earlier whorls.* Subgenus GONGYLOSTOMA Alb.

c. Three to seven spiral laminæ developed, increasing in size from the upper to the lowest one, which is largest. Section *Pycnoptychia* P. & V.

c[1]. Three laminæ, the lowest smallest, upper largest. Section *Callonia* C. & F.

c[2]. Two subequal spirals; a median whorl with accessory laminæ upon the upper and basal walls. Section *Sectilumen* P. & V.

c[3]. Two spirals, the lower dentate in upper whorls, and in an intermediate whorl expanding into a very broad, flat or cup-like plate. Section *Esochara* P. & V.

c[4]. Two gradually increasing spirals, the lower crenulate or denticulate; sometimes a short, low, third spiral interposed in an intermediate whorl. Section *Gongylostoma s. str.*

c[5]. Two strong, subequal spirals, both crenulated or denticulate (Haiti). Section *Amphicosmia* P. & V.

c[6]. One incised or denticulate lower lamina with sometimes a smaller one above it. Section *Tomelasmus* P. & V.

a[1]. Radula with the posterior cusp (ectocone) sub-obsolete or wanting on the first or both lateral teeth; two laterals on each side enormously developed, the marginals abruptly smaller, narrow, probably functionless, with vestigial cusps; arranged in horizontal lines (Pl. XVII fig. 4). Axis of the shell without laminæ.

Genus BRACHYPODELLA Beck.

b. Inner lateral tooth with a vestigial posterior cusp (ectocone) without cutting point; outer lateral with cutting point developed on the ectocone. Subgenus BRACHYPODELLA.

c. Axis slender throughout, rarely with a small spiral fold; shell slender and elongate. Section *Brachypodella* s. str.

c[1]. Axis strong, heavily calloused; shell obese. Section *Strophina* Mörch.

b^1. Inner lateral tooth with no ectocone; that of the outer lateral without cutting point. Species all Jamaican.

c. Axis slender, straight; last whorl of shell becoming free, and keeled below; aperture subcircular, angular below, as wide as high.

d. Shell small, narrowly fusiform, with strongly ribbed whorls. Section *Geoscala* P. & V.

d^1. Shell slender, pillar-like, white and smooth, of many narrow whorls.
Section *Mychostoma* Alb.

c^1. Axis a mere edge of contact between whorls; shell white, sinistral, slender, of many oblique whorls, the last not free; aperture oval, longer than wide. Section *Apoma* Beck.

II. Axis of the shell a hollow column; radula of normal form and arrangement; central teeth tricuspid, short and wide; laterals numerous, similar, bicuspid; marginals wide, very short, multicuspid (Pl. XVII, fig. 2).

a. Shell very slender and elongate, thin, not conspicuously calcareous, the axis subcylindrical or bulging in each whorl, usually rugose. Genus EPIROBIA S. & P.

a^1. Shell stout, pupiform, with entire spire, conspicuously calcareous, etc., etc. Genus HOLOSPIRA Mart.

III. CLASSIFIED LISTS OF SPECIES.

As the groups defined by us in the preceding table of classification differ radically in limits from those hitherto accepted, it is necessary to supplement the characterization of the genera and subgenera by detailed lists of species. These lists contain only species whose characters we have ascertained by the examination of sections. Those we have not been able to examine are omitted,[4] although a large part of them could doubtless be approximately grouped by the published information.

The names of species of which the radula is known are distinguished by the following symbols: "(C F)" after the name of a species indicates that the dentition has been examined by Crosse &

[4] The lists are, therefore, a catalogue of the species in the collection of the Academy, excluding a considerable number of doubtful, unidentified or new species. Any forms not mentioned herein we will be glad to receive and offer an exchange for.

Fischer;[5] "(B.)" that it has been examined by W. G. Binney;[6] "(S P.)" by Strebel & Pfeffer;[7] "(P V.)" by ourselves.

Genus **UROCOPTIS** Beck.

This genus is restricted to Cuba, Jamaica and Haiti, with a few stragglers from the Cuban fauna in south Florida. It is practically a group of the Greater Antilles. The typical forms, with the axis simple, are the most widely spread and probably the oldest type. The large, stout forms being a local development common to Jamaica and Haiti.

The forms with spiral folds or other ornamentation of the axis are confined to Cuba and the adjacent portion of Haiti. There is every reason to believe them autochthonous to Cuban soil, a few species recently spreading eastward.

This genus shows the bond between Jamaica and Haiti to be rather stronger than between Cuba and Haiti, the Cuban groups occurring in Haiti being represented by very few species, and these restricted to the extreme western end of the island.

The elements common to Jamaica and Cuba are the more generalized and presumably older sectional groups of the genus.

Respecting the habits and environment of the Jamaican Cylindrellas of both the genera *Urocoptis* and *Brachypodella*, Mr. Charles T. Simpson writes of the experiences of Mr. J. B. Henderson and himself, as follows: "*C. sanguinea, rosea, obesa, cylindrus, aspera, brevis* and allied forms live on the ground among the scrub and dead leaves, and are of just about the color of their surroundings. We found *C. nobilior* abundant in a talus of decomposed shaly rock at Bogwalk, of which it was almost exactly the color. *C. seminuda, alba* and *robertsi* are found in the crevices of craggy limestone rocks, among cliffs. *C. rubra* and *tenella* live in the ground in thickets where there is abundance of dead and decaying wood. *The shells, in form and color, always look exactly like pieces of broken twigs*, which are found abundantly with them, and it was a long time before Henderson and I found a single specimen. They are very abundant though in proper localities. *C. gracilis* Wood grows invariably on the trunks and stems of trees in thick scrub. These trees have grayish or whitish spotted bark; the little rascals attach themselves to it by the foot and stand out with the shell nearly at

[5] Journal de Conchyliologie, 1870.
[6] Ann. N. Y. Acad. Sci., III.
[7] Beitr. Mex. Moll.

right angles to the trunk or limb, and as the shell is always more or less dirty, the resemblance to a thorn is so astonishing that we doubtless passed by thousands of them, never dreaming for a moment that they were Cylindrellas."

Mr. Uselma C. Smith found *B. elongata* living on limestone cliffs, upon which the white shells hung like stalactites, for which he at first mistook them.

Subgenus **Urocoptis** Beck.

Type *U. cylindrus* (Chemn.), Pl. XVIII, fig. 11 (axis) and Pl. XVII, fig. 5 (dentition).

Section Urocoptis, s. s.

Species of Jamaica.

U. amethystina (Chitty).
U. aspera (Ad.).
U. baquieana (Chitty).
U. brevis (Pfr.) [C F.].
U. carnea (Ad.).
U. cylindrus (Chemn.).
U. gravesii (Ad.).
U. lata (Ad.).
U. megacheila (Chitty).
U. nobilior (Ad.).
U. procera (Ad.).
U. rosea (C. B. Ad. not Pfr.) [C F., B., S P., P V.].
U. sanguinea (Pfr.) [C F.].
U. zonata (Ad.).

Species of Hayti.

U. adamsiana (Pfr.).
U. arcuata (W. & M.).
U. crenata (W. & M.).
U. eugenii (Dohrn).
U. eximia (Pfr.).
U. flammulata (Pfr.).
U. gruneri (Pfr.).
U. guigouana (Petit).
U. mabuja (Weinl.).
U. malleata (Pfr.).
U. menkeana (Pfr.).
U. puncturata (Pfr.).

Section Cochlodinella Pils. & Van.

Type *U. poeyana* (Orb.). Radula with 12.1.12 teeth, which are typical for the genus in form, but decrease rather rapidly.

Species of Cuba and Florida.

U. angulifera (Gundl.).
U. atropurpurea (Arango).
U. goniostoma (Gundl.).
U. illamellata (Wright).
U. jejuna (Gld.).
U. lactaria (Gld.).
U. mamillata (Wright).
U. mixta (Wright).
U. paradoxa (Arango).
U. poeyana (Orb.) [B., P V.].
U. presasiana (Pfr.).
U. variegata (Pfr.).

Species of Jamaica.

U. augustæ (C. B. Ad.).
U. hollandi (C. B. Ad.).
U. hydrophana (Chitty).
U. pupæformis (C. B. Ad.).
U. striata (Chitty).

Section SPIROSTEMMA Pils. & Van.

Type *U. rubra* (C. B. Ad.), Pl. XVIII, fig. 12. The species are all Jamaican.

U. dunkeriana (Pfr.).
U. montana (C. B. Ad.).
U. princeps (C. B. Ad.).
U. pusilla (C. B. Ad.).
U. rubra (C. B. Ad.).
U. similis (C. B. Ad.).
U. tenella (C. B. Ad.).
U. tenera (C. B. Ad.).

Subgenus **Arangia** Pils. & Van.

Type *C. sowerbiana* Pfr., Pl. XVIII, fig. 20. Subgeneric name in memory of the Cuban naturalist, Rafeal Arango.

U. sowerbiana Pfr., Cuba.
U. monticola Weinl. Gonave I.

Subgenus **Idiostemma** Pils. & Van.

Type *C. uncata* Gundl., Pl. XVII, fig. 10.

A Cuban group, containing some of the most peculiar species of the genus. There is a series of species leading by gradual stages from the axial pairs of hooks of the typical forms to the oblique nodes or ribs of *U. lateralis*, etc.

U. uncata (Gundl.).
U. perlata (Gundl.) [C F., P.V.]
U. lævigata (Gundl.).
U. intusmalleata (Gundl.).
U. geminata (Pfr.).
U. fastigata (Gundl.).
U. lineata (Gundl.).
U. lateralis (Paz.) [P V.].

Section MACEO Pils. & Van.

Radula with the teeth very rapidly decreasing, the third decidedly smaller than second, formula about 8.1.8. Subgeneric name in honor of a Cuban patriot.

U. interrupta (Gundl.) [P V.], Cuba. Pl. XVII, fig. 7.

Subgenus **Gongylostoma** Albers.

Section PYCNOPTYCHIA Pils. & Van.

Type *U. humboldtiana* (Pfr.), Pl. XVIII, fig. 14. Species all Cuban.

U. humboldtiana (Pfr.) [B.].
U. oviediana (D. Orb.).
U. scæva (Gundl.) [C F.].
U. shuttleworthiana (Poey).
U. striatella (Wright).
U. trilamellata (Pfr.).
U. vignalensis (Wright) [C F].

Section CALLONIA Crosse & Fischer.

Type *C. elliottii* Poey. Radula typical. See Pl. XVIII, fig. 18, *U. dautzenbergiana* (Crosse). Species all Cuban.

We have enlarged the group of Crosse and Fischer to include other Cuban species having the same internal structure and dentition.

Species elaborately sculptured with hollow ribs:—

U. elliottii (Poey) [C F.].
U. dautzenbergiana (Crosse) [P V.].

Somewhat smooth species:—

U. brunnescens (Gundl.).
U. clara (Wright).
U. guirensis (Gundl.).
U. infortunata (Arango).
U. notata (Gundl.).
U. vincta (Gundl.).
U. saxosa (Poey).

Species with beaded suture:—

U. albocrenata (Gundl.)

Section SECTILUMEN Pils. & Van.

U. ornata (Gundl.) [B., P V.]. Cuba. Pl. XVII, fig. 9.

Section ESOCHARA Pils. & Van.

Type *U. strangulata* (Poey), Pl. XVIII, fig. 15. Distribution, Cuba.

U. fabreana (Poey) [P V.].
U. strangulata (Poey).
U. teneriensis (Wright).

Section GONGYLOSTOMA Albers (restricted).

Type *U. elegans* (Pfr.), Pl. XVIII, fig. 17 (variety). Also Pl. XVIII, fig. 16, *U. pruinosa*. Distribution, Cuba.

U. artemesiæ (Gundl.).
U. auberiana (D. Orb.).
U. concreta (Gundl.).
U. coronadoi (Arang).
U. crispula (Pfr.).
U. elegans (Pfr.) [B., P V.].
U. fortis (Gundl.).
U. gutierezi (Arango).
U. lavalleana (Orb.).
U. obliqua (Pfr.).
U. planospira (Pfr.).
U. pruinosa (Morel.) [P V.].

Section TOMELASMUS Pils. & Van.

Type *U. torquata* (Morel.), Pl. XVII, fig. 8; also Pl. XVIII, fig. 13, *U. wrighti* var. Radula typical. Species all Cuban.

U. aculeus (Morel.).
U. acus (Pfr.).
U. adnata (Pfr.).
U. affinis (Pfr.) [P V.].
U. angustior (Wright).
U. arcustriata (Wr.).
U. assimilis (Arango).
U. capillacea (Pfr.).
U. coerulans (Poey).
U. colorata (Arango).
U. crenulata (Gdl.).
U. crystallina (Wright).
U. decolorata (Gundl.).
U. diaphana (Wright).
U. discors (Poey).
U. fibrosa (Gundl.).
U. fusiformis (Wr.).
U. garciana (Wright).
U. heynemani (Pfr.).
U. hidalgoi (Arango).
U. hilleri (Pfr.) [P V.].
U. incerta (Arango).
U. integra (Pfr.).
U. irrorata (Gundl.).
U. macra (Wright).
U. plumbea (Wright).
U. producta (Gundl.).
U. sauvalleana (Gundl.) [P V.].
U. scabrosa (Gundl.).
U. thomsoni (Arango).
U. torquata (Morel.).
U. unguiculata (Arango).
U. ventricosa (Gundl.) [P V.]
U. violacea (Wright).
U. wrighti (Pfr.).

Section AMPHICOSMIA Pils. & Van.

Type *C. salleana* Pfr., Pl. XVIII, fig. 22.

Proposed for three San Domingo species in which the columella bears two spiral laminæ, *both* finely denticulate.

U. salleana (Pfr.).
U. hjalmarsoni (Pfr.).
U. gracilicollis (Auct.).

Genus **BRACHYPODELLA** Beck, 1838.

In this genus the radula is more highly specialized than in *Urocoptis* and the shell generally less so, internal armature of the axis being entirely absent, or limited to a weak, scarcely noticeable, spiral fold above.

The geographic range of *Brachypodella* includes not only the territory occupied by *Urocoptis*, but surpasses it on all sides: in the Bahamas on the north, the Virgin group on the east, the whole Caribbean chain and northern border of South America on the south, and west and southwest is sparsely distributed over Central America and southeastern Mexico.

The distribution of the minor groups is suggestive. The Jamaican sections form a group by themselves characterized by the extremely aberrant dentition as well as the modified shells. The species of other islands and the mainland are decidedly less specialized, and show but a small amount of variation in general appearance. The section *Strophina* has the dentition of typical *Brachypodella.*

Section Brachypodella *s. s.*

Type *B. antiperversa* Fér.

This subgenus has a less specialized radula and wider geographic range than the others. The species are all small, mainly quite slender forms, for the most part not exhibiting great variety of form; but two exceptions may be noticed: *B. brooksiana* of Cuba, and some related species, have the neck enormously drawn out; while in some of the continental forms there is a weak spiral lamina upon the pillar.

Continental Species: Tabasco and Yucatan to Venezuela.

B. bourguignatiana (Ancey).
B. hanleyana (Pfr.).
B. morini (Morel.).
B. speluncæ (Morel.).
B. speluncæ var. *dubia* (Pils.).
B. subtilis (Morel.).

Insular species: Curacao and Trinidad to Porto Rico.

B. raveni (Bld.). Curacao.
B. trinitaria (Pfr.) [P V.]. Trinidad.
B. costata (Gldg.) [C F.]. Barbados.
B. antiperversa (Fér.) [P V.]. Guadeloupe.
B. collaris (Auct.) [P V.]. Guadeloupe, Martinique.
B. pallida (Gldg.). St. John, Tortola, St. Thomas, Porto Rico.
B. chordata (Pfr.). St. Croix.
B. portoricensis (Pfr.). Porto Rico.
B. riisei (Pfr.) [P V.]. Porto Rico.

Greater Antilles—Haiti.

B. dominicensis (Pfr.).
B. gouldiana (Pfr.).
B. obesa (Weinl. & Mts.).
B. smithiana (Pfr.).
B. weinlandi (Pfr.).

Greater Antilles—Cuba.

B. blainiana (Gundl.).
B. brooksiana (Gdl.) [C F., P. V.].
B. camoensis (Pfr.).
B. capillacea (Pfr.).
B. cyclostoma (Pfr.) [B., P V.].
B. modesta (Poey).
B. philippiana (Pfr.).
B. plicata (Poey) [P V.].
B. porrecta (Gld.).
B. rugeli (Shutt.).
B. scalarina (Shutt.).

B. gracillima (Poey).
B. gundlachiana (Poey).
B. marmorata (Shutt.).
B. minuta (Gundl.).
B. scopulosa (Gundl.).
B. sexdecimalis (Jien.).
B. soluta (Pfr.).
B. turcasiana (Gundl.).

Bahamas.

B. bahamensis (Pfr.). New Providence, [C F., P V.].

Section STROPHINA Mörch.

B. laterradii (Grat.) [P V.]. San Domingo.

Section GEOSCALA Pils. & Van.

Type *B. seminuda* (C. B. Ads.).

A Jamaican group similar to some Brachypodellas except in the dentition, which is of the highly evolved type seen in *Mychostoma*. The shell differs from this last group in being fusiform, fewer whorled and strongly costate.

B. seminuda (C. B. Ad.) [B., P V.].
B. costulata (C. B. Ad.).
B. inornata (C. B. Ad.).
B. robertsi (C. B. Ad.).

Subgenus **Mychostoma** Albers.

Mychostoma Alb., Die Hel. (edit. 1), p. 207. All species are Jamaican.

B. agnesiana (C. B. Ad.) [C F., P V.].
B. alba (Ad.).
B. alabastrina (Pfr.).
B. pearmaniana (Chitty).
B. subula (Fér.) [B.].

Subgenus **Apoma** Beck.

Apoma Beck, Index Moll., p. 89.

Casta Alb., Die Hel., p. 208.

A very distinct group, containing two sinistral Jamaican species. Type *Turbo elongatus* (Wood), Pl. XVIII, fig. 21.

Von Martens objects to the name *Apoma* because of its inapplicability as implying that other allied groups should be operculated; but it was obviously given to direct attention to the most conspicuous difference between this group and *Clausilia*, and from this point of view is eminently appropriate.

B. gracilis (Wood) [C F., S P.].
B. elongata (Chemn.) [B., P V.].

Genus **ANOMA** Albers.

1850. *Anoma* Alb., Die Heliceen, p. 209, for *acus* Pfr., *gossei* Pfr., *tricolor* Pfr. (the last selected as type by von Martens, Die Hel. 2d edit., 1860, p. 269). Not *Anomus* Fairm. Hemiptera 1846.

1850. *Leia* Albers, Die Hel., p. 207. Sole species *L. maugeri* Wood. Not *Leia* Meigen in Diptera, 1818, nor Meg., Coleoptera, 1821.

1852. *Lia* Mörch, Catal. Yoldi, p. 35. Sole species *L. maugeri.* Not *Lia* Esch., in Coleoptera, 1829.

1869. *Inliaculus* Schaufuss, in Paetel's Moll. Syst. et Catal., p. 15.

1894. *Vendrysia* Simpson, Proc. U. S. Nat. Mus., xvii, p. 430. Substitute for *Leia.*

Distribution, Jamaica; mountains of the interior.

Of the several names proposed for this group, *Anoma* has priority. It has the disadvantage of being preceded by *Anomus,* which some writers would hold to be identical. Those adhering to this view will adopt the name *Inliaculus* of Schaufuss; but pending some concerted action upon this point in "nymology" the oldest name may be allowed to stand.

The dentition (Pl. XVII, figs. 3 and 6, *A. maugeri*) is extremely peculiar, differing from that of *Urocoptis* in having the cusps of the teeth serrate.

A. maugeri (Wood).	*A. zebrina* (Pfr.).
A. blandiana (Pfr.).	*A. tricolor* (Pfr.).
A. macrostoma (Pfr.).	*A. gossei* (Pfr.).

Genus **MACROCERAMUS** Guilding.

1822. *Cochlodina, 1re groupe, Pupoides* Fér., Tabl. Systematique, p. 24, 61.

1828. *Macroceramus* Guilding, Zool. Journ., IV, p. 168. *M. signatus.*

1850. *Colobus* Alb., Die Heliceen p. 177. Not of Illiger, 1811, Merrian, 1820 (Rept.), or Serv., 1833 (Coleopt.).

For anatomy see Crosse & Fischer, Journ. de Conchyl., 1870, p. 20; Moll. Terr. Mex., I, p. 419. Binney, Terr. Moll., V, p. 384; Ann. N. Y. Acad., III, p. 126. Strebel & Pfeffer, Beitr. Mex. L. u. S.-W. Conch., IV, p. 89.

Preponderantly Antillean, this genus has representatives upon the mainland bordering the Gulf of Mexico from Venezuela to Florida. These peripheral species are apparently all members of the section *Microceramus.* In the West Indies the genus is present on nearly every island, but is especially developed in Cuba, to which *Spiroceramus* is confined. It is poorly represented in Jamaica by a few species of the group *Microceramus,* to which the species of the Bahamas likewise belong.

Synopsis of subgenera.

I. Axis slender, straight and simple.

a. Macroceramus. Shell comparatively solid and large. Type *M. signatus* Gldg.

a'. Microceramus Pils. & Van., (n. s.-g.). Shell smaller, thin. Type *M. floridanus* Pils.

II. Axis with a strong spiral lamina.

Spiroceramus Pils. & Van., (n. s.-g.). Dentition unknown. Type *M. amplus* Gundl.

Genus **PINERIA** Poey.

This small group, originally described from the Isle of Pines, but also occurring in several of the Caribbean Islands, is probably an offshoot of the genus *Macroceramus.* The peculiar features of the external anatomy described by Poey should be re-examined.

Genus **EPIROBIA** Strebel & Pfeffer, 1880.

Epirobia S. & P., Beitrag zur Kenntniss der Fauna mexikanischer Land- u. Süsswasser-Conchylien, Theil IV, pp. 77, 85.

Type *E. polygyra* Pfr. Pl. XVII, fig. 2 (dentition). For figure of the axis, see Strebel, *l. c.*, pl. 14, f. 14.

Many-whorled, slender species of Eastern Mexico, usually retaining the spire intact, differing from *Urocoptis* and *Brachypodella* in dentition and in the hollow axis. Notwithstanding the entirely "Cylindrella"-like aspect of the shell externally, these features unquestionably locate the group near *Holospira* and *Coelocentrum.*

Strebel and Pfeffer referred all of the Mexican Cylindrellas to their group; but it must be restricted by removal of the forms with solid axis, which apparently belong to *Brachypodella.* In addition to the two species mentioned below, *E. berendti* Pfr. [S P.] belongs here, and probably *gassiesi* Pfr. and *swiftiana* Crosse also. The "*E. morini* Morelet," of Strebel & Pfeffer was incorrectly identified, and probably a form of *E. polygyra.*[8] The true *C. morini* is a *Brachypodella* with acutely keeled base.

E. polygyra Pfr. [S P., P V.].

E. apiostoma Pfr.

[8] Since this paper was written, this form has been referred by Dr. von Martens to *C. polygyrella* Mts. It is a true *Epirobia.*

Genus **HOLOSPIRA** von Martens.

This genus, which is confined to the mainland of Mexico and the adjacent States of the Union, offers an interesting series of structures in the internal lamellæ, parallel to those of *Urocoptis*. The principal divergence from that genus is in the frequent development of parietal and basal lamellæ, which are of rare occurrence in the Antillean genera.

Professor Dall,[9] who has ably investigated the subject, gives the following classification, which seems worthy of unqualified approval:—

Subgenus HOLOSPIRA s. s., type *N. pilocerei* Pfr., with section *Bostrichocentrum* Strebel & Pfeffer, *Haplostemma, Eudistemma* and *Distomospira* Dall.

Subgenus METASTOMA Strebel & Pfeffer, type *H. roemeri* Pfr.

Subgenus CŒLOSTEMMA Dall, type *H. elizabethæ* Pilsbry.

The first group includes species with an axial plait and usually various other armature. More or less similar structures occur in *Gongylostoma*. *Metastoma* has the axis simple, as in typical *Urocoptis* and *Brachypodella*. In *Cœlostemma* a swollen, vertically costulate axis is found, unlike any Antillean type, although there is some analogy with the subgenus *Idiostemma* Pils. & Van.

Genus **EUCALODIUM** Crosse & Fischer.

In this Mexican genus the large, solid shell resembles typical *Urocoptis;* the axis is solid and sinuous, with a continuous spiral plait, as in the subgenus *Arangia* P. & V., of *Urocoptis*.

The subgenus *Oligostylus* Pils.[10] has the axis straight and smooth, as in typical *Urocoptis*.

These two types of pillar are exactly paralleled also in the genus *Macroceramus* Gldg. and its subgenus *Spiroceramus* Pils. & Van.

Subgenus **Anisospira** Strebel & Pfeffer.

An eastern Mexican group, of few species. The soft anatomy is still unknown. It seems to be a subgenus subordinate to *Eucalodium.*

Genus **BERENDTIA** Crosse & Fischer.

Like *Spartocentrum,* to which it is closely allied; but with the axis solid, slender and smooth, and the spire tapering, with fewer, more

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[9] Proc. U. S. National Museum, xix, p. 344, 1896.
[10] See Dall, The Nautilus IX, p. 51; Proc. U. S. Nat. Mus. XIX, p. 348.

rapidly widening whorls. The only species, *B. taylori* Pfr., inhabits the table land of Lower California.

Genus **CŒLOCENTRUM** Crosse & Fischer.

The hollow and usually vertically ribbed axis is unlike any of the Antillean types, although radiating spines, such as Dall describes in *C. astrophorea*, recall certain forms of *Gongylostoma*. In the section *Spartocentrum* Dall[11] there is a spiral inflation and no vertical riblets.

Genus **CERION** (Bolt.) Mörch.

See Proc. Acad. Nat. Sci. Phila., 1896, p. 315.

This genus has generally been placed in the neighborhood of *Pupa*, but it is not closely allied to that group in shell characters and is entirely diverse in genitalia. It may possibly belong to the *Odontostominæ* (*Odontostomus*, *Tomigerus*, *Anastoma*) of South America; but we prefer to associate Cerion with the *Holospira* and *Eucalodium* groups of *Urocoptidæ*.[12]

As this genus has been made the subject of special papers by Dr. W. H. Dall and by the present writers, it need only be said here that it differs from the other genera in being strictly littoral in distribution, never straying far from the sea shore. The Miocene forms (*Eostrophia*) are probably aberrant rather than primitive, in lacking parietal and axial laminæ.

Genus **MEGASPIRA** Lea.

A Brazilian group very peculiar in its polygyrate shell with large, rounded nuclear whorls, plicate columella and peculiar internal armature, somewhat recalling *Gongylostoma*, *Idiostemma*, etc. This has been described and figured by Gabb.[13] The dentition we have now examined (Pl. XVII, fig. 1), the radula having been found in a dry shell. There are 28·1·28 teeth, arranged in slightly sinuous transverse rows, and of the type usual in ground snails, much like those of *Eucalodium*, *Berendtia*, etc.

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[11] See Nautilus IX, p. 51 (Sept., 1895), type *Cœlocentrum irregulare* Gabb. The genus *Teneritia* Mabille, Bull. Soc. Philomathique de Paris, (Ser. 8), Vol. IX, p. 79 (1897 or 1898) is a synonym of *Spartocentrum*. Types *Berendtia digueti* and *B. minorina* Mabille. M. Mabille is perfectly right in separating his group from *Berendtia*, but he overlooks the only really important differential character, viz., the hollow axis.

[12] Dall has hinted at the same relationship. See Proc. U. S. Nat. Mus., XIX, p. 347, 348, 1897.

[13] American Journal of Conchology II, p. 64.

Megaspira was placed in the vicinity of *Clausilia* by Deshayes, who thought the internal structure indicated the presence of a clausilium. This inference does not seem justified by the facts of the case, though we are far from denying its possibility; our specimen with the soft parts dried in shows no trace of a clausilium. Upon the whole, it would appear that *Megaspira* is an aberrant member of the *Urocoptidæ*, nearest perhaps to *Eucalodium* among existing genera.

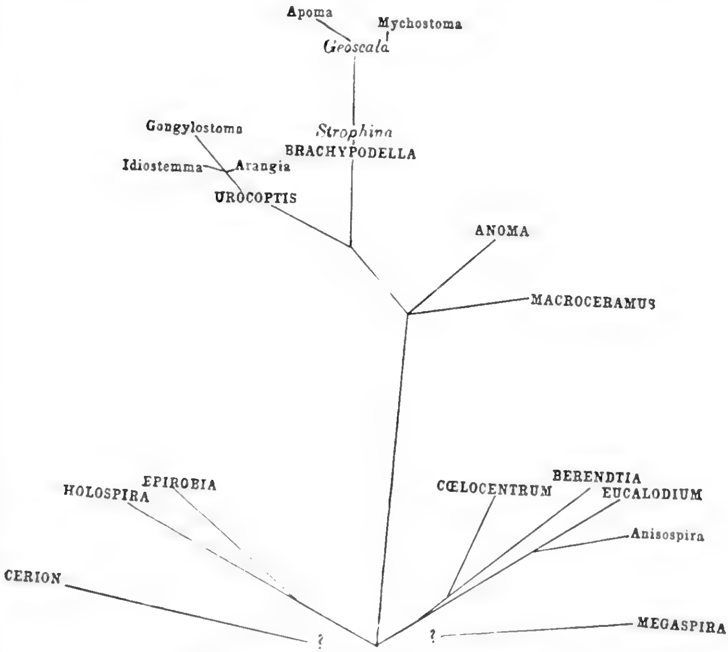
The South African genus *Cœlaxis* and the Papuan and Australian *Perrieria* are somewhat similar to the foregoing American genera, but are doubtless correctly referred to *Pupidæ*, near *Clausilia*. *Perrieria* has a complicated internal armature, only partially worked out by Fischer.

The Colombian *Rhodea* is probably referable to the *Achatinidæ*, grouping near *Subulina* Beck (type *S. octona*).

TABLE SHOWING GEOGRAPHIC DISTRIBUTION OF THE UROCOPTIDÆ.

	Northern South America.	Lower California.	Mexico, Central America.	Caribbean Is.	Porto Rico, Virgin Is.	Haiti.	Jamaica.	Cuba.	Bahamas.	S. Florida.
Genus UROCOPTIS	–	–	–	–	–	*	*	*	–	*
Section *Urocoptis* (restricted)	–	–	–	–	–	*	*	–	–	–
Section *Cochlodinella*	–	–	–	–	–	–	*	*	–	*
Section *Spirostemma*	–	–	–	–	–	–	*	–	–	–
Subgenus *Arangia*	–	–	–	–	–	*	–	*	–	–
Subgenus *Idiostemma*	–	–	–	–	–	–	–	*	–	–
Section *Maceo*	–	–	–	–	–	–	–	*	–	–
Subgenus *Gongylostoma*	–	–	–	–	–	*	–	*	–	–
Section *Pycnoptychia*	–	–	–	–	–	–	–	*	–	–
Section *Callonia*	–	–	–	–	–	–	–	*	–	–
Section *Sectilumen*	–	–	–	–	–	–	–	*	–	–
Section *Esochara*	–	–	–	–	–	–	–	*	–	–
Section *Gongylostoma* (*s. s.*)	–	–	–	–	–	–	–	*	–	–
Section *Amphicosmia*	–	–	–	–	–	*	–	–	–	–
Section *Tomelasmus*	–	–	–	–	–	–	–	*	–	–
Genus BRACHYPODELLA	*	–	*	*	*	*	*	*	*	–
Section *Brachypodella* (*s. s.*)	*	–	*	*	*	*	–	*	*	–
Section *Strophina*	–	–	–	–	–	*	–	–	–	–
Section *Geoscala*	–	–	–	–	–	–	*	–	–	–
Section *Mychostoma*	–	–	–	–	–	–	*	–	–	–
Section *Apoma*	–	–	–	–	–	–	*	–	–	–
Genus EPIROBIA	–	–	*	–	–	–	–	–	–	–
Genus HOLOSPIRA	–	–	*	–	–	–	–	–	–	–
Genus MACROCERAMUS	–	–	*	*	*	*	*	*	*	*
Genus ANOMA (*Lia*)	–	–	–	–	–	–	*	–	–	–
Genus EUCALODIUM	–	–	*	–	–	–	–	–	–	–
Genus COELOCENTRUM	–	*	*	–	–	–	–	–	–	–
Genus BERENDTIA	–	*	–	–	–	–	–	–	–	–
Genus CERION	Curacao.	–	–	–	*	*	–	*	*	*

SUGGESTED PHYLOGENY OF THE GENERA AND PRINCIPAL SUBGENERA OF UROCOPTIDÆ.



EXPLANATION OF PLATES.

Plate XVII.

Fig. 1. *Megaspira elata* Gld. Half of a transverse row of teeth (the outermost marginals placed above, to the left).
Fig. 2. *Epirobia polygyra* (Pfr.). The same, a few outermost marginal teeth lacking.
Fig. 3. *Anoma maugeri* (Wood). Group of teeth from the median part of the radula.
Fig. 4. *Brachypodella* (*Apoma*) *elongata* (Ch.). Half of a transverse row of teeth.
Fig. 5. *Urocoptis cylindrus* (Ch.), very small variety from Portland, Jamaica. Half of a transverse row of teeth.
Fig. 6. *Anoma maugeri* (Wood). A lateral tooth seen in profile.
Fig. 7. *Urocoptis* (*Macro*) *interrupta* (Gundl.). Section of shell.
Fig. 8. *Urocoptis* (*Tomelasmus*) *torquata* (Morel.). Section of shell.
Fig. 9. *Urocoptis* (*Sectilumen*) *ornata* (Gundl.).
Fig. 10. *Urocoptis* (*Idiostemma*) *uncata* (Gundl.).

Plate XVIII.

Fig. 11. *Urocoptis cylindrus* (Chemn.) (*C. rosea* var. *major* C. B. Ad.).
Fig. 12. *Urocoptis* (*Spirostemma*) *rubra* (C. B. Ad.).
Fig. 13. *Urocoptis* (*Tomelasmus*) *wrighti* (Pfr.) var.
Fig. 14. *Urocoptis* (*Pycnoptychia*) *humboldtiana* (Pfr.).
Fig. 15. *Urocoptis* (*Esochora*) *strangulata* (Poey).
Fig. 16. *Urocoptis* (*Gongylostoma*) *pruinosa* (Morel.).
Fig. 17. *Urocoptis* (*Gongylostoma*) *elegans* (Pfr.).
Fig. 18. *Urocoptis* (*Callonia*) *dautzenbergiana* (Crosse).
Fig. 19. *Brachypodella* (*Mychostoma*) *agnesiana* (C. B. Ad.).
Fig. 20. *Urocoptis* (*Arangia*) *sowerbiana* (Pfr.).
Fig. 21. *Brachypodella* (*Apoma*) *elongata* (Chemn.).
Fig. 22. *Urocoptis* (*Amphicosmia*) *salleana* (Pfr.).

CHITONS COLLECTED BY DR. HAROLD HEATH AT PACIFIC GROVE, NEAR MONTEREY, CALIFORNIA.

BY H. A. PILSBRY.

During the summer of 1897 Dr. Heath collected a series of invertebrates and fishes for the Academy, including some twenty-four species and varieties of Polyplacophora. As he has kindly engaged to collect again during the present season, a full report on the Chitons, with illustrations of new, unfigured and unusual forms may be deferred until further specimens come to hand; but it may be well to enumerate the forms already seen, and describe two which seem to be new.

It is evident that the Mopalias require more study than has yet been given them. At Pacific Grove, the typical *muscosa*, typical *lignosa* and typical *Hindsii* occur, without, so far as the series seen shows, any specimens of intermediate character. The reference of these to one species may, therefore, have been premature. A *Mopalia* described below, differs from those hitherto known in the perfectly regular form of the tail valve, which is like that of *Ischnochiton*, thus breaking down, in large measure, the distinction between the *Ischnochitonidæ* and the *Mopaliidæ*. This lawless species is new, and I have given myself the pleasure of associating the name of my friend Dr. Heath with it.

The occurrence of two seven-valved adult monsters is also notable. I shall return to these on a later occasion.

LEPIDOPLEURIDÆ.

Lepidopleurus rugatus Cpr.

Lepidopleurus nexus Cpr.

ISCHNOCHITONIDÆ.

Tonicella lineata Wood.

Trachydermon (Cyanoplax) Raymondi Pils.

A small form of the species, occurring in tide pools.

Trachydermon (Cyanoplax) Hartwegi Cpr.

Ischnochiton radians Cpr.

This species is very similar to *I. interstinctus* Gld., but the teeth are longer and the slits decidedly deeper.

Ischnochiton scabricostatus Cpr. var.

Ischnochiton regularis Cpr.

One specimen has but seven valves, but in all other respects is perfectly normal.

Ischnochiton Mertensii Midd.

Ischnochiton Cooperi Cpr.

Ischnochiton (**decipiens** var.?) **sinudentatus** Cpr.

Ischnochiton (**Stenoradsia**) **Magdalenensis** Hinds.

Callistochiton crassicostatus Pils.

Callistochiton palmulatus var. **mirabilis** Pils.

Chætopleura gemmea Cpr.

Nuttallina Californica 'Nutt.' Rve.

Nuttallina Thomasi Pilsbry, n. sp.

In tide pools with *Tr. Raymondi*. See below.

MOPALIIDÆ.

Mopalia muscosa Gld. Typical.

Mopalia muscosa lignosa Gld. Typical.

Mopalia muscosa Hindsii 'Sow.' Rve. Typical.

Mopalia Heathii Pilsbry. See below.

Mopalia ciliata Sow. Typical.

Placiphorella velata Cpr.

ACANTHOCHITIDÆ.

Katharina tunicata Wood.

Cryptochiton Stelleri Midd.

One full grown specimen is 7-valved, otherwise normal.

Mopalia Heathii n. sp.

Oblong, rather elevated, carinated, with nearly straight side slopes; surface smoothish to the naked eye, lusterless, and in color (1) olive-green with some lighter spots, or purplish maculation, or slight roseate suffusion, or (2) vivid red, with scattered blue spots.

Valves shaped as in *M. lignosa*, but without a median anterior projection of the tegmentum; the intermediate valves very faintly radially trisulcate at the sides, the anterior two grooves defining the low, slight and inconspicuous diagonal rib, the lateral areas not raised; entire surface very finely and evenly granulate, the granules small, rather pointed, separated, intervals very minutely, radially wrinkle-granulate. Anterior valve with a few faint, shallow radial furrows. Posterior valve with semicircular posterior outline, the mucro in front of the middle of tegmentum, profile of the surface in front of it convex, that of the posterior slope decidedly concave.

Interior deep rose color or slightly purplish ; sutural laminæ and sinus about as in *lignosa*. Teeth rather long and somewhat roughened, as in *lignosa*. Valve i with 8 slits ; ii–vii with 1–1 ; valve viii entirely " Ischnoid," with regular, crescentic insertion plate, cut by 7 or 8 slits, which are somewhat closer posteriorly ; no sinus behind.

Girdle leathery, nude except for solitary or two or three closely grouped long bristles at all or part of the sutures, one on each side of the head valve, and two behind the tail valve.

Gills about 25 on each side, not extending quite to the anterior end of the foot.

Length 25, width 12 mm. (dried specimen), or smaller.

In one specimen there are 9 bristles on each side and one in the middle in front. Another lacks this median bristle ; and in still another, some of the sutures are without bristles. In all, some of them are broken off close to the girdle, leaving only stumps or pores.

This form resembles *M. sinuata* and *imporcata* in the sutural bristles, but differs from them in sculpture and form of the tail valve. The latter is completely as in *Ischnochiton*, and its form is approached only by *M. acuta* Cpr., which however has a slight caudal sinus, much stronger sculpture, more depressed and more posterior mucro, and scattered hairs on the girdle, without sutural bristles. It is also blue-green or pale blue inside, while *M. Heathii* is rose colored. One of the specimens was dredged in 17 fms. ; station of the others unknown.

Nuttallina Thomasi n. sp.

General form oblong, rather depressed, not keeled dorsally ; surface granulose when not eroded. Color blackish or dark brown, with a whitish band on each side of the median line of back, or irregular whitish maculation ; girdle dark.

Intermediate valves short and wide, with a slight or hardly noticeable depression on each side of the jugum, and others in front of and behind the scarcely defined, obsolete, diagonal convexity ; the anterior and posterior margins subparallel, slightly arcuate. Anterior valve granulate, without radial ribs, the posterior margin excavated mesially. Posterior valve with tegmentum slightly wider than the anterior, the obtuse mucro somewhat behind the middle.

Interior blue-green, with the area behind the valve-callus dark brown, or livid purplish, with light sutural laminæ and blue-green area behind the sinus. Slits in valve i, 9 or 10 ; valves ii to vii, 1–1 ; valve viii, 10 or 11. Teeth rather separated, those of valve i unequal, slightly rugose outside; posterior tooth of valves ii to vii small, very obliquely directed forward; teeth of valve viii very short, strongly directed forward and roughened. Sinus wide and square, spongy, the area behind it transversely grooved. Eaves rather wide, "spongy" or porous.

Girdle sparsely covered with short, rigid, obtuse, glossy spines of a blackish-brown color, or occasionally some are whitish.

Gills in type specimen, 26 on left, 23 on right side; not quite reaching the anterior end of the foot. In another there are 23 on the left, 25 on the right side.

Length 15, breadth 8 mm., or smaller.

Pacific Grove, in small tide-pools 4 to 8 ft. above mean tide mark.

This species differs markedly from *N. Californica* ('Nutt.' Rve.) and *N. fluxa* (Cpr.)[1] in the shorter valves, lack of radial ribs on the anterior and intermediate valves, and more anterior mucro of the posterior valve, and the single slitting of valves ii to vii. I at first considered it a *Middendorffia*, but the girdle is like that of *Nuttallina*, not having the peculiarly modified spines of the Mediterranean *Middendorffia*. It lives with a small form of *Trachydermon* (*Cyanoplax*) *Raymondi*, which is much more numerous in the tide-pools. From that species it may be known by the spiny girdle. Nearly all the specimens collected are much eroded.

This species may be considered the type of a new subgenus of *Nuttallina*, with the following differential characters: Intermediate valves with 1–1 slits; anterior valve not radially ribbed; posterior valve with the mucro post-median, but not terminal. Other characters as in *Nuttallina*.

At Mr. Heath's request, it is named in honor of Mr. Thomas, who found the first specimens.

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[1] =*Ch. scaber* Rve., 1847, not of Blainville, 1825.

NOTES ON MR. THOMAS MEEHAN'S PAPER ON THE PLANTS OF LEWIS AND CLARK'S EXPEDITION ACROSS THE CONTINENT, 1804–06.

BY DR. ELLIOTT COUES.

Many years ago I prepared for publication in these *Proceedings* a paper on the plants of Fort Macon, N. C. It never appeared, because I submitted it to Professor Asa Gray, who told me it was a very good one, but asked me what was the use of printing it. Taking the hint to heart, I have from that day to this curbed any aspirations I may have felt to botanical authorship; and it now behooves me to explain why I presume to have anything to say on a botanical subject. In fact, I do not now write on Lewis and Clark's plants, but solely on the localities where their plants were procured. I do not pretend to any knowledge of botany, but if there is anything I do know, it is exactly where Lewis and Clark were on every day, almost every hour, from start to finish of their famous expedition. Consequently, I can give the precise locality of every specimen which bears a date in the herbarium that Mr. Meehan recently discovered to be still extant, and thus available for the determination of so many of the type specimens of Pursh's species. This discovery seems to me one of the happiest and most important that could have been made, and I doubt not that Mr. Meehan's identifications of these plants, with the assistance of Messrs. Robinson and Greenman, will be justly regarded as a boon to working botanists. I could wish that these writers had effected what I conceive should have been done to set forth the whole matter in its proper light, but since they did not give the requisite precision to Pursh's generally loose and vague, sometimes wholly erroneous, indications of locality, that duty seems to devolve upon me.

In reading Mr. Meehan's paper, I have been little short of astounded at the kind of geography which seems to have answered the purposes of the botanists concerned in this case. Nothing of the sort would satisfy a zoölogist, I am sure. To describe a new species upon a type specimen, assigned to "the banks of the Missouri," or to "the valleys of the Rocky Mountains," would not be tolerated in zoölogy, and should not be endured in botany, when the data required to pin every dated specimen down to the precise spot where it was collected are ample, and easily accessible in the edition of Lewis and Clark which I brought out in 1893.

Neither praise nor blame attaches to me for any of the botany which appears in that work. As stated in my preface, most of the botanical determinations were those of Mr. F. H. Knowlton, whom I engaged for that purpose, and whose identifications of the plants mentioned or described by Lewis and Clark I accepted without question in any instance. That they should all prove to be correct was not to be expected, and I am now aware of several errors. In the case of the trees, the mistakes have, perhaps, all been detected and corrected in the admirable critical review lately published by Professor C. S. Sargent in *Garden and Forest*, Nos. 465, 466, January 20th and 27, 1897. I could wish that the same searchlight had been turned by Mr. Meehan and his collaborators upon the rest of the botany in my book, and venture to suggest that the whole subject will not be put in its full light or final shape till this has been thoroughly well done.

Great as are the obligations under which Mr. Meehan and his assistants have placed all who are in any way interested in this subject, in the paper which I now proceed to annotate geographically, there remains for some one the agreeable and useful task of reviewing Lewis and Clark's botanical *text* as distinguished from their *specimens*. For it is a curious fact, as I find on studying Mr. Meehan's paper, that the plants of which Lewis and Clark have most to say in their Journal, are not, as a rule, those of which specimens are now extant in their herbarium. Their botany, it may be said, runs in two parallel courses. One of these is represented by the specimens which they *collected*, and which became so many of Pursh's types; the other, by the herbs, shrubs and trees which they *observed*, and noted in their narrative, but did not actually collect. Oftentimes, to be sure, they describe what is in the herbarium, but I should imagine that fifty, if not a hundred species are to be found in the book, no specimens of which are known to be extant. This would appear to me to be a field of research at once alluring and stimulating to some well equipped botanist, and I trust that the work may soon be done once and forever. Lewis and Clark's whole botany could easily be set abreast of the status I have myself been able to confer upon their zoölogy, their ethnology and their geography.

With these remarks, which I trust will be found neither ungracious nor presumptuous, I proceed to review Mr. Meehan's paper from a purely geographical point of view. I take his list precisely as it stands, assuming the identifications to be correct in every instance, and raising no botanical questions whatever. I only follow the zoölogists' rules of nomenclature in writing all specific and subspecific names with a lower case initial letter, all personal names in the genitive case with a single *i*, all trinomial names without the intervention of " var."—a practice which I think most botanists would like, if they could once get used to it.

Anemone canadensis L. (*A. pennsylvanica* L.)

August 17, 1804. Missouri River, close to the mouth of the creek on which the Omahas resided ; now Omadi Creek, in Dakota Co., Nebraska. L. & C. there August 13–20, 1804.

Anemone quinquefolia L.

June 15, 1806. Collins' Creek, a branch of the Kooskooskee ; now Nahwah River, or Lo Lo fork of Clearwater River, in Shoshone Co., Idaho.

Clematis douglasi Hook. *C. hirsutissima* Pursh, Fl., 384.

No date. Pursh has " plains of the Columbia, May." L. & C. were not on the Columbia itself in May of either year. In May, 1806, they travelled by land approximately up Snake River or Lewis' fork to the mouth of the Kooskooskee, 1st–4th, up the Kooskooskee, 4th–13th, and were at their Camp Chopunnish, on the right bank of the Kooskooskee, nearly opposite but a little below the mouth of Commearp Creek, now known as Lawyer's Cañon Creek, till June 10th. This is a notable locality, where many plants were collected in May and June, 1806. The position is in Shoshone Co., across the river from, and nearly opposite, that of present Kamai or Kamiah, in Nez Percés Co., Idaho.

Delphinium menziesi DC.

April 14, 1806. On the Columbia River, one day's journey by boat below The Dalles, coming up stream.

Dentaria tenella Pursh, Fl. 439.

April 1, 1806. On the Columbia, at the mouth of Quicksand River of L. & C., now called Sandy River. This explains the statement of locality in Mr. Meehan's paper as " Columbia near *quicksands*."

Erysimum aspersum DC. *E. lanceolatum* Pursh, Fl. 436, nec R. Br.

June 1, 1806. Camp Chopunnish, as above described. This is on the Kooskooskee. But the other specimen which Mr. Meehan adduces from "Rockford Camp, *April 17, 1806,*" is from The Dalles of the Columbia. "Rockford" Camp, elsewhere called "Rocky" or "Rock," is a mistake for Rock Fort or Fort Rock Camp, as L. & C. called it when they were at The Dalles. The position is at the mouth of their Quinett Creek, called Wasco Creek on some maps, and now Mill Creek. The position is one of the best known on the Columbia, Oregon side. L. & C. were there October 17, 1805, going down, and April 15–17, 1806, coming up.

Cleome integrifolia T. & G. *C. serrulata* Pursh, Fl. 441.

August 25, 1804. At or very near mouth of Vermilion River, Clay Co., South Dakota. (Whitestone River of L. & C.)

August 29, 1806. At or near mouth of White River, Lyman Co., South Dakota.

Cerastium arvense L. *C. elongatum* Pursh, Fl. 321.

April 22, 1806. On the Columbia, between Des Chutes and John Day Rivers (the Towanahiooks and Le Page's Rivers of L. & C.). "Plains of the Columbia," as given, is therefore quite right.

Malvastrum coccineum Gray. *Cristaria coccinea* Pursh, Fl. 453.

July 20, 1806. "Plains of the Missouri," as given, is a mistake, unless the phrase is used in a very broad sense. On this date the expedition was widely separated. Lewis was high up on Maria's River near its forks in N. W. Montana; Clark was on the Yellowstone, at Camp Cottonwood, above Clark's fork of that river. Clark was busy building boats, and no doubt Lewis collected the plant. The latter botanized that day, as we see by his Journal, p. 1090 of my edition.

Linum lewisi Pursh, Fl. 210.

July 9, 1806, and *July 19, 1806*, for the same specimen; the dates conflict, but "valleys of the Rocky Mountains," as given, can be right for neither date in 1806, if the locality of this particular specimen is meant. On July 9, 1806, Lewis was on Sun River, at or near Fort Shaw, Montana. On July 19, 1806, he was high up on Maria's River; both of these places are out of the mountains. But probably the label was only meant to indicate the general range of the plant, not the exact locality of the specimen. Perennial flax was first noticed by the expedition on the Missouri above the Great Falls "for several days" before July 19, 1805, below, at and above Dearborn's River, in the vicinity, not close, of Helena, Montana. The species then described was identified as *L. perenne* by Mr. F. H. Knowlton, p. 423 of my edition of the work. Some of the country traversed in July, 1805, distinctly includes "valleys of the Rocky Mountains," and I suspect that "1806" should read 1805; also, that July "9" and "19" are merely scribal duplication of a single date.

Claytonia lanceolata Pursh, Fl. 175, t. 3.

June 27, 1806. "Headwaters of the Kooskooskee" is quite right. L. & C. were on the Lo Lo or Northern Nez Percé Trail, along the divide between sources of both N. and S. forks of that river, in central Idaho. It is the same day on which they notice *Erythronium grandiflorum.*

Claytonia perfoliata Don. (In Mr. Meehan's footnote, p. 19.)

March 26, 1806. On the lower Columbia, above Puget's Island and below the Cowlitz River.

April 17, 1806. "Rocky Camp," *i. e.*, The Dalles, as above explained.

Claytonia sibirica L. (In Mr. Meehan's footnote, p. 19.)

April 8, 1806. In camp on the Columbia, in Multnomah Co., Oregon, about 10 miles above Quicksand or Sandy River; vicinity of the place called Cape Horn.

Claytonia linearis Dougl. (In Mr. Meehan's footnote, p. 20.)

June 27, 1806. As above said for *C. lanceolata.*

Lewisia triphylla Rob.

June 27, 1806. Same as the last.

Lewisia rediviva Pursh, Fl. 368.

July 1, 1806. At mouth of Traveller's Rest Creek of L. & C., *i. e.*, of the Lou Lou Fork of the Bitter-root River, some 12 miles south of Missoula, Montana. It should be explained "Clark's River," the assigned location of this plant and some others, always means Bitter-root River, in so far as any plants collected are concerned. Lewis named Clark's River September 6, 1805, when the expedition was in Ross' Hole near the head of the east fork of the Bitter-root River; the party went down this river only as far as the Lou Lou Fork just said, up which they turned sharp and so on over the Bitter-root range to the sources of the Kooskooskee. They were never on the Clark's River of modern geography, as the great stream of which the Bitter-root is a collateral head does not now bear Clark's name above the junction of the Bitter-root with Hellgate River. I may add that *Lewisia rediviva*, the racine amère (or bitter root) of the French, is the plant from which the river, its valley, and the mountain range on the west derive their name. An alternative name of the Bitter-root was St. Mary's River, imposed by Father P. J. De Smet in 1842.

Montia parviflora Howell. *Claytonia perfoliata* Pursh, Fl. 176, nec Don.

March 26, 1806. As above said for *Claytonia perfoliata.*

April 17, 1806. As above said for *Claytonia perfoliata.*

Montia sibirica Howell. *Claytonia alsinoides* Pursh, Fl. 175.

April 8, 1806. As above said for *Claytonia sibirica.* There seems to be a duplication of the record of the same specimens of this and preceding species in Mr. Meehan's main text and footnotes.

Pachystima myrsinites Raf. *Ilex? myrsinites* Pursh, Fl. 119.

June 16, 1806. On the Lo Lo Trail, vicinity of Hungry Creek of L. & C., a branch of the north fork of the south fork of Kooskooskee River, next east of Collins' Creek.

November 16, 1805. In camp on the Columbia in sight of the ocean, at the landward end of Haley's or Baker's Bay, just inside Chinook Point.

I heartily agree with Mr. Meehan that the name of this genus should be written *Pachystigma.*

Ceanothus velutinus Dougl.

(No date.)

Rhamnus purshiana DC. *R. alnifolia* Pursh, Fl. 166, nec Mchx.

May 29, 1806. Camp Chopunnish.

Rhus canadensis trilobata Gray.

October 1, 1804. In the Little Bend of the Missouri (Lookout Bend of L. & C.), at or near the mouth of Cheyenne River. "First discovered in the neighborhood of the Kancez River," *i. e.*, when L. & C. were about the mouth of Kansas or Kaw River, which was reached June 26, 1804; "now very common" means at the date said, Oct. 1, when they were in the said bend.

Cissus ampelopsis Pers.

September 14, 1806. "Council Bluffs, Missouri," as given, is not any locality, for Council Bluffs, Pottawattamie Co., Iowa, did not exist in 1806, and the Council Bluff of L. & C. was much higher up and on the other side of the river, where now stands Fort Calhoun, Washington Co., Nebraska. L. & C. passed it September 8, 1806, coming rapidly down river; they were, therefore, many miles below when they camped at Leavenworth, Kansas, on the 14th, having come 53 miles that day.

Acer circinatum Pursh, Fl. 267.

October—, 1805. "Great Rapids of the Columbia." The date can be set closer, as L. & C. did not reach the Cascades till October 30, 1805. The vine maple is fully described on p. 834 of my edition, along with *Acer macrophyllum.*

Acer macrophyllum Pursh, Fl. 267.

April 10, 1806. Cascades of the Columbia, on the home voyage. But L. & C. had noticed it in the same region the previous autumn.

Polygala alba Nutt. *P. senega var. tenuifolia* Pursh, Fl. 750.

August 10, 1806. At or near White Earth River of L. & C., now Muddy River, a branch of the Missouri, at whose mouth is Williston, Montana, near the east boundary of the Fort Buford military reservation. (Not modern White Earth River, which is a different stream, much lower down.)

Amorpha fruticosa angustifolia Pursh, Fl. 466.

August 27, 1806. Great Bend of the Missouri, as stated. This formation is below Pierre, South Dakota, and just above the Crow Creek Agency.

Astragalus missouriensis Nutt.

September 18, year not given. If 1804, one day below the Great Bend of the Missouri, going up; if 1806, on the Missouri from Grand to La Mine River, within the recent State of Missouri; most probably 1804.

Astragalus mortoni Nutt.

September 15, 1804. At or near mouth of White River, Lyman Co., South Dakota.

September 5, 1804. Mouth of the Niobrara River, or within one day above it.

Lupinus argenteus Pursh, Fl. 468.

July 7, 1806. "On the Cokahlaishkit"—an interesting locality. This is the River of the Road to Buffalo of L. & C., now the Big Blackfoot River, a branch of Hellgate River. On the 7th Lewis was on its headwaters, as this is the day he went over Lewis and Clark's Pass of the Continental Divide to the Middle Fork of Dearborn's River, thus passing from Deer Lodge County to Lewis and Clark County, Montana.

Lupinus sericeus Pursh, Fl. 468.

June 5, 1806. Camp Chopunnish on the Kooskooskee.

Oxytropis nana Nutt. *var.* *O. argentata* Pursh, Fl. 473.

July —, 1806. "Near the head of Clark's River" means the Bitter-root River at the mouth of its Lou Lou branch, the Traveller's Rest Creek of L. & C., and the date is July 1st or 2d, when Lewis was botanizing as the Journal shows, p. 1065 of my edition. See *Trifolium microcephalum*, below.

Petalostemon violaceus Mchx. Pursh, Fl. 461.

July 22, 1806. "On the Missouri;" impossible. At this date Lewis was on Cut-bank Creek, one of the main headwaters of Maria's River, in N. W. Montana near the foot of the Rocky Mountains, and Clark was on the Yellowstone. No doubt Lewis collected the specimen.

September 2d, year not given; no locality indicated. If 1804, at Bonhomme, South Dakota; if 1805, on Fish Creek, a tributary of Salmon River, Idaho; if 1806, at or near James' River, South Dakota. The first and third of these are practically the same locality, as the expedition crossed the years 1804 and 1806 in passing Bonhomme Island on September 1st. I presume the year is 1804, for, in the case of the related *Psoralea argophylla*, collected October 17, 1804, and in the present case of *Petalostemon violaceus*, Lewis makes similar remarks on the use of these plants by the Indians in decoctions for wounds.

Psoralea argophylla Pursh, Fl. 475.

October 17, 1804. On the Missouri, very near the mouth of Cannonball River, North Dakota.

Psoralea tenuiflora Pursh, Fl. 475.

September 21, 1804. Great Bend of the Missouri, as stated.

Trifolium megacephalum Nutt. *Lupinaster macrocephalus* Pursh, Fl. 479, t. 23.

April 17, 1806. Rock Fort Camp (not "Rockford") at The Dalles of the Columbia.

Trifolium microcephalum Pursh, Fl. 478.

July 1, 1806. Same spot as *Oxytropis nana*, above; here called "Valley of Clark's River." The Journal, p. 1066 of my edition, speaks of "two species" of clover in this valley, one with a very narrow, small leaf and a pale red flower, the other with a white flower, and nearly as luxuriant in its growth as our red clover.

Amelanchier alnifolia Nutt. *Pyrus sanguinea* Pursh, Fl. 340, in part.

April 15, 1806. Rock Fort Camp. The species is also recorded repeatedly by L. & C. in widely separated localities; see my edition, pp. 277, 282, 419, 828.

Cratægus douglasi Lindl. *C. glandulosus* Pursh, Fl. 337.

April 29 or 19, 1806; for dates conflict in main text and its footnote. If 19th, the place is Celilo Falls of the Columbia; if 29th, mouth of Wallawalla River, on the Columbia, site of *old* Fort Wallawalla and of modern Wallula. It is also elsewhere reported, by L. & C. on the Columbia, much lower down. Mr. Meehan refers to the Journal of January 20, 1806, but there is no allusion to the plant at that date. He evidently means the description of No. 12 of the botanical list drawn up at Fort Clatsop; this is found on p. 826 of my edition, but there are no dates in this list. I am sorry to find that Mr. Knowlton has discredited the identification, supposing No. 12 to be *Pyrus rivularis*. It is correctly given, however, on p. 908, March 25, 1806, when the expedition was in the vicinity of Puget's Island. Again, on June 10, 1806 (p. 1041 of my edition), when L. & C. left Camp Chopunnish, they speak of the "purple haw," and Mr. Knowlton there bracketed *Viburnum pauciflorum*—no doubt in error, as pointed out by Professor C. S. Sargent in his admirable paper on the trees of the expedition in *Garden and Forest*, No. 466, January 27, 1897, p. 39.

Geum triflorum Pursh. *G. ciliatum* Pursh, Fl. 352.

June 12, 1806. Camp on Quamash Flats, the modern Weippe or Oyipe Prairie in Shoshone Co., Idaho, on the Lo Lo Trail near the west base of the mountains.

Pyrus sambucifolia Cham. and Schl. (?).

June 27, 1806. On the Lo Lo Trail, same place as *Claytonia lanceolata*.

Potentilla anserina L.

March 13, 1806. Fort Clatsop, L. & C. winter quarters of 1805–06, a short distance up their Netul, now commonly called Lewis and Clark's River, a small stream which falls into the Columbia near its mouth on the Oregon side.

Potentilla fruticosa L. Pursh, Fl. 355.

July 5, 1806. "Prairie of the Knobs," as given, is a remakable place on the Cokahlaishkit or Big Blackfoot River, one day west of Lewis and Clark's Pass, in Deer Lodge County, Montana. It is also called Blackfoot Prairie and Stevens' Prairie, but Lewis did not reach it till July 6th.

Prunus demissa Nutt.

August 10, 1806. "A cherry found near the beaver bents on the Missouri." I do not know what these are, but the place meant is present Beaver Creek, in Flannery Co., North Dakota, almost on the border of Mountraille Co., about where *present* White Earth River (not the one so named by L. & C.) falls into the left bank of the Missouri. The Journal of this date, p. 1173 of my edition, has this note: "In the low grounds of the river Captain Clark found to-day a species of cherry which he had never seen before, and which seems peculiar to this small district of country, though even here it is not very abundant." No identification was offered in my work, as I had no hint of what the species was, and I am particularly pleased now to find it out.

Prunus virginiana L.

May 29, 1806. Camp Chopunnish.

Prunus ?

June 27, 1806. On the Lo Lo Trail, east of Lo Lo Fork (Collins' Creek), and west of the main range of the Bitter-root Mountains, Shoshone Co., Idaho.

Prunus ?

May 7, 1806. Main Kooskooskee River above Colter's or Potlatch Creek, and below the mouth of the Chopunnish or North Fork.

Prunus sp. (*P. pumila* of Mr. Meehan's footnote.)

May 29, 1806. Camp Chopunnish.

Purshia tridentata DC. *Tigarea tridentata* Pursh, Fl. 333, t. 15.

July 6, 1806. Prairie of the Knobs, as above described for *Potentilla fruticosa.*

Rosa woodsi Lindl.

September 5, 1804. On the Missouri, immediately above the Niobrara.

October 18, 1804. On the Missouri, immediately above the Cannonball, not "at or near Fort Mandan" as Mr. Meehan states, but much below that site, which was not reached till the 26th. Mr. Meehan cites May 18, 1806, Camp Chopunnish, as the date on which L. & C. "saw the wild roses in bloom." I find no allusion to roses in the Journal of that day, but on June 10, 1806, when L. & C. had just left Camp Chopunnish, they "observed two species of wild rose, both of a damask-red color." These Mr. Knowlton supposed to be *R. nutkana* and *R. sayi ?*, which names were accordingly bracketed in my edition, p. 1041.

Rubus nutkanus velutinus Brew.

April 15, 1806. Rock Fort Camp, on the Columbia.

Rubus spectabilis Pursh, Fl. 348, t. 16.

March 27, 1806. Lower Columbia River, above Kalama River, in the vicinity of Deer Island. The plant is not mentioned in the Journal of this date, but was discovered by L. & C. in this vicinity, near the mouth of the Multomah or Willamette, November 4, 1805 ; see my edition, p. 695.

Spiræa discolor Pursh, Fl. 342.

May 29, 1806. Camp Chopunnish.

Philadelphus lewisi Pursh, Fl. 329.

May 6, 1806. Main Kooskooskee River, vicinity of Colter's or Potlatch Creek, below mouth of the North Fork.

July 4, 1806. "On the waters of Clark's River." This means Hellgate River, between Missoula, Montana, and the mouth of Big Blackfoot River, in Missoula Co., Montana.

Ribes aureum Pursh, Fl. 164.

July 29, 1805. Three Forks of the Missouri, junction of Jefferson, Madison and Gallatin Rivers. Both currants and gooseberries are mentioned at this date, and one species, which Mr. Knowlton identified from the description as *R. oxyacanthoides*, is described at length ; fruit large, jet black with crimson pulp, extremely acid, etc. But the original mention of *R. aureum* is earlier in the work, p. 419, July 17, 1805, when L. & C. were at Pine or Half Breed Island and Rapids, a little below the mouth of Dearborn River.

It is here particularly described, along with two other kinds of currants which Mr. Knowlton identified as *R. hudsonianum* and *R. viscosissimum*, and two species of gooseberries which he doubtfully referred to *R. rotundifolium* and *R. oxyacanthoides*.

April 16, 1806. Rock Fort Camp, on the Columbia.

Ribes menziesi Pursh, Fl. 372.

April 8, 1806. Columbia River, at the place above said for *Montia* or *Claytonia sibirica*.

Ribes viscosissimum Pursh, Fl. 163.

June 16, 1806. "Heights of the Rocky Mountains." This means on the Lo Lo Trail over the Bitter-root Mountains, at the same place that *Pachystigma myrsinites* was procured.

Clarkia pulchella Pursh, Fl. 260, t. 11.

June 1, 1806. "Kooskooskee and Clark's River." It is impossible for a specimen to have been collected on those two rivers on the same day; at the date said, L. & C. were in Camp Chopunnish on the Kooskooskee. See *Erysimum asperum*, above.

Œnothera cæspitosa Nutt. (Pursh, Fl. 735.) *O. scapigera* Pursh, Fl. 263.

July 17, 1806. "Near the falls of the Missouri" is correct. Lewis that day went from the Great Falls over to Teton or Tansy River.

Œnothera heterantha Nutt.

June 14, 1806. "Squamash flats." This means the Quamash Flats on Weippe or Oyipe Prairie; same spot where *Geum triflorum* was taken on the 12th.

Sedum stenopetalum Pursh, Fl. 324.

June 15 and July 1, 1806. On the Lo Lo Trail; at first date immediately east of the Quamash Flats, at the other date at the mouth of Traveller's Rest Creek in the Bitter-root Valley.

Label only of a supposed Angelica.

September 3, 1805. On Fish Creek, the north fork of Salmon River, in Lemhi Co., Idaho.

June 25, 1806. On the Lo Lo Trail in the Bitter-root Mountains, on Hungry Creek.

Peucedanum ?

April 14, 1806. On the Columbia, at or near Sepulcher Rock, which is an aboriginal burying place about 3 miles below Cataract or Klikitat River.

Peucedanum leiocarpum Nutt. *Smyrnium nudicaule* Pursh, Fl. 196.

April 15, 1806. Rock Fort Camp, at The Dalles of the Columbia.

Peucedanum simplex Nutt. (or *P. triternatum* Pursh).

May 6, 1806. On the main Kooskooskee River; same place as the supposed *Philadelphus lewisi*, above.

Peucedanum utriculatum Nutt.? *Phellandrium aquaticum* Pursh, Fl. 195.

June 10, 1806. Near Camp Chopunnish, which L. & C. left that day, travelling north down and nearly parallel with the Kooskooskee, past Collins' Creek to the Quamash Flats.

One or another of the foregoing species of *Peucedanum* is the plant called *cows, cowas* or *cowish*, and particularly described at no one of the above dates, but at May 9, 1806, p. 999 of my edition, where I call it *P. cous.* It appears as "cow-weed" in the McVickar edition of the work.

Cymopterus campestris Nutt.? (Mr. Meehan's suggested identification, in a footnote).

April 29, 1806. On the Columbia at the mouth of Wallawalla River. This is the shapelell or shappalell of L. & C. There is no mention of it at this date in the Journal, but the name appears on April 14, 1806, p. 949 of my edition.

(Label only).

April 25, 1806. On the Columbia, approaching Umatilla River. At date of May 16, 1806, p. 1014 of my edition, is mentioned "a kind of fennel, called by the Shoshonees yearhah, resembling anniseed." This is supposed to be yamp, *Carum gairdneri* or a related species. See also p. 552.

(Two unidentified Umbellifers).

April 14, 15, 1806. Below and at Rock Fort Camp on the Columbia.

Cornus canadensis L.

June 16, 1806. On the Lo Lo Trail, Collins' Creek to Hungry Creek, with *Pachystigma myrsinites*, *Ribes viscosissimum* and *Lonicera ciliosa.*

Lonicera ciliosa Poir. *Caprifolium ciliosum* Pursh, Fl. 160.

June 5 and June 16, 1805. Camp Chopunnish and the Lo Lo Trail. This record is quite right; but in enumerating the same species among plants of Fort Clatsop, p. 835 of my edition, I understand L. & C. to have been mistaken. While at Quamash Flats, June 10, 1806, L. & C. speak of "the honeysuckle bearing a white berry," which Mr. Knowlton supposed to be *Symphoricarpos racemosus*, and so I used the name on p. 1041 of my edition.

Lonicera involucrata Banks.

September 2, 1805. "On the waters of the Columbia" does not mean the river itself of that name, but its general watershed. On this date L. & C. were on their Fish Creek, which is the north fork of Salmon River, in Lemhi Co., Idaho.

July 7, 1806. Sources of Big Blackfoot River, near Lewis and Clark's Pass, in Deer Lodge Co., Montana.

Achillea millefolium L. *A. tomentosa* Pursh, Fl. 563, nec Willd.

May 20, 1806. Camp Chopunnish.

Aplopappus spinulosus DC. *Amellus spinulosus* Pursh, Fl. 564.

September 15, 1804. On the Missouri, passing mouth of White River, Lyman Co., South Dakota.

(What has become of the big H with which the name of this genus ought to begin? Botanists should not tolerate such a Cockneyism as "*Aplopappus.*" No one can aspire to grammatical propriety without an aspirate.)

Aplopappus sp.

October —, 1805. L. & C. reached the Columbia itself on the 16th, and were on it the rest of the month; prior to that date in October, 1805, they were on the Kooskooskee and Snake Rivers.

Artemisia cana Pursh, Fl. 521.

October 1, 1804. In Lookout Bend of the Missouri of L. & C., now called the Little Bend, passing mouth of Big Cheyenne River.

October 2, 1804. A few miles further up the Missouri—practically the same locality as the last.

Artemisia dracunculoides Pursh. *A. dracunculus* Pursh, Fl. 521, nec L.

September 15, 1804. On the Missouri, passing mouth of White River, Lyman Co., South Dakota.

Artemisia frigida Willd. Pursh, Fl. 521.

September 2, 1804. On the Missouri at Bonhomme Island, Bonhomme, South Dakota.

October 3, 1804. On the Missouri, two days above Big Cheyenne River, nearing Little Cheyenne River.

Artemisia longifolia Nutt. *A. integrifolia* Pursh, Fl. 520.

October 1 and 3, 1804. See preceding species of this genus. L. and C. do not speak of sage brush in their Journal at any of the above dates. On April 14, 1805, when they were on the Missouri between the Little Missouri and present White Earth Rivers, they speak of aromatic plants "resembling the sage, hyssop, wormwood," etc., p. 273 of my edition.

Artemisia ludoviciana Nutt. ?

April 10, 1806. "Rockford Camp" as given is impossible, as L. & C. were not at Rock Fort Camp till April 15th that year. On the 10th they had reached the head of tide-water of the Columbia, vicinity of Beacon Rock, and were drawing their boats up the Cascades from Brant Island.

Aster oblongifolius Nutt.

September 21, 1804. Big Bend of the Missouri, as correctly stated.

Aster oreganus Nutt.

October —, 1805. "Lewis River." If on Lewis' River itself the date was October 10–16th, while L. & C. were descending Snake or Lewis' River from the mouth of the Kooskooskee to the Columbia itself.

"Bidens-like."

October —, 1805. "Lewis River," as last said.

Balsamorrhiza sagittata Nutt. *Buphthalmum sagittatum* Pursh, Fl. 564.

April 14, 1806. On the Columbia, one day below Rock Fort Camp.

July 7, 1806. Lewis and Clark's Pass of the Continental Divide, near head of Big Blackfoot River, in Dear Lodge Co., Montana.

Bigelowia graveolens Gray. *Chrysocoma dracunculoides* Pursh, Fl. 517.

May 6, 1806. Main Kooskooskee River, below Camp Chopunnish.

October 2, 1804. Just above Little or Lookout Bend of the Missouri; see *Artemisia cana* above.

Bigelowia graveolens albicaulis Gray. *Chrysocoma nauseosa* Pall. in herb. Pursh, Fl. 517.

October 15, 1805. "On the Columbia River" as given is not quite right, as that day L. & C. were descending Snake River, and did not reach its confluence with the Columbia till the 16th.

Cnicus edulis Gray.

March 13, 1806. Fort Clatsop, as correctly given. Mr. Meehan quotes the Journal of January 20th for this species, though nothing is said of it on that date in the Journal as printed. The passage cited by Mr. Meehan occurs in the general account of the botany of Fort Clatsop, where *Cnicus edulis* is No. 1 of the list, p. 821 of my edition; "shanatanque" of the natives. But it is quite true that the botanical matter begins in Clark's Codex P, p. 89 of the manuscript, at date of January 20, 1806.

Eriophyllum cæspitosum Dougl. *Actinella lanata* Pursh, Fl. 560.

June 6, 1806. Camp Chopunnish.

Gaillardia aristata Pursh, Fl. 573.

July 7, 1806. As above, under *Balsamorrhiza sagittata.*

Grindelia squarrosa Dunal. *Donia squarrosa* Pursh, Fl. 559.

August 17, 1804. Camp near the Omaha village on the Missouri, nearly opposite mouth of Omadi Creek.

Gutierrezia euthamiæ T. & G. *Solidago sarothræ* Pursh, Fl. 540.

September 19 and 21, 1804 (one of these dates misprinted "1805"). Approaching and on the Great Bend of the Missouri.

Liatris pycnostachya Mchx.

September 15, 1804. On the Missouri, passing White River.

Liatris scariosa Willd.

September 12, 1804. Three days below White River, passing Shannon's or Washinanpi Creek, vicinity of Rosebud Landing, Gregory Co., South Dakota.

Matricaria discoidea DC. *Santolina suaveolens* Pursh, Fl. 520.

June 9, 1806. Camp Chopunnish.

Microseris macrochæta Gr.

April 17, 1806, "Rock" Camp, as here given, is the *Rock Fort* Camp already often mentioned.

Solidago rigida L.

September 13, 1804. Two days below White River, on the Missouri.

Composite?

May 27, 1806. Camp Chopunnish.

Arctostaphylos uva-ursi Spreng.

No date. No. 33, Fort Mandan. This fort was occupied November, 1804–April, 1805. Mr. Meehan says, in speaking of the name "sacacommis" used for this plant by "Engagés," that it is not clear who "Engagés" were; but an *engagé* was any hired man of a fur trading company; the word means precisely the same as *employé* or employee. Mr. Meehan states that "Professor Knowlton in the notes to Coues' edition of the travels, suggests the name *Arctostaphylos pungens* for this." But I cannot find *A. pungens* in my book. Sacacommis is given in four places, p. 139, p. 674, p. 729, p. 827, in each instance correctly identified as the bear-berry, *A. ura-ursi.* This is one of the few botanical identifications that I made myself, as I happened to know the plant very well.

Arbutus menziesi Pursh, Fl. 282.

November 1, 1805. Cascades of the Columbia, a little above head of tide-water.

Gaultheria shallon Pursh, Fl. 283.

June 20, 1806. "On the coast of the Pacific Ocean," as given, is impossible. At that date L. & C. were on the Lo Lo Trail in northern Idaho. I suppose this date to be a misprint for some day in *January,* 1806, when L. & C. were at Fort Clatsop, and repeatedly mention the salal, shallun or shellwell with particularity; see my edition, p. 731, p. 739, p. 791, p. 798, p. 825. The form of the name shallum, adduced by Mr. Meehan, does not occur in my work.

Vaccinium myrtillus L. (*V. myrtilloides* L. in Mr. Meehan's footnote.)

June 20, 1806. "Fort Clatsop," as given, is impossible; see under *Gaultheria shallon.*

Vaccinium ovatum Pursh, Fl. 290.

June 27, 1806. "Fort Clatsop," as given, is impossible; see under *Gaultheria shallon.*

While on the question of *Vaccinium*, I should much like to know what botanists can make of the "cranberry of the low and viny kind" mentioned by L. and C. in the Fort Clatsop list of plants, No. 11, p. 826 of my edition, and considered by Mr. Knowlton to be *V. macrocarpon, ibid.*

Dodecatheon meadia L.

April 16, 1806. Rock Fort Camp, on the Columbia. In his footnote Mr. Meehan says: "There might have been a specimen collected on the march up the Missouri in 1804, as in the Journal under date April 17th, it is noted that 'violets, doves foot and cowslips are in bloom,' the *Dodecatheon* being probably referred to as cowslips." But L. and C. were not on the voyage up the Missouri on April 14, 1804; they did not start till May 14, 1804, and at date of April 17, 1804, there is not a word about cowslips in the Journal. What Mr. Meehan means is a passage in the meteorological register kept by L. and C. at Camp Dubois, at the mouth of Wood River, which empties into the Mississippi in Illinois, till the date of their departure. The correct quotation for April 17, 1804, is: "the violet, dove's-foot, and cowslip are in blow," p. 1283 of my edition. Mr. Meehan's other citation of "cowslip," at date of April 9, 1806, also found in the meteorological register, p. 1295 of my edition, is correctly referred to the Columbia River.

Frasera thyrsiflora Hook. *Swertia fastigiata* Pursh, Fl. 101.

June 14, 1806. "Squamash flats," as given, means Quamash flats, on the Lo Lo Trail, west of the Bitter-root Mountains. So also does Pursh's "on the Missouri Flats near the Rocky Mountains," which reads curiously to one who knows the geography of the route. It is wrong by several hundred miles—yet not so far out of the way as some others of his that I could instance.

Colloma linearis Nutt.

April 17, 1806. "Rockford"=Rock Fort Camp, on the Columbia.

Gilia aggregata Spreng. *Cantua aggregata* Pursh, Fl. 147.

June 26, 1806. Hungry Creek, as given, is correct; a small tributary of the north fork of the south fork of the Kooskooskee, east of Collins' Creek, in the mountains of the Lo Lo Trail. Pursh's "banks of the Mississippi," as cited in Mr. Meehan's paper, is more than a thousand miles out of the way; and if this be an inadvertence for "banks of the Missouri," still it is wrong by several hundred miles.

Polemonium cæruleum L.

June 27, 1806. One day further east than the last, on the Lo Lo Trail over the Bitter-root Mountains.

Phacelia circinata Jacq. *P. heterophylla* Pursh, Fl. 140. *P. scabiosæfolia* Pursh, MS. (type).

June 9, 1806. Camp Chopunnish, the day before L. and C. left it. Mr. Meehan's footnote is erroneous in citing "on the Kooskooskee, *August* 9, 1806"—I presume merely by a slip of the pen. On August 9, 1806, L. and C. were on the Missouri below the mouth of the Yellowstone.

Phacelia menziesi Torr. *Hydrophyllum lineare* Pursh, Fl. 134.

April 17, 1806. Rocky=Rock Fort Camp, on the Columbia—not "on the banks of the Missouri," as Pursh has it.

Plagiobothrys tenellus Gray.

April 17, 1806. As the last.

Krynitskia sp.?

April 17, 1806. As the last.

Nicotiana quadrivalvis Pursh, Fl. 141.

October 12, 1804. "The Ricara's town" said was one of the 3 Arikara villages which were flourishing in 1804 within 8 miles above the mouth of Wetarhoo River of L. and C., now Grand River, South Dakota—one of them on Ashley Island, the other two a little higher up, on the right bank of the Missouri. Pursh says of *N. quadrivalvis*, "the tobacco prepared from it is excellent." That makes me believe he never smoked the nasty stuff.

Mimulus luteus L. Pursh, Fl. 426.

July 4, 1806. "On the waters of Clark's River" means Hellgate River, close by Missoula, Montana.

Orthocarpus tenuifolius Benth. *Bartsia tenuifolia* Pursh, Fl. 429.

July 1, 1806. "Valley of Clark's River" means the mouth of Traveller's Rest Creek, the Lou Lou Fork of the Bitter-root River.

Pedicularis grœnlandica Retz. Pursh, Fl. 426.

July 6, 1806. "On the low plains on the heath of Clark's River" means Prairie of the Knobs on Big Blackfoot River.

P. scopulorum Gray? *P. elata* Pursh, Fl. 425, nec Willd.

July 6, 1806. As the last. Nothing is simpler than the geographical explanation of the apparent discrepancies in this identification and the three preceding ones. The Bitter-root, the Hellgate and the Big Blackfoot are three of the sources of Clark's River, coming together in the vicinity of Missoula. July 1st to 6th Lewis went down the Bitter-root to Missoula, up the Hellgate to the Big Blackfoot, and up the latter to within one day's march of Lewis and Clark's Pass of the Continental Divide. As I have said before, neither Lewis nor Clark ever saw Clark's River as understood by modern geographers.

Pentstemon diffusus Dougl.

May 20, 1806. Camp Chopunnish.

Synthyris reniformis major Hook.

June 26, 1806. Hungry Creek, as said.

Salvia lanceolata Willd. *S. trichostemmoides* Pursh, Fl. 19.

September 21, 1804. Big Bend of the Missouri, as said.

Scutellaria angustifolia Pursh, Fl. 412.

June 5, 1806. Camp Chopunnish.

Oxybaphus nyctagineus Sweet. *Allionia ovata* Pursh, Fl. 97.

September 1, 1804. At or near Bonhomme Island, South Dakota.

Atriplex canescens James. *Calligonum canescens* Pursh, Fl. 370.

September 21, 1804. Big Bend of the Missouri, as said.

Atriplex nuttalli Wats.

July 20, 1806. "High plains of Missouri" is doubly impossible: there are no high plains in Missouri, and if high plains of the Missouri River be meant, it is wrong; for at this date Lewis was high up on Maria's River, and Clark was on the Yellowstone.

Sarcobatus maculatus Torr.[1]

July 20, 1806. As last said. This is the "pulpy leaved thorn" of L. & C., p. 325, p. 462, and p. 463, of my edition, there correctly identified by Mr. Knowlton as *S. vermicularis.*

Polygonum bistortoides Pursh, Fl. 271.

June 12, 1806. Quamash flats, as said, but by no means "on the banks of the Missouri," as Pursh says, for there are none such. Among the several Quamash flats described and mapped by L. and C. the one where they were on June 12, 1806, is the Weippe or Oyipe Prairie near the west end of the Lo Lo Trail, in Shoshone Co., Idaho.

Elæagnus argentea Pursh, Fl. 114.

July 6, 1806. Prairie of the Knobs, on Big Blackfoot River.

Shepherdia argentea Nutt. *Hippophæ argentea* Pursh, Fl. 115.

A. No. 39, no date. But date is easily supplied, if the specimen was "obtained at the mouth of the River *Quicourre;*" for this is a L. and C. way of spelling L'Eau qui Court, French name of Running Water or Niobrara River, where L. and C. camped September 4, 1804; they passed it again September 6, 1806, but that the former date is the one is shown by the fact they speak of sending the speci-

[1] *Sarcobatus maculatus* Torr., in my paper, was a misprint for *Sarcobatus vermicularis* Torr. (J. M.)

men in a box to Captain Stoddard at St. Louis, and this box started from Fort Mandan April 7, 1805.

Euphorbia heterophylla L. *E. cyathophora* Pursh, Fl. 605, nec Willd.

October 4, 1804. On the Missouri, above Big Cheyenne River, and nearing Little Cheyenne River.

Euphorbia marginata Pursh, Fl. 607.

July 28, 1806. "On the Yellowstone River, M. Lewis." This is impossible, because Lewis was never on the Yellowstone, though he passed its mouth twice; and at the date said he was on the Missouri above Maria's River, at the Cracon du Nez or Grog Spring, in the vicinity of Fort Benton. Clark was on the Yellowstone at this date, below the mouth of the Bighorn, and above the mouth of Tongue River.

Maclura aurantiaca.

(No label.)

Betula ? *i. e.* **Alnus rubra.**

March 26, 1806. Lower Columbia River, between Puget's Island and Cowlitz River. I am pleased to find Mr. Meehan confirming the identification of the black alder several times mentioned by L. & C. and given in my edition as *Alnus rubra*, p. 698, p. 724, p. 749, p. 833, p. 911.

Quercus garryana Dougl.

March 26, 1806. Same place as last said.

Quercus macrocarpa depressa Englm.

September 5, 1804. From the Niobrara River, where L. & C. camped on the 4th (not on the 5th), upward. The "White Point" Creek which Mr. Meehan cites in this connection is the White Paint Creek of L. and C., now known as Bazile Creek, which falls into the Missouri next below the Niobrara and on the same side. The date on which L. and C. described this tree particularly is the 16th, not 15th, as cited by Mr. Meehan; they were then camped a short distance above White River, one mile above their Corvus Creek, now known as American Crow Creek. This oak is the one malidentified by Mr. Knowlton in my edition, p. 119, as *Q. undulata* var. *wrighti*, and first referred to *Q. macrocarpa* by Prof. Sargent, *Garden and Forest*, No. 465, January 20, 1897, p. 28—a masterly criticism of the way all the L. & C. trees were handled in my work, and one for which I am profoundly grateful to its distinguished author.

Populus monilifera Ait. *P. angulata* Pursh, Fl. 619, nec Willd.

August —, 1806. Somewhere on the Missouri; location not determinable.

Populus trichocarpa T. and G.

June —, 1806. "Cotton tree of the Columbia." But L. & C. were not on the Columbia in any part of June, 1806, the whole of which month they spent either at Camp Chopunnish or on the Lo Lo Trail in Idaho. While they were low down on the Columbia they mentioned this species twice, March 25 and 27, 1806; see my edition, p. 908 and p. 911, where *P. trichocarpa* is correctly given.

Calypso borealis Salisb. Pursh, Fl. 593.

June 16, 1806. Hungry Creek, as said.

Iris missouriensis Nutt. *I. sibirica* Pursh, Fl. 30, nec Wlld.

July 5, 1806. Prairie of the Knobs, on the Big Blackfoot River.

Allium sp. (Perhaps in part *A. angulosum* Pursh, Fl. 223. It may be *A. reticulatum*.)

April 30, 1806. Neither of the three botanists concerned in this case seem to know what sort of an onion it is. All I know about it is, that if it was collected at the date said, it was not collected "on the waters of the Kooskooskee," as said; for on April 30, 1806, L. & C. were on the Wallawalla in the vicinity of Touchet River.

Brodiæa douglasi Wats. *B. grandiflora* Pursh, Fl. 223, nec Smith.

April 20, 1806. Great Falls of the Columbia, near Celilo. Mr. Meehan speaks of this as the "hyacinth of Colorado Plains," by slip of the pen for Columbia Plains. The passage of L. & C. which he cites as from the Journal of April 16th, occurs in the meteorological register of that date, p. 1295 of my edition. Mr. Knowlton imagined this hyacinth, as mentioned by L. & C. on April 16th, to be quamash, and so it stands *Camassia esculenta* on p. 952 of my edition, by egregious error.

Calochortus elegans Pursh, Fl. 240.

May 17, 1806. Camp Chopunnish.

Camassia esculenta Lindl. *Phalangium quamash* Pursh, Fl. 226.

June 23, 1806. Quamash flats on the Lo Lo Trail. Pursh is far out with his "upper part of the Missouri" as the location of this specimen. In citing the Journal of June 29, 1806, for the blooming of this species, Mr. Meehan means the meteorological register of that date, p. 1297 of my edition. It should be particularly noted that the Quamash flats of L. & C. of June 29th are not those of June 23d. The latter are on Weippe Prairie, near the west end of the Lo Lo Trail; the former are near the east end of that trail, on Quamash or Glade Creek, also called Prairie and Takon Creek. Both are in Idaho, but over 100 miles apart.

I do not understand why Mr. Meehan, or Messrs. Robinson and Greenman, should use *Camassia esculenta* as the technical name of this plant. The first specific name being *quamash* Pursh, 1814, and the first tenable generic name being *Quamasia* Rafinesque, February, 1818, the coupling of these as *Quamasia quamash* is the required name of the plant, as first given by Mr. Coville, Pr. Biol. Soc. Wash. XI, April 21, 1897, p. 64.

Erythronium grandiflorum Pursh, Fl. 231.

June 5, 1806. Camp Chopunnish.

Erythronium grandiflorum parviflorum Wats.

May 8, 1806. Kooskooskee River, below Camp Chopunnish, near mouth of the north fork of the river.

Fritillaria lanceolata Pursh, Fl. 230.

April 10, 1806. Brant Island in the Columbia, at foot of the Cascades, near head of tide water.

Fritillaria pudica Spreng. *Lilium? pudicum* Pursh, Fl. 228, t. 8.

May 8, 1806. Kooskooskee River, below Camp Chopunnish.

Trillium ovatum Pursh, Fl. 245.

April 10, 1806. Same place as *Fritillaria lanceolata.*

Trillium petiolatum Pursh. Fl. 244.

June 15, 1806. On the Lo Lo Trail, on or near Collins' Creek.

Veratrum viride Ait. or *V. californicum* Dur.

June 25, 1806. On the Lo Lo Trail, on or near Hungry Creek.

Xerophyllum tenax Nutt. *Helonias tenax* Pursh, Fl. 243.

June 15, 1806. Same place as *Trillium petiolatum.*

Zygadenus elegans Pursh, Fl. 241.

July 7, 1806. Head of Cokalahishkit or Big Blackfoot River, near Lewis and Clark's Pass.

Aira brevifolia Pursh, Fl. 76 (or *Poa tenuifolia* Nutt.).

June 10, 1806. At or near Camp Chopunnish, which L. & C. left this day.

Hordeum jubatum Pursh, Fl. 89.

March 13, 1806. Fort Clatsop.

July 12, 1806. White Bear Islands of L. & C., still so called, in the Missouri near mouth of Sun River, above the Great Falls, adjoining city of Great Falls, Cascade Co., Montana.

Festuca ovina L. var.

June 10, 1806. See under *Aira brevifolia.*

Agropyron divergens Nees. *Festuca spicata* Pursh, Fl. 83.

June 10, 1806. As last.

Koeleria cristata Pers. Pursh, Fl. 85.

June 10, 1806. As last. All the grasses of this date reported as from "Plains of the Columbia," where none of them were collected.

Stipa spartea Trin. *S. juncea* Pursh, Fl. 72, nec L. (*S. comata* Trin., fide Scribner).

July 8, 1806. East base of Continental Divide, in Lewis and Clark Co., Montana, about headwaters of north fork of Dearborn River and of Sun River.

Zizania aquatica L.

No. 59. *September 8th,* year not said. If 1804, on the Missouri near Fort Randall, South Dakota. If 1805, in the Bitter-root Valley, Montana. If 1806, on the lower Missouri between the Council Bluff and the mouth of the Platte.

Spartina gracilis Trin.?

(No label.)

Pinus ponderosa Dougl.

October 1, 1805. In Canoe Camp, on the main Kooskooskee, at the mouth of its north fork, or Chopunnish River of L. & C.

Juniperus communis L.

October 17, 1804. On the Missouri, a little below Cannonball River—same place as *Psoralea argophylla.*

Juniperus occidentalis Hook. *J. excelsa* Pursh, Fl. 647.

October 2, 1804. In the Little or Lookout Bend of the Missouri, at or near mouth of Big Cheyenne River.

Juniperus sabina procumbens Pursh, Fl. 647.

October 16, 1804. On the Missouri at or near Fort Yates, North Dakota. This is far from being "within the Rocky Mountains," Pursh.

Equisetum arvense L.

August 10, 1804. On the Missouri, above Little Sioux and below Big Sioux River; Monona Co., Iowa, on the right hand going up; Burt and Blackbird Counties, Nebraska, on the left.

Aspidium spinulosum Sw.

June 20, 1806. "Fort Clatsop;" but date impossible, as L. & C. were on the Lo Lo Trail in Idaho at this date. Probably "June" is here in error for *January.*

Lomaria spicant Desv. *Blechnum boreale* Pursh, Fl. 669, nec Willd.

June 20, 1806. "Fort Clatsop;" impossible; see last.

Hypnum oreganum Sull.

June 20, 1806. "Fort Clatsop;" impossible; see *Aspidium spinulosum.*

Bazzania trilobata (L.). S. F. Gray.

July 1, 1806. Mouth of Traveller's Rest Creek, or Lou Lou Fork of Bitter-Root River.

Egregia menziesi (Turn.) Aresch. (*Phyllospora menziesi.*)

November 17, 1805. Mouth of the Columbia River.

Sorbus microcarpa Pursh.

September 4, 1805, and June 27, 1806. Two different specimens, as well as dates, may be in question. In any event, on September 4, 1805, L. & C. passed over the Bitter-root range from Idaho into Montana, from Fish Creek, the north fork of Salmon River, to Ross' Hole, near the head of the east fork of the Bitter-root River; and on June 27, 1806, they were on the Lo Lo Trail, in the Bitter-root Mountains, nearing its east end, about to pass from Idaho into Montana, but at a place 100 miles or more distant from the other. The two situations, however, I should suppose to be practically identical, from a botanical standpoint.

(Label only.)

April 14, 1806. On the Columbia, one day below Rock Fort Camp.

Phlox speciosa Pursh, Fl. 149.

May 7, 1806. Not "on the Plains of the Columbia," as said, but on the main Kooskooskee River, below Camp Chopunnish.

LIST OF BATS COLLECTED BY DR. W. L. ABBOTT IN SIAM.

BY GERRIT S. MILLER, JR.

During the year 1896, Dr. W. L. Abbott made an extensive collection of mammals in the State of Trong, Lower Siam, a region whose fauna has hitherto been practically unknown. The collection, which Dr. Abbott has presented to the United States National Museum, includes sixty-one bats, all but six of which were sent to Washington in formalin. Eleven species are represented. Three of these prove to be new, while several others are of special interest. Considerable time must elapse before it will be possible to prepare a complete account of Dr. Abbott's Malayan collections. Meanwhile it seems advisable to publish a list of the bats that he has thus far taken, and the following is printed here by permission of the Secretary of the Smithsonian Institution.

Pteropus medius Temminck.

One skin (♀ young adult, No. 83,277) taken on April 15, 1896 I refer with some hesitation to this species. Its measurements are as follows: head and body, 260;[1] expanse of wings, 1,296;[1] forearm, 175; thumb (with claw), 75; second finger, 127; third finger, 315; fourth finger, 246; fifth finger, 230; tibia, 85; foot (with claws), 55; ear from meatus, 39; ear from crown, 37; width of ear, 22; skull: basal length, 167; basilar length (Hensel), 164; palatal length, 39; palatal width (anterior end of first molar), 13.4; zygomatic breadth, 36; breadth across postorbital processes, 28; length of nasals, 20; greatest breadth of nasals, 6; maxillary tooth row (exclusive of canine), 20; crown of first molar, 6.6x4; canine at level of cingulum, 4x3.2; greatest length of mandible, 56; depth of mandible at anterior base of first molar, 6.6; depth of mandible through angular and coronoid processes, 24; mandibular tooth row (exclusive of incisors and canine) 27; crown of first lower molar, 6x3.4; lower canine at level of cingulum, 2.8x3.

Cynopterus angulatus sp. nov.

Type.—Adult ♂ (in alcohol), No. 83,569, United States National Museum, Trong, Lower Siam, collected in 1896 by Dr. W. L. Abbott.

[1] From fresh specimen by collector.

General characters.—Size medium (forearm 60–70); tail well-developed; incisors $\frac{4}{4}$; ear conspicuously rimmed with white; posterior border of ear conch with well-developed angular projection immediately above base; general color dull rufous.

Ears.—Ears about double length of muzzle; laid forward they reach to anterior corner of eye. General form of ear as in *Cynopterus brachysoma* (see Dobson, Monograph of the Asiatic Chiroptera, p. 28), but projection at base of outer margin sharply angled instead of bluntly rounded. Tip of conch rather narrowly rounded off. A slight, though distinct, concavity in posterior border immediately below tip. Rim of ear with a conspicuous whitish border, about 1.5 mm. wide near base and narrowing to a mere trace at tip, but nevertheless continuous. Area occupied by white border on anterior margin distinctly thickened. Inner surface of ear conch with six indistinct cross ridges. Basal third of ear furred externally, the remainder naked inside and out except for a few hairs along anterior margin.

Membranes.—Membranes thick and leathery, broad and ample. Interfemoral membrane deeply emarginate, only 6 mm. wide in middle. Wings from sides of back and middle of outer toe.

Fur and color.—Throughout the body the fur is short and scant, that on the middle of back only 6 mm. in length. In males it is distinctly longer on sides of neck (10 mm. in type), and in both sexes it is much shorter on throat and on sides of body (this especially noticeable in females). The fur of the body extends to middle of forearm, both above and below, but does not reach the membranes except in middle of uropatagium. Propatagium thinly haired below through proximal half. Wings with scattered hairs below along sides of body and behind forearm.

General color of two males (skins) burnt umber, to a varying extent tinged with red and overlaid with olivaceus, darker on crown of head and paler along middle of belly. A female is paler throughout, the general color more closely approaching the chestnut and russet of Ridgway. Ears and membranes of dry specimens blackish, the former edged with dirty yellowish-white. Metacarpals and phalanges of fingers varied with whitish, which irregularly involves the membrane close to the bone.

Skull.—The skull is strongly built and moderately angular. Old individuals show a tendency to form a sagittal crest.] Face line slightly concave immediately behind tip of rostrum, then nearly straight to highest point about over middle of brain case. Frontal region with a broad longitudinal groove running from between postorbital processes to within about 3 mm. of tip of rostrum. Postorbital processes well-developed, about 4 mm. long. Extent of bony palate behind molars equal to distance between second premolars.

Teeth.—Upper incisors in pairs, the outer tooth slightly smaller than the inner. First upper premolar about as large as inner incisor, occupying less than half the space between canine and second premolar. Crowns of second and third premolars about equal when viewed from above, the first much the larger when viewed from the side. Molar about equal to third premolar, but with slightly narrower crown. Outer lower incisors distinctly larger than inner, the incisor row slightly bowed outward. First lower premolar more than double as large as first upper premolar, and like it occupying the middle of the space between the canine and second premolar. Crowns of second and third premolars and first molar subequal when viewed from above, but regularly graded in height from before backward when viewed from the side. Second lower molar about one-third as large as first and equal to first premolar.

TABLE OF MEASUREMENTS OF *CYNOPTERUS ANGULATUS.*

Number	83524	83569*	83572	83592	83593	84441	84491
Sex	♂	♂	♀	♀	♀	♀	♂
Total length	97	110	114	123	118		
Tail	8	9	11	10	9		
Tibia	24	24.6	24	29	28	26	25
Foot	13	15	14.6	16	16	14	14
Calcar	7	6	6.4	7	7	7	7
Forearm	61	66	70	71	68	65	65
Thumb	23	26	26	29	28	26	
Second finger	47	45	48	49	50	45	
Third finger	111	110	118	120	115		
Fourth finger	88	84	91	93	91		
Fifth finger	87	83	89	89	88		
Ear from meatus	18.4	18	20	21	21		
Ear from crown	15	17	17	18	18		
Width of ear	12	13	14	14	14		
Skull: Basal length					29	28	27
Basilar length of Hensel					24.4	25	24
Greatest length					32	31.4	29
Zygomatic breadth					21	21	19
Width across postorbital processes					11.8	11.4	12
Width immediately behind postorbital processes					7	6.6	6.4
Length of palate					14	14	13
Breadth of palate at anterior border of molar					7	6.6	6.4
Upper tooth row exclusive of incisors					10	10.4	10
Length of mandible					24	25	22.6
Depth of mandible at anterior border of second premolar					3	3	2.8
Depth of mandible through angular and coronoid processes					13	13	11.8
Lower tooth row					12	12	11

*Type.

General remarks.—*Cynopterus angulatus* bears a strong resemblance to *C. marginatus*, but is readily distinguishable by its considerably smaller size and by the form of the ear. It is larger than *C. brachysoma*, the only other known species with similarly formed ear, and quite different in color.

This bat is represented in Dr. Abbott's collection by two skeletons, three skins with skulls, and six specimens in formalin.

Rhinolophus trifoliatus Temminck.

Four specimens in formalin. For measurements see table.

Rhinolophus affinis Horsfield.

Four specimens in formalin.

TABLE OF MEASUREMENTS OF *RHINOLOPHUS TRIFOLIATUS* AND *R. AFFINIS*.

	R. trifoliatus.			*R. affinis.*		
Number	83525	83537	83573	83538	83540	83571
Sex	♂	♀	♀	♀	♀	♂
Total length	96	104	100	85	87	85
Tail	38	38	35	23	25	25
Tibia	26	25	25	24	24	25
Foot	11	12	12.4	10	10	10.6
Calcar	16.4	12	14	7	7	10
Forearm	53	53	53	51	50	51
Thumb	7	8.4	8	8.6	7.6	9
Second finger	38	37	38	40	41	42
Third finger	87	90	90	77	74	78
Fourth finger	71	71	73	61	64	64
Fifth finger	74	78	77	63	65	65
Ear from meatus	26.4	27	29	20	22	22
Ear from crown	22	23	24	17	18	18
Width of ear (exclusive of antitragus)	19	18	18	16.6	16	16
Length of nose leaf from lip	19	20	21	16	15	16
Greatest width of nose leaf	12	12	12	9	9	9.4

Hipposideros larvatus (Horsfield).

One skin and ten specimens in formalin.

The form occuring in Trong differs considerably from the *Hipposideros larvatus* of Dobson and Blanford, which is represented in the National Museum collection by two specimens (in alcohol) taken at Bhano, Upper Burma, by Fea. As the type of *Phyllorhina larvata* Horsfield came from Java, the probabilities are that if either of the mainland forms is referable to the typical subspecies, it is the one inhabiting the southern half of the Malay Peninsula. Assuming this to be the case, the form of *Hipposideros larvatus* found in Assam and Upper Burma is unnamed. As compared with the northern and better known form, that from Trong is slightly smaller in general size. The foot is disproportionately smaller, and the ear is narrower in proportion to its length. The skull is smaller and the teeth, especially in the lower jaw, are comparatively slender and weak.

TABLE OF MEASUREMENTS OF TWO FORMS OF *HIPPOSIDEROS LARVATUS.*

	Locality.											
	Bhano Burma.		Trong, Lower Siam.									
Number	18478	18479	83539	83543	83566	83544	83567	83568	83565	83541	83542	83570
Sex	♂	♂	♂	♂	♀	♀	♀	♀	♀	♀	♀	♀
Total length	113	110	105	105	106	106	104	96	106	100	99	106
Tail	39	37	36	37	36.6	37	36	30	37	32	35	39
Tibia	26	25	23	23	23	24	22.4	22	24.6	22	21	23
Foot	12.6	13	10	10	9.8	9.4	10	10	10	10	10	10
Calcar	16	15	13	14	14	14.6	13	13.8	14	13	13	12.4
Forearm	63	59	57	58	58	59	57.6	56.4	61	57	55	59
Thumb	11	10.4	8.6	9	9.6	9.6	9	8	8.6	8.8	8.6	9
Second finger	52	50	46	47	48	48	47	46	50	47	45	47
Third finger	91	86	82	83	85	85	82	79	85	83	81	83
Fourth finger	68	70	65	66	66	67	65	64	67	65	64	67
Fifth finger	72	70	64	65	65	65	63	62	66	63	62	65
Ear from meatus	23	24	23	24	24	23.4	22	22	23	22.4	23	24
Ear from crown	18	19	19	18	18	17.4	17	16.4	17	18	17	19
Width of ear	21	20.4	18	18	19	18.6	18	18	18	19	18.4	19
Length of nose leaf from lip	10	9.6	9	10	11	11	10	9	9	9.6	9	10
Width of nose leaf	6.8	7	7	6.6	7	6.6	6	6	6	6.4	6	6.4

Megaderma spasma (Linnæus).

An adult male in formalin and one skin. The latter is an adult female taken on March 28, 1896. On the label of this specimen Dr. Abbott has written : "Uterus contained a fetus about two inches in length and hairless. Discoidal placenta about ¾ inch in diameter."

While this bat is clearly not related to *Megaderma lyra*, I am not satisfied that it is the *M. spasma* of Dobson and Blanford. From the descriptions of the latter species it differs in the following characters : skull with small but evident postorbital processes (more pronounced than in Dobson's figure of *M. lyra*); mesopterygoid fossa divided by a central longitudinal ridge in its anterior half only; first upper premolar very small and partly hidden by cingulum of second premolar which is almost, or quite, in contact with canine; inner basal cusp of upper canine indistinct; middle lower incisors trifid; posterior branch of tragus apparently longer; free upper part of nose leaf with very strongly convex sides and a deep constriction at base; heart shaped supplemental leaf above nostrils barely reaching edge of principal leaf.

Measurements: head and body, ♂, 77; head, ♂, 28; tibia, ♂, 32, ♀, 32; foot, ♂, 16, ♀, 15; calcar, ♂ 13.4, ♀, 11; forearm, ♂, 57;

thumb, ♂, 16.4, ♀, 18; second finger, ♂, 51, ♀, 51; third finger, ♂, 100, ♀, 101; fourth finger, ♂, 78, ♀, 73; fifth finger, ♂, 79, ♀, 78; ear from meatus, ♂, 38, ♀, 33; ear from crown, ♂, 32, ♀, 27; width of ear, ♂, 25, ♀, 23; tragus (from posterior base) to posterior tip, ♂, 20, ♀, 19; tragus (from posterior base) to anterior tip, ♂, 11.4, ♀, 10; nose leaf from edge of upper lip, ♂, 12.4, ♀, 12; greatest width of nose leaf (2 mm. below tip), ♂, 7.4, ♀, 7.8.

Skull: basilar length, ♂, 18; greatest length, ♂, 24.6, ♀, 25; length of bony palate in median line, ♂, 6.2; zygomatic breadth, ♂, 15; breadth across postorbital processes, ♂, 5.8, ♀, 5.6; upper tooth row, ♂, 10, ♀, 9.6; mandible, ♂, 17.8, ♀, 17; mandibular tooth row, ♂, 11.6, ♀, 11.4.

Tylonycteris pachypus (Temminck).

Twenty-eight specimens in formalin.

The genus *Tylonycteris*, although currently united with *Vespertilio* (=“*Vesperus*”) appears to be perfectly valid. It may be defined as follows: Dental formula (as in *Vespertilio*), $i, \frac{2-2}{3-3}$; $c, \frac{1-1}{1-1}$; $pm, \frac{1-1}{2-2}$; $m, \frac{3-3}{3-3}=32$; skull very broad and flat, with greatly reduced rostrum and no trace of sagittal crest; ball of thumb and sole of foot provided with broad, disc-shaped pads.

Four specimens from Buitenzorg, Java, agree in size with those from Trong, but in color they are much lighter. This difference may be due to alteration in color resulting from long immersion in alcohol. The Javan specimens were collected by G. B. Ferrari, and have been in the National Museum since 1890.

Scotophilus kuhli Leach.

An adult female and three young.

The genus represented by this bat is so closely related to the North American *Nycticeius* that it is doubtful whether the two can be regarded as distinct. The characters pointed out by Dobson, however, appear to be of nearly as much importance as those separating *Nycticeius* and *Rhogeëssa*.

Myotis muricola (Hodgson).

Four specimens in formalin. These are chiefly interesting from the fact that they formed part of the meal of a nocturnal, bat-eating hawk, *Machærhamphus alcinus*.

Kerivoula minuta sp. nov.

Type.—Adult ♂ (in alcohol), No. 83,547, Trong, Lower Siam, September, 1896. Collected by Dr. W. L. Abbott.

General characters.—About the size of the Bornean *Kerivoula pusilla* Thomas,[2] but with shorter ears, feet and legs, less hairy wings, and more uniform coloration. Upper incisors bicuspidate; crowns of upper premolars with transverse diameter equal to or slightly greater than antero-posterior diameter.

Ears.—The ears are relatively shorter than in *K. hardwickii*; laid forward they reach to nostril. Anterior border extremely convex, much more so than in *K. hardwickii*, but probably about as in *K. pusilla*. Posterior border with subterminal concavity very shallow and close to tip of ear. Tragus essentially as in *K. hardwickii*, but with a distinct notch immediately above anterior base.

Membranes.—Membranes very thin and delicate, light brown with irregular pellucid mottling. The specimen is in an excellent state of preservation, so that this mottling of the membranes must be regarded as a normal character. Wings essentially naked as in *K. hardwickii*; uropatagium more hairy. The fur of the body extends along the base of the wings in a very narrow line only; beyond this a few inconspicuous hairs are scattered over the area bounded externally by the line from elbow to knee. Proximal half of interfemoral membrane rather thickly sprinkled with yellowish hairs, which extend along the legs to feet.

Fur and color.—Fur long and soft, but not dense; that on middle of back about 10 mm. in length.

Color ochraceus buff throughout, scarcely paler on the belly, the hairs of the back faintly tipped with rufous. Except on the head and membranes the hairs are everywhere plumbeous at base.

Skull.—Skull much smaller than that of *K. hardwickii*, but with relatively broader and heavier rostrum. Brain case much more inflated anteriorly than in *K. hardwickii*.

Teeth.—Each upper incisor bicuspidate, relatively smaller than in *K. hardwickii*; the outer separated from the canine by a distinct space. First and second upper premolars subequal in all dimensions, the transverse diameter of each equalling or slightly exceeding the antero posterior diameter. Crowns of molars relatively narrower than in *K. hardwickii*. Two inner lower incisors trifid and each considerably smaller than the unicuspid outer incisor. Lower premolars essentially like those of the upper jaw.

Measurements.—Total length, 70; head and body, 31 (33)[3]; tail,

[2] Ann. and Mag. Nat. Hist., 6th ser., XIV, p. 461, December, 1894.

[3] Measurements in parenthesis are those of the type of *K. pusilla*, an adult female, as given by Thomas in the original description.

35 (39); tibia, 11.4 (14); foot without claws, 4.4 (6.2); foot with claws, 5.2; calcar, 9; forearm, 27 (28); thumb, 4; second finger, 27 (28.5); third finger, 58 (56); fourth finger, 44; fifth finger, 42; ear from meatus, 10 (11.6); ear from crown, 8; width of ear, 10; distance between tips, 21 (25); tragus, 6.4. Skull: greatest length, 11.4; zygomatic breadth, 7; length of palate in median line, 5; upper tooth row (exclusive of incisors), 4.6; mandible, 8.8; lower tooth row (exclusive of incisors), 4.8.

General remarks.—Kerivoula minuta is in no way closely related to *K. hardwickii* or to any of the species hitherto known from the mainland of Asia. Its relationships are wholly with the small Bornean form recently described by Mr. Thomas as *K. pusilla.*

Dr. Abbott secured only one specimen of this species.

Emballonura peninsularis sp. nov.

Type.—Adult ♂ (in alcohol), No. 83,575, United States National Museum, Trong, Lower Siam, November, 1896. Collected by Dr. W. L. Abbott.

General characters.—In general appearance most like *Emballonura monticola* Temminck, one of the smaller members of the genus, but in size slightly surpassing *E. semicaudata* (Peale), the largest species hitherto known.

Ears.—Ears moderate; when laid forward they extend slightly beyond nostril. Anterior margin straight from base (over middle of eye) to about middle, whence it is faintly convex to slight concavity immediately below tip. Tip very narrowly rounded off. Posterior border concave immediately below tip, then gently and evenly convex to faint notch opposite base of tragus, after which it is more abruptly convex to base, which is distinctly below line of lower lip. Inner surface of conch with thirteen cross striations arising near posterior border and disappearing shortly beyond middle.

Tragus with anterior and posterior borders nearly parallel, though on close inspection each is seen to be very faintly concave. As a result the tragus is slightly narrower at mid height than at base or immediately below the bluntly rounded tip. Whole periphery of tragus faintly crenulate. A trace of a lobe on posterior margin just below level of anterior base.

Membranes.—The membranes are full and ample, but in no way peculiar. Wings from ankles. Uropatagium including tail to base of penultimate vertebra. Distance from tip of tail to free edge of membrane considerably more than length of tail. Upper surface of uropatagium thinly furred to line of tip of tail. Lower surface of uropatagium rather thickly sprinkled with short hairs along veins except near legs. Wings naked except where fur of body extends both above and below to line joining middle of humerus with lower third of femur.

Fur and color.—Fur of middle of back about 11 mm. in length. Face and muzzle practically naked. Fur of head covering basal third of ears.

Dorsal surface uniform dark sepia; under parts much paler, very near the broccoli brown of Ridgway. Hairs everywhere, both above and below, indistinctly whitish at base. Muzzle, ears and membranes blackish.

Feet.—The feet are slender, a little less than half as long as tibia and considerably more than half as long as calcar. Calcar slender, weak and ill-defined, 3–5 mm. shorter than tibia, terminating in a small lobe.

Skull.—Skull thin and papery; muzzle about $\frac{3}{4}$ as wide as brain case, slightly inflated laterally, and with a deep central longitudinal groove; postorbital processes long and very slender, reaching almost to highest point of zygomata; brain case strongly inflated posteriorly. Measurements of two skulls: No. 83,574, ♀ adult; greatest length, 14; basilar length, 10.4; zygomatic breadth, 8.8; greatest anteorbital breadth, 5.8; palatal length, 4; width of palate between posterior molars, 3.4; length of upper tooth row (exclusive of incisors) 5.2; mandible, 9.6; lower tooth row (exclusive of incisors), 5.6. No. 83,556, ♂ adult; greatest length, 14; basilar length, 10.4; zygomatic breadth, 9; greatest anteorbital breadth, 5.4; length of postorbital process, 3; palatal length, 4; width of palate between posterior molars, 3; length of upper tooth row (exclusive of incisors), 5.2; mandible, 9; lower tooth row (exclusive of incisors) 5.4.

Teeth.—The teeth are essentially as in the *E. monticola* of Dobson, except that the first upper premolar is tightly wedged between the canine and second premolar, and the first lower premolar is very much smaller than the second in cross section.

General remarks.—*Emballonura peninsularis* needs comparison with only one species, the *E. monticola* of Temminck.[4] I have seen no specimens from Java, the type locality of this form, but Tem-

[4] Van der Hoeven's Tijdschrift voor Naturlijke Geschiedenis en Physiologie, V, p. 25, 1838.

minck's original description is so full that it furnishes a satisfactory basis for comparison. In passing it may be remarked that the Philippine bat referred by Dobson to *E. monticola*[5] is probably a distinct species from either the Javan or peninsular forms, as the discrepancies in measurements are too great to be the result of mere individual variation.

From *E. monticola* the peninsular form differs chiefly in its larger size (forearm 43–45 instead of 40, extent of wings about 280 instead of 215–230) and longer tail (see table of measurements). None of the Trong specimens show the snuff-colored head and fore-neck mentioned as occasionally occurring in *E. monticola.* The fur of the ventral surface of the body is nearly as noticeably whitish at base as that of the back, while in *E. monticola* it is said to be brown at base. As shown in the table of measurements, *Emballonura peninsularis* slightly exceeds *E. semicaudata* in size. It is thus the largest known species of the genus.

Dr. Abbott secured seven specimens, all of which were sent to the National Museum in formalin.

TABLE OF MEASUREMENTS OF *EMBALLONURA MONTICOLA, E. SEMICAUDATA* AN *E. PENINSULARIS.*

	E. monticola.[6]	*E. monticola.*[7]	*E. semicaudata.*	*E. peninsularis.*						
Number			3727*	83574	83579	83556	83575*	83576	83577	83578
Sex				♀	♀	♂	♂	♂	♂	♂
Total length		57		60	62	61	61	60	60	60
Tail	12.7	10.4	15	12	14.6	16	13.6	13	14	15
Width of interfemoral membrane beyond tail			18	20	20	22	21	19	20	21
Tibia	11.4		16.4	16	16	17	17	16.4	16	16
Foot			6.4	6.4	7	6.4	6	6.8	6.6	6.4
Calcar			11	13	13	14	13	11	12	13
Forearm	35.6	40	41	44	43	44	45	44	43	45
Thumb	5.1		7	7	6	7.4	6	6	7	7
Second finger			34	37	37	38	37	35	36	39
Third finger			67	70	70	74	73	72	72	75
Fourth finger			47	50	47	51	50	48	49	51
Fifth finger			46	46	44	47	48	45	46	48
Ear from meatus			11	12	11	13.4	12	11.4	12	11.4
Ear from crown				9.8	10	10	11	10	10	10
Width of ear			7	9	8.6	9	9.4	10	10	10
Tragus	4.6		4.4	4.4	5	4.6	4.8	5	5.4	5
Width of tragus at tip			2.4	2	1.6	1.6	1.6	1.4	1.8	1.6

[5] Catal. Chiroptera Brit. Mus., p. 361–362.
[6] Luzon, Philippine Islands (from Dobson).
[7] Java (from Temminck).
* Type.

DESCRIPTIONS OF FIVE NEW PHYLLOSTOME BATS.

BY GERRIT S. MILLER, JR.

The greater part of the material on which are based the descriptions of the following five new bats is contained in the United States National Museum, and the descriptions are published here by permission of the Secretary of the Smithsonian Institution. An important collection from Jamaica, sent by the Museum of the Institute of Jamaica to the United States Department of Agriculture, and submitted to me for determination by Dr. C. Hart Merriam, includes topotypes of the little known *Natalus micropus* Dobson, and the unique type of *Reithronycteris aphylla*. The type and only known specimen of *Glossophaga longirostris* forms part of a small collection of bats made by Mr. W. W. Brown, Jr., at Santa Marta, Colombia, and referred to me for identification by Mr. Outram Bangs. Series of specimens from each of these collections are to be presented to the National Museum.

CHILONATALUS subgen. nov. (Natalinæ).

Type *Natalus micropus* Dobson.

Subgeneric characters.—Similar to typical *Natalus* Gray, but with conspicuous dermal outgrowths on chin and above nostrils. These outgrowths, as pointed out by Dobson, produce a strong resemblance to *Chilonycteris*. Males with a large glandular swelling on forehead, between and slightly in front of eyes (figure 1).

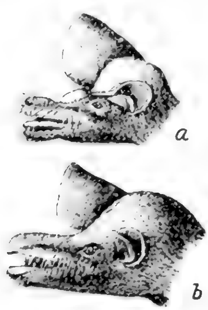

Fig. 1.—Head of *Chilonatalus* (a) and *Natalus* (b), left ear removed. (Slightly enlarged).

General remarks.—*Natulus micropus* and *N. brevimanus* differ so remarkably from the other members of the genus that they must be regarded as forming at least a distinct subgenus. The form of the glandular elevation above the nostrils and the apparently double lower lip, taken in connection with the other characters pointed out by Harrison Allen in which the *Natalinæ* resemble *Chilonycteris* and *Mormoops*, may indicate a closer relationship between the two groups than has heretofore been suspected.

TABLE OF MEASUREMENTS OF *NATALUS MICROPUS* AND *N. BREVIMANUS.*

Name.	Locality.	Number.	Sex.	Total length.	Tail vertebræ.	Tibia.	Foot.	Forearm.	Thumb.	Second finger.	Third finger.	Fourth finger.	Fifth finger.	Ear from meatus.	Ear from crown.	Tragus.
N. micropus	Jamaica.		♀	80	47	18	7	34	4	34	65	48	48	11.4	11	4
N. micropus	Jamaica.		♂	82	44	16.4	7	32	4	32	63	48	48	13	11	4.6
N. micropus	Jamaica.		♂	84	47	16.8	7	34	4.1	34	64	47	48	13	11	4.4
N. micropus (average)	Jamaica.			82	46	17	7	33.3	4.1	33.3	64	47.6	48	12.3	11	4.3
N. brevimanus	Old Providence.	15,803	♂	81	44	15	7	31	4	32	57	42	43	14	12	4.6
N. brevimanus	Old Providence.	15,821	♂	86	45	15	7	32	4	32	60	45	45	14	12	4.4
N. brevimanus	Old Providence.	15,823	♂	87	48	15	6.8	33	3.8	33	61	45	46	14.4	11.8	4
N. brevimanus	Old Providence.	15,824	♂	87	48	15	6	32.6	4	32.4	60	45	45	13	12	4
N. brevimanus	Old Providence.	15,825	♂	83	45	15	6.4	33.4	4	33	60	45	45	14	11	5
N. brevimanus	Old Providence.	15,832	♂	81	44	15	6	32	3.8	32.4	57	42	44	14.2	12	4.4
N. brevimanus	Old Providence.	15,835	♂	84	45	15	6.4	31.4	4	31	56	41	44	14	11.8	4.4
N. brevimanus	Old Providence.	15,844	♂	87	46	16	6	32.4	4	32	58	44	44	13	12	4.6
N. brevimanus	Old Providence.	15,854	♂	84	47	15	7	32	4	32.6	58	42	43.6	14	11.6	4.4
N. brevimanus	Old Providence.	15,855	♂	88	45	15	6.6	32	4	32.6	59	44	45	14	12	4
N. brevimanus	Old Providence.	15,810	♀	86	46	16	7	32	4	34	60	45	45	14	11	4
N. brevimanus	Old Providence.	15,811	♀	85	46	15	7	33	4	33	60	44	44	14	11	4
N. brevimanus	Old Providence.	15,814	♀	86	43	15	7	23.4	4	32	60	44	45	14	11	4.4
N. brevimanus	Old Providence.	15,826	♀	85	46	15.6	7	33	4	33	60	45	45	13.6	12	4.6
N. brevimanus	Old Providence.	15,830	♀	82	47	16	6.6	33	4	31	57	44	45	13	12.4	4.4
N. brevimanus	Old Providence.	15,838	♀	85	48	16	6.4	32.4	4	34	60	45	45	14	12.4	4.6
N. brevimanus	Old Providence.	15,846	♀	87	47	16	7	32.4	4	34	61	44	45	14.4	12.4	4
N. brevimanus	Old Providence.	15,849	♀	90	48	15.4	7	32	4	33.4	60	44	45	12.6	12	4.6
N. brevimanus	Old Providence.	15,852	♀	83	46	15	7	33	4	33	61	45	46	13.4	11.4	4
N. brevimanus	Old Providence.	15,853	♀	88	49	16	6.4	33	4	34	61	45	46	13	12	4.6
N. brevimanus (average)	Old Providence.			85.2	46.1	15.8	6.7	32.4	3.98	32.7	59.3	44	44.8	13.8	11.8	4.3

Natalus (Chilonatalus) brevimanus sp. nov.

Natalus micropus J. A. Allen, Bull. Am. Mus. Nat. Hist., III, p. 169, November, 14, 1890.

Type.—Adult ♂ (in alcohol), No. 15.835, United States National Museum, Old Providence Island, Caribbean Sea. Presented by Chas. B. Cory.

Specific characters.—Slightly smaller than *Natalus micropus* Dobson[1] from Jamaica and with relatively longer ears and shorter fingers. Color apparently paler than in *N. micropus.*

General remarks.—Dr. J. A. Allen recorded the occurrence of this bat on the island of Old Providence as long ago as 1890, but with only a single individual at hand, he naturally considered it the same as the Jamaican species. On comparing fifty-seven specimens from Old Providence with three from Jamaica, I find a slight but remarkably constant difference. Taking into consideration the perfect isolation of the two forms it seems best to apply to them binomial names. The characters are well brought out in the following table of measurements. The apparent lighter color of *N. brevimanus* may be due to the bleaching effect of alcohol, as I have seen no skins, and both lots of specimens have been preserved for an unknown length of time.

Micronycteris microtis sp. nov.

Type.—Adult ♂ (skin and skull) No. $\frac{16366}{23367}$, United States National Museum. Collected at Greytown, Nicaragua, by Dr. L. F. H. Birt.

Specific characters.—Smaller than *Micronycteris minutus* (Gervais); thumb, foot, calcar and membranes as in *M. megalotis* Gray; ear from meatus about half as long as forearm; middle lower premolar relatively larger than in *M. megalotis;* general color wood-brown, scarcely paler on ventral surface.

Fur and color.—The fur is distributed precisely as in *M. megalotis*, except that there is a slightly more extensive sprinkling of hairs on the dorsal surface of forearm. Fur on middle of back about 10 mm. in length.

Color uniform wood-brown, slightly richer on dorsal surface. Hairs on body both dorsally and ventrally, nearly white through basal third.

Ears.—Ears densely furred on basal half externally, the fur running up along anterior border to within 5 mm. of tip. Distal half

[1] Proc. Zoöl. Soc. Lond., 1880, p. 443.

bare, with a few very fine scattered hairs. In form the ears are much like those of *M. megalotis.* Their tips, however, are more abruptly narrowed, a condition made still more apparent by their much smaller size. Inner surface of auricle with eight sharply defined cross ridges arising at posterior border and extending about half way across ear. The distance between the uppermost and lowermost ridge is about 5 mm.

Feet.—Foot distinctly shorter than calcar and slightly more than half as long as tibia.

Skull.—In the type the brain case is more elevated immediately behind the orbits, and the zygomata are less flaring than in the skulls of *M. megalotis* with which I have compared it, but these differences may prove to be individual.

Teeth.—When viewed from above, the crowns of the three lower premolars appear to be of approximately equal size, though the second is slightly smaller than either of the others. In *M. megalotis* the crown of the middle lower premolar is very conspicuously smaller than the first. In other respects the teeth of the two species appear to be identical.

General remarks.—*Micronycteris microtis* is so different from the other described species of the genus that it needs no special comparison with any. From *M. megalotis* its nearest geographical ally, its small ears and uniform wood brown color separate it at a glance. Yet it is probably most closely related to *M. megalotis* and *M. hirsuta*, since *M. behnii* and *M. minuta*, the only other known species, are distinguished by differences in the proportions of the parts of the fingers and feet, to say nothing of the peculiar attachment of the wings in *M. minuta.*

In the type of *Micronycteris microtis* the exact form of the nose leaf cannot be determined. The free, upright portion of the leaf, however, appears to be shorter and broader than in either of the races of *M. megalotis.* The whole leaf is finely pubescent.

The striation of the inner side of the ear is very different in *Micronycteris microtis* and *M. megalotis.* In the latter, instead of eight sharply defined ridges crowded into the space of 5 mm., there are thirteen ill defined striæ with a distance of nearly 10 mm. between the first and last.

Micronycteris megalotis mexicanus subsp. nov.

Type.—Adult ♀ (in alcohol) No. 52,105, United States National Museum (Biological Survey collection). Collected at Plantinar, Jalisco, Mexico, April 4, 1892, by E. W. Nelson. Original number 2,389.

Subspecific characters.—About the size of typical *Micronycteris megalotis* Gray, but with longer middle finger and apparently lighter color.

General remarks.—While the Mexican material at hand is fairly satisfactory, lacking only skins for the accurate determination of color characters, the South American series is very deficient. Yet the nine specimens that I refer to true *megalotis* agree very closely among themselves, and differ fairly constantly from the Mexican form. The color appears to be paler in the Mexican specimens, but as all are preserved in alcohol no special weight can be attached to this fact. The real characters of the two forms are shown in the accompanying table of measurements.

Dobson's key to the species of *Micronycteris* (= 'Schizostoma') rearranged and extended to include the two new forms just described is as follows:

First phalanx of middle finger conspicuously shorter than second; forearm 47 . . . . *M. behnii* (Peters).

First phalanx of middle finger approximately equal to second; forearm 30–40.

- Wings from tibiæ; metacarpal of thumb about equal to remaining parts; calcar shorter than foot . . *M. minuta* (Gervais).
- Wings from tarsus or metatarsus; metacarpal of thumb much longer than remaining parts; calcar longer than foot.
  - Legs and forearms conspicuously hairy. *M. hirsuta* (Peters).
  - Legs and forearms essentially bare.
    - Ear from meatus about one-half forearm *M. microtis* Miller.
    - Ear from meatus about two-thirds forearm.
      - Longest finger 60–64 . *M. megalotis megalotis* Gray.
      - Longest finger 68–72 . *M. megalotis mexicanus* Miller.

Glossophaga longirostris sp. nov.

Type.—Adult ♀ (skin and skull) No. 8,046, Bangs collection, Santa Marta Mountains (near Santa Marta), Colombia, February 10, 1898. Collected by W. W. Brown, Jr. Original number, 60.

Specific characters.—Much larger than any species hitherto described; skull large and greatly elongated, color darker than in either phase of *G. soricina.*

TABLE OF MEASUREMENTS OF THREE FORMS OF *MICRONYCTERIS*.

Name.	Locality.	Number.	Sex.	Total length.	Head and body.	Tail.	Tibia.	Foot.	Forearm.	Thumb.	Longest finger.	metacarpal.	1st phalanx.	2d phalanx.	Ear from meatus.	Ear from crown	Width of ear.	Tragus.	Height of nose leaf.	Width of nose leaf.
M. microtis	Greytown, Nicaragua	16,366*	♂	—	—	—	12.6	8	31	8.8	58	26	12.6	14	16	12	9	5.8	3.8	4
M. megalotis megalotis	Trinidad.	21,027	♂	55	40	13	15	8	32	9	60	24	13	13	21	16.4	13	6	6.4	4
M. megalotis megalotis	Margarita Island.	63,214	♀	—	—	—	15	9	33.4	10	63	28	13	14.6	21	17.6	15	6.4	5.4	4
M. megalotis megalotis.	Margarita Island	63,215	♂	—	—	—	15	8.8	33	10	60	27	13	13.8	21	17	14	6	6	4
M. megalotis megalotis.	Santa Marta, Colombia.	8,047†	♀	—	—	—	14	9	34	9	62	27	14	13.6	—	—	—	—	—	—
M. megalotis megalotis.	Santa Marta. Colombia.	8,048†	♂	—	—	—	15	10	33.6	10	62	26	13.6	13.6	—	—	—	—	—	—
M. megalotis megalotis	Santa Marta, Colombia	8,055†	♂	60	42	13	14	8.4	31.6	9	65	27	13	13.4	22	17	14	6.6	6	5
M. megalotis megalotis	Santa Marta, Colombia	8,056†	♀	60	46	13.4	15	9	—	9	64	28	13	14	23	18	-	7	6	5
M. megalotis megalotis, (average)	Santa Marta, Colombia.			58	44	13.2	14.5	8.8	33.4	9.3	62	27	13.2	13.5	21.6	17.2	14	6.4	5.9	4.4
M. megalotis megalotis.	Patuca, Honduras.	21,014	♂	57	43	12	14	7	33	6	64	27	12.6	14	20	16	14	7	6	4
M. megalotis megalotis	Patuca, Honduras.	21,015	♂	56	44	13	13	7	32	8	61	26	13	13	20	15	14	6.8	6	4
M. megalotis mexicana	Manzanillo, Colima.	51,638	♀	64	46	17	16	9	36	10	71	30	14	14.4	21	16	15	6.8	6	4.2
M. megalotis mexicana.	Manzanillo, Colima	51,639	♂	60	43	15	—	8.8	—	8	67	28	13	13	21	16	14	6	6.2	4
M. megalotis mexicana	Colima, Colima	51,641	♂	59	44	15.6	15	9	35	9.6	70	30	14	14	22	17	15	6.6	7	4.4
M. megalotis mexicana	Colima, Colima	51,642	♂	61	46	12	13.4	9	35	9	68	30	13	14	21.4	17	14	6.4	6.4	4.8
M. megalotis mexicana	Colima, Colima	51,643	♀	57	45	12.4	14	9	36.4	9	68	30	13	14.4	21.4	17	14	7	6	4
M. megalotis mexicana	Colima, Colima	51,644	♂	58	45	14	15	9	35	10	67	28	13	14	22	18	15	6.6	7	4
M. megalotis mexicana	Colima, Colima	51,645	♀	-	42	—	15.6	8	35	9	69	29	13.6	14	23	18	15	7.6	6	4.6
M. megalotis mexicana	Plantinar, Jalisco.	52,094	♂	—	43	—	15.4	8	36	8	71	30	13	14	22	17	15	6.8	6	4.6
M. megalotis mexicana.	Plantinar, Jalisco.	52,103	♀	—	43	14	15	9	35.6	9	71	30	13.4	14	22	17	16	7	6.4	4.4
M. megalotis mexicana.	Plantinar, Jalisco.	52,104	♂	—	43	13	16	10	34.6	8.6	69	30	13	14	21.6	16.4	14.6	6.6	6	4
M. megalotis mexicana.	Plantinar, Jalisco.	52,105*	♀	57	44	15	16	10	36	9	72	29	14.8	15	21.4	16	14	7	7	4.4
M. megalotis mexicana	Plantinar, Jalisco.	52,106	♀	57	40	13.6	15	8.4	36	10.4	70	29	13.8	14.4	21.4	17	15	7.2	6	4.4
M. megalotis mexicana.	Sto. Domingo, Oaxace.	8,119	♀	65	48	13	16.4	10	37	10	72	31	15	16	22	18	15	7	—	—
M. megalotis mexicana, (average)				60	44	14.9	15.2	9	35.6	9.2	69.7	29	13.6	14.2	2[illegible].7	17	14.7	6.8	6.3	4.3

* Type.

† Bangs collection

Fur and color.—In quality and distribution the fur resembles that of *G. soricina.* It is 7 mm. in length on middle of back, slightly longer on throat and shorter on belly.

Color above dark hair brown, slightly tinged with Prout's brown, the hairs everywhere very pale hair brown through basal two-thirds or three-fourths. Belly light broccoli brown, becoming much darker on chest and throat.

Ears.—As nearly as can be determined from the dried specimen the ears are essentially as in *G. soricina,* though considerably larger and apparently with broader tragus.

Skull.—Aside from its conspicuously larger size the skull of *Glossonhaga longirostris* differs from that of *G. soricina* in its relatively longer rostrum, the sides of which are more nearly parallel, less strongly arched brain-case, and in the narrowness of the backward prolongation of the bony palate behind the plain of the last molar. In *G. soricina* the width of the bony palate at the constriction immediately behind the last molar is contained only twice in the distance from the latter point to the tip of the hamular. In *G. longirostris* it is contained nearly two and one-half times.

Teeth.—In the only known specimen of *Glossophaga longirostris* —an adult, though by no means aged individual—the incisors have all been shed. Distinct traces of the alveoli can still be seen in the mandible, but these are nearly obliterated in the upper jaw. Whether this condition is normal, as in the genus *Lichonycteris,*[2] it is, of course, impossible to say. In much older individuals of *G. soricina* and *G. truei*[3] the incisors are invariably present, so far as my observation has gone. In relative size the premolars and molars are essentially as in *G. soricina.* All, however, are very distinctly narrower. Or, in other words, the teeth have shared in the general elongation of the jaws without undergoing any proportional increase in width. In the lower premolars where the characters are most strongly marked, the width of each tooth is appreciably less than in *G. soricina,* while the longitudinal extent of the three together exceeds the same measurement in *G. soricina* by nearly one millimetre.

Measurements.—Total length, 80;[4] tail, 18;[4] tibia, 16; foot, 10;[4] thumb, 9; forearm, 39; longest finger, 80; ear, 14.[4] Skull: total

[2] Thomas, Ann. & Mag. Nat. Hist., ser. 6, XVI, p. 55, July, 1895.
[3] H. Allen, Science, N. S., V, No. 108, p. 153, January 22, 1897.
[4] Collector's measurement.

length, 23.4 (19.8);[5] basilar length, 19.8 (16.2); zygomatic breadth, 10.8 (9.6); last molar to tip of hamular, 7 (5.6); last width of bony palate behind molars, 2.4 (2.2); mandible, 15.8 (13); maxillary tooth row, 8.2 (6.8); mandibular tooth row, 8.6 (7).

General remarks.—*Glossophaga longirostris* needs no close comparison with other members of its genus. Should the early deciduous incisors prove to be a constant character, the animal will probably require at least subgeneric separation from the forms related to *G. soricina.*

REITHRONYCTERIS gen. nov. (Glossophaginæ.)

Type *Reithronycteris aphylla* sp. nov.

Generic characters.—Dental formula (as in *Phyllonycteris*), $i, \frac{2-2}{2-2}$; $c, \frac{1-1}{1-1}$; $pm, \frac{2-2}{2-2}$; $m, \frac{3-3}{3-3}=32$; zygomatic arches incomplete (as in *Hemiderma*); floor of brain-case from basisphenoid forward elevated out of its usual position, so that the roof of the posterior nares is formed by two longitudinal folds, given off by the pterygoids and nearly meeting in the median line in the region usually occupied by the basisphenoid and presphenoid (figures 3 and 4); calcar absent; nostrils perforating a disc-shaped elevation which lacks a true "leaf" or free, pointed process above (the conditions are exactly reproduced in *Brachyphylla*); ears small and separate; tongue broader than in *Phyllonycteris* and more abruptly narrowed at tip, the papillæ short and stiff; tail about as long as femur.

General remarks.—*Reithronycteris* is a very aberrant member of the subfamily *Glossophagina*. Its broad teeth, heavy rostrum, massive lower jaw and broad tongue with short papillæ remove it widely from extreme forms such as *Chœronycteris* and *Lichonycteris*. In its reduced nose leaf and in the form of the mandible and of the mandibular teeth it resembles *Brachyphylla*. Whether these characters indicate any real affinities with the *Stenodermata* is, however, very questionable.[6] In addition to these less important characters, *Reithronycteris* differs from all other bats with which I am acquainted in the structure of the interpterygoid region.

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[5]Measurements in parenthesis are those of an adult female, *Glossophaga soricina*, from Cuernavaco, Morelos, Mexico (No. 36,017, U. S. Nat. Mus.).

[6]Since this paper has been in type I have received the late Dr. Harrison Allen's monograph of the Glossophaginæ (Trans. Am. Philos. Soc., N. S., XIX, pt. II, pp. 237–266, June, 1898). Here *Brachyphylla* is united with *Phyllonycteris* to form the group 'Brachyphyllina,' placed at that end of the glossophagine series nearest the Stenodermatinæ.

Reithronycteris aphylla sp. nov.

Type.—Adult ♂ (in alcohol) No. 9, Museum of the Institute of Jamaica. Collected in Jamaica. No further history.

Specific characters.—External appearance much as in *Phyllonycteris sezekorni* Peters,[7] but muzzle conspicuously broader and terminating in a disc-shaped rudimentary nose leaf like that of *Brachyphylla cavernarum.* Feet relatively larger than in *Phyllonycteris sezekorni*, and interfemoral membrane much less developed. Skull broader and more heavily built than that of *P. sezekorni* and lacking the slender, but complete zygomatic arches often present in the latter.[8] Teeth conspicuously shorter and broader than in *Phyllonycteris sezekorni;* front lower molar very slightly larger than succeeding ones, not greatly elongated as in *P. sezekorni.* Color, of specimen preserved in alcohol for an unknown period, light yellowish brown.

Fur and color.—The fur is short, about 6 mm. in length on middle of back, 4 mm. on belly; it is very closely confined to the body, barely reaching the membranes. Color both above and below light yellowish brown. Ears and membranes light brown.

Ears.—The ears are short; when laid forward they reach just beyond inner canthus of eye. Anterior border strongly convex from base to a little above middle, then nearly straight to narrowly rounded off tip. Posterior border slightly concave below tip, then convex (the curve about the same as that of anterior border) to base. Posteriorbase in line with upper lip,the distance from cornerof mouth a little less than from the latter point to chin. A wart (concealed by the hair) about as large as eye midway between corner of mouth and posterior base of ear. Inner surface of ear with seven ill defined cross ridges.

Tragus a little less than half height of ear. Anterior border gently and evenly convex from base to acicular tip. Posterior border with four deep scallops, subtending as many prominent tooth like projections, of which the basal is less developed than the others (it does not show in the view from which figure was taken).

Feet.—Foot very large, fully three-fourths as long as tibia, the toes deeply cleft and provided with large claws. No trace of calcar.

[7] This comparison is made with specimens from Nassau, Bahamas. These may prove to be different from the typical Cuban form.

[8] Dobson, basing his description on Jamaican material, states that in *Phyllonycteris* the zygomatic arches are incomplete. This is not true of the Bahaman specimens. There is little reason, however, to believe that the Jamaican *Phyllonycteris* with pointed nose leaf is the same as that found in the Bahamas, and no certainty that either is true *sezekorni.*

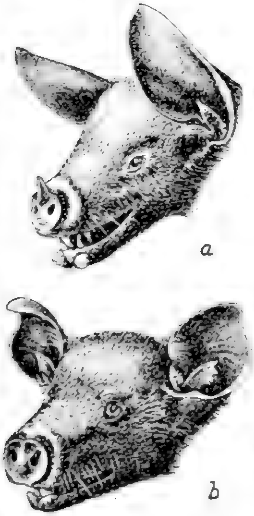

Fig. 2.—Head of *Phyllonycteris sezekorni* (a) and *Reithronycteris aphylla* (b). (Slightly enlarged).

Membranes.—Wings full and ample, attached at middle of tibia. Uropatagium reduced to a narrow frill scarcely wider than the fleshy part of the thigh, and reaching not quite to middle of tibia. Tail included to middle in membrane.

Tongue.—The tongue (figure 5) while distinctly of the glossophagine type is considerably broader in proportion to its length than in any of the other members of the group that I have examined. At the tip it narrows very abruptly to an unusually acute point. The terminal area of elongated stiff papillæ has much the same general shape as in *Phyllonycteris sezekorni*, allowance being made for the difference arising from the greater breadth of the tongue, but the individual paplliæ are shorter and of more uniform length, so that the median groove is less conspicuous (this difference is very difficult to represent in the drawing).

Skull.—The skull (figure 3) is larger and more massively built than that of *Phyllonycteris* or any other glassophagine genus with which I am acquainted. The rostrum is especially broad and deep. Face line straight from nostril to middle of brain case; a well developed sagittal crest and lambdoid crest; bony palate behind molars narrower than in *Phyllonycteris sezekorni*. The hamular processes are very broad and strongly concave internally, the resulting form quite different from that in *Phyllonycteris* or *Glossophaga*. The structure of the floor of the brain case has already been referred to. Unfortunately

Fig. 3.—Skull of *Reithronycteris aphylla*. (About 1½ times natural size).

the type is so old that it is impossible to trace the sutures in this part of the skull, but the longitudinal folds forming the roof of the posterior nares are apparently given off by the pterygoids. In figure 4 is shown a diagrammatic cross section just in front of the hamulars.

Fig. 4. — Diagrammatic cross section through pterygoids and floor of brain case at region marked *a–b* in fig. 3; *pt,*=pterygoid, *b. sp.*=basisphenoid.

Mandible very heavy and massive, especially in the region of the symphysis. It is quite unlike that of any other member of the *Glossophaginæ*, and closely resembles that of *Brachyphylla*, allowance being made for its much smaller size.

Teeth.—In number and arrangement the teeth agree with those of *Phyllonycteris sezekorni*, but in form they are even less typically glossophagine, than is especially the case with the mandibular teeth, which strongly resemble those of *Brachyphylla cavernarum*. In relative size the teeth agree with those of *Phyllonycteris sezekorni* except that the front upper premolar is larger, the second upper premolar smaller, and the front lower molar much shorter. The lower premolars are less crowded than in *P. sezekorni*.

Measurements.—Total length, 88; head, 28; greatest breadth of muzzle in front of eyes, 10; eye to eye, 8; eye to tip of muzzle, 10.4; ear from meatus, 16; ear from crown, 13; width of ear, 12; tragus, 8; tail, 12; free part of tail, 6; tibia, 22.8; foot, 17; claws, 5; width of uropatagium at middle of femur, 6; forearm, 48; thumb, 14; second finger, 37; third finger, 84; fourth finger, 66; fifth finger, 64; penis, 10. Skull: greatest length, 26; basilar length, 20; interorbital breadth, 5.4; mastoid breadth, 12.4; depth of brain case, 9; depth of rostrum at anterior end of first molar, 6; width of palate between last molars, 5; last molar to tip of hamular, 7.8; upper tooth row exclusive of incisors, 8; greatest length of mandible, 16.6; depth of mandible at space between premolars, 3; lower tooth row exclusive of incisors, 9.

General remarks.—*Reithronycteris aphylla* needs close comparison with only one described species, the *Phyllonycteris poeyi* of Gundlach.[8] This bat, from the "Kaffeepflanzung Fundator," Cuba, is still wholly unknown except for the rather meagre original description. In size, color, general structure of the nose leaf, and absence of calcar, it agrees very closely with *Reithronycteris*

[8] Monatsber. K. Akad. Wissensch., Berlin, 1860, p. 817.

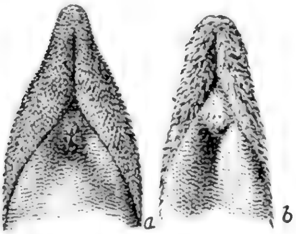

Fig. 5.—Tip of tongue (dorsal surface) of *Reithronycteris aphylla* (a) and *Phyllonycteris sezekorni* (b). (About 5 times natural size).

aphylla, but the ear is longer and narrower (18.5x11 instead of 16x12), the rudimentary nose leaf quite different in form (5.75x4. 5 instead of 4x6), the tail is shorter, especially in its free portion, and the forearm and fingers are slightly shorter. These differences coupled with the seeming impossibility that anyone should consider animals so widely different in aspect as *Phyllonycteris sezekorni* and *Reithronycteris aphylla* as possibly individual variations of one and the same species,[9] make it appear more reasonable to apply a new specific name to the Jamaican bat.

[9] Gundlach says (under *Phyllonycteris sezekorni*): "Die Vergleichung einer grösseren Anzahl von Exemplaren wird übrigens entscheiden müssen, ob diess eine selbständige Art ist oder ob sie mit der vorhergehenden zu vereinigen sein wird."

JUNE 7.

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

Twenty-eight persons present.

The deaths of Professors Jules Marcou and Fridolin Sandberger, Correspondents, were announced.

JUNE 14.

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

Twenty-five persons present.

Papers under the following titles were presented for publication:—

"List of Fishes collected at the Canary Islands by Mr. O. F. Cook, with Descriptions of Four New Species." By David Starr Jordan and James Alexander Gunn, Jr.

"Hyalodendron navalium, a New Genus and Species of Euplectillid Sponge." By J. Percy Moore.

JUNE 21.

MR. BENJAMIN SMITH LYMAN in the Chair.

Nineteen persons present.

A paper entitled "A New Chipmunk from northeastern China," by Gerrit S. Miller, Jr., was presented for publication.

JUNE 28.

MR. CHARLES MORRIS in the Chair.

Thirteen persons present.

The COMMITTEE ON THE HAYDEN GEOLOGICAL MEMORIAL AWARD reported in favor of conferring the medal and the interest on the fund for 1898 on PROFESSOR OTTO MARTIN TORELL, the Director of the Geological Survey of Sweden, in recognition of the value of his contributions to the literature of geological science, his able direction of the Swedish Geological Survey, and the eminence of his standing among geologists.

The award was made by the Academy in accordance with the recommendation of the Committee.

The following were ordered to be printed:—

LIST OF FISHES COLLECTED AT THE CANARY ISLANDS BY MR. O. F. COOK, WITH DESCRIPTIONS OF FOUR NEW SPECIES.

BY DAVID STARR JORDAN AND JAMES ALEXANDER GUNN, JR.

In 1891, Mr. O. F. Cook presented to the Museum of the Leland Stanford Junior University a valuable collection of fishes which he had obtained on a visit to the Canary Islands. We give below an annotated list of the species contained in this collection with a description of those which are new. The following species seem to be new to science.

Umbrina valida Jordan and Gunn, No. 10,584, L. S. Jr. U.
Scorpæna rubellio Jordan and Gunn, No. 4,291, L. S. Jr. U.
Scorpæna teneriffea Jordan and Gunn, No. 3,111, L. S. Jr. U.
Blennius canariensis Jordan and Gunn, No. 4,285, L. S. Jr. U.

Family GALEIDÆ.

1. **Mustelus canis** (Mitchill).

One specimen.

Family SQUALIDÆ.

2. **Centrophorus granulosus** (Bloch & Schneider).

One specimen.

Family RAJIDÆ.

3. **Raja clavata** Linnæus.

One specimen. It differs from Günther's description in having three rows of claw-like spines along the tail, instead of one, and in the absence of a patch of claw-like spines on the side of the head and on the pectoral.

Family DASYATIDÆ.

4. **Dasyatis pastinacea** (Linnæus.)

Family LEPTOCEPHALIDÆ.

5. **Leptocephalus conger** (Linnæus).

One specimen. It differs from the descriptions at hand in that the length of the pectoral fin is contained two and one-half times in that of the head, instead of three and one-half times.

Family MURÆNIDÆ.

6. **Muræna augusti** Kaup.

The one specimen of this species differs from Günther's description in that the tubule of the anterior nostril, instead of being as long as the diameter of the eye, is only half that length.

7. **Muræna helena** Linnæus.

One specimen.

8. **Muræna melanotis** Kaup.

Two specimens.

9. **Lycodontis vicinus** (Castelnau) (?).

Three specimens. They differ from published descriptions in being mottled with whitish instead of with purplish or a darker brown than the body color. We do not feel certain of their identity with this species, and its synonymy as given by Jordan and Evermann is somewhat doubtful.

Family CLUPEIDÆ.

10. **Clupanodon maderensis** (Lowe).

One specimen. The pectoral fins are shorter than described.

Family SYNODONTIDÆ.

11. **Synodus saurus** (Linnæus).

Two specimens.

Family ESOCIDÆ.

12. **Esox belone** (Linnæus).

One specimen.

Family MACRORHAMPHOSIDÆ.

13. **Macrorhamphosus scolopax** (Linnæus).

Eight specimens.

Family ATHERINIDÆ.

14. **Atherina boyeri** Risso.

Three specimens.

Family MUGILIDÆ.

15. **Liza aurata** (Risso).

Four specimens.

Family SPHYRÆNIDÆ.

16. **Sphyræna sphyræna** (Linnæus).

Four specimens.

Family MULLIDÆ.

17. **Mullus surmuletus** Linnæus.

One specimen.

Family SCOMBRIDÆ.

18. **Scomber colias** Gmelin.

Four specimens.

Family GEMPHYLIDÆ.

19. **Prometheichthys prometheus** (Cuv. & Val.).

The single specimen of this species has six extremely large canine teeth on the premaxillary instead of four as described and figured by Goode and Bean and by Cuvier and Valenciennes.

20. **Ruvettus pretiosus** (Cocc.).

One specimen.

Family LEPIDOPODIDÆ.

21. **Lepidopus caudatus** (Euphrasen).

Two specimens.

Family CARANGIDÆ.

22. **Trachurus picturatus** (Bowdich).

Two specimens.

23. **Hypodis glaucus** (Linnæus).

One specimen.

Family SERRANIDÆ.

24. **Serranus scriba** (Linnæus).

Two specimens.

25. **Epinephelus guaza** (Linnæus).

One single specimen (= *Epinephelus gigas* [Brunnich]) differs from ordinary specimens by the absence of "faint, whitish spots arranged in vertical series."

Family SPARIDÆ.

26. **Diplodus vulgaris** (Cuvier & Valenciennes).

Two specimens.

27. **Diplodus sargus** (Linnæus).

Three specimens.

28. **Pagrus pagrus** (Linnæus).

Two specimens.

29. Pagellus centrodontus (Delaroche).

The single specimen of *P. centrodontus* in this collection has only eight soft rays in the anal fin instead of twelve; but the fish had evidently received an injury, during life, by which some of the posterior anal rays were torn away.

30. Pagellus bogaraveo (Brünnich).

One specimen.

31. Pagellus mormyrus (Linnæus).

One specimen.

32. Pagellus erythrinus (Linnæus).

One specimen.

Family KYPHOSIDÆ.

33. Spondyliosoma cantharus (Linnæus).

One specimen.

34. Box boops (Linnæus).

One specimen.

Family SCIÆNIDÆ.

35. Umbrina valida Jordan & Gunn, new species.

Head $3\frac{1}{4}$ in length; depth 3; eye in head $3\frac{3}{4}$; D. X–I–29; A. II–7; scales 7–47–11. Body rather stout, back elevated, ventral line from anal to lower lip nearly straight; mouth low, lower jaw embraced within upper when mouth is closed; maxillary extending to vertical from anterior edge of pupil; snout blunt, rounded, scaly, extending a little beyond premaxillary; anterior nostril circular, a membrane half closing it on postero-ventral side; posterior nostril large, pyriform, slightly nearer to orbit than to anterior nostril, a membrane nearly half closing it on dorsal side; teeth villiform, subequal, in broad bands which are interrupted at median line in both jaws; preopercle denticulate on its bony edge; barbel below symphysis short, thick, blunt; third and fourth dorsal spines longest, $2\frac{1}{2}$ in head; pectorals equal to, or slightly longer than ventrals and reaching more than half way to vent, $1\frac{2}{5}$ in head; caudal truncate, except for three or four dorsal rays which are abruptly produced; second anal spine strong, $2\frac{2}{3}$ in head; gill rakers 5 + 10, short, thick.

Color (in spirits) yellowish-olive with a dark violet streak along each row of scales; these streaks intersect with the lateral line; vertical and ventral fins dark; pectorals dark behind. One specimen, from Canary Islands, 30 cm. long, exclusive of caudal; collected by O. F. Cook. This well-marked species is nearest to *Umbrina coroides* Cuvier & Valenciennes. The latter has, at all ages, well-marked black cross-bands.

Family POMACENTRIDÆ.

36. Chromis chromis (Linnæus).

One specimen.

37. Abudefduf luridus (Broussonet).

The two specimens of this species agree perfectly with the genus *Abudefduf* as defined by Jordan and Evermann, except that the teeth are not emarginate. The front teeth are truncate and those in the sides of the mouth rounded. This species agrees in this regard with *Stegastes imbricatus* Jenyns, but in the genus or subgenus *Stegastes*, the snout is fully scaled.

Family LABRIDÆ.

38. Centrolabrus trutta Lowe.

Two specimens.

39. Diastodon scrofa (Cuvier & Valenciennes).

Two specimens.

40. Sparisoma cretense (Linnæus).

Four specimens.

41. Thalassoma unimaculatum (Lowe).

Head $3\frac{1}{3}$; depth $3\frac{1}{2}$; eye in head $5\frac{1}{4}$, in inter-orbital width $1\frac{1}{2}$; snout in head $2\frac{7}{8}$. D. VIII–13; A. III–11; scales 2 to 3–26 to 29 –9 to 10, before D. 6. Body-color (in spirits) olive-gray; perpendicular, violet-black or reddish-brown streaks, extending across centers of scales, two-thirds down sides of body, and alternating with white streaks which extend to ventral surface; crossing these are faint, longitudinal, white streaks, extending along each row of scales and sometimes giving body a mesh-work appearance; top of head and snout black or violet; a more or less distinct black stripe from eye to near posterior edge of opercle; pectorals with a small, black spot superiorly in axil, or not, darkened at tip or not; outer rays of caudal extended along and darkened; basal one-third of anal violet, the outer two-thirds white; a black spot on the back at each side of dorsal at bases of second to fifth soft rays; dorsal with a broad, dark-violet stripe along its whole length, leaving a narrow, white margin along the crest and the base, the latter usually interrupted by union of black spot of back and violet stripe of fin. Five specimens from Canary Islands, 7.5 to 10 cm. long, exclusive of caudal; collected by O. F. Cook. This specimen is apparently distinct from *Thalassoma pavo*, differing at least in color.

Family TETRAODONTIDÆ.

42. Sphæroides spengleri (Bloch).

Two specimens.

Family SCORPÆNIDÆ.

43. Scorpæna rubellio Jordan & Gunn, new species.

Head $2\frac{1}{2}$; depth 3; eye in head 4, in inter-orbital width $\frac{2}{3}$; snout in head $3\frac{3}{4}$. D. XII–10; A. III–5; scales ctenoid and rather small, 7–26–16, before D. 6. Breast closely covered with small, smooth scales; ctenoid scales on operculum and on posterior part of cheek above sub-orbital ridge; a single, horizontal row of scales, some of them smooth, below sub-orbital ridge, and near them a few scattered, cup-shaped, rudimentary ones; on top of head, from occiput to nostrils, are scattered, minute, cup-shaped or flat scales, imbedded in the skin, upon each of which is produced, usually from the posterior edge, one or two upright prickles. Inter-orbital area moderately concave, its longitudinal ridges hardly perceptible. No occipital or sub-ocular groove or pit. Supra-orbital and anterior nasal plumules each shorter than diameter of pupil. Three moderate spines on supra-orbital crest, followed posteriorly by a row of three others; two rather low opercular ridges ending in spines; a series of three spines behind middle of eye, the first one directed upward, the third with a smaller one above it. Sub-orbital ridge moderate, bearing two spines; behind it two closely apposed spines on edge of preopercle, the hinder one larger; below these, and also on edge of preopercle, a row of four, short, stout spines. The anterior and postero-ventral extremities of pre-orbital produced into spines which project over the maxillary. Two pairs of barbels, attached nearer lip than median line. Fourth dorsal spine longest; $2\frac{1}{3}$ in head; last soft ray joined by membrane for nearly its whole length to the back. Second anal spine longest, longer than longest dorsal. Last ventral ray attached to the body by membrane for half its length.

Body color (in spirits) reddish-brown; a dark area at origin of lateral line, fading posteriorly. Head covered with dark specks. Dorsal mottled with reddish-brown and light. The dark base of caudal separated by a light area from the dark spots arranged in three or four transverse bars on the distal two-thirds of the rays. Anal chiefly dark with only a few white specks. Ventrals white, shaded with a little brown. Numerous scattered brown specks on rays of pectorals. On the posterior side of base of pectoral and gradually diminishing in number posteriorly in the axil and on the body area which the fin covers when folded back are numerous white specks, about as large as the pores of lateral line. One specimen from Canary Islands; length 9.5 cm. exclusive of caudal; collected by O. F. Cook.

This species is allied to *Scorpæna porcus*, but differs in the armature of the head, in the coloration and in the more densely scaled breast.

44. Scorpæna teneriffea Jordan & Gunn, new species.

Head $2\frac{2}{5}$; depth 3; eye in head $3\frac{1}{3}$, in inter-orbital width $\frac{1}{2}$; snout in head $4\frac{1}{2}$. D. XII–10; A. III–5; scales 6–25–13, before D. 2. Breast and head scaleless, latter pustulate, spinous, without tentacles except over anterior nostrils; a deep inter-orbital groove corrugated by a furrow along its bottom and terminating posteriorly in a deeper, transverse, occipital groove which is continuous with the post-orbital cavities. A pair of small spines in occipital groove, two pairs of large ones behind it; a large, hooked spine in each post-orbital pit, half way between which and the large supra-scapular spine are two short, broad ones; one or two small spines in anterior part of post-orbital pit; a large spine anteriorly, and two small ones posteriorly on supra-orbital ridge; two inter-nasal spines; preorbital with anterior and postero-ventral extremities produced into spines and with three or four median spines, the anterior of which is largest and all of which, together with the one at postero-ventral extremity, project over the maxillary; sub-orbital ridge strong, with three spines; behind these, and situated on the posterior edge of preopercle, are two closely apposed spines, the hinder one the larger; below this point, and also on posterior edge of preopercle, are four, short, stout spines; two ridges, the lower one stronger, cross the opercle terminating posteriorly in strong spines; a strong humeral spine above axil. Scales ctenoid, moderately large. Third and fourth dorsal spines longest, more than half length of head. Second anal spine longest, nearly equal to longest dorsal.

Color (in spirits) reddish-brown above, white and yellowish-white below; a dark area on lower part of cheek and opercle; a small dark spot above, and one or two behind axil of pectoral; irregular dark spots on pectoral, lower rays tipped with white; spinous dorsal slightly darkened, a few dark spots on soft dorsal. Caudal fan-shaped, almost immaculate at base, but with large, dark spots between the rays disposed in two or three transverse bars, in the central region of fin, and irregularly near its extremity. Anal white with a few dark spots; ventrals white with one or two spots. One specimen 13.5 cm. long from Canary Islands, collected by O. F. Cook.

This species seems to be distinct from the Madeira species *Scorpæna ustulate* Lowe, to which it is allied.

Family GOBIIDÆ.

45. Gobius niger Linnæus.

One specimen.

Family TRACHINIDÆ.

46. Trachinus draco Linnæus.

Three specimens.

Family BLENNIIDÆ.

47. Labrisomus nuchipinnis (Quoy & Gaimard).

In the two specimens of this species the band of villiform teeth is broader behind the upper front teeth than that behind the lower.

48. Blennius canariensis Jordan & Gunn, new species.

Head $4\frac{2}{5}$; depth $4\frac{1}{4}$; eye in head $4\frac{1}{2}$, in inter-orbital width $\frac{3}{5}$. D. XI–22; A. II–22; snout rounded, obtuse, 3 in head. Two canine teeth in each jaw, the lower ones twice as large as the upper, incisors long, villiform, in single series in each jaw, not fixed. Dorsal beginning above margin of preopercle, continuous, extending to caudal but not uniting with it. Ventrals inserted below origin of dorsal, $7\frac{7}{8}$ in body-length. Distance of anal from caudal equals diameter of eye. Supra-orbital cirrus bifid, as long as half diameter of eye; anterior nostril with a flap equalling one-third diameter of eye. Caudal fan-shaped.

Body color (in spirits) reddish-brown, whitish below; posterior half of body sometimes whitish, in which case, three longitudinal interrupted brown stripes extend over the light part. Ventrals and pectorals reddish-brown; vertical fins darker; anal dark violet, the rays tipped with white and sometimes whitish at base. Two specimens from Canary Islands, 10 and 10.5 cm. long; collected by O. F. Cook.

This species seems to be different from *Blennius tentacularis* and from all others with which we have been able to compare it.

Family TRIGLIDÆ.

49. Trigla hirundo (Linnæus).

One specimen.

50. Trigla lineata (Linnæus).

One specimen.

Family GADIDÆ.

51. Urophycis mediterraneus (Delaroche).

One specimen.

Family PLEURONECTIDÆ.

52. Platophrys podas (Delaroche).

The three specimens of this species differ from published descriptions in having a re-entrant angle at the base of the snout, and in not having an angle opposite the upper eye.

Family SOLEIDÆ.

53. Solea lascaris (Risso).

Two specimens.

54. Quenselia ocellata (Linnæus).

One specimen.

A NEW CHIPMUNK FROM NORTHEASTERN CHINA.

BY GERRIT S. MILLER, JR.

In a paper recently published in these *Proceedings* (1898, pp. 120–125) Mr. S. N. Rhoads refers two chipmunks from the Province of Pechili, northeastern China, to *Eutamias asiaticus* (Gmelin). Through the kindness of Mr. Witmer Stone I now have the specimens before me. They agree perfectly—allowance being made for difference in pelage—with a skin in the United States National Museum taken near Peking, and differ widely from published descriptions of *Eutamias asiaticus*[1] and from a skin of the latter (in the National Museum) labelled 'Fort Ulba, Siberia.'[2] Considering the isolation of the region inhabited by the Pechili Chipmunk, and the extreme plasticity of the genus *Eutamias*, it is not surprising that the animal should prove to be distinct from its Siberian congener. The question immediately arises, however, as to what true *Eutamias asiaticus* really is, and at present it is impossible to give a wholly satisfactory answer. Gmelin based his *Sciurus striatus α asiaticus* primarily on the *Sciurus striatus* of Pallas,[3] a composite of the Asiatic and American species, but composed chiefly of the former. The range of the Asiatic animal extends, according to Pallas, from the Dwina River in Russia, east through the whole of Siberia. That only one species of *Eutamias* occurs in this vast area is almost beyond the possibility of belief. But however many forms there may be, and whatever one Pallas may have had in hand when he wrote his description, the animal that he described was approximately like the 'Ulba' specimen, and consequently very unlike the Chinese form. Roughly speaking, the Chinese animal is a pale, grayish, brown-striped form much like *Eutamias merriami* and *E. senex*, while the 'Ulba' specimen, together with those usually re-

[1] See, for instance, Allen, Bull. Am. Mus. Nat. Hist., III, pp. 71, 72, June, 1890.

[2] This locality I have been unable to find on any map. In the Government of Tomsk, however, there is a river whose name is variously spelled as Uba, Ouba and Ooba. The name on the Museum label may be a *lapsus pennæ* for Uba.

[3] Glires, p. 378.

garded as true *asiaticus*, resembles the members of the brightly colored, black-striped *quadrivittatus* group. That Pallas had before him a specimen of the latter type, is clearly proved by his excellent description. The back he says is marked with five black stripes, of which the middle one extends from nape to base of tail, the outer from shoulder to thigh.[4] The specific name *asiaticus*, based on this description, is obviously inapplicable to an animal which has only one, or at most three, black dorsal stripes. The Chinese form, on account of its striking resemblance to the American *Eutamias senex* may be called:

Eutamias senescens sp. nov.

Tamias (*Eutamias*) *asiaticus* Rhoads, Proc. Acad. Nat. Sci. Philadelphia, 1898, p. 122. (Nec *Sciurus striatus a asiaticus* Gmelin, 1788, nec *Tamias asiaticus* Allen, 1890).

Type.—Adult ♀ (skin and skull) No. 83,395, United States National Museum, collected August 21, 1896, on low barren hills fifteen miles west of Peking, China, by Geo. D. Wilder.

General characters.—Much paler and grayer than *Eutamias asiaticus*; only the middle part of central dark stripe constantly black; feet larger than in a specimen of supposed *asiaticus* from 'Fort Ulba, Siberia.'

Color.—Type specimen in fresh post nuptial pelage: sides pale yellowish-brown, becoming grizzly gray at shoulders, rump tinged with orange rufous; crown slightly browner than shoulders and nape; sides of head yellowish-gray, with the usual stripes, the latter light brown and ill defined; ears concolor with crown, a whitish stripe along posterior border on outer side, a faint yellowish wash within, belly soiled whitish; tail with three bands of color, a broad, pale yellowish, median area, followed by a black subterminal band and a white border, the pattern very distinct beneath but obscured on the dorsal surface, where in addition to the three color bands normally present, the hairs have dusky bases; median dorsal stripe extending from nape to base of tail, dusky brown anteriorly, becoming black near middle and fading to pale reddish-brown posteriorly; second stripe shorter and slightly paler than first; outer stripe broader than either of the others, much paler and less well defined; outer white stripe dusky whitish (about like belly), slightly broader

[4] "Dorsum *fasciis* quinque nigris, longitudinalibus striatum, quarum media a nucha ad caudam, proximæ a cervice ad clunes, extimæ a scapulis ad femora protenduntur."

than inner, which is much the same color as grizzle of neck and shoulders; whole back sprinkled with black and reddish hairs, the latter most numerous along the edges of the dark stripes.

Adult female in worn winter pelage (No. 4,601, Academy of Natural Sciences of Philadelphia, Tung Ching Tzu, Pechili, China, May 30, 1897. Skin considerably over-stuffed): ground color throughout much paler than in the type, rump scarcely tinged with reddish; dark stripes on both head and body more conspicuous; the second dorsal stripe black in middle, the median white stripes paler; tail much less bushy but similar in arrangement of colors, except at base where new hairs are coming in. The other specimen (♂ ad. No. 4,602, Sian Lang Kou, Pechili, China, June 18, 1897), likewise in worn winter pelage is similar to the last, but a shade less pallid.

Measurements.—The material at hand furnishes a rather unsatisfactory basis for measurements. The following, however, are fairly accurate.

Number	sex	total length	tail	hind foot	front foot
		m.m.	m.m.	m.m.	m.m.
83,395	♀	297	127	40	24
4,601	♀	—	—	38	22
4,602	♂	—	—	38	23

The 'Fort Ulba' specimen measures: hind foot, 36; front foot, 20.

General remarks.—The cranial characters of *Eutamias senescens* have been sufficiently described by Mr. Rhoads in his paper, to which reference has already been made.

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JULY 5.

MR. BENJAMIN SMITH LYMAN in the Chair.

Nine persons present.

Papers under the following titles were presented for publication :—

"Contributions to Neotropical Herpetology." By Robert Baird McLain.

"Critical Notes on a Collection of Reptiles from the Western Coast of the United States." By Robert Baird McLain.

"The Eastern Reptiles in the Collection of the Museum of the Leland Stanford University, Zoological Department." By Robert Baird McLain.

JULY 12.

MR. BENJAMIN SMITH LYMAN in the Chair.

Eleven persons present.

A paper entitled "Descriptions of Three New Rodents from the Olympic Mountains, Washington," by C. Hart Merriam, was presented for publication.

JULY 19.

MR. CHARLES MORRIS in the Chair.

Twelve persons present.

A paper entitled "A New Land Snail from Clarion Island," by Henry A. Pilsbry, was presented for publication.

JULY 26.

MR. CHARLES MORRIS in the Chair.

Eleven persons present.

Charles M. Burk, M. D., was elected a member.

The following were ordered to be printed :—

DESCRIPTIONS OF THREE NEW RODENTS FROM THE OLYMPIC MOUNTAINS, WASHINGTON.

BY C. HART MERRIAM.

Owing to an unavoidable delay in the publication of my report on the Olympic Mountains, it seems desirable that the following new species of mammals should be recorded as early as practicable.

Arctomys olympus sp. nov.

Type.—From Timberline at head of Soleduc River, Olympic Mountains, Washington. No. 90,518, ♂ ad. U. S. Nat. Mus. Biological Survey Coll. Collected August 27, 1897, by C. Hart Merriam and Vernon Bailey. Original No. 6,210.

Characters.—Size and general characters as in *A. caligatus*, from which it differs markedly in color, the feet being brown instead of black, and upper parts in summer pelage uniform dull ochraceous yellow, without the hoary shoulders and fore back, dark posterior back, or the blackish top of head of that species.

Color.—Entire upper parts except ears and nose, dull buffy or ochraceous yellowish, becoming brown on underparts; ears and feet brown; chin and nose white, with a dark bar across face between nose and eyes. This face bar is probably absent in full summer pelage, and indicates the beginning of the fall change to blackish pelage.

Measurements.—Type specimen, ♂ ad., measured in flesh: Total length, 750 mm.; tail vertebræ, 210 mm.; hind foot, 110 mm.

Eutamias caurinus sp. nov.

Type.—From Timberline near head of Soleduc River, Olympic Mountains, Washington. No. 90,636, ♂ ad. U. S. Nat. Mus. Biological Survey Coll. Collected August 27, 1897, by C. Hart Merriam. Original No. 6,211.

Characters.—(Type specimen in post breeding pelage—molt not completed posteriorly). Similar to *E. amœnus*, but hind feet longer; underside of tail with black border broader, and median chestnut-fulvous band darkened by mixture of black hairs; post-auricular patches obsolete; face stripes duller; back of neck not grayish or hoary, but grizzled with fulvous, like shoulders; middle pair of pale dorsal stripes less sharply defined anteriorly and everywhere mixed with fulvous hairs.

Measurements.—Type specimen measured in flesh: Total length, 210 mm.; tail vertebræ, 85 mm.; hind foot, 34 mm.

Microtus macrurus sp. nov.

Type.—From Lake Cushman, Olympic Mountains, Washington. No. 66,151 ♀ ad., U. S. Nat. Mus. Biological Survey Coll. Collected June 26, 1894, by Clark P. Streator. Original number 3,975.

Characters.—Similar to *M mordax* but larger, with longer tail and decidedly larger hind feet; color darker.

Color.—Upper parts brownish bister with a grizzled 'pepper and salt' appearance, suggesting *M. austerus*: under parts whitish, the plumbeous under-fur showing through; tail bicolor, dusky above, whitish below, the tip sometimes white, sometimes dusky all round. In summer pelage the back is browner and the under parts are washed with buffy.

Cranial characters.—Skull similar to that of *M. mordax*, but slightly larger, with rostrum and nasals slightly broader.

Measurements.—Type specimen: Total length, 220 mm.; tail vertebræ, 88 mm.; hind foot, 24 mm. Average of 5 specimens from Olympic Mountains: Total length, 204 mm.; tail vertebræ, 80; hind foot 24·3.

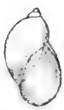
Average of 5 specimens of *M. mordax* from Saw Tooth Lake, Idaho: Total length, 182 mm.; tail vertebræ, 66·5; hind foot, 22.

Remarks.—In coloration *Microtus macrurus* agrees closely with *M. longicaudus* from the Black Hills of South Dakota, but in size and proportions it differs from *longicaudus* even more than from *mordax*. All three of these animals are very closely related, and it would not be far amiss if both *mordax* and *macrurus* were placed as subspecies of *longicaudus*.

A NEW LAND SHELL FROM CLARION ISLAND.

BY HENRY A PILSBRY.

Succinea Mcgregori n. sp.



Shell ovate, thin, red-amber colored, irregularly wrinkled-striate, composed of 3½ very convex whorls separated by deeply impressed sutures. Aperture two-thirds the length of the shell, regularly ovate, oblique, its width contained 1⅗ times in its length; columella arcuate, its edge thread-like above.

Alt. 13⅓, diam. 8, length of aperture 9 mm.

Alt. 12½, diam. 7, length of aperture 8½ mm.

Clarion Island, collected by Mr. R. C. McGregor, in whose honor the species is named.

This species closely resembles *S. Donneti* Pfr. from Chili in form, but differs in color, the Chilian species being pale yellowish corneous. It has the deep reddish hue of many Hawaiian Succineas, such as *S. canella* Gld., or the Japanese group to which *S. lauta* belongs. *S. Oregonensis* Lea is decidedly shorter and not of so dark a color.

At my request Mr. McGregor furnished the following notes on Clarion Island:

"Clarion Island is some three hundred miles southwest of Cape San Lucas. The sandy beaches are covered with broken coral. Back of the beach where we landed is level ground for a quarter of a mile, covered in places with cacti and vines (*Ipomœa cathartica* Poir., *Phaseolus atropurpureus* D. C. and *Sophora tomentosa* L.). The troublesome bush, *Caesalpinia Bonducella* Roxb., with its sharp, curved spines, abounds on the hillsides and the flats. The interior of the island rises in more or less rough hills. There are quite a number of elevated flats or plateaux covered with a tangle of vines, grasses and shrubs. Among the last are *Euphorbia Clarionensis* Brandegee and *E. Californica* Benth., on the stems of which was found the only land shell. This mollusk closely resembles the bark of these plants, and was very abundant. One might collect twenty or thirty specimens from a single plant.

"Clarion Island is decidedly tropical, though it includes in its fauna insular forms of birds of such temperate zone genera as *Speotyto*, *Zenaidura* and *Troglodytes*. There are no mammals on the island. Lizards and several species of snakes were captured."

AUGUST 2.

MR. CHARLES MORRIS in the Chair.

Nine persons present.

AUGUST 9.

MR. BENJAMIN SMITH LYMAN in the Chair.

Thirteen persons present.

The following biographical note was presented by the Committe on the Hayden Memorial Award :

OTTO MARTIN TORELL.—Born in Varberg in Sweden, the 5th of June, 1828, he passed the examination for entrance into the University of Lund in 1844, and was made Doctor of Philosophy, 1853. He then turned his attention to medical studies, and passed the second examination for physicians in the year 1858. He became Adjunct Professor of Zoology in 1860, and in 1866 was nominated as Professor of Zoology and Geology at the University of Lund. He soon left the University for Stockholm, and was in 1871 appointed Chief of the Geological Survey of Sweden, which office he resigned some months ago.

In 1856 he visited Switzerland with the object of studying the glaciers, and in 1857 he made a voyage to Iceland with the same view. His main purpose was to determine whether it is probable that glaciers formerly covered the whole of Scandinavia.

In 1858, in company with A. E. Nordenskiold, he went to Spitzbergen for the first time, and the following year to Greenland. These voyages may be said to have led to the Swedish Polar Expeditions, and Torell was himself the leader or manager of the first of these of any importance, namely, the expedition to Spitzbergen in 1861, which was very rich in scientific results.

The most important part of his work at Spitzbergen was his deep sea investigations with the grapnel, which were executed in order to study the animal life at the bottom of the sea (2,500 meters below the surface), a depth from which before that time only foraminifers had been obtained. This discovery afterwards led to many researches of the sea bottom, through which, one may say, a new era has arisen in the history of the geology and physical geography of the ocean bed.

Partly for scientific studies and partly as a member of geological and geographical congresses, Professor Torell has made many journeys to Denmark, Germany, Switzerland, Italy, France, Belgium, Holland, England, and the United States.

He was one of the first Swedish naturalists to accept the glacial theory in place of the theory (by Sefstrom) of the "rullstensflod." Of his works, those which treat of the ice period are the most important. To these, belong "Contribution to the molluscan fauna, with a general view of the natural state of the Arctic Regions," (1859); "Investigations of the Ice Period," 1, (1873), 2, (1873), and 3, (1887); and "On the causes of glacial phenomena in the northeastern portion of North America."

Partly by these works and partly by lectures Torell has, in Sweden as abroad, powerfully contributed to the dissemination of the theory that the territory of northern Europe, where great blocks of Scandinavian rocks have been found, was formerly covered by land ice, extending from Scandinavia, like the ice in Greenland at the present time, and not, as had been formerly supposed, by a frozen sea (Eismeer).

Among other works of Torell may be mentioned: "On geological researches in Norway," (1865); "Contribution to the geognosy and paleontology of the Spargurite Stages," (1867); "Petrificata Suecana formationis Cambricæ," (1870); "Sur les traces les plus anciennes de l'existence de l'homme en Suède," (1876); "On the most important crystalline minerals," (1882); "The deposits on both sides of the boundary between Sweden and Norway," (1888). In 1868 the Scientific Society in Haarlem awarded to him its first prize for his work on the origin of the diluvial deposits at Gröningen in Holland.

Dr. Torell is a member of the Royal Society of Sciences of Swedens (1870), of the Agricultural Academy (1872), and of many other scientific societies in Sweden and abroad.

He is Commander of the Swedish "North Star;" Grand Officer of the Italian Order of the Crown; Knight of the second class of the Russian Order of St. Anna; Commander of the Danish Dannébrog; Officer of Public Instruction and Officier de la Legion d'honneur.

AUGUST 16.

MR. BENJAMIN SMITH LYMAN in the Chair.

Ten persons present.

Papers under the following titles were presented for publication:—

"Description of a new genus and species of Microtine Rodent from Siberia." By Gerrit S. Miller, Jr.

"Notes on the Arctic Red-backed Mice." By Gerrit S. Miller, Jr.

AUGUST 23.

MR. BENJAMIN SMITH LYMAN in the Chair.

Six persons present.

The death of James Hall, a Correspondent, the 7th inst., was announced.

AUGUST 30.

MR. BENJAMIN SMITH LYMAN in the Chair.

Nine persons present.

The following were ordered to be printed:—

NOTES ON THE ARCTIC RED-BACKED MICE.

BY GERRIT S. MILLER, JR.

"We challenge the proof that *Mus rutilus* is not a circumpolar species." The view thus forcibly expressed by Dr. Elliott Coues twenty-one years ago[1] fairly represents current opinion in regard to the Arctic Red-backed Mice, at least so far as concerns those of Alaska and the Old World. From time to time during this period, *Evotomys rufocanus* has been recognized as a distinct form; but *Evotomys rutilus* is universally regarded as an exceptionally homogeneous and wide-ranging circumpolar species. Writing of the Red-backed Mice in 1897, Mr. Vernon Bailey says: "The only circumpolar species [of *Evotomys*] is the Arctic *E. rutilus,* which does not undergo any considerable change throughout the circumference of the Arctic zone."[2]

A recent examination of the Arctic red-backed mice in the United States National Museum convinces me that the *Evotomys rutilus* of authors is far from the unvarying species that it has been represented. While the material at hand is too limited to form the basis of anything like a final revision, it clearly proves the distinctness of *Evotomys rufocanus,* and also the existence of three forms of so-called *rutilus,* one in the extreme north of Europe, one in Kamtschatka, and one in Alaska.

The *Mus rutilus* of Pallas came from Siberia immediately east of the Obi. As no specimens from this region are available for comparison, the question of the exact identity of the species must, for the time being, remain open. Geographical considerations lead me to apply the name *rutilus* provisionally to the most westerly of the Old World forms rather than to the one occurring in Kamtschatka. The latter is the *Arvicola wosnessenskii* of Polyakoff. Its identity with Richardson's *Arvicola rubricatus* from Bering Strait, is too uncertain to be worthy of serious consideration at present. The latter is described as slate color on the back, and nearly scarlet on the sides—a color pattern quite unknown in the genus *Evotomys.*

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[1] Monogr. N. Am. Rodentia, p. 138.
[2] Proc. Biolog. Soc. Washington, XI, p. 113.

Even if it be assumed, as Baird has suggested,[3] that the colors of the back and sides were accidentally transposed in Richardson's description, the case is not much helped, since no known member of the *rutilus* group has slate colored sides. Although Baird assumed that Richardson's animal came from Siberia, the statement in the original description that it "appears to be quite distinct from any American meadow mouse hitherto described," leads to the belief that the type locality was on the Alaskan side of the strait. The objections to applying the name to the Alaskan animal are, however, no less than in the case of the Kamtschatkan species.

The general characters of *Evotomys rufocanus*, and of the three species hitherto confused under the name *rutilus*, are given in the following synopsis:

Teeth large and heavy as in *Microtus* (never perfectly rooted?); molar rows about 6.5 mm.; posterior lower molar long, somewhat encapsulated; skull with prominent postorbital processes; sides clear gray (highly aberrant) . . . . *E. rufocanus.*

Teeth small and weak (perfectly rooted in adult); molar rows about 5 mm.; posterior lower molar short, not encapsulated; skull without prominent postorbital processes; sides strongly fulvous (typical *Evotomys*).

- Skull narrow; rostral protuberances standing out conspicuously from root of zygoma (fig. 1 *a*); audital bullæ small; feet slender . . . . *E. wosnessenskii.*
- Skull broad; rostral protuberances not standing out conspicuously from root of zygoma (fig. 1 *b*); audital bullæ large; feet broad.
  - Nasal bones short, contained 3½ times in greatest length of skull; tail 34–40 mm.; color generally chestnut *E. rutilus.*
  - Nasal bones long, contained only 3 times in greatest length of skull; tail 20–30 mm.; color generally dull ferruginous. . . . . *E. alascensis.*

Evotomys rufocanus (Sundevall).

1846. *Arvicola rufocanus* Sundevall, Oefv. Vet Akad. Foerh., p. 122.
1897. *Evotomys rufocanus* Bailey, Proc. Biolog. Soc. Washington, XI, p. 122, May 13, 1897.

Skull.—The only skull of *Evotomys rufocanus* that I have at hand is badly damaged. Nevertheless it shows strong characters to dis-

[3] Mam. N. Am., p. 551.

tinguish it from that of *E. rutilus*, or in fact from any other known member of the genus. The anterior edge of the squamosal is produced to form a very distinct postorbital process, quite as in many species of *Microtus*. The mandible is massively built and, like the skull, shows a degree of angularity more in keeping with *Microtus* than *Evotomys*. The palate, although damaged, appears to be that of typical *Evotomys*. Mr. Bailey says of this species: "*Evotomys rufocanus* (Sundevall) of northern Europe is remarkable for its large molars and almost microtine form of skull." He gives the following measurements of a skull from Lapland: basal length, 25 mm.; nasals, 7.6; zygomatic breadth, 15; mastoid breadth, 12.2; alveolar length of upper molar series 6.7.

Teeth.—The teeth of *Evotomys rufocanus* are chiefly remarkable for their large size and great strength. Their development relatively to the size of the skull is more in accord with the proportions normal in *Microtus* than in *Evotomys*. Apparently the molars do not develop as complete roots as in other species of *Evotomys*. The root of the lower incisor is nearly as long as in some species of *Microtus*, and the long back lower molar is encapsulated, though not conspicuously so. The enamel pattern (fig. 2 *d*) differs widely from that of *Evotomys rutilus* (fig. 2 *a*). Its most striking peculiarities are the simplicity of the posterior upper molar, and the shallow reentrant angles on the outer side of the posterior lower molar.

Color.—A specimen in fresh autumnal pelage has a well defined dorsal stripe of a color intermediate between the hazel and cinnamon rufous of Ridgway. This stripe begins between the eyes and extends back nearly to base of tail. Ears colored like dorsal stripe. Sides an indescribable grizzle of hair brown, whitish, black, and slate color. Whole under parts soiled buffy-white, darkened by the slaty bases of the hairs, which show through irregularly on the surface. Cheeks, muzzle, and sides of head similar to sides of body, but slightly darker. Tail sharply bicolor, brownish above, dirty white below. Feet dirty whitish.

General remarks.—Mr. Bailey has already called attention to the fact that *Evotomys rufocanus* "is the most divergent form of the genus known." So divergent is the animal that it may well be questioned whether it is to be regarded as a true *Evotomys*. Its heavy and apparently imperfectly rooted teeth more closely resemble those of many species of typical *Microtus* than they do the weak, perfectly rooted teeth of true *Evotomys*. The relationships of the root of the lower incisor and the posterior lower molar, while not typical of either genus are clearly suggestive of *Microtus* rather than *Evotomys*. The palate structure, on the other hand, appears to agree with that of *Evotomys*. The question of the animal's true position cannot be answered until good series of specimens representing different ages are available for comparison.

Evotomys wosnessenskii (Polyakoff).

1839. ?? *Arvicola rubricatus* Richardson, Zoölogy of Beechey's Voyage of the Blossom, p. 7 (Bering Strait).
1881. *Arvicola wosnessenskii* Polyakoff, Appendix to Volume XXXIX of the Memoirs of the St. Petersburg Academy of Sciences, p. 56 (text in Russian) Kamtschatka.
1884. *Arvicola wosnessenskii* Lataste, Ann. Mus. Civ. di St. Nat di Genova, XX, p. 28.

Skull.—The skull of *Evotomys wosnessenskii* as compared with that of *E. rutilus* and *E. alascensis* is slightly narrower and more depressed, though the differences in general form are not very striking. The anterior edges of the antorbital foramina are folded outward so as to form conspicuous swellings, which for want of a better name I have called rostral protuberances. These protuberances are apparently formed by the wall of a canal which takes a superficial downward course from the anterior edge of the antorbital foramen, and probably transmits a branch of the fifth nerve. In *Evotomys wosnessenskii* the rostral protuberances stand further forward from the bases of the zygomata than in *E. alascensis* (fig. 1). This position as well as their large size makes them very conspicuous. Audital bullæ small, much smaller than in *E. rutilus* or *E. alascensis*, their greatest breadth about equal to alveolar length of maxillary tooth row. Mandible slender and lightly built, with weaker articular process and angular process than in the related species.

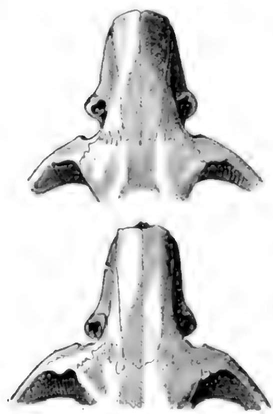

Fig. 1. Rostrum of *Evotomys wosnessenskii* (upper figure) and *E. alascensis* (lower figure). (x 3⅔).

Measurements of an adult skull from Bering Island: greatest length, 24 mm.; basal length, 22.8; basilar length, 21; zygomatic breadth, 13.6; mastoid breadth, 11; interorbital constriction, 4; nasals, 7.8; incisive foramen, 5 6; diastema, 7.4; maxillary molar series (alveoli), 5; mandible, 13.8; mandibular molar series (alveoli), 5.

Teeth.—The teeth of *Evotomys wosnessenskii* (fig. 2 *b*) present no characters of special importance.

Ears.—The ears are slightly smaller than in *E. alascensis*, but not peculiar in form.

Feet.—The hind feet are slender and much less densely furred than in *E. alascensis.* The latter character at first sight appears to be due to season, as most of the National Museum specimens of *E. wosnessenskii* were taken in summer, while the Alaskan series is chiefly composed of October skins. Several of the Kamtschatkan specimens were, however, taken during the last week in September, and one as late as October 8th. In none of these does the hairiness of the hind foot closely approach the condition found in Alaskan specimens taken from three weeks to a month later.

Tail.—The tail is more slender than in *E. alascensis*, and less densely haired than in either *E. alascensis* or *E. rutilus.* The difference is fully apparent on comparison of specimens in winter pelage.

Color.—Autumnal specimens have the dorsal stripe a clear, deep, tawny, finely and inconspicuously sprinkled with black. Sides ochraceous buff. Belly dull whitish, faintly darkened by the slaty bases of the hairs. Summer adults are essentially similar, but immature specimens are much darker and duller.

Measurements.—For measurements of *Evotomys wosnessenskii* see table, page 366.

Specimens examined.—Total number of specimens examined 26, from the following localities:

Kamtschatka: Bering Island, 17; Kalakhtyrka, 1; Petropaulski, 6; no definite locality, 2.

General remarks.—*Evotomys wosnessenskii* is more distinct from *E. rutilus* and *E. alascensis* than either of these is from the other. Aside from its cranial characters it is easily distinguishable from its allies by its slender, thinly haired tail and feet.

Evotomys rutilus (Pallas).

1778. *Mus rutilus* Pallas, Nov. Sp., Quadr. Glir. Ord., p. 246 (Siberia, east of the Obi).

1874. *Evotomys rutilus* Coues, Proc. Acad. Nat. Sci. Philadelphia, p. 187, (part).

Skull.—In the north European *Evotomys* to which I have provisionally restricted the name *rutilus*, the skull closely resembles that of *E. alascensis*, except that the rostral protuberances are placed further forward, as in *E. wosnessenskii*, and the nasal bones are shorter relatively to the length of the skull. In *E. alascensis* the nasal bones form about 33.3 percent of the occipitonasal length, while in *E. rutilus* they form about 28.5 percent only. The difference is due to the less backward extent of the nasals in *E. rutilus*, rather than to any actual shortening of the rostrum. Audital bullæ large and rounded as in *E. alascensis*, very different from those of *E. wosnessenskii.*

Measurements of an adult skull from Lapland: greatest length, 24 mm.; basal length, 22.4; basilar length, 20.6; zygomatic breadth, 13; mastoid breadth, 11.8; interorbital constriction, 4; nasals, 7; incisive foramen, 5; diastema, 7.4; maxillary molar series (alveoli), 5; mandible, 13.8; mandibular molar series (alveoli), 5.

Teeth.—The teeth of *Evotomys rutilus* (fig. 2 *a*) do not differ appreciably from those of *E. wosnessenskii* and *E. alascensis.*

Ears, feet and tail.—So far as can be judged from dry skins the ears of *Evotomys rutilus* do not differ appreciably in form from those of *E. alascensis* and *E. wosnessenskii.* They are, however, apparently a trifle larger than in the latter. Feet broad, as in the Alaskan form. Tail about as in *E. alascensis*, but considerably longer and somewhat less densely haired.

Color.—An adult male from northern Sweden taken in December and another specimen from same region but without date, agree very closely in color. Both have the dorsal stripe a clear bright chestnut, faintly darkened by a slight admixture of black-tipped hairs. The sides are ochraceous-buff, and the belly dirty white or cream color. Feet whitish; ears chestnut. Tail sharply bicolor, brownish, tinged with red above, dirty white below. Fur everywhere slaty plumbeous at base, this color appearing irregularly at surface on belly and sides. Two other undated skins from Lapland are slightly paler in color.

Measurements.—For measurements of *Evotomys rutilus* see table, page 366.

Specimens examined.—Four, from the following localities:

Lapland: no definite locality, 2.

Sweden: Karesnando, 1; no definite locality (northern Sweden), 1.

General remarks.—The Arctic red-backed mouse of northern Europe is readily distinguishable among the known Arctic forms[4]

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[4] There are no less than five of these, *E. rutilus*, *E. wosnessenskii*, *E. alascensis*, *E. ungava*, and *E. proteus.* For descriptions of the last two, both of which are from Labrador, see Bailey, Proc. Biolog. Soc. Washington, XI, pp. 130, 131, and 137, May 13, 1897.

by its bright color, absence of any known dusky phase, relatively long tail, and small square skull with large audital bullæ, conspicuous rostral protuberances, and short nasal bones.

Evotomys alascensis sp. nov.

1839. ?? *Arvicola rubricatus* Richardson, Zoölogy of Beechey's Voyage of the Blossom, p. 7 (Bering Strait).
1877. *Evotomys rutilus* Coues, Monogr. N. Am. Rodentia, p. 136 (part).
1897. *Evotomys rutilus* Bailey, Proc. Biolog. Soc. Washington, XI, p. 118 (part).

Type.—Adult ♂, number $\frac{14,359}{22,226}$ United States National Museum, collected at St. Michael's, Alaska, October 26, 1897, by E. W. Nelson. Original number, 96.

General characters.—See synopsis, page 359.

Skull.—The skull of *Evotomys alascensis* more closely resembles that of *E. rutilus* than it does that of its geographically nearer ally *E. wosnessenskii*. The brain case is broad and squarish in outline. Squamosals produced into very small, pointed postorbital processes. Audital bullæ large, their greatest breadth considerably more than alveolar length of maxillary molar series. Rostral protuberances (fig. 1 *b*) much closer to roots of zygomata than in either of the Old World species. The nasal bones (fig. 1) are longer than in either *E. rutilus* or *E. wosnessenskii*. This difference is not due to greater length of rostrum, but to greater backward prolongation of the nasal bones. The nasal branches of the premaxillaries also extend further back than in either of the Old World forms.

The skull of the type specimen measures: greatest length, 25 mm; basal length 22.6; basilar length, 21.8; zygomatic breadth, 13.4; mastoid breadth, 11.6; interorbital constriction, 4.6; nasals, 8; incisive foramen, 5; diastema, 7; maxillary molar series (alveoli), 5.2; mandible, 14; mandibular molar series (alveoli), 5.

Teeth.—The enamel pattern (fig. 2 *c*) is essentially as in Old World Arctic species.

Ears.—The ears do not differ in form from those of *E. rutilus* and *E. wosnessenskii*, but they are appreciably larger than in the latter.

Feet.—The front feet present no characters of importance. The hind feet, like those of *E. rutilus*, are short, broad, and very densely haired both above, on the sides, and below. On the sole the hair extends from the heel to the middle row of tubercles.

Color.—In the type the dorsal stripe is dull ferruginous sprinkled with black hairs, which, however, are very inconspicuous. Sides ochraceous-buff, finely 'lined' with black. Belly clear buff, shading to grayish on the throat. Feet buffy-whitish; face mixed buffy and

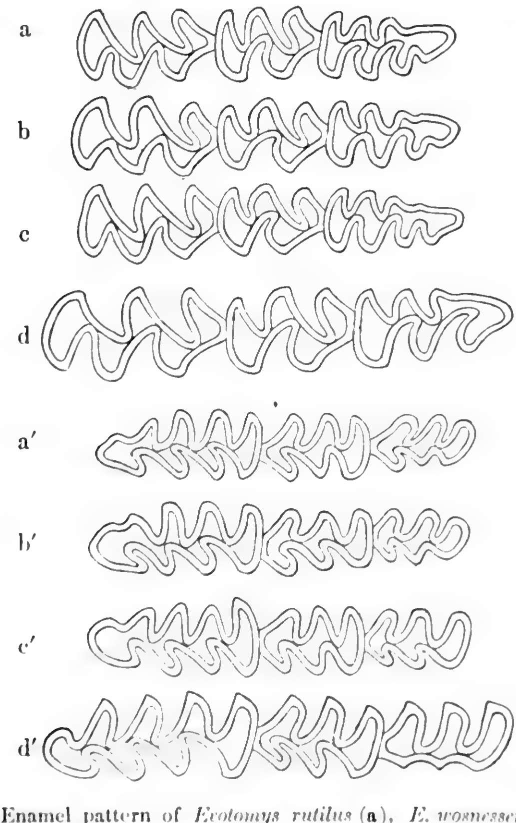

FIG. 2. Enamel pattern of *Evotomys rutilus* (a), *E. wosnessenskii* (b), *E. alascensis* (c), and *E. rufocanus* (d). Lower teeth below, upper teeth above. (x 10).

reddish. Ears concolor with dorsal stripe. Tail sharply bicolor, buffy below, brownish tinged with red above.

A series of seventeen skins taken at St. Michaels, Alaska, during October and November show little variation in color. In some specimens there is less of the buff wash on the belly, but this is absent in one only. Several are much darker below than the type. In one immature individual the red of the dorsal stripe is much duller than in the adults.

Measurements.—For measurements see accompanying table.

MEASUREMENTS OF THREE SPECIES OF ARCTIC EVOTOMYS.

Name.	Locality.	Number.	Sex.	Total length.	Head and body.	Tail vertebræ.	Pencil.	Hind foot.	Ear from meatus.
				mm.	mm.	mm.	mm.	mm.	mm.
E. wosnessenskii	Bering Island, Kamtschatka.	15,330	♀	121	85	29	8	17	11
E. wosnessenskii	Bering Island, Kamtschatka.	15,331	♂	132	90	32	5	18	11
E. wosnessenskii	Bering Island, Kamtschatka.	15,333	♂	126	88	32	5	17	11.6
E. wosnessenskii	Bering Island, Kamtschatka.	63,221	♀	143	—	35	5	17.5	—
E. wosnessenskii	Bering Island, Kamtschatka.	63,223	♀	138	—	32	5.6	17.5	—
E. wosnessenskii	Bering Island, Kamtschatka.	83,996	♂	—	84	22	5	16	12
E. wosnessenskii	Bering Island, Kamtschatka.	83,997	♂	—	82	22.5	4	17	12.5
E. wosnessenskii	Bering Island, Kamtschatka.	83,999	♀	—	100	30	7	17	13
E. wosnessenskii	Petropaulski, Kamtschatka.	84,004	♂	132	—	23	6	17	—
E. rutilus	Northern Sweden.	21,372	—	—	—	34	11	18	—
E. rutilus	Northern Sweden.	402	♂	—	—	39	9	18.4	—
E. rutilus	Lapland.	405	—	—	—	30	10	18	—
E. alascensis	Fort Yukon, Alaska.	59,924	♂	110	84	23	12	18	12.6
E. alascensis	St. Michaels, Alaska.	14,352	♂	—	—	28	9	18	—
E. alascensis	St. Michaels, Alaska.	14,354	♂	—	—	27	10.4	18.6	—
E. alascensis	St. Michaels, Alaska.	14,356	♂	—	—	24	11.6	19	—
E. alascensis	St. Michaels, Alaska.	14,358	♂	—	—	26	10	18	—
E. alascensis	St. Michaels, Alaska.	14,359	♂	—	—	24	10	18.4	—
E. alascensis	St. Michaels, Alaska.	14,363	♂	—	—	26	10	18	—
E. alascensis	St. Michaels, Alaska.	59,915	♂	130	91	30	11	19	12

Specimens examined.—Total number of specimens examined 21, from the following localities:

Alaska: Fort Yukon, 2; St. Michæls, 19.

General remarks.—*Evotomys alascensis* appears to be more closely related to the European *E. rutilus* than to the Kamtschatkan *E. wosnessenskii* or to any of the American species. It has the broad skull, large audital bullæ and broad feet of *E. rutilus*, but differs from both European and Kamtschatkan species in its long nasal bones, and in the position of the rostral protuberances.

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DESCRIPTION OF A NEW GENUS AND SPECIES OF MICROTINE RODENT FROM SIBERIA.

BY GERRIT S. MILLER, JR.

Before the first ocean telegraph cable was laid, the Western Union Telegraph Company organized an expedition to investigate the practicability of an overland international line by way of Alaska and Siberia. A few mammals were collected during this exploration, and among them is a mouse representing an undescribed genus and species. It was taken at Plover Bay, Bering Strait, Siberia. In general appearance this animal resembles a lemming. So close is the likeness that the specimen remained for many years in the National Museum collection labelled '*Myodes.*' Recently, however, Mr. F. W. True detected the error in identification and referred the subject to me for further study. I find that the species, while possessing no important characters not found in *Microtus* and *Evotomys*, yet combines the peculiarities of these two genera so perfectly that it is necessary either to recognize the new form as an annectant genus, or to reduce *Evotomys* to the rank of a subgenus of *Microtus*, and treat the Plover Bay animal as still another subgenus. While the latter course would be the more logical, it would involve the serious inconvenience of uniting two large, widely spread, and elsewhere sharply defined genera. Hence I prefer the first alternative.

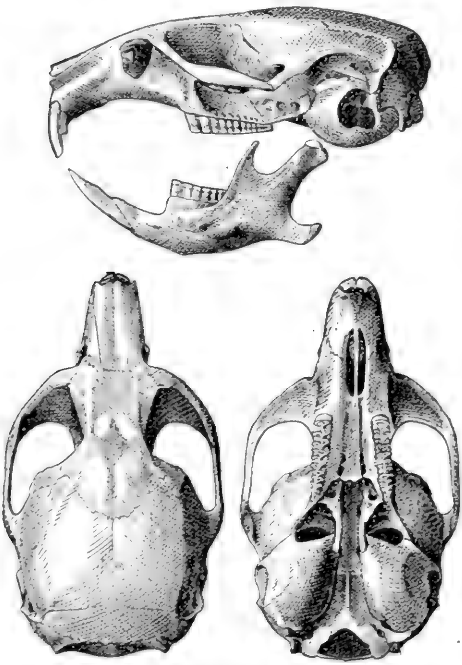

FIG. 1. Skull of *Aschizomys lemminus* (x 2).

ASCHIZOMYS gen. nov. (*Microtinæ*).

Type, *Aschizomys lemminus* sp. nov.

Generic characters.—Skull (fig. 1) broad, depressed, lightly built, smooth and rounded. Palate as in true *Evotomys*.[1] Molars small and weak, their angles rounded as in *Evotomys* (fig. 2), but the teeth growing from a persistent pulp as in *Microtus* (fig. 3). Lower incisor with long root (nearly as in *Microtus*) which strongly displaces root of large posterior lower molar (fig. 4). Form lemming-like. Tail vertebræ shorter than hind foot; pencil nearly as long as vertebræ. Plantar tubercles six. Number of mammæ unknown.

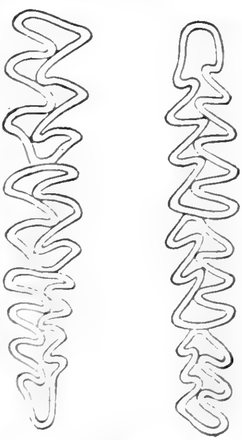

FIG. 2. Enamel pattern of *Aschizomys lemminus*. (x 10).

Remarks.—As already intimated, the proper disposition of this genus is open to serious question. It must be recognized as an intermediate between *Evotomys* and *Microtus*, but opinions may well vary between the logical course of combining all three under one generic name, and the convenient expedient of allowing each to stand as a full genus. For the present I have chosen the latter course. A third alternative would be to remove from *Microtus* and unite with *Aschizomys* the subgenera *Eothenomys*[2] and *Anteliomys*,[2] in which the palate structure of *Evotomys* is exactly reproduced. With these might be joined the highly aberrant *Evotomys rufocanus*.[3] This would not only remove anomalous forms from *Microtus* and *Evotomys*, but would also create a fairly homogeneous group characterized by the combination of shelf-like palate with long-rooted lower incisor and encapsulated posterior lower molar. When good material representing all these questionable forms can be brought together, some such course as this may prove necessary.

Aschizomys lemminus sp. nov.

Type.—Adult, number [illegible] United States National Museum, collected at Kelsey Station, Plover Bay, Bering Strait, by C. W. Baxter.

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[1] See North American Fauna, No. 12, fig. 7, and pl. II, fig. 10, July 23, 1896.

[2] See North American Fauna, No. 12, pp. 45–49, pl. II, figs. 8 and 11.

[3] For characters of *Evotomys rufocanus* see antea, p. 359–361.

External form.[4]—Ears broad and rounded, longer than the fur immediately in front of their bases. (In the dry skin the ears have shrunk considerably and appear much shorter than the surrounding fur).

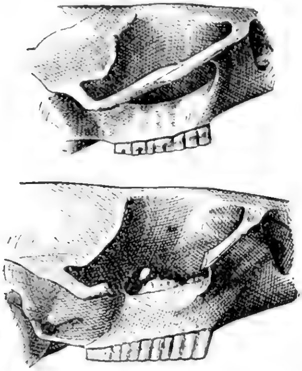

FIG. 3. Side view of molars; upper figure *Erotomys*, lower figure *Aschizomys* (x $2\frac{2}{3}$).

Muzzle hairy; septum of the nostrils naked, the free edges crenulate and grooved transversely.

Fore feet large, with five prominent tubercles. Palms naked, claws short and stout; thumb rudimentary, with a convex, compressed nail.

Hind foot broad; soles with six tubercles, of which five are subequal and one much smaller. Hinder part of sole densely hairy as far forward as the posterior tubercle; anteriorly granular, with a considerable number of short, white hairs interspersed among the granules. Claws moderate, overhung with white hairs. Tail club-shaped. Whiskers long, reaching to the shoulder.

Fur and color.—The fur is everywhere dense, soft and silky, that on the back about 10 mm. in length; on the belly it is nearly as long. Throughout the pelage the hairs are slate-gray at base. On the back the slaty portion occupies about the basal two-thirds of the hairs. Beyond this is a narrow subterminal band of pale yellowish wood-brown. The extreme tips of the hairs are sepia. The resulting surface color is a fine grizzle of sepia and yellowish-brown, very uniform throughout the dorsal surface. There is no indication of a darker dorsal area, but the shading is slightly heavier across the lumbar region than elsewhere. In front of each ear is an indistinct tuft of whitish hairs. Sides, belly, all four feet and legs, and under side of tail light straw-yellow, sharply defined from color of dorsal surface.

This description can be only approximately correct, since it is taken from the skin which had been immersed in alcohol for many years.

Tail.—Before skinning, the tail was club-shaped, and in its present condition it retains a trace of this form. For a short distance

[4] From notes made by Mr. F. W. True before the specimen was removed from alcohol.

at base it is covered with short, loose hairs, similar in texture to those of the body. Near the middle of the tail the hairs become abruptly much elongated, stiffened and strongly directed backward. The pencil thus formed is nearly as long as the tail vertebræ. It is distinctly flattened from above. The general appearance of the tail is much like that of *Dicrostonyx,* but it is even more bushy than in average specimens of any lemming.

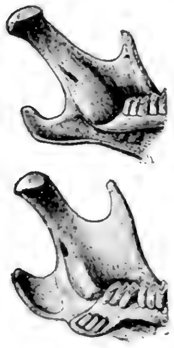

Fig. 4. Inner side of left mandible viewed slightly from behind; upper figure *Evotomys*, lower figure *Aschizomys*. (x 3⅔).

Skull.—In general form the skull (fig. 1) is much like that of *Evotomys alascensis,* though it is considerably larger. The rostrum is more tapering than in *E. alascensis,* and the rostral protuberances,[5] although apparently uninjured, are much less conspicuous. The incisive foramen is considerably shorter than in *Evotomys alascensis* or *E. wosnessenskii;* audital bullæ of about the same actual size as in the former, therefore relatively intermediate between the two. Mandible rather more heavily built than in *Evotomys alascensis.*

Teeth.—Upper incisors relatively smaller than in *Evotomys alascensis;* molars relatively slightly larger. Enamel pattern (fig. 2) apparently not essentially different from that of the Arctic red-backed mice.[6] The posterior upper molar is, however, remarkably long. It has four distinct salient angles on each side.

Measurements.—Total length, 99 mm.; head and body, 85; tail vertebræ, 16; pencil, 14; hind foot, 17.5; ear from meatus, 11.5; ear in dry skin, 8.3.

Skull: greatest length, 25.4 mm.; basal length, 23.8; basilar length, 22; zygomatic breadth, 14.8; interorbital breadth, 4; mastoid breadth, 12.6; occipital depth, 7; fronto-palatal depth (at middle of molar series), 7; length of nasals, 3; incisive foramen, 4.6; maxillary tooth row (alveoli), 6; mandible, 15; mandibular tooth row (alveoli), 6.

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[5] See antea, p. 364.

[6] See antea, p. 365, fig. 2, *a-c.*

BOTANICAL OBSERVATIONS ON THE MEXICAN FLORA, ESPECIALLY ON THE FLORA OF THE VALLEY OF MEXICO.

BY JOHN W. HARSHBERGER, PH. D.

Leaving Philadelphia, Tuesday August 4, 1896, for a botanical excursion to Mexico, the capital of the Republic was reached Tuesday August 11th, at 6 p. m. Several stops were made en route, one at St. Louis, where the Missouri Botanical Garden was visited, and one at Eagle Pass, Texas, where Sunday was spent. During the sojourn in the City of Mexico, numerous botanical trips were made into the surrounding country in company with Mr. C. G. Pringle, to whom I extend my most hearty thanks for much kindness and suggestive help. The itinerary is herewith given.

ITINERARY.

August 12, 1896, (Wednesday).—Visited a number of the lots in the City of Mexico, where cattle and burros are allowed to roam at will, and where a number of interesting plants were collected.

August 13th, (Thursday).—Mr. Pringle, Tranquelino Duran, a Mexican boy, and the writer visited Salazar by the National Railroad. Salazar is situated on the crest of the western mountain ridge, known as the Sierra de las Cruces. Here was fought, in 1810, the battle between Hidalgo and the Spaniards, resulting in a victory for the patriots. Salazar is situated at an elevation of from 10,000 to 11,000 feet above sea level. Many cool springs gush from the hillsides, mostly denuded of timber, and many alpine plants were found in the upland meadows.

August 15th, (Saturday).—Tlalpam was visited this day. In reaching this town, we passed through Cherubusco, made famous by the fight there between the Americans and Mexicans. Tlalpam is a quiet suburban town of some 7,000 inhabitants, fourteen miles south of the City of Mexico. There are many flower and fruit gardens hereabouts, for the supply of the city markets; important factories of cotton, woollen cloth and paper are in the neighborhood. The eastern road from Tlalpam leads to Lake Xochimilcho, where we gathered the several interesting aquatics found on and near the chinampas. The botanist must needs hire a canoe to procure specimens. The town is a veritable Venice.

August 17, (Monday).—The town and hills of Guadalupe, the Cerro de Tepeyac and Cerro de Gachupines visited, and a number of noteworthy plants collected. Guadalupe, some three miles north of the capital, is reached by tram-cars from the Plaza Mayor, and is interesting on account of the Sacred Chapel of Nuestra Señora de Guadalupe.

August 18th, (Tuesday).—An interesting locality visited this day was that of LaCima near the summit of Ajusco at about 10,000 feet elevation. The hill above the Indian town afforded more plants than could be conveniently carried. The pedregal in the neighborhood also yielded a rich harvest.

August 20th, (Thursday).—This day was spent in the neighborhood of Tlalpam, where the fields and ditches yielded a rich supply of plants. The edge of the Tlalpam pedregal was visited, and the interesting plants of the northern portion of the lava-bed collected and noted.

August 22d, (Saturday).—Another trip was made to the Tlalpam pedregal and to the hills beyond. In the pedregal, *Senecio praecox* DC., *Cereus serpentinus* and *Wigandia* were noted, and specimens collected for future study at home.

August 25th, (Tuesday).—The pedregal of Tlalpam extending to Tizapan, the lava bed was visited in the neighborhood of that town. Here the plants were found in the same abundance as lower down the mountain side, so that the pedregal in all its parts may be said to be a veritable flower garden.

August 26th, (Wednesday).—The writer left the City of Mexico for the Mexican tropics, via the Mexican Railroad to Orizaba and Cordoba; the next few days were spent amid the tropical luxuriance of the Mexican flora. Epiphytic orchids and other interesting plants were collected about Orizaba and in the neighborhood of the waterfall called Rincon Grande.

August 29th, (Saturday).—Returned to the City of Mexico, where the plants collected in the tierra caliente were preserved, some in formalin, others by drying.

August 31st, (Monday).—Visited the Tlalpam pedregal on the Mexican, Cuernavaca and Pacific Railroad at a much higher elevation than formerly visited, at about 9,000 feet. Here Dahlias were found in the greatest profusion and abundance. Returning down the mountain side after a rough tramp over the pedregal, we took a train for the City at Eslava, where a number of plants were found.

September 1st, (Tuesday).—Left the City of Mexico alone en route for Guadalajara via Irapuato, where a number of days (September 2d to September 5th) were spent. The celebrated barranca was visited in company with an Indian, and a number of plants collected.

September 5th–September 9, 1896.—This time was profitably spent in a trip to Tampico on the Gulf Coast.[1] En route the beautiful Tamasopo Cañon was admired, as also the extensive palm forests about Rascon and eastward. No botanical exploration of the country was made.

September 10, 1896.—Ciudad Juarez and El Paso were reached on the homeward journey. A hasty botanical survey was made of the hills about El Paso, but little of interest was found in the immediate vicinage of the town, because of the extreme dryness of the season.

TOPOGRAPHY AND GEOGRAPHY OF THE PLACES VISITED.

The Valley of Mexico, situated 7,350 feet above the level of the sea, is of an elliptical form with its long axis running in a north and south direction. The greatest length of the valley according to Orozco and Berra is from Cerro de Sincoque on the north to Cerro del Teutli on the southern border of Lake Xochimilcho, a distance of about 45 miles. The greatest breadth of the valley is from the Hacienda de los Morales, westward a distance of 21 miles. This most beautiful of basin-shaped valleys is walled in by high hills and lofty mountains on all sides. Sierra del Ajusco rises in a series of ridges and peaks to the south, the highest point the volcano of Ajusco, long since extinct, lifting its peak 13,612 feet above sea level. In the east, this ridge of mountains sinks, and forms between Amecameca and Ozumba, a broad saddle, over which passes the railroad from the capital to the State of Morelos. The eastern mountainous rim stretches itself as a mighty wall, separating the Valley of Anahuac from Pueblo. It culminates in the southeast in the volcanic peak of Popocatepetl (17,782 feet), and in Iztaccihuatl a long high broken mountain mass, 16,060 feet elevation. Contiguous to Iztaccihuatllying to the north, we find the continuous ranges called Cerro Telapon, Cerro Tlaloc, Cerro Tlamacas, Cerro Cha-

[1] See an article by the writer in Bot. Gazette, May, 1898, p. 362.

pingo and the small Sierra de Patlachique—to the east as an outlier in the Valley of Puebla, Monte de Rio Frio. These are all of volcanic origin. About the north foot of Cerro Tlamacas spread the the fruitful plains of Otumba and Apam. The railroad to Vera Cruz crosses here.

The enclosure of the Valley of Mexico is completed to the west by the Sierra de las Cruces, continued northward by the spurs called Monte alto and Monte bajo, and ending finally in the Sierra de Tepotzatlan and Cerro de Sincoque, separated from the northern range of hills by the railroad cut and drainage ditch, Tajo de Nochistongo. The floor of the valley is generally level and uniform with six large lakes filling the more depressed portions. Their size and elevation in metres and square kilometers is given in the subjoined table:

	Area.	I, 1862.	II, 1868.
Lake Texcoco.	182,495 sq. km.	—1,907 m.	—0.85 m.
Lake Chalco.	104,985 sq. km.	+1,175 m.	+2.16 m.
Lake Xaltocan.	54,072 sq. km.	+1,567 m.	+2.05 m.
Lake Xochimilcho . . .	47,050 sq. km.	+1,202 m.	+2.16 m.
Lake Zumpango.	17,205 sq. km.	+4,155 m.	+5.75 m.
Lake San Cristobal . . .	11,060 sq. km.	+1,690 m.	+2.05 m.
	416,867 sq. km.		

The relative elevation, minus or plus, has been referred to the base of one of the corners of the National Palace on the Plaza Mayor, as the zero level. During the diluvial period of geologic time the lakes were very much more extended than now. The whole Valley of Mexico was filled by a large inland sea with here and there a volcanic hill rising, as an island, or as a peninsula, out of its surface. Texcoco was in the past quite saline. Fernando Cortez in a letter to Charles V, dated 1500, says: "En el dicho llano (del Valle de Mexico) hay dos lagunas, que casi lo ocupan todo. E la una de estas lagunas es de aqua dulce, y la otra, que es mayor, es de aqua salada." The earth of the plains surrounded Texcoco Lake is impregnated with salt, and in many places the saline material forms a rich efflorescence. The flora of this region of the valley has a marked character. Various species of *Chenopodium*, *Atriplex*, *Salsola* and *Grati-*

ola are found growing here as saline plants. The chinampas are the so-called floating islands, more especially found in Lake Xochimilcho.

A number of small conical volcanoes rise from the floor of the valley, and are known locally as Cerro de taza (cupped hill, Kuppen). One remarkable collection of these low hills is to be found in the neighborhood of the town of Guadalupe, separating the Valley of Mexico into a northern and southern portion. These, the so-called Sierra de Guadalupe, are connected with the western mountain chain Monte bajo, by the low ridge Cuesta de Barrientos, and with the north-eastern ridges by the Cerro de Chiconautla. The northern half of the valley thus formed is occupied by Lakes Zumpango, Xaltocan and San Cristobal, the southern half by the three lakes best known to travellers, Texcoco, Chalco and Xochimilcho.

A few words are necessary as to the geography, topography and geology of the region visited botanically. Cerro de Tepeyac, one of the hills of the aforementioned Sierra de Guadalupe, is 140 ft. high; very few plants are found on this hill. If one ascends the east side, he finds for the first 115 ft. a fine crystalline rock of a dark violet-gray color of a close texture frequently spotted with green, scaly, porous particles. The summit of the hill is covered with a pitchstone-like rock formation about 16 to 26 ft. thick. By a rocky bridge, Cerro de Tepeyac is connected with the Cerro Gachupines. Felix and Lenk[2] say of this hill: "An dessen Abhang passirt man zunächst zwei, 5 bezw. 8 m. mächtige Pechsteinzonen, zwischen und über welchen der röthlichgraue, körnige Andesit sich ausbreitet, der die Hauptmasse des Berges ausmacht und in einigen Steinbrüchen zu industriellen Zwecken abgebaut wird."

The pedregal of Tlalpam, or of San Angel is one of the most interesting formations in the valley, covering an area of about 7,000 acres. The pedregal is an extinct lava stream situated between the towns of San Angel and Tlalpam, and extending southward up the sides of the Sierra del Ajusco to the hill called Chitle. It was formed when the southern mountains were in active volcanic eruption. The eye of the traveller sweeps unobstructedly over an arid black landscape, which might be compared to the sudden stiffening of the rolling surface of the sea. The country is extremely uneven and rugged; the coulee of lava is full of cracks, blisters,

[2] 1890. Felix and Lenk, Beiträge zur Geologie und Paläontologie der Republik Mexico, I, 70.

caverns and sinks produced during the process of cooling. It is raised into cones, presents most curious sinuosities, and is here and there broken down into rugged jagged protuberances, as sharp and cutting as a knife's edge. This interesting coulee is from 33 to 50 ft. thick over its greatest extent, and from 20 to 26 ft. thick along its borders. Felix and Lenk[3] give a very interesting and true description of this lava bed. "Wogenberg erhebt sich neben Wogenthal; hier ist die Lava glatt und mit einer glänzenden Erstarrungskruste überzogen, dort ist sie, wie der Gischt der Welle, schaumig und schlackig. Deutlich kann man beobachten, wie die erstarrte Oberfläche häufig geborsten ist und auf den weitreichenden Rissen dünn flüssigere Lavamassen emporgequollen sind, die von den klaffenden Spaltenrändern mächtige Blocke mitgerissen und nach kurzem Transport zu chaotischen Trümmerhaufen aufgestaut haben.—Ausser kleinen, einst durch die Gasentwicklung in der Lavamasse entstandenen Hohlräumen, welche schliesslich zur kleinheit der Dampfpore herabsinken, finden sich stellenweise in ihr auch geräumige mehrere cubikmeter haltende Grotten, welche genetisch wohl als sogenannten 'Schlackensäcke' zu betrachten sind. Durch späteren der Einsturz Decken oder durch die bei Abkühlung in Folge der eintretenden Contraction aufgerissenen Spalten sind sie zum Theilgeöffnet und bieten zahlreichen Fledermäusen Wohnung, dem Reisenden bei einbrechendem Unwetter schützendes Obdach." The lava of the Tlalpam pedregal is a typical hypersthene free basalt.

But that which concerns us most are the plants, which together form a very rich and remarkable flora. Among the causes which favored the development of this peculiar flora may be mentioned the soil temperature, which is warm and uniform, owing to the soil being a basaltic scoria in the protection of which a large number of herbaceous plants flourish; the direction of the wind, the humidity of the atmosphere of this region also favor a rich plant growth. The pedregal is surrounded by high hills, protected thus from the tempestuous winds of the north. Woods of pine, oak and fir clothe the hillsides and serve as an additional protection. In this region are found deep cañadas, always damp and wet from abundant water, which comes from numerous showers and the spray of waterfalls which precipitate themselves from various heights. As a result of these factors, the climate of the pedregal is more temper-

[3] 1890. Felix and Lenk, l. c., 79.

ate and more constant than that of the City of Mexico, or of the Hacienda de Eslava, where a meteorological station has been established. In consequence of the meteorological conditions, the pedregal supports a flora made up of many representatives of the tierra fria, tierra templada and tierra caliente.

The Serrania de las Cruces is a continuation northwestward of the Sierra del Ajusco. It is an elevated region, and by reason of that elevation and exposure to the winds of the north and west presents a very distinct flora. One part of the region, that on the west flanks of the Serrania del Ajusco, is very humid; the central portion is more dry. Large forests of fir, *Abies religiosa,* once covered the western side, but these are fast disappearing before the axe of Mexican wood choppers. The higher elevations present a characteristic alpine flora. Many of the places with an eastern exposure are quite sterile, as to the abundance of plants found in such localities.

CATALOGUE OF SPECIES FROM THE VALLEY OF MEXICO.[4]

A. *Lots. City of Mexico.*

FICOIDEÆ.

1. **Sesuvium portulacastrum** Linn. Syst. ed X, 1,058; Jacq. Amer., t. 95, Biol. Centr. Amer., I, 556.

North Mexico, South Mexico, Nicaragua. Common on the seashores within the tropics. "Verdolaga de Costa," (Cuba). Aug. 12 (1).

ONAGRACEÆ.

2. **Œnothera rosea** [Soland in] Ait. Hort. Kew. ed. I, ii, 3; DC. Prodr., III, 51; Biol. Centr. Amer. Bot., I, 454.

Widely distributed through Mexico, extending into Texas; also in Colombia and some of the West Indian Islands. Naturalized in tropical Africa, India and the Canary Islands. Aug. 12 (3).

COMPOSITÆ.

3. **Aster Potosinus** A. Gray in Proc. Amer. Acad., XV, (1880), 32; Biol. Centr. Amer. Bot., II, 122.

North Mexico, mountains of San Luis Potosi, 6,000 to 8,000 feet (Parry & Palmer, 384). Aug. 12 (4).

[4] The natural orders are arranged according to the Engler and Prantl system. The species are according to the Index Kewensis with the aid of HEMSLEY'S Biologia Centrali Americana (Botany). See for a description of the ecological plant regions of the Valley of Mexico an article by the writer: "A Botanical Excursion to Mexico." Amer. Journ. Pharm., 68, p. 588, and the translation Una Excursion botánica á México, El Tiempo Diario Catolico, Dec. 4, 1896.

4. **Erigeron scaposus** DC., Prodr., V, 287.
Aster rivularis Lees in Linnæa, V, 143, excl. synon.

Widely distributed in Mexico. Aug. 12 (2).

B. *Tlalpam Valley of Mexico.*

SALICACEÆ.

5. **Salix Bonplandiana** H. B. K., Nov. gen. et Sp., II, 24, tt. 101, 102; DC., Prodr. XVI, 2, p. 200.

A tree found in several recorded districts in South Mexico. Along roads leading from Tlalpam to Lake Xochimilcho, "Sauce" (Mexico). Aug. 15 (86).

NYCTAGINACEÆ.

6. **Mirabilis Jalapa** Linn., Sp. Pl., 177; Choisy in DC. Prodr., XIII, 2, p. 427; Lam. Ill., Pl., t. 105; Bot. Mag., t. 371.

Roadsides near Tlalpam. Abundant in other parts of Mexico.

"Maravilla" (Cuba); "Marvel of Peru"; "Four o'clock"; "False Jalap." Aug. 15 (81).

CARYOPHYLLACEÆ.

7. **Arenaria lanuginosa** Rohrb. in Mart. Fl. Bras., XIV, ii, 274; Biol. Centr. Amer. Bot., I, 69.
Arenaria alsinoides Willd. in Ges. Naturf. Fr. Berl. Mag., VII, (1813) 201.

Common from North Carolina to Mexico, southward to Peru and Bolivia. Tlalpam, Aug. 22 (215).

ILLECEBRACEÆ.

8. **Corrigiola Andina** Planch & Triana in Ann. Sc. Nat. Sér., IV, XVII (1862) 146; Biol. Centr. Amer. Bot., III, 11.

Found in North and South Mexico and Colombia; Tlalpam, Aug. 22 (220).

RANUNCULACEÆ.

9. **Ranunculus orthorhynchus** Hook., Fl. Bor. Am., I, 21, t. 9; Biol. Centr. Amer. Bot., I, 7.
Ranunculus dichotomus Moç et Sessé in DC. Syst. Veg. I, 288.

A widely distributed plant in Mexico. Ditches near Lake Xochimilcho, Aug. 15 (80).

PAPAVERACEÆ.

10. **Argemone Mexicana** Linn., Sp. Pl., 508; Lam. Ill., t. 452; Materia Medica Mexicana, 153 (plate).

This is now a common weed in most tropical and sub-tropical countries, flowering from April to October, and abundant in cultivated fields. Introduced with ballast into Philadelphia. It is used by the bush doctors of the Bahamas according to Dolley[5] for the small-pox. "Its seeds have been used elsewhere as a substitute for Ipecacuanha, its juice is said to destroy warts, to be efficacious against the bites of venomous serpents, and to be useful in opthalmia."

"El Chicalate"; "Argemone du Mexique"; "Adormidera espinosa," Chicalotl (Mexico); "Cardo Santo" (Antilles, Cuba); "Prickly-poppy"; "Mexican Poppy," "Yellow-thistle," "Fin Bush." Roadsides near Tlalpam, Aug. 15 (82).

CRUCIFERÆ.

11. **Raphanus Raphanistrum** Linn., Sp. Pl., 669.

This plant is naturalized in Mexico, and occurs in the collections of many travellers. "Wild Radish." Aug. 20 (185).

12. **Sisymbrium canescens** Nutt., Gen. Am., II, 68.

In North America from Arctic Circle to South Mexico. Tlalpam, Aug. 22 (221).

RESEDACEÆ.

13. **Reseda Luteola** Linn. Sp. Pl., 449; Biol. Centr. Amer. Bot., I, 46.

Without doubt an introduced plant. Tlalpam, Aug. 20 (186).

LEGUMINOSÆ.

14. **Phaseolus** sp.

Near Tlalpam, Aug. 15 (103).

15. **Trifolium amabile** H. B. K. Nov. gen. et sp., VI, 503, t. 593; Biol. Centr. Amer. Bot., I, 232.

Abundant throughout Mexico. The several specimens collected in 1896 are questionably referred to this species. Tlalpam, Aug. 20 (155).

GERANIACEÆ.

16. **Oxalis divergens** Benth. Pl. Hartw., 9; Bot. Reg., t. 1,620; Biol. Centr. Amer. Bot., I, 163.

Collected by various botanists in several parts of Mexico along ditches. Tlalpam, Aug. 20 (178).

17. **Erodium cicutarium** L'Herit ex Ait. Hort. Kew. ed. I, ii, 414; Leman in DC. Fl. Fr., IV, 840; Biol. Centr. Amer. Bot., I, 161.

Widely dispersed in the north temperate regions of the Old World, and now exceedingly common in many parts of North Amer-

[5] Dolley, Prov. List Plants of Bahama Islands.

ica, but supposed to have been originally introduced by the Spaniards. Collected by botanists in several places. Tlalpam fields, Aug. 20 (183).

ANACARDIACEÆ.

18. Schinus molle Linn. Sp. Pl., 388; Lam. Ill., t. 822; Biol. Cent. Am. Bot., I, 221.

Dispersed from country to country by the birds tzenzontles and xilgueros, which eat the fruit and void the seeds. Found in Tropical America to South Brazil, occurring in the Andes at 12,000 to 13,000 feet. Supposed to have been introduced by the early Spaniards in order to procure wood in the volcanic district (Christy). Will bear droughts and the intense summer heat of Central Australia better than almost any introduced plant (Von Mueller). The plant, which flowers from March to May in Mexico, occurs in the Valley on the pedregal in saline soils, fertile soils and along the margins of Lake Texcoco. "El Arbol de Peru"; "Pelonquahuitl"; "Copalquahuitl"; "Molle"; "Pimienta de America." Roadsides near Tlalpam, Aug. 15 (84).

MALVACEÆ.

19. Sphaeralcea angustifolia G. Don. Gen. Syst., I, 465; Biol. Centr. Amer. Bot., I, 113.

Malva angustifolia Cav. Diss., I, 64, t. 20; Bot. Mag., t. 2,839.
Sphaeroma angustifolium Schl. in Linnaea, XI, 353.

Widely distributed in Mexico according to the collections of botanists. Tlalpam, Aug. 20 (181).

LYTHRACEÆ.

20. Cuphea sp.

Near ditches. Tlalpam, Aug. 15 (85).

21. Lythrum alatum Pursh. Fl. Am. Sept., I, 334; Biol. Cent. Am. Bot., I, 447.

From Canada southward, chiefly in the eastern and southern States to South Mexico. Roadsides near Tlalpam, Aug. 15 (87).

ONAGRACEÆ.

22. Œnothera rosea [Soland. in] Ait. Hort. Kew., ed. I, ii, 3.

(Repeated). Tlalpam, Aug. 20 (172).

PRIMULACEÆ.

23. Anagallis arvensis Linn. Sp. Pl., 148; Biol. Centr. Amer. Bot., II, 289.

A widely dispersed Old World plant naturalized, and common in some parts of Mexico (Hemsley). Tlalpam, Aug. 22 (no number).

POLEMONIACEÆ.

24. **Cobæa scandens** Cav. Ic., I, 11, t. 16, 17; Biol. Centr. Amer. Bot., II, 358; Bot. Mag., t. 851; Flore des Serres, t. 1,467.

Walls of gardens. Tlalpam, Aug. 20 (148).

LABIATÆ.

25. **Salvia Mexicana** Linn. Sp. Pl., 25; DC. Prodr., XII, 337; Biol. Centr. Amer. Bot., II, 361; Cav. Ic., I, p. 16. t. 26.

Reported from a number of localities in North and South Mexico. Tlalpam, Aug. 22 (222).

26. **Salvia amarissima** Orteg. Hort. Matr., Dec. 4; DC. Prodr., XII, 317; Bot. Reg., t. 347; Biol. Centr. Amer. Bot., II, 553.

Reported from several localities in Mexico. The specimens collected in 1896 are doubtfully referred to this species, differing in several respects, notably the rough hairs and long petioles from the plant so named in the herbarium of the Academy of Natural Sciences. It may be a variety, which I here propose, as variety *petiolaris* n. var. Tlalpam, Aug. 22 (223).

SOLANACEÆ.

27. **Solanum Cervantesii** Lag. Gen. et Sp., Nov. 10; Biol. Cent. Am. Bot., II, 406.

North and South Mexico. Roadsides near Tlalpam, Aug. 15 (83).

28. **Solanum nigrum** L., var. **villosum** Mill. S. nigrum Linn. Sp. Pl., 186; Biol. Centr. Amer. Bot., II, 412.

This species is a common weed in nearly all tropical and temperate countries, but it is impossible to determine where it is really indigenous (Hemsley). Tlalpam (154).

29. **Solanum cornutum** Lam. Illustr., II, 25; DC. Prodr., XIII, i, 328; Jacq. Eclog., t. 104; Biol. Centr. Amer. Bot., II, 407.

North and South Mexico. Tlalpam, Aug. 20 (180). Asa Gray distinguishes *S. cornutum* by its simple, non-stellate hairs, otherwise it is much like *S. rostratum* from Colorado.

30. **Nicotiana glauca** R. Grah. in Edinb. N. Phil. Journ. (Apr.–June, 1828) 175; Bot. Mag., t. 2,837; DC. Prodr., XIII, i, 562; Biol. Centr. Amer. Bot., II, 434.

"This quickly growing arborescent species can be raised on mere sand on the coast, as one of the best plants to establish shelter and stay the shifting of the sand waves. There the poisonous quality of its foliage is not objectionable. It is inadmissible to pastural places on account of its deleteriousness" (Von Mueller). North and

South Mexico, Valley of Mexico. Roadsides near Tlalpam and growing on walls and roofs of adobe houses.

PLANTAGINACEÆ.

31. Plantago hirtella H. B. K. Nov. Gen. et Sp., II, 229, t. 127; A. Gray, Synop. Fl. N. Am., II, 392; Biol. Centr. Amer. Bot., II, 575.

California, Mexico, Chili. Tlalpam, Aug. 20 (153).

COMPOSITÆ.

32. Eupatorium sp.

Tlalpam, Valley of Mexico, Aug. 20 (179).

33. Heterotheca Lamarckii Cass. in Dict. Sc. Nat., XXI, 130; DC. Prodr., V, 317; S. Wats., Proc. Am. Acad., XVIII, 102; Biol. Centr. Amer. Bot., IV, 52.

South Carolina, westward and southward, North Mexico, Monterey, Nuevo Leon. Tlalpam, Aug. 20 (182).

34. Heterospermum pinnatum Cav. Ic., III, 34, t. 267; Willd., Sp. Pl., III, 2,129; Biol. Centr. Amer. Bot., II, 195.

North and South Mexico, collected by a number of botanists. Tlalpam, Aug. 20 (219).

35. Schkuhria virgata DC. Prodr., V, 654; Biol. Centr. Amer. Bot., II, 212.

North Mexico, region of San Luis Potosi, 6,000 to 8,000 feet (Parry & Palmer); South Mexico, Guanajuato (Mendez); near Tacubaya (Schaffner); Chapultepec (Bilimek); Guatemala. Tlalpam, Aug. 22 (214).

C. *Lake Xochimilcho, Valley of Mexico.*

MARSILIACEÆ.

36. Marsilia heterophylla ?

Ditches near Xochimilcho, Aug. 15 (78).

ALISMACÆ.

37. Sagittaria sagittifolia Linn. var. **Mexicana**, Mart. et Gal.

S. sagittifolia Linn., Sp. Pl., 993; Biol. Centr. Amer. Bot., III, 439; var. *Mexicana* Mart. et Gal. in Bull. Acad. Brux., IX, 8; Micheli in DC. Monogr. Phanerog., III, 66.

Lake Xochimilcho on wet chinampas, Aug. 15 (92).

CYPERACEÆ.

38. Cyperus unioloides R. Br. Prodr. Fl. N. Holl., 216; Clarke in Journ. Linn. Soc., XXI, 61.

Cyperus bromoides Willd. ex Link, III, 85; Kunth. Enum. Pl. II, 8.

Found in South Mexico, Guatemala, Venezuela and Paraguay. Other varieties of this species are found in India, Australia and South Africa. Lake Xochimilcho on chinampas, Aug. 15 (93).

ERIOCAULONEÆ.

39. **Eriocaulon Benthami** Kunth Enum., Pl. III, 545; Biol. Centr. Amer. Bot., III, 443; Koern in Mart. Fl. Bras., III, 490.

Recorded from South Mexico and Guatemala. Lake Xochimilcho on chinampas, Aug. 15 (97).

PONTEDERIACEÆ.

40. **Eichornia azurea** Kunth Enum., Pl. IV, 129; Solms in DC. Monogr. Phanerog., IV, 528; Abhandl. Naturf. Gesell., Halle, VI, 177, cum icon.; Bot. Mag., t. 6,487.

Pontederia azurea Swartz, Fl. Ind. occ., I, 609.

Common over Tropical and Extra-tropical South America and the West Indies. Closely similar to the water hyacinth *Piaropus* (*Pontederia, Eichornia*) *speciosa* Kunth, a native of South America. Whether this plant is indigenous to the canals and lakes of the Valley of Mexico is a question; at any rate it is very abundant in many of the ditches in the City of Mexico, and is also found abundantly floating about in Lake Xochimilcho. The related Water Hyacinth is extremely troublesome to navigation in the rivers of Florida.[6]

Lake Xochimilcho, Aug. 15 (88).

POLYGONACEÆ.

41. **Polygonum amphibium** Linn., Sp. Pl., 361; DC. Prodr., XIV, 115; A. Gr., Man. Bot. ed. 5, 416; Fl. Dan., t. 282.

A very widely dispersed species in the temperate and subtropical regions of the N. Hemisphere. Lake Xochimilcho on the edge of the chinampas, Aug. 15 (91).

NYMPHAEACEÆ.

42. **Nymphæa Mexicana** Zucc. in Abh. Akad. Muench., I, (1832), 365; Flora (1832) II; Beibl, 75; Biol. Centr. Amer. Bot., I, 26.

The flowers of this plant are straw-yellow. Lake Xochimilcho, Aug. 15 (100).

43. **Nymphæa tussilagifolia** Lehm., Ind. Sem. Hort. Hamb. (1853), 10; Ann. Sc. Nat., ser. 4, Vol. I, 326.

Collected by Lehman in Lake Chalco near Yotla, also found in the Amazon. The flowers of this handsome water lily are white. Lake Xochimilcho, Aug. 15 (101).

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[6] See the Water Hyacinth and its Relation to Navigation in Florida, Bull. 18, Div. of Bot. U. S. Dept. Agric., H. J. Webber.

RANUNCULACEÆ.

44. **Ranunculus Cymbalaria** Pursh. Fl. Am. Sept., II, 392; DC. Syst. I, 252; Biol. Centr. Amer. Bot., I, 16.

Distributed from Canada to the Argentine Republic, also in Northern Asia and Europe. Ditches near Lake Xochimilcho, Aug. 15 (79).

SCROPHULARIACEÆ.

45. **Escobedea (linearis) laevis** Cham & Schlecht in Linnaea, V, (1830), 108; DC. Prodr., X, p. 337; Biol. Centr. Amer. Bot., II, 456, also plate.

Recorded from a number of localities in South Mexico. Lake Xochimilcho on the chinampas. Flowers white. Aug. 15 (90).

LOBELIACEÆ.

46. **Lobelia fulgens** Willd. Hort. Berol., t. 85; DC. Prodr., VII, 382; Biol. Centr. Amer. Bot.. II, 267.

Lobelia splendens Willd., Hort. Berol., t. 86; A. Gr., Synop. Fl. N. Am. II, 3; Bot. Mag., t. 4,960 (var. ignea).

From Texas to Panama throughout Mexico. Lake Xochimilcho on chinampas, Aug. 15 (89).

COMPOSITÆ.

47. **Solidago paniculata** DC. Prodr., V, 340; Biol. Centr. Amer. Bot., II, 116.

S. Mexicana H. B. K., Nov. Gen. et. Sp., IV, 104?

Lake Xochimilcho on chinampas, Aug. 15 (95).

48. **Cnicus linearifolius** Watson.

Lake Xochimilcho on chinampas, Aug. 15 (99).

49. **Bidens chrysanthemoides** Michx. Fl. Bor. Am., II, 136; Torr. & Gr., Fl. N. Am., II, 352; Biol. Centr. Amer. Bot., II, 201.

Common from Canada throughout the United States east of the Rocky Mountains and in Arizona, California and North Mexico. Lake Xochimilcho on chinampas, Aug. 15 (102).

D. *Cerro de Guadalupe, Valley of Mexico.*

LILIACEÆ.

50. **Milla biflora** Cav. Ic., II, 76, t. 196; S. Watson, Proc. Am. Acad., XIV, 240, et XVIII, 165; Bot. Reg., t. 1,555.

Found in New Mexico, South Arizona, North and South Mexico. Cerro de Guadalupe growing on exposed rocky faces of the hill in small soil pockets, Aug. 18 (108).

PORTULACACEÆ.

51. **Talinum aurantiacum** Engelm. in Bost. Jour. Nat. Hist., VI, (1850), 153; Biol. Centr. Amer. Bot., I, 78.

Texas and New Mexico to North and South Mexico in sandy places. Cerro de Guadalupe on rock faces,[7] Aug. 18 (106).

52. **Talinum patens** Willd. Sp. Pl., II, 863; Biol. Centr. Amer. Bot., I, 79.

North and South Mexico, also in South America, West Indies and some of the Pacific Islands. Cerro de Guadalupe on rock faces, Aug. 18 (109).

GERANIACEÆ.

53. **Oxalis decaphylla** H. B. & K. Gen. et Sp., V, 238, t. 468; Biol. Centr. Amer. Bot., I, 163.

Texas to North Mexico to South Mexico. This oxalid shows great senstivity to light, in that its leaves assume the hot sun position in the same manner in which they show nyctitropic, or sleep movements. Each of the ten leaflets arranged at the end of the common petiole in a circular manner, first fold the two halves on each side of the midrib back to back, and then they all fold down together like the closing of an umbrella. Cerro de Guadalupe, Aug. 18 (107).

CACTACEÆ.

54. **Mammillaria strobiliformis** Scheer ex Salm. Dyck. Cact. Hort. Dyck., ed. II, 104; Biol. Centr. Amer. Bot., I, 524.

Collected by Potts in Chihuahua. I refer the plant collected by me doubtfully to this species. Cerro de Guadalupe, Aug. 18.

BIGNONIACEÆ.

55. **Tecoma mollis** H. B. K. Nov. Gen. et. Sp., III, 144; DC. Prodr., IX, 224; Biol. Centr. Amer. Bot., II, 496.

North and South Mexico. Cerro de Guadalupe, Aug. 18.

E. *Pedregal near Tlalpam. Valley of Mexico.*

6. **Selaginella lepidophylla** Sering. Monogr. Lycopod. II, 72; Biol. Centr. Amer. Bot., III, 707.

Texas through Mexico, southward to Peru. One of the so-called resurrection plants. In normal grown condition, the leaves and

[7] See An Ecological Study of the Genus Talinum with Descriptions of Two Species, Bull. Torrey Botan. Club, XXIV, p. 182, Apr., 1897, J. W. Harshberger.

branches are outspread, and the plant becomes mortar-shaped; when dry it rolls up and may preserve this form for years. If again wetted it unrolls.

Abundant on faces and sides of the lava. Pedregal near Tlalpam, Aug. 20 (190).

FILICES.

57. **Polypodium** sp.

Pedregal near Tlalpam, Aug. 20 (164).

58. **Notholaena ferruginea** Desv. Hook, Sp. Fil. V, 108; Eaton Ferns N. Am., I, 297 t. 39, figs. 7–10; Biol. Centr. Amer. Bot., III, 673.

Texas, New Mexico, Arizona, North and South Mexico, West Indies and Colombia to Chili.

Bare faces of rocks, pedregal, Aug. 22 (208).

59. **Cheilanthes myriophylla** Desv. Hook, Sp. Fil., II, 100, t. 105 A; Biol. Centr. Amer., III, 616.

North and South Mexico reported from several localities and the pedregal by Bourgeau; in Peru and Chili.

Bare rocks, pedregal, Aug. 22 (207).

GRAMINEÆ.

60. **Bouteloua prostrata** Lag. in Varied. Cienc., ii, IV (1805) 141; Gen. et. Sp. Nov. 5th; S. Wats. in Proc. Am. Acad., XVIII, 176; Biol. Cent. Am. Bot., III, 562.

"This annual grass is widely distributed from Mexico to Colorado, prevailing in bottom land, where it frequently mats the ground but does not seem to be relished by cattle" (Vasey).

North and South Mexico, Colombia and Ecuador. Pedregal, Aug. 20 (156).

61. **Microchloa setacea** R. Brown, Prodr., I, 208; S. Wats., Proc. Amer. Acad., XVIII, 176; Biol. Centr. Amer. Bot., III, 557.

Reported from North Mexico southward to Bolivia and Brazil. Also in North Australia, tropical Africa and Asia.

Hills near Tlalpam, pedregal, Aug. 22 (204).

CYPERACEÆ.

62. **Cyperus seslerioides** H. B. K. Nov. Gen. et Sp. I, 209; Biol. Centr. Amer. Bot., III, 451.

Reported in North and South Mexico, also on the Orinoco.

Pedregal, Aug. 22 (196).

COMMELINACEÆ.

63. **Commelina scabra** Benth. Pl. Hartw., 26; C. B. Clarke in DC. Monogr. Phanerog., III, 153 Biol. Centr. Amer. Bot., III, 389.

South Mexico in several places. Pedregal, Aug. 22 (218).

LILIACEÆ.

64. **Milla biflora** Cav. Ic., II, 76 t. 196.

Pedregal, Aug. 20 (repeated).

65. **Calochortus flavus** Schult. f. Syst., VII, 1535; Biol. Cent. Am. Bot., III, 380.

Reported in both North and South Mexico. The flowers have large nectar glands on the petals guarded by hairs.

Pedregal, Aug. 20 (161).

ORCHIDACEÆ.

66. **Habenaria filifera** Wats.

Collected by Mexican botanists on Sierra de Ajusco at Eslava, 8,000 feet. Pedregal, Aug. 22.

CUPULIFERÆ.

67. **Quercus undulata** Torr. var. **grisea** Engelm. Q. undulata in Ann. Lyc. N. York, II, (1828) 248, t. 4.

A low-growing, scrubby tree, used for fire-wood. Pedregal, Aug. 22 (195).

PORTULACACEÆ.

68. **Talinum napiforme** DC. (Char. amplif.) Hemsley, Diag. Pl. Nov. pars altera., 23; DC. Prodr., III, 357; Biol. Centr. Amer. Bot., I, 79; Bull. Torrey Bot. Club, XXIV, 183, t. 299.

Described from drawing made by DC. of the species. Pedregal, Aug. 20 (166).

CARYOPHYLLACEÆ.

69. **Drymaria gracilis** Cham. & Schlecht. in Linnaea, V (1830) 232; Biol. Centr. Amer. Bot., I, 73.

South Mexico. Pedregal, Aug. 22 (199).

RANUNCULACEÆ.

70. **Clematis dioica** Linn. Syst. ed. X, 1084; Sloane, Hist. Jam., I, 199, t. 128, fig. 1; Biol. Centr. Amer. Bot., I, 2.

Recorded in several places in South Mexico, also found in Brazil, Colombia and West Indies, "Cabello de Angel" (Cuba).

Pedregal, Aug. 20 (162).

LEGUMINOSÆ.

71. **Phaseolus** sp.

Pedregal near Tlalpam, Aug. 20th (187).

72. **Zornia diphylla** Pers. Syn., II, 318; Benth in Mart. Fl. Bras., XV, 80 tt., 21, 22; Biol. Centr. Amer. Bot., I, 273.

A very variable plant, common in most tropical and subtropical regions throughout the world, and occurring in nearly all collections from Panama, Costa Rica, Nicaragua, Guatemala and Mexico. The two leaflets usually assume the hot sun position standing up vertically back to back. When the plant is in flower, these serve to enclose the blossom.

Pedregal on exposed lava in rosettes, Aug. 20 (167).

73. **Eysenhardtia amorphoides** H. B. & K. Nov. Gen. et Sp., VI, 489 t. 592.

From New Mexico, Texas, through North to South Mexico. "Palo dulce blanco;" "Coatle." Used as a succedaneum for sandal-wood. Pedregal, Aug. 22 (197).

74. **Crotalaria pumila** Orteg. Hort. Matr., 23; Biol. Centr. Amer. Bot., I, 228.

From New Mexico to South Mexico. Pedregal, Aug. 22 (217).

75. **Phaseolus** sp.

Pedregal, Aug. 22 (212).

EUPHORBIACEÆ.

76. **Acalypha phleoides** Cav. in Anal. Hist. Nat. Madr., II (1800) 139; Biol. Centr. Amer. Bot., III, 127.

Abundant in two varieties through Mexico, The plant collected in 1896 in the Valley of Mexico is doubtfully referred to this species. Pedregal, Aug. 22 (203).

77. **Euphorbia adenoptera** Bertol. Misc. Bot., III, 20, t. 23; DC. Prod., XV, 2, 49.

Distributed from Florida, Texas, New Mexico to South Mexico, West Indies and South America. Doubtfully referred by me to this species. Pedregal, Aug. 22 (202).

SAPINDACEÆ.

78. **Cardiospermum Halicacabum** Linn. Sp. Pl. 366; Biol. Cent. Am. Bot., I, 209.

A very common plant in tropical and subtropical regions of both hemispheres. It was difficult for me to distinguish my plant from *C. molle*, which it closely resembles. North and South Mexico. Pedregal, Aug. 20, climbing over other plants (159).

MALVACEAE.

79. **Malvastrum Peruvianum** A. Gray. Bot. U. S. Explor. Exped., I, 146; Biol. Centr. Amer. Bot., I, 99.

Pedregal, Aug. 22 (224).

CACTACEÆ.

80. **Cereus serpentinus** DC. Prodr. III, 467; Biol. Centr. Amer. Bot., 546; Bot. Mag., t. 35, 66.

South Mexico, used occasionally for forming hedges. Pedregal, Aug. 22.

UMBELLIFERÆ.

81. **Eryngium comosum** Delar. Eryng. 30, t. 7; Biol. Centr. Amer. Bot. I, 560.

Recorded from a number of stations in South Mexico. Pedregal, Aug. 22 (211).

ASCLEPIADACEÆ.

82. **Asclepias neglecta** Hemsley. Biol. Centr. Amer. Bot., II, 325.

Recorded from South Mexico by a number of botanists. The specimens collected in 1896 doubtfully referred to this species. Hills above Tlalpam portion of pedregal, Aug. 22 (194).

83. **Aselepias Linaria** Cav. Ic., I, 42, t. 57; Biol. Centr. Amer. Bot., II, 324; DC. Prodr., VIII, 570.

North and South Mexico. Pedregal, Aug. 20 (165).

84. **Philibertia elegans** Hemsl. Biol. Centr. Amer. Bot., II, 318.

Recorded from a number of localities in South Mexico. A climbing or trailing plant. Pedregal, Aug. 20 (188).

PLUMBAGINACEÆ.

85. **Plumbago pulchella** Boiss. in DC. Prodr., XII, 692; Biol. Cent. Am. Bot., II, 287.

From North to South Mexico. Used by the Mexican Indians to raise blisters, cure toothache and the running of the eyes (Materia Medica Mexicana, p. 79, fig.) "El Pañete"; "Jiricua"; "Tlepatli"; "Yerba del alacrán"; "Cola depescado"; "Cola de iguana"; "Yerba lumbre." Pedregal, Aug. 22 (213).

CONVOLVULACEÆ.

86. **Ipomoea longipedunculata** Hemsl. Biol. Centr. Amer. Bot., II, 389.

Pedregal, Aug. 20 (175).

VERBENACEÆ.

87. **Priva tuberosa** S. Wats. in Proc. Amer. Acad., XVIII (1883) 135.

Pedregal near Tlalpam, Aug. 22 (198).

LABIATÆ.

88. **Mentha rotundifolia** Huds. Fl. Angl. ed. I, 221; Biol. Cent. Am. Bot., II, 546.

Naturalized in some parts of Mexico. Found also in Europe, Asia, and Northern Africa. Pedregal, Aug. 22 (221a).

SOLANACEÆ.

89. **Nectouxia formosa** H. B. & K. Nov. Gen. et Sp., III, 10, t. 193; Biol. Centr. Amer. Bot., II, 425.

This herbaceous monotype has been collected in a number of places in Mexico. The fruit is eaten. Pedregal, Aug. 20.

90. Solanum bulbocastanum Dun. in Poir Encyc. Suppl., III, 749; Biol. Centr. Amer. Bot., II, 405.

Pedregal, Aug. 22 (209).

SCROPHULARIACEÆ.

91. Pedicularis Mexicana Zucc. ex Bunge in Bull. Phys. Math. Acad. Petersb., I, (1843) 384; Biol. Centr. Amer. Bot., II, 467.

Pedregal, Aug. 20 (184).

92. Lamourouxia rhinanthifolia H. B. & K. Nov. Gen. et Sp., II, 337, t. 169; Biol. Centr. Amer. Bot., II, 466.

Collected in quite a number of places through Mexico. Pedregal, Aug. 22 (193).

ACANTHACEÆ.

93. Calophanes decumbens A. Gr. Syn. Fl. N. Am., II, i, 325; Biol. Centr. Amer. Bot. II, 502.

From Texas, Arizona to the Valley of Mexico. Pedregal, Aug. 22 (200).

94. Ruellia sp.

On hills above pedregal near Tlalpam, Aug. 22 (205).

COMPOSITÆ.

95. Tagetes lucifer Cav. Ic., III, 33, t. 264; Biol. Centr. Amer. Bot., II, 222; DC. Prodr. V, 643; Bot. Mag., t. 740.

Extending from Texas through North to South Mexico. Collected by Bourgeau in pedregal. "Pericon." pedregal, Aug. 20 (192).

96. Dahlia coccinea Cav. Ic., III, 33, t. 266; Bot. Mag., t. 762; Biol. Centr. Amer. Bot., II, 196.

Collected by Bourgeau in the Valley of Mexico. This plant has a northerly and extensive distribution. "From the Cordilleras of Chihuahua, within 200 miles of the United States boundary, it ranges southward through the mountains to Jalisco and the Valley of Mexico. It shows a remarkable variation in color from cardinal of several shades, through scarlet, scarlet-orange, mandarin, orange, lemon-yellow, yellow. The so-called scarlet-orange rays are scarlet with lines of yellow running through, so that the strap-shaped corolla has a somewhat banded appearance. The ligulate corolla is about an inch long and half an inch broad. The entire head varies in size from two inches in the cardinal ones to three inches in the scarlet-orange." (See my article "The Native Dahlias of Mexico," Science n. s. VI, 909, Dec. 17, 1897).

Pedregal near Tlalpam, Aug. 20 (160).

97. Zinnia pauciflora Linn. Sp. Pl. ed. II, 1,269; Lam. Ill., t. 685, f. 1; Biol. Centr. Amer. Bot., II, 154; Amer. Acad. Arts & Sci., XXXII, 19.

Mexico, Andes of Peru, Bolivia, St. Thomas, W. I., and introduced into W. Africa and Cape Verde Islands. Pedregal, Aug. 20 (157).

98. Zexmenia aurea Benth & Hook, f. Gen., II, 371, in nota sub Wedelia; Biol. Centr. Amer. Bot., II, 172.

Pedregal, Aug. 22 (191).

99. Tagetes micrantha Cav. Ic., IV, 31, t. 352; DC. Prodr., V, 646; Biol. Centr. Amer. Bot., II, 222.

Recorded by a number of botanists from Arizona and Texas southward to Costa Rica. Pedregal, Aug. 22 (201).

100. Pectis prostrata Cav. Ic., IV, 12, t. 324; DC., Prodr., V, 100; Biol. Centr. Amer. Bot., II, 226.

Collected in Florida, New Mexico, Mexico, Colombia and the West Indies (Cuba). "Romero macho" (Cuba); Pedregal, Aug. 22 (210).

101. Stevia Eupatoria Willd. Sp. Pl., III, 1,775; Bot. Mag., t. 1,849; Biol. Centr. Amer. Bot., II, 86.

The specimens resemble *Stevia linoides* Schult. Bip., although the inflorescence is flatter and more compact. The plant is, therefore, doubtfully referred to the above named species; North and South Mexico. Pedregal, Aug. 22 (206).

101b. Senecio praecox DC., Prodr., VI, 431.

Senecio praecox is a composite plant inhabiting the volcanic beds in the Valley of Mexico. It has a cylindrical stem rising three or four feet from the ground with clustered, deeply lobed leaves at the top. The plant stores up an abundant supply of water in the pith, which is gradually used up during the dry season in Mexico, which lasts from October to June. The flowers develop in April at the expense of the reserved supply of water. Loss of water during the dry season is prevented by the fall of the leaves, and by the protective cork and balsam secreted in the exo- and endocortex. The water stored in the turgid discs of pith is gradually conducted by the woody cells and tracheids, which penetrate into the medulla by wedge shaped ingrowths, representing the primary bundles, to the growing point where it is used. That this is the case, is shown by the dry parchment-like pith membranes, which were left in a piece of a stem which had remained in the dry state for over sixteen months. Conduction of water in this stem was accomplished without the aid of root pressure, without any appreciable influence on the part of the small green leaves in drawing up the liquid by the pumping action of transpiration.[8]

Pedregal near Tlalpam, Aug. 22.

F. *Pedregal near Tizapan, Valley of Mexico.*

Tizapan is a suburban village of the City of Mexico, much higher in elevation above the floor of the valley than Tlalpam, which lies to the northwest of Tlalpam. The pedregal near Tizapan presents the same rugged characters as elsewhere. Along its edge, here, runs the small stream known as Rio Cherubusco. The region shows the same profusion of flowering plants as elsewhere in the pedregal.

FILICES.

102. Pellæa gracilis.

Pedregal, 7,500–8000 feet, Aug. 25 (334).

COMMELINACEÆ.

103. Tradescantia crassifolia Cav. Ic., I, 54, t. 75; Bot. Mag., t. 1,598; Biol. Centr. Amer. Bot., III, 391.

North and South Mexico, pedregal (Bourgeau). Pedregal, 7,500–8000 feet, Aug. 25 (227).

DIOSCOREACEÆ.

104. Dioscorea sp.

Pedregal, 7,500–7,800 feet, Aug. 25 (440).

PORTULACACEÆ.

105. Calandrinia grandiflora Lindl. Bot. Reg., t. 1,194.

Pedregal, 7,500–7,800 feet, Aug. 25 (337).

LEGUMINOSÆ.

106. Eysenhardtia amorphoides H. B. & K. Nov. Gen. et. Sp., VI, 489.

Pedregal, 7,500–7,800 feet, Aug. 25.

107. Zornia diphylla Pers. Syn., II, 318.

Pedregal, 7,500–7,800 feet, Aug. 25.

108. Cassia sp.

Pedregal, 7,500–7,800 feet, Aug. 25.

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[8] See abstract of paper Water Storage and Conduction in *Senecio praecox* from Mexico, read at Soc. Botanical Physiologists and Morphologists at Cornell University, in Bot. Gaz., Feb., 1898, p. 116, also Science, n. s., vii, p. 120.

109. **Indigofera** sp.

Pedregal, 7,500–7,800 feet, Aug. 25.

SAPINDACEÆ.

110. **Dodonæa viscosa** Jacq. Enum. Pl. Carib., 19; Linn. Mant., 228; Biol. Centr. Amer. Bot., I, 215.

Collected by Dr. José Ramirez on the pedregal at Eslava. A plant found in nearly all tropical, sub-tropical and south temperate regions throughout the world, and very common in Central America and Mexico. I doubtfully refer the plant collected to this species.

"Chapulistle;" "Limonillo." Pedregal, Aug. 25 (276).

SOLANACEÆ.

111. **Solanum nigrum** Linn. Sp. Pl., 186; DC. Prodr., XIII, i, 50; Biol. Centr. Amer. Bot., II, 412.

A common weed in nearly all tropical and temperate countries; but it is impossible to determine where it is really indigenous. Collected by Dr. José Ramirez at Eslava 8,725 feet. Tizapan pedregal, Aug. 25.

COMPOSITÆ.

112. **Dahlia coccinea** Cav. Ic., III, 33, t. 266.

Tizapan pedregal, 7,500–7,800 feet (228 a. See ante).

G. *Contreras.*

Contreras is a station on the Mexico, Cuernavaca and Pacific Railroad 17.5 miles from the City of Mexico. The following plants were collected while the train stopped.

PHYTOLACCACEÆ.

113. **Phytolacca octandra** Linn. Sp. Pl., ed. II, 631; DC. Prodr., XIII, ii, 32; Biol. Centr. Amer. Bot., III, 30.

South Mexico and southward to Peru and Uruguay, and in the West Indies. Aug. 18 (114).

SOLANACEÆ.

114. **Physalis pubescens** Linn. Sp. Pl., 183; Griseb. Fl. Br. W. Ind., 435; Biol. Centr. Amer., III, 420.

Generally dispersed in tropical America, Aug. 18 (113).

H. *Eslava.*

The Hacienda of Eslava and the village of that name are distant from the City of Mexico 19 miles. The pedregal, which here reaches its northern limit, is elevated 2,500–3,500 metres (8,000–11,800 feet). The flora presents a greater richness than lower down, the region being protected from the cold winds, which blow over the valley, by the forests of oak and pine and by the high hills to the west and north. It is, therefore, warmer.

CONIFERÆ.

115. Pinus leiophylla Schlecht & Cham. in Linnæa, VI, (1832), 354; Biol. Centr. Amer. Bot., , III 187.

Collected by a number of botanists in different parts of Mexico. Peak of Orizaba, 7–9,000 feet (Linden); Pedregal and Cañada de Tizapan (Christy). Called "Pino;" "Ocotechino" by the Mexicans. Eslava pedregal 8–10,000 feet, Aug. 31 (396).

AMARYLLIDACEÆ.

116. Agave megalacantha Hemsl. Diag. Pl. Nov. Mex., 3, 55; Tab. LXXXVIII, A.

Eslava pedregal, 9,000 feet, Aug. 31 (400). (Collected by Bourgeau here).

CUPULIFERÆ.

117. Quercus reticulata Humb. Bonpl. Fl. Æquin., II, 40, t. 86; Biol. Centr. Amer. Bot., III, 176.

Collected in several parts of South Mexico. Peak of Orizaba, 8,000 to 10,000 feet (Liebmann); San Angel (Bourgeau), etc.; Eslava pedregal, 8–10,000 feet, Aug. 31 (394).

LEGUMINOSÆ.

118. Lupinus sylvaticus Hemsl. Biol. Centr. Amer. Bot., I, 231.

North and South Mexico, Valley of Mexico, Desierto Viejo (Bourgeau). Eslava pedregal, 9,000 feet, Aug. 31.

RHAMNACEÆ.

119. Ceanothus azureus Desf. Tabl. ed. II, 232; Biol. Centr. Amer. Bot., I, 199; Bot. Reg., t. 291.

Recorded from a number of localities in Mexico, and collected by Dr. José Ramirez at Eslava, 8,830 feet; a very ornamental plant in flower. "Sayolistle;" "Cuaicuastle." Eslava pedregal, 10,000 feet, Aug. 31 (393).

OROBANCHACEÆ.

120. Conopholis Mexicana A. Gray ex S. Wats. in Proc. Amer. Acad., XVIII, (1882–83), 131.

Really not distinct from *C. Americana* Wallr., which ranges from New England to Michigan and Florida. Eslava pedregal, 9,000 feet; parasitic on roots of oak. Aug. 31.

RUBIACEÆ.

121. **Crusea brachyphylla** Cham. & Schlecht in Linnæa, V, (1830), 165; Biol. Centr. Amer. Bot., II, 57.

South Mexico, peak of Orizaba at 7,000 feet; Eslava pedregal, 8–10,000 feet, Aug. 31 (399).

COMPOSITÆ.

122. **Dahlia Merckii** Lehm. Delect. Sem. Hort. Hamb. (1839), ex Linnæa, XIV, (1840) 130; Biol. Centr. Amer. Bot., II, 197.

North Mexico, region of San Luis Potosi, 6,000 to 8,000 feet (Parry & Palmer); South Mexico, Real de Monte (Coulter), summit of a mountain near Guadalupe (Bourgeau). This dahlia is one of the showy species; the color of its flowers runs from purple to pure white through the gradual fading out of the purple color. One most commonly sees in a state of nature the white heads, which are tinted with lavender or pale purple at the base of the ray floret. The heads in each case are nearly uniform in size, being about an inch and three-fourths across. (See an article of mine, "The Native Dahlias of Mexico," Science n. s., VI, 910, Dec. 17, 1897).

Eslava pedregal, Aug. 31; 10,000 feet.

123. **Dahlia coccinea** Cav. Ic., III, 33, t. 266.

Eslava pedregal, 10,000 feet, Aug. 31; (see ante).

124. **Dahlia variabilis** Desf. Cat. Hort. Par., ed. III, 182.

This dahlia is confined to the region around, including the Valley of Mexico. It is a most striking plant, growing from 5 to 6 feet tall, and bearing flowers ranging in color from purple to sulphur-yellow through the following gradations: lavender-purple, heliotrope, heliotrope-yellow (various shades of lighter and lighter hue approaching yellow), sulphur-yellow. The heads in which the ray florets are colored heliotrope-yellow, are in reality of an heliotrope color, the bases of the ligulate corolla being of a yellow color, shading off into heliotrope. They are broad (1 inch), long (2 inches) and ovate spatulate. See "The Native Dahlias of Mexico," (Science n. s., VI, 909, Dec. 17, 1897).

Eslava pedregal, 10,000 feet, Aug. 31 (390).

125. **Cosmos** sp.

Eslava pedregal, 9,000 feet, Aug. 31 (384).

126. **Stevia nudiflora.**

Eslava pedregal, 9,000 feet, Aug. 31 (385).

127. Stevia sp.

Eslava pedregal, 9,000 feet, Aug. 31 (386).

I. *La Cima. Summit of Sierra del Ajusco.*

La Cima is an Indian town 38 miles from the city of Mexico on the crest or summit of the Sierra del Ajusco at about 11,000 feet above sea level. It is, therefore, about 2,000 feet lower than the Cerro Grande del Ajusco, or volcanic cone (13,612 feet). It was from this extinct crater, that the great pedregal of Tlalpam and many of the smaller pedregals were formed by lava flows in prehistoric times. The pedregal of La Cima is lower than the town, which consists of a few adobe huts. It presents the same rugged features, as those of the great lava bed between San Angel and Tlalpam, which has been already fully described. Most of the plants mentioned in the accompanying list are from the hill overlooking and directly above the town on the east side of the railroad. The soil of this hill is of a rich black character and is marked by many foot paths running in every direction.

CONIFERÆ.

128. Juniperus tetragona Schlecht in Linnæa, XII (1838) 195; DC. Prodr., XVI, ii, 491; Biol. Centr. Amer. Bot., III, 184.

Reported from North Mexico in the Sierra Madre to South Mexico and ascending on the peak of Orizaba to the limits of vegetation 12,000 to 14,000 feet. Pedregal, La Cima, Sierra del Ajusco, 11,000 feet, Aug. 18 (125).

129. Pinus Montezumæ Lamb. Gen. Pin. ed., I, iii, 149, t. 64; Biol. Centr. Amer. Bot., III, 188.

A plant of many synonyms; it stretches from North to South Mexico, extending to timber line on Orizaba, Popocatepetl and Iztaccihuatl, 10–14,000 feet. La Cima, Sierra del Ajusco, 11,000 feet, Aug. 18 (126).

LILIACEÆ.

130. Stenanthium frigidum Kunth. Enum., Pl. IV, 189 (1843); Biol. Centr. Amer. Bot., III, 381; Baker in Journ. Linn. Soc., XVII, 184.

South Mexico, peak of Orizaba 9,000 to 12,500 feet (Linden); Anganguio, 9,000 feet (Hartweg). Pedregal, La Cima, 10,000 feet, Aug. 18 (132).

131. Anthericum sp.

Sierra del Ajusco. A plant with fascicled roots for storage of food, an inch, or two long. Aug. 18 (143).

IRIDACEÆ.

132. **Sisyrinchium Schaffneri** S. Wats. in Proc. Amer. Acad., XVIII, (1883) 160.

Sierra del Ajusco, Aug. 18 (144).

ORCHIDACEÆ.

133. **Microstylis tenuis** Wats.

La Cima, pedregal, Aug. 18 (117 specimen lost).

134. **Spiranthes aurantiaca** Hemsl. Biol. Centr. Amer. Bot., III, 300.

Reported from several stations in South Mexico. The specimens here were collected by Mr. John MacGlashen assistant to Mr. Pringle. La Cima, pedregal, Sierra del Ajusco, Aug. 18 (116).

PIPERACEÆ.

135. **Peperomia umbilicata** Ruiz and Pav. Fl. Per., I, 30, t. 45, f. b.; Biol. Centr. Amer. Bot., III, 66.

North to South Mexico, Colombia and Bolivia. The small tubers are of a piquant flavor resembling the true pepper (pimienta); hence, "Pimienta de tierra." Sierra del Ajusco, 11,000 feet, Aug. 18 (145).

SAXIFRAGACEÆ.

136. **Ribes Jorullense** H. B. & K. Nov. Gen. et Sp., VI, 61; Biol. Centr. Amer. Bot., I, 386.

Emetic properties are attributed to the roots of this plant, called "Saracuacho" by the Mexicans. La Cima, pedregal, Aug. 18 (124).

137. **Ribes microphyllum** H. B. & K. Nov. Gen. et Sp., VI, 62; Biol. Centr. Amer. Bot., I, 386.

La Cima, pedregal, 11,000 feet, Aug. 18 (115).

ONAGRACEÆ.

138. **Oenothera sinuata** Linn. Mant., II, 228; Biol. Centr. Amer. Bot., I, 454.

From the United States southward through Mexico. Sierra del Ajusco, 10,000 feet, Aug. 18 (138).

UMBELLIFERÆ.

139. **Eryngium montanum** Coult. & Rose.

La Cima, pedregal, Aug. 18 (112).

CORNACEÆ.

140. **Garrya laurifiolia** Benth. Pl. Hartw., 14; Biol. Centr. Amer. Bot., I, 576.

Reported from a number of localities in North and South Mexico. A plant used medicinally. "El Cuauchichic;" "Chichicuahuitl." Sierra del Ajusco, Aug. 18 (147).

ERICACEÆ.

141. **Pernettya ciliaris** D. Don. ex. G. Don Gen. Syst., III, 837; Biol. Centr. Amer. Bot., II, 280.

A strong, low growing, woody shrub with ericaceous lanceolate leaves and red berries and strong root development. Said to be poisonous to sheep. La Cima, Sierra del Ajusco, Aug. 18 (133).

GENTIANACEÆ.

142. **Halenia parviflora** G. Don. Gen. Syst., IV, 177; Biol. Centr. Am. Bot., II, 352.

Distributed through Mexico to Colombia and Peru. La Cima, Sierra del Ajusco, Aug. 18 (137).

BORAGINACEÆ.

143. **Lithospermum angustifolium** Michx. Fl. Bor. Am., I, 130; Biol. Centr. Amer. Bot., II, 381.

Illinois to Wisconsin, southward to Texas and westward to Utah and Arizona, also in Mexico. La Cima, Sierra del Ajusco, Aug. 18 (136).

144. **Lithospermum distichum** Orteg. Hort. Matr., Dec. 8; Biol. Centr. Amer. Bot. II, 381.

South Mexico, peak of Orizaba, 11,000 to 12,000 feet (Galeotti). Sierra del Ajusco, Aug. 18 (146).

LABIATÆ.

145. **Salvia gleohomaefolia** H. B. & K. Nov. Gen. et Sp., II, 290, t. 141; Biol. Centr. Amer. Bot., II, 556.

South Mexico between Guanajuato and Santa Rosa at about 8,800 feet (Humb. & Bonpl.). Sierra del Ajusco, Aug. 18 (142).

SOLANACEÆ.

146. **Nectouxia formosa** H. B. & K. Nov. Gen. et Sp., III, 10, t. 193.

Reported from various parts of Mexico. La Cima, Sierra del Ajusco, 11,000 feet, Aug. 18 (110).

147. **Solanum tuberosum** Linn. Sp. Pl., 185; Biol. Centr. Amer. Bot., II, 416.

"The potato is wild in Mexico, but whether really indigenous it is impossible to say. It is probable that more than one species was concerned in the parentage of the cultivated varieties. On the other hand, several tuberiferous *Solani* described by various authors as distinct species differ less from each other than the more distinct of the cultivated varieties." These plants in such an unfrequented place as the pedregal on top of a high mountain are probably wild.

Ejemplar silvestre recogido de la montaña. This plant was one foot high with purple flowers. Pedregal, La Cima, 10,000 feet, Aug. 18 (131).

148. **Solanum tuberosum** Linn. var. **boreale** Gray.

Sierra del Ajusco, Aug. 18 (140).

SCROPHULARIACEÆ.

149. **Castilleja angustifolia** Mart. & Gal. in Bull. Acad. Brux., XII, ii, (1845) 29; Biol. Centr. Amer. Bot., II, 460.

Sierra del Ajusco, Aug. 18 (123A).

150. **Castilleja tenuiflora** Benth. Pl. Hartw., 22.

Pedregal, La Cima, Aug. 18 (123).

151. **Pentstemon barbatus** Roth. Catalect. fasc., III, 49; Nutt. Gen. Am., II, 53.

Pentstemon coccineus Engelm. in Wisliz.Tour. North. Mex., 107 (Sketch, 23).

Colorado, New Mexico, North and South Mexico. La Cima, Sierra del Ajusco, 10,000 feet, Aug. 18 (104).

152. **Pentstemon imberbis** Trautv. in Bull. Sc. Petersb. V, (1839) 345; Biol. Centr. Amer. Bot., II, 445.

Reported by a number of botanists in North and South Mexico. La Cima, Sierra del Ajusco, Aug. 18 (104a).

153. **Pedicularis Mexicana** Zucc. ex Bunge, in Bull. Phys. Math. Acad. Petersb., I, (1843) 384.

Pedregal, La Cima, 11,000 feet, Aug. 18 (111).

CAPRIFOLIACEÆ.

154. **Symphoricarpos microphyllus** H. B. & K. Nov. Gen. et Sp. III, 424; Biol. Centr. Amer. Bot., II, 4.

North Mexico, region of San Luis Potosi to South Mexico. Pedregal, La Cima, Sierra del Ajusco, Aug. 18 (122).

COMPOSITÆ.

155. **Stevia serrata** Cav. Ic., IV, 33, t. 355; Biol. Centr. Amer. Bot., II, 89.

North Mexico, region of San Luis Potosi; South Mexico, near Tacubaya (Bourgeau). La Cima, pedregal, Aug. 18 (127).

156. **Stevia linoides** Sch. Bip. in Linnæa, XXV, (1852) 284.

The specimens collected are doubtfully referred to this species. La Cima, Sierra del Ajusco, Aug. 18 (128).

157. **Senecio Sanguisorbæ** DC. Prodr., VI, 427; Biol. Centr. Amer. Bot., II, 247.

A plant ranging from San Luis Potosi in North Mexico to Real del Monte in South Mexico. La Cima, Sierra del Ajusco, Aug. 18 (139).

158. Dahlia Merckii Lehm. Delect. Sem. Hort. Hamb., 1839; ex Linnæa, XIV, (1840) Litt., 130.

La Cima, pedregal, Aug. 18 (118, see ante).

159. Gnaphalium Bourgovii A. Gray in Proc. Amer. Acad., XIX, (1883) 3.

The plant is questionably referred to this species. South Mexico. A plant resembling *G. cheiranthifolium* Lam. La Cima, in railroad cut below the town. Aug. 18 (121).

J. *Salazar and Sierra de las Cruces.*

A brief description of this region is given in the introductory geographical portion. The region is one of great exposure to trying and cold winds, we, therefore, find a more truely alpine flora than at La Cima, although the elevations are about the same. This accounts for the presence at Salazar of low, cespitose, or dwarfed species.

A ditch along the railroad before reaching Salazar afforded many interesting plants. Las Cruces Valley, the scene of the battle in 1810 between Hidalgo and the Spaniards resulting in a victory for the patriots, yielded a great variety of plants. The level of the mountain meadows composing the valley is about 10,000 feet altitude. Many cold springs, render the district fine botanizing ground.

FILICES.

160. Polypodium heteromorphum Hook. et Grev. Ic. Fil., t. 108; Biol. Centr. Amer. Bot. III, 660.

Sides of ditches, Salazar, Sierra de las Cruces. Extending from South Mexico to Colombia and Ecuador. Aug. 13 (59).

GRAMINEÆ.

161. Brachypodium Mexicanum Linn. Hort. Berol., I, 41; Biol. Centr. Amer. Bot., III, 584.

North Mexico, region of San Luis Potosi (Virlet D'Aoust); South Mexico, Chapultepec and Tacubaya (Schaffner); Chinantla, San Felipè, (Liebmann).

Salazar, 10,000 feet, Sierra de las Cruces, Aug. 13 (32).

ERIOCAULONACEÆ.

162. Eriocaulon sp.

Boggy places, Salazar, Sierra de las Cruces, 10,000 feet, Aug. 13 (50).

COMMELINACEÆ.

163. **Weldenia candida** Schult f. in Flora, XII, (1829) 3t., 1A.; C. B. Clarke in DC. Monogr. Phanerog., III, 319; Biol. Centr. Amer. Bot., III, 396.

South Mexico, between Chico and Real del Monte (Ehrenberg), Nevada de Toluca (Karwinski), Cuesta de Catinga (Schiede); Guatemala, Volcan de Agua at 14,000 feet (Hartweg). "Yerba de la rata." At base of *Abies religiosa*, Salazar, Sierra de las Cruces, 10,000 feet, Aug. 13 (13).

164. **Commelina** sp.

Salazar, 10,000 feet, Aug. 13 (17a).

165. **Tradescantia** sp.

Salazar, 10,000 feet, Aug. 13 (24).

IRIDACEÆ.

166. **Sisyrinchium Schaffneri** S. Wats. in Proc. Amer. Acad., XVIII, (1883), 160; Biol. Centr. Amer. Bot., III. 330.

North Mexico, region of San Luis Potosi, (Schaffner, Parry & Palmer). Salazar, Sierra de las Cruces, 10,000 feet, Aug. 13 (26).

URTICACEÆ.

167. **Urtica Breweri** S. Watson in Proc. Amer. Acad., X, (1875), 348.

Salazar, 10,000 feet, Aug. 13 (56).

PORTULACACEÆ.

168. **Claytonia perfoliata** Donn. Ind. Hort. Cant., 25, ex. Willd. Sp., Pl., I, 1,186; Bot. Mag., t. 1,336; Biol. Centr. Amer. Bot., I, 80.

Temperate North America to South Mexico. An annual succulent herb, serving for salad and also for spinach. The Indians of Mexico, eat it raw. "Qualite de venado." Salazar, Aug. 13 (55).

CARYOPHYLLACEÆ.

169. **Arenaria alsinoides** Willd. ex Schlecht in Ges. Naturf. Fr. Berl. Mag., VII, (1813), 201.

A. lanuginosa Rohrb. in Mart. Fl. Bras., XIV, ii, 274.

Common from North Carolina to Mexico, Central America, Peru and Bolivia also in the West Indies. Salazar, Aug. 13 (48).

170. **Arenaria decussata** Willd. ex Schlecht in Ges. Naturf. Fr. Berl. Mag., VII, (1813), 212; Biol. Centr. Amer. Bot., I, 70.

A dwarf alpine plant collected at Salazar, 1–2 inches high. North to South Mexico. Salazar, Aug. 13 (27).

171. **Cerastium viscosum** Linn. Sp. Pl. 437.

C. glomeratum Thuill, Fl. Par. ed., II, 226.

Salazar, 10,000 feet, Aug. 13 (16).

RANUNCULACEÆ.

172. Thalictrum strigillosum Hemsl. Diagn. Pl., Nov. 1; Biol. Cent. Am. Bot., I, 4.

T. Hernandezii Tausch in Presl. Rel. Hænk., II, 69.

South Mexico, rare in ravines among bushes (Schaffner), Tizapan, Valley of Mexico (Bourgeau), Zimapan (Coulter), mountains around Mitla, Oaxaca (Andrieux), between San Miguel and La Jaya (Schiede). The specimens collected by me are doubtfully referred to this species. A plant which is used as a diuretic and for kidney complaints. "El Cozticpatli." Salazar, Aug. 13 (76).

173. Ranunculus stoloniferus Hemsl. Diagn. Pl., Nov. 17; Biol. Centr. Amer. Bot., I, 8.

North to South Mexico. Salazar, 10,000 feet, Aug. 13 (11).

174. Ranunculus dichotomus Moc. & Sessé ex DC. Syst., I, 288; Biol. Centr. Amer. Bot., I, 6.

R. orthorynchus Hook. Fl. Bor. Am., I, 21, t. 9.

Recorded from a number of localities throughout Mexico. Salazar, 10,000 feet, Aug. 13 (54).

CRASSULACEÆ.

175. Sedum Moranense H. B. K. Nov. Gen. et Sp., VI, 44; Biol. Centr. Amer. Bot., I, 397.

"Siempreviva." Salazar, 10,000 feet, Aug. 13 (57).

ROSACEÆ.

176. Potentilla candicans Humb. & Bonpl. var. **nana** Nutt.

A plant confined to South Mexico. Its woody roots contain tannin. The plant contributes in a great part to the turf of the region. An alpine xerophyte. Salazar, 10,000 feet, Aug. 13 (72).

177. Fragaria Mexicana Schlecht in Linnæa, XIII, (1839), 265; Biol. Centr. Amer. Bot., I, 375.

F. vesca Linn. Sp. Pl., 494.

A strawberry distributed from North Mexico, where it is common in the Sierra Madre to South Mexico. Salazar, Aug. 12 (12).

LEGUMINOSÆ.

178. Trifolium Schiedeanum S. Wats. in Proc. Am. Acad., XVII, (1882), 339; Biol. Centr. Amer. Bot., IV, 25.

Distributed from North to South Mexico. Salazar, 10,000 feet, Aug. 13 (64).

179. **Trifolium involucratum** Ortega. Hort. Matr., Dec. 33; Willd. Sp. Pl., III, 1,372; Biol. Centr. Amer. Bot., I, 232.

A plant found in California, Colorado, New Mexico, extending to South Mexico. Salazar, 10,000 feet, Aug. 13 (70).

180. **Astragalus didymocarpus** Hook. Arn. Bot. Beech. Voy., 334.

Salazar, 10,000 feet, Aug. 31 (44).

181. **Astragalus reptans** Willd. Hort. Ber., II, 88, t. 88; Biol. Cent. Am. Bot., I, 266.

South Mexico, Tacubaya, Valley of Mexico (Bourgeau); Chapultepec (Bilimek). Salazar, Sierra de las Cruces, 11,000 feet, Aug. 13 (20).

GERANIACEÆ.

182. **Geranium** sp.

Salazar, 10,000 feet, Aug. 13 (65).

183. **Erodium cicutarium** L'Herit. ex Ait. Hort. Kew. ed., I, ii, 414; Biol. Centr. Amer. Bot., I, 161.

A plant widely dispersed in the north temperate regions of the Old World, and now exceedingly common in many parts of North America, but supposed to have been originally introduced by the Spaniards. Used as a fodder plant in Europe. Extends from North to South Mexico.

"Alfilaria"; "Storksbill"; "Pinclover"; "Pingrass"; "Pinweed"; "Filaria" "Filaree"; "Alfilarilla." Salazar, 10,000 feet, Aug. 13 (14).

184. **Oxalis violacea** Linn. Sp. Pl., 434.

Salazar, 10,000 feet, Aug. 13 (69).

185. **Oxalis corniculata** Linn. var. **repens** n. var. probably *O. repens* Thunb., Diss. Oxal., 16: Prod. Pl. Cap., 82.

This plant is found in nearly all (except the colder) parts of the world, varying very much. North Mexico to South Mexico, Guatemala and Nicaragua. Salazar, Aug. 13 (18).

LINACEÆ.

186. **Linum Mexicanum** H. B. & K. Nov. Gen. et Sp., VI, 39; Bot. Reg., t. 1,326; Biol. Centr. Amer. Bot., I, 143.

Abundant in South Mexico. Salazar, 10,000 feet, Aug. 13 (63).

EUPHORBIACEÆ.

187. **Euphorbia campestris** Cham. & Schlecht in Linnæa, V, (1830), 84; Biol. Centr. Amer. Bot., III, 92.

Collected by a number of botanists in South Mexico. Salazar, Aug. 13 (35).

VIOLACEÆ.

188. Viola Grahami Benth. Pl. Hartw., 35; Biol. Centr. Amer. Bot., 1, 50.

North and South Mexico. Salazar, Aug. 13 (8, 15).

189. Viola flagelliformis Hemsl. Diagn. Pl., Nov. 20; Biol. Cent. Am. Bot., I, 50.

Salazar, 10,000 feet, Aug. 13 (15a).

ONAGRACEÆ.

190. Epilobium Bonplandianum H. B. & K. Nov. Gen. et Sp., VI, 95.

Salazar, Sierra de las Cruces, Aug. 13 (38).

191. Fuchsia microphylla H. B. & K. Nov. Gen. et Sp., VI, 103, Biol. Centr. Amer. Bot., I, 458.

Abundant in South Mexico. Growing along irrigating ditches, 11,000 feet. Salazar, Aug. 13 (30).

UMBELLIFERÆ.

192. Angelica Pringlei Coulter & Rose.

Salazar, Sierra de las Cruces, 10,000 feet, Aug. 13 (45).

193. Eryngium ranunculoides Benth. Pl. Hartw., 38; Biol. Cent. Am. Bot., I, 562.

South Mexico in mountain pastures, Aganguio (Hartweg). Salazar, in mountain meadows, 10,000 feet, Aug. 13 (50a).

194. Eryngium dilatatum Lam. Encyc., IV, 755.

Salazar, 10,000 feet, Aug. 13 (50).

ERICACEÆ.

195. Pyrola secunda Linn. Sp. Pl., 396; Biol. Centr. Amer. Bot., II, 283.

South Mexico, peak of Orizaba, 8,000 to 10,000 feet (Liebmann), Desierto Viejo, Valley of Mexico (Bourgeau). Salazar, 10,000 feet, Aug. 13 (34).

LOGANIACEÆ.

196. Buddleia Humboldtiana Rœm. & Schult. Syst., III, 93; Biol. Centr. Amer. Bot., II, 341.

From Southwest Texas and Southern New Mexico to Oaxaca. "En las cañadas y al margen de los arroyos. Se usa como forraje para las reses" (Ramirez). Salazar on mountain sides, 11,000 feet, Aug. 13 (29).

ASCLEPIADACEÆ.

197. Asclepias sp.

Salazar, Sierra de las Cruces, Aug. 13 (46).

LABIATÆ.

198. Salvia fulgens Cav. Ic., I, 15, t. 23; Biol. Centr. Amer. Bot., II, 556; DC. Prodr., XII, 333.

South Mexico. Salazar, 10,000 feet, Aug. 13 (62).

199. Salvia nana H. B. & K. Nov. Gen. et Sp., II, 289; Biol. Centr. Amer. Bot., II, 561; DC. Prodr., XII, 304.

North Mexico to Guatemala. Doubtfully referred to this. Salazar, 10,000 feet, Aug. 13 (71).

200. Stachys coccinea Jacq. Hort. Schœnb., III, 18, t. 284; Biol. Centr. Amer. Bot., II, 571.

Texas to Arizona, North Mexico to Guatemala (Volcan de Fuego, 7,000 feet). Salazar, 10,000 feet, Aug. 13 (42).

201. Stachys repens Mart. & Gal. in Bull. Acad. Brux., XI, ii, (1844), 194; Biol. Centr. Amer. Bot., II, 573; DC. Prodr., XII, 479.

South Mexico, Peak of Orizaba, 9,500 to 11,000 feet (Galeotti, Linden); Desierto Viejo (Bourgeau). Salazar, Sierra de las Cruces, Aug. 13 (43).

202. Prunella vulgaris Linn. Sp. Pl., 600; DC. Prodr., XII, 410; Biol. Centr. Amer. Bot., II, 570.

This species is spread over the whole range of the genus in Europe, Asia, America and Australia. Salazar, 10,000 feet, Aug. 13 (25).

SOLANACEÆ.

203. Physalis lobata Torr. in Ann. Lyc. N. York, II, (1826), 226. A. Gray, Synop. Fl. N. Am., II, 233; Biol. Centr. Amer. Bot., IV, 75.

Colorado, Arizona, Texas—North Mexico, mountains west of Saltillo, Coahuila (Palmer). My specimen is doubtfully referred to this species. Salazar, 10,000 feet, Aug. 13 (51).

204. Solanum tuberosum Linn. Sp. Pl., 185.

Salazar, away from highway and railroad along an irrigating ditch. 10,000 feet, Aug. 13 (53). (A plant 18 inches high, rough hispid with deep purple flowers, No. 61).

SCROPHULARIACEÆ.

205. Sibthorpia Pitchinchensis H. B. & K. Nov. Gen. et Sp., II, 390, t. 175; Biol. Centr. Amer. Bot., II, 454.

South Mexico, Vera Cruz to Orizaba (Müller), Zimapan (Coulter), Valley of Mexico (Bourgeau), peak of Orizaba, 9,000 to 12,000 feet (Galeotti, Linden), Cordillera of Oaxaca at 9,000 feet (Galeotti). Colombia to Peru, Bolivia and Argentina. Salazar, Sierra de las Cruces, 10,000 feet, Aug. 13 (47).

206. Castilleja tenuiflora Benth. Pl. Hartw., 22; Biol. Centr. Amer. Bot., II, 463.

Salazar, 10,000 feet, Aug. 13 (68).

207. Castilleja Schaffneri Hemsl. Biol. Centr. Amer. Bot., II, 462, tab. LXIII, B., figs. 7–13.

A small alpine plant 2 inches high. Salazar, 10,000 feet, Aug. 13 (17).

208. Mimulus luteus Linn. Sp. Pl., ed. II, 884; DC. Prodr., X, 370; Bot. Mag., t. 150, 3,336, 3,363; Biol. Centr. Amer. Bot., II, 449.

A variable species common in Western America, from the Aleutian Islands and Alaska, through Mexico and along the Andes to South Chili. Also naturalized in some parts of the Old World (Hemsley). Salazar, Sierra de las Cruces, 10,000 feet, Aug. 13 (65a).

209. Pentstemon campanulatus Willd. Sp. Pl., III, 228; DC. Prodr., X, 326; Biol. Centr. Amer. Bot., II, 444; Bot. Mag., t. 1,878 ett. 3,884.

South Mexico, very common. Salazar, Sierra de las Cruces. In fir forests at about 10,000 feet, Aug. 13 (31).

PLANTAGINACEÆ.

210. Plantago Patagonica Jacq. Ic. Pl. Rar., II, 9, t. 306; Coll. Suppl., 35.

The specimens collected are doubtfully referred to this species. They may be *P. Mexicana* Link. (Enum. Hort. Berol., I, 121). Salazar, 10,000 feet, Aug. 13 (9).

211. Plantago hirtella H. B. & K. Nov. Gen. et Sp., II, 229, t. 127. A. Gr., Synop. Fl. N. Am., II, 392; Biol. Centr. Amer. Bot., II, 575.

Salazar, Sierra de las Cruces, 10,000 feet, Aug. 13 (40).

RUBIACEÆ.

212. Houstonia Palmeri A. Gray. Proc. Amer. Acad., XVII, (1881–'82), 202; Biol. Centr. Amer. Bot., IV, 47.

A small alpine plant. Salazar, 11,000 feet, Aug. 13 (23).

LOBELIACEÆ.

213. Lobelia nana H. B. & K. Nov. Gen. et Sp., III, 317, t. 272; DC. Prodr., VII, 379; Biol. Centr. Amer. Bot., II, 268.

South Mexico, near Real del Monte and Moran, at about 8,000 feet (Humboldt & Bonpland), Vera Cruz to Orizaba (Muller), peak of Orizaba, 11,000 to 12,500 feet (Linden). A small plant, alpine in habit. Salazar, Sierra de las Cruces, 10,000 feet, Aug. 13 (23).

214. Lobelia fulgens Willd. Hort. Berol., t. 85.

Salazar, Aug. 13. Collected also at Lake Xochimilcho (ante). (77).

COMPOSITÆ.

215. Gnaphalium purpureum Linn. Sp. Pl., 854.

Salazar, Sierra de las Cruces, 10,000 feet, Aug. 13 (6).

216. Eupatorium Popocatepetlense Schlecht. ex Hemsl. Biol. Centr. Am. Bot., II, 99 nomen.

North Mexico, region of San Luis Potosi, 6,000 to 8,000 feet (Parry & Palmer); South Mexico, Chiápas (Ghiesbreght). Salazar, 10,000 feet, Aug. 13 (31).

217. Eupatorium pycnocephalum Less. in Linnæa, VI, (1831), 404.

Salazar, 10,000 feet, Aug. 13 (39).

218. Senecio (Cacalia) silphifolia n. sp.

A plant resembling greatly in habit our western American Compass-plant *Silphium laciniatum* with large leaves which stand vertically at various angles. The plant bears an upright corymb of flowers. Named here tentatively, because, it has been probably named and distributed with Pringle's plants of 1896. Salazar, 10,500 feet in meadows, Aug. 13 (28).

Orizaba and Cordoba.

Orizaba (4,000 feet) and Cordoba (2,700 feet) on the line of the Mexican Railroad (Ferro-Carril Mexicano) can be treated of together. Orizaba is a town of 15,000 inhabitants, 82 miles from Vera Cruz and 181 miles from the City of Mexico. The town lies in a little valley surrounded by very fine mountains. The peak of Orizaba, however, cannot be seen, save a tiny strip of glittering white over the crest of the Cerro de la Escamela. The other surrounding hills are: the Barrego; the Ranchito de Cristo; Jalapilla; San Juan del Rio; the Rincon Grande; and La Perla. The town is composed, for the most part, of low houses with red-tiled roofs; it is crossed by two small streams, and by the little river Orizaba (through a rocky ravine filled with tropical plants), all of which unite near by in the River Blanco, which plunges over a precipice in a cascade in the Rincon Grande. The valley alone was explored botanically during the short time at the disposal of the writer. The several ravines were followed through the town to the outskirts, when circling the town, the fields and copses and woods were investigated for the plants that might be in flower. Most of the larger trees were found to be loaded down with epiphytes, orchids, tillandsias, and mistletoe with several ferns. To one who for the first time visits a tropical country, the very wealth of the material completely nonplusses him for a time. The region abounds in orchids. Only the smaller forms were collected although many fine large ones were seen. A botanist is at once impressed with the luxuriance of the epiphytic growths. A hasty visit was also paid to the Rincon Grande, where a number of plants were collected within the influence of the spray of the water-fall.

Only two hours were spent at Cordoba, between trains, so that only a most hasty and superficial collection of plants was made of the flora of this most interesting tropical region.

FILICES.

219. **Adiantum Capillus-Veneris** Linn. Hook. Sp. Fil., II, 36; Biol. Centr. Amer. Bot., III, 607.

A plant very widely diffused in temperate regions, throughout the world including the mountains of Mexico, where it occurs up to an altitude of 10,000 feet on the peak of Orizaba. Orizaba, Aug. 27 (363).

220. **Polypodium aureum** Linn. Hook. Sp. Fil. V, 16; Biol. Centr. Amer. Bot., III, 655.

A fern extending from Florida southward in Mexico to Brazil. The specimens collected by me were found in the forks of trees. Orizaba, Aug. 27 (369).

221. **Nephrolepis cordifolia** Presl. Hook. et Bak. Syn. Fil., 300; Biol. Centr. Amer. Bot., III, 652.

South Mexico to Brazil and Peru, also in Cuba. Orizaba, Aug. 27 (356).

LILIACEÆ.

222. **Schoenocaulon officinale** A. Gray in Benth. Pl. Hartw., 29; Biol. Centr. Amer. Bot., III, 383.

South Mexico to Guatemala and Venezuela. Slopes of El Borrego, abundant. Orizaba, Aug. 27 (4,500 feet), (349).

ORCHIDACEÆ.

223. **Cypripedium irapeanum** La Llave Lex. Nov. Veg. Desc. fasc., II (Orch. Opusc.) 10; Biol. Centr. Amer. Bot., III, 307.

C. molle Lindl. in Benth., Pl. Hartw., 72.

South Mexico to Guatemala. Slopes of hills near waterfall in Rincon Grande. Orizaba, Aug. 27; flowers yellow, (328).

224. **Epidendrum virens** Lindl. & Paxt. Flow. Gard., I, (1850-51), 152; Biol. Centr. Amer. Bot., III, 242.

The living specimens collected and brought home, I doubtfully refer them to this species. Orizaba, Aug. 27 (394).

PIPERACEÆ.

225. **Piper umbellatum** Linn. Sp. Pl., 30; Biol. Centr. Amer. Bot., III, 56.

South Mexico, southward to Peru and Brazil, also in West Indies. Cordoba, Aug. 26 (346).

226. **Piper** sp.

Orizaba, Aug. 27 (371).

CARYOPHYLLACEÆ.

227. **Silene Armeria** Linn. Sp. Pl., 420.

Orizaba, Aug. 27 (366).

ANONACEÆ.

228. **Anona Cherimolia** Miller Gard. Dict. ed. VIII, n. 5; Biol. Centr. Amer. Bot., I, 18; Bot. Mag., t. 2,011.

Extending from South Mexico to Ecuador and Peru; widely spread in Tropical America. Naturalized in some of the West Indian Islands according to Grisebach.

"One of the 'Custard Apples.' This shrub or tree might be tried in frostless forest valleys where the humidity and rich soil will prove favorable to its growth. It is hardy in the wildest coast regions of Spain, also in Chili. In Jamaica it is cultivated up to 5,000 feet." (Mueller). Orizaba, Aug. 27 (380).

LEGUMINOSÆ.

229. **Mimosa albida** H. & B. in Willd. Spec., IV, 1,030.

Cordoba, Aug. 26 (350). "Sensitive Plant."

MALVACEÆ.

230. **Malvaviscus arboreus** Cav. Diss., III, t. 48; Biol. Centr. Amer. Bot., I, 118.

North Mexico to Guatemala, Panama; also common in the West Indies including Cuba. Orizaba, Aug. 27 (362).

CACTACEÆ.

231. **Cereus triangularis** Mill. Gard. Dict. ed. VIII, n. 9; Bot. Mag., t. 1,834; Biol. Centr. Amer. Bot., I, 547.

Orizaba, Aug. 27.

232. Phyllocactus grandis Lem. in Fl. des Serres, III, (1847), 255, verso.

Mexico, region of Orizaba, Honduras. Orizaba in Rincon Grande, Aug. 27 (373).

MYRTACEÆ.

233. Psidium Guajava Linn. Sp. Pl., 470; Biol. Centr. Amer. Bot., I, 406.

From the West Indies and Mexico to South Brazil. "This handsome evergreen and useful bush should engage universal attention anywhere in warm lowlands, for the sake of its aromatic wholesome berries, which attain the size of a hen's egg, and can be converted into a delicious jelly. The pulp is generally cream colored or reddish, but varies in the many varieties which have arisen in culture, some of them bearing all the year round. Propagation is easy from suckers, cuttings or seeds. This big shrub is easily held under control in extra-tropic countries, but in the warmest and moistest tropical regions it may become irrepressible, as it spreads readily from suckers, and gets disseminated by birds and cattle easily." (Mueller). Orizaba, Aug. 27 (367).

ARALIACEÆ.

234. Dendropanax arboreum Decne. & Planch, Rev. Hort., ser. IV, iii (1854), 107.

This species has a wide range in the West Indies and tropical South America. "Vibona," (Cuba). Orizaba, Aug. 27 (353).

ASCLEPIADACEÆ.

235. Gonolobus erianthus Decne. in DC. Prodr., VIII, 592; Biol. Centr. Amer. Bot., II, 331.

The specimens collected by me are more hairy than those distributed by Pringle. It is possible that they are to be referred to *G. atratus* Gray with broader leaves, but the same pubescence. South Mexico to Guatemala. Orizaba, Aug. 27 (364).

VERBENACEÆ.

236. Duranta Plumieri Jacq. Select. Am., 186, t. 176, f. 76; Biol. Centr. Amer. Bot., II, 538.

A shrub 8 to 12 feet high in rough rocky woods, not uncommon from Florida through South Mexico to Peru, Brazil and in the West Indies. "Violetina" (Cuba). Orizaba, Aug. 27 (352).

237. Lantana camara Linn. Sp. Pl., 874; DC. Prodr., XI, 598; Biol. Centr. Amer. Bot., II, 527.

Georgia, Florida, Texas, Mexico, and generally dispersed in tropical South America and West Indies. "Filigrana" (Cuba). Orizaba, Aug. 27 (358).

CUCURBITACEÆ.

238. Sechium edule Swartz. Fl. Ind. Occ., II, 1,150; Biol. Centr. Amer. Bot., I, 491.

"The large, starchy root of this climber can be consumed as a culinary vegetable, while the good-sized fruits are also edible. The fruit often germinates before it drops. The plant bears, even in the first year, and may ripen one hundred fruits a year. Cultivated up to 5,000 feet in Jamaica" (Mueller).

South Mexico, Santa Anita near Mexico (Bourgeau), Orizaba (Botteri), valley of Cordova (Bourgeau); Panama, without locality (Seemann); West Indies and Tropical South America. "Chow-Chow" (Jamaica); "Chocho," "Chayota" (Mexico).

COMPOSITÆ.

239. Senecio grandifolius Less. in Linnaea, V, (1830), 162; Biol. Centr. Amer. Bot., II, 240.

South Mexico, region of Orizaba (Botteri, Bourgeau), valley of Cordova (Bourgeau), Montecinos, Vera Cruz (Linden).

Orizaba, Aug. 26th (360).

ADDENDA

(with families omitted).

240. Thalia dealbata Fras. Thal. dealbata, t. I; Bot. Mag., t. 1,690; Biol. Centr. Amer. Bot., III, 310.

Along ditches of Mexican Central R. R., near Guadalajara.

241. Nymphaea gracilis Zucc. in Abh. Akad. Muench., I (1832), 362; Biol. Centr. Amer. Bot., I, 25.

"A Mexican species of great merit, has large, handsome, star-shaped white flowers, which are borne on stout stems well above the foliage. It is worthy of note as being the only white day-blooming tropical or tender species; a very vigorous plant, free-flowering, the flowers possessing a delicate fragrance, resembling Lily of the Valley" (1897), Tricker, The Water Garden, p. 90, fig. on p. 91 and pl. III. South Mexico, lakes near Oaxaca, 5,000 feet (Galeotti), Mexico (Karwinski), ditches at Tacubaya, Valley of Mexico (Bourgeau), Aguas Calientes (Hartweg).

In ponds along Mexican Central R. R. near Guadalajara.

242. Talinum Greenmanii Harshberger in Bull. Torrey Bot. Club, XXIV, 183, Apr. 24, 1897, Plate 299, Fig. 4.

Volcanic gravel, Sierra del Ajusco, Mexico, 8,500 feet. Possibly it is *T. humile* described by E. L. Greene. Pringle *Plantæ mexicanæ,* No. 6,472. Named in honor of Jesse Moore Greenman, of the Gray Herbarium, Cambridge, Mass.

243. Agave Americana Linn. Sp. Pl., 323.

A plant extensively cultivated throughout Mexico for its fibre and for the juice which yields, upon fermentation, the national beverage, pulqué.

244. Taxodium mucronatum Tenore in Ann. Sc. Nat. sér. III, xix, (1853), 355.

A tree found reaching gigantic girth in several parts of Mexico. The grove of Mexican cypresses below the Castle of Chapultepec being noted for the size of the individual species composing it. Two notable trees are found in it, one 19½ feet in diameter, the other, the tree of Montezuma, 14 feet in diameter. Another gigantic specimen is found at Tule on the road from Oaxaca to Guatemala, circumference, five feet from ground, 146 feet; longest diameter, 40 feet; shortest diameter of the trunk, 20 feet. This tree was also met with at Las Canoas on the Tampico branch of the Mexican Central Railroad. "Ahuehuete."

245. Zea Mays Linn. × **Euchlaena Mexicana** Schrad. *Zea Mays* Linn., Sp., pl. 971. *Euchlaena Mexicana* Schrad. Ind. Sem. Hort. Gotting (1832).—Cf. Linnaea viii (1833) Litt. 25.

The hybrids of these two plants throw considerable light upon the origin of our cultivated maize. I would refer the student to several papers upon this subject by the writer, as follows:

1. Maize: A Botanical and Economic Study. Contrib. Botan. Lab. University of Penna., I, pp. 75–202, with 4 plates. A Spanish translation of the entire paper appeared in Mexico, entitled "El Maiz: Estudio Botánico y Económico" (1894), pp. 164.
2. Fertile Crosses of Teosinthe and Maize. Garden and Forest, IX, p. 522.
3. Notes on the Hybrid of Maize and Teosinthe. Garden and Forest, X, p. 48.
4. The Uses of Plants Among the Ancient Peruvians. Bull. of the Museum of Science and Art, University of Penna., I.

FOSSIL MOLLUSKS AND DIATOMS FROM THE DISMAL SWAMP, VIRGINIA AND NORTH CAROLINA; INDICATION OF THE GEOLOGICAL AGE OF THE DEPOSIT.

BY LEWIS WOOLMAN.

WITH NOTES ON THE DIATOMS.

BY CHARLES S. BOYER.

During the winter of 1897–98 the Dismal Swamp Canal was widened and deepened, and the level of the central portion lowered so as to dispense with the middle two of the four locks heretofore in use. The work was done by the McManus Construction Company of Philadelphia, steam rotary dredging machines being used in excavating. These dredges brought up from the bottom, at points both south and north of the Virginia-North Carolina boundary, large numbers of marine mollusks. Through the appreciative interest in scientific matters of M. Homer, Secretary and Treasurer of the Construction Company, we have been furnished on three occasions with specimens of these shells, which he specially and personally collected on his visits to the field of operations.

It is the purpose of this paper to put on record the species of these shells and also of the marine diatoms which were associated with them in the same matrix, and to indicate, though perhaps tentatively, from a study of both the macroscopic and microscopic fossils, the geological age of the bed from which they were obtained.

The Dismal Swamp Canal connects on the south at a point near South Mills, N. C., with the headwaters of the Pasquotank River, a tributary of Albemarle Sound, and on the north at a point near Deep Creek with the waters of the south branch of the Elizabeth River, a tributary of the James River and the Chesapeake Bay. The general direction of the canal between these two points is northward, with, however, a decidedly obtuse angled bend, or bow, to the westward, the angle being near Drummond Lake, from which a feeder canal brings the water from the lake into the main canal. This feeder was also deepened.

M. Homer states that the shells furnished by him were obtained from the following localities:—

1st.—A point on the main canal in North Carolina, two to three miles south of the Virginia boundary.

2d.—A point on the main canal in Virginia, about five miles north of the feeder, or four miles north of Wallaceton, a small Post Office and settlement on drained land near the centre of the swamp.

3d.—A point about midway of the feeder, say one and one-half miles west of its junction with the main canal.

A noticeable peculiarity, as stated by M. Homer, is that the collections from the main canal, from both the Virginia and North Carolina localities, contain great numbers of the large conch, *Fulgur carica*, while this shell is wanting in those thrown out from the feeder. Here, however, the oysters, *Ostrea virginica*, are exceedingly numerous, and many of them are of extra large size, one specimen in the possession of M. Homer measuring ten inches in length and four and one-half inches in width.

But few specimens, comprising only three species, were brought from the locality south of the Virginia-North Carolina line. M. Homer, however, states that the shells seemed as varied in form and as plentiful there as north of Wallaceton.

In one lump of clay matrix, about the size of a walnut, obtained from the bottom of the dredgings north of Wallaceton, we discovered, on a preliminary microscopic examination, a very few diatoms, and a few, though perhaps a slightly larger number of sponge spicules. A separation and cleaning of the diatoms from this lump of clay was made by a fellow member of the Academy, John A. Shulze, after which the forms were identified by another member, Prof. C. S. Boyer. The mollusks were jointly identified by Prof. H. A. Pilsbry of the Conchological Section of the Academy and C. W. Johnston, Curator of the Wagner Free Institute of Science.

Below we tabulate the mollusks according to their range in geological time into three columns headed Miocene (M), Pliocene (P) and Recent (R)—under Recent are included both Pleistocene and now living forms. On the right, in two additional columns, we note the occurrence of such of the forms as have been found in the Croatan, N. C., and the Waccamaw, S. C., beds, both of which contain a somewhat similar molluscan fauna.

The geological range, as noted in the first three columns, we take from Dr. W. H. Dall's "Tables of Species" from the Waccamaw and the Croatan beds.[1]

[1] Transactions of the Wagner Free Institute of Science, Vol. III, Part 2, pages 210 to 215.

The Croatan beds are in North Carolina, about 120 miles slightly west of south of the Dismal Swamp, and about eighteen miles from the nearest point on the coast. They are on the northern border of a similar swamp area on the southern side of the Neuse River, and are about fifteen miles below Newbern. Both the Croatan and the Dismal Swamp shell localities are approximately 75 or 80 miles eastward of the rocks of the Piedmont plateau, which rocks bound the inland border of the less consolidated beds of the Atlantic Coastal plain. The two localities occupy a similar position both geographically and stratigraphically.

The Waccamaw beds are in the extreme eastern part of the State of South Carolina, and are exposed along the banks of the Waccamaw River from some four miles, to about 18 miles above Conway. They are on low ground, and are also on the western side of another of the swamp areas that occur on the seaward margin of the coastal plain from Cape May County, N. J., to South Carolina and Georgia. Geographically, they are similarly situated to the Croatan and the Dismal Swamp localities.

Fossil mollusks from the Croatan and the Waccamaw localities have been carefully studied and listed by Dr. W. H. Dall, who refers both beds to the Pliocene. The fauna, however, when considered with reference to the percentage of recent over extinct forms, would indicate that the Croatan beds were slightly the younger of the two deposits, there being, according to Dr. Dall, 83 per cent. of recent forms in the Croatan and only 70 per cent. in the Waccamaw beds. In summing up, Dr. Dall says "the Croatan beds are obviously newer than those of the Waccamaw, yet when compared with the admitted Pleistocene beds of South Carolina such as those of Simmons Bluff, the presence on the Neuse" [the locality of the Croatan beds] "of 41 out of 90 species, which have not been known later than the Pliocene, forbids us to regard the fauna as later than Pliocene."

In the study of the mollusks from the Dismal Swamp Canal the writer has had the advantage of some correspondence with Dr. W. H. Dall and of consultation with Prof. H. A. Pilsbry and C. W. Johnson, the latter of whom has collected a full series of shells from the Croatan beds, and a like series from the Waccamaw beds, both of which collections are now displayed in the Museum of the Wagner Free Institute of Science of Philadelphia, and with which the shells from the Dismal Swamp have been carefully compared.

The three species previousiy noted as having been collected from the bottom of the old south level near South Mills, N. C., were *Urosalpinx cinerea*, *Fulgur carica* and *Ostrea virginica*—the elevation of the surface at this point being about 11 feet.

All the forms, however, listed below, excepting *Urosalpinx cinerea* Say, were obtained from a locality along the Deep Creek level of the Old Canal, at a point four miles north of Wallaceton, Va., and from a depth of about ten feet, the elevation of the surface being about sixteen feet. The Deep Creek level is next north of the summit level of the old canal, the latter having an elevation of about twenty feet.

Ostrea virginica, generally much larger and more numerous than at South Mills or at north of Wallaceton, was likewise brought up in the dredgings from the bottom of the feeder leading from Drummond Lake, say at approximately ten feet below the surface level, which, at the point under consideration, is about twenty feet above tide, the elevation of the surface of the lake being, according to a survey made by the U. S. Engineers during the winter of 1895–1896, $22\frac{16}{100}$ feet.

Mollusks from the base of a low escarpment on the western border of the swamp near Suffolk, Va., and near the Jericho Canal, which leads north-westwardly from Lake Drummond to the Nansemond River, have been noted by Prof. N. S. Shaler. After listing the species as identified by Dr. W. H. Dall, he says: "Traces of this same deposit occur a few miles south of Suffolk, and I suspect the existence of similar beds near Elizabeth City. From certain comminuted fragments taken from the bottom of the main Dismal Swamp Canal, it seems to me not improbable that the beds were touched in making that excavation. I am, therefore, disposed to believe that the foundation rocks beneath the swamp district consist mainly of the beds indicated by the foregoing list of fossils."[2]

Prof. Shaler thus indicates fossil beds which the recent deepening of the Dismal Swamp Canal has abundantly verified, though very few of the species in Prof. Shaler's collection and our own are the same; and yet, as will be seen further on, upon analyzing the forms in the two collections, they tell a similar geological tale.

We now insert tables of the mollusks from the Dismal Swamp and the Jericho Canal localities.

[2] Tenth Annual Report U. S. Geol. Survey, page 316.

TABLE OF SPECIES OF MOLLUSKS DREDGED FROM THE DISMAL SWAMP CANAL IN NORTH CAROLINA AND VIRGINIA.

Mollusks.	Range in time.			Found also in the Croatan beds, N. C.	And in the Waccamaw beds, S. C.
	M.	P.	R.		
Arca limula Conr., one	x	x		o	o
Arca plicatura Conr., var. *sublineolata* D'Orb., numerous	x	x			
Corbula contracta Say	x	x	x	o	o
Cytherea convexa Say = (*C. sayana* Conr.)	x	x	x	o	o
Mulinia (*Mactra*) *lateralis* Say	x	x	x	o	o
Nucula proxima Say	x	x	x		
Venus mercenaria Lam'k	x	x	x	o	o
Lucina crenulata Conr	x	x	x	o	o
Olivella nitidula Dillw	x	x	x	o	o
Polynices (*Natica*) (*Neverita*) *duplicata* Say	x	x	x	o	o
Tornatina (*Bulla*) *canaliculata* Say	x	x	x	o	o
Nassa obsoleta Say, few	x	x	x	o	o
Divaricella (*Lucina*) *quadrisulcata* D'Orb	x	x	x		o
Cæcum cooperi Smith		x	x		o
Ostrea virginica Gmel		x	x		
Crepidula plana Say		x	x	o	o
Eupleura caudata Say		x	x	o	o
Fulgur canaliculatum Say, one		x	x	o	o
Fulgur carica Gmel., numerous		x	x	o	o
Nassa trivittata Say, numerous		x	x	o	
Scala lineata Say		x	x	o	
Turbonilla reticulata Ads		x	x	o	o
Spisula (*Mactra*) *solidissima* Dillw			x		
Tellina tenera Say			x		
Solen americanus Gmel			x	o	o
Urosalpinx cinerea Say			x	o	o
Coral.					
Astrangia danae Agas			x		

For comparison with the above we tabulate in a similar manner the list of fossils obtained by Prof. N. S. Shaler, from the northwestern part of the Dismal Swamp, near Suffolk, and identified by Dr. Dall. We take the list from Prof. Shaler's monograph on the Dismal Swamp in the Tenth Annual Report of the United States Geological Survey, page 315.

TABLE OF MOLLUSCAN SPECIES FOUND IN BEDS EXPOSED BY A ROAD CUTTING NEAR THE JERICHO CANAL, TWO MILES EAST OF SUFFOLK, VA.

	Range in time.			Found also in the Croatan beds, N. C.	And in the Waccamaw beds, S. C.
	M.	P.	R.		
Arca incile Conr.	x				
Crassatella undulata Say	x				
Mactra congesta Conr	x			o	
Anachis (*Columbella*) *avara* Say			x		o ?
Turritella apicalis Hp. (var.)		x			
Pecten eboreus Conr	x	x			o
Abra aequalis Say	x	x	x	o	o
Callista convexa Say (=*C. sayana* Conr.)	x	x	x	o	o
Eryphyla lunata Conr	x	x	x	o	
Gouldia cerina Ad	x	x	x		
Leda acuta Conr.	x	x	x	o	o
Lucina crenulata Conr	x	x	x	o	o
Yoldia limatula Say	x	x	x	o	
Dosinia elegans Conr		x	x		o
Ostrea virginica Gmel		x	x		
Pecten exasperatus Sowb		x	x		
Crepidula convexa Say		x	x	o	o
Liomesus stimpsonii Dall		x	x		
Turbonilla interrupta Totten		x	x	o	o
Cadulus carolinensis Bush			x		
Cardium islandicum Lin			x		
Chione albida Gmel			x		
Nucula tenuis Mtg			x		
Tellina tenta Say			x		
Tellina modesta Verrill			x		
Scalaria clathratula Adams			x		
Ethalia ——— Sp. ? fragm.					
Eulima ——— Sp. ?					
Balanus ——— Sp. ?					

Of the 26 species of mollusks from near Wallaceton, 17 occur at both Croatan and Waccamaw, 2 others occur at Croatan and not at Waccamaw, and still 2 others at Waccamaw and not at Croatan, while 5 have not been recorded at either of these two localities.

Of the 26 specifically identified out of the 29 forms from near Jericho, 6 occur at both Croatan and Waccamaw, 1 occurs at Croatan only, and 3 at Waccamaw only, while 16, more than half of which are recent, have not been noted at either of these localities.

In the lists above there are but 3 species occurring in both localities, viz.: *Cytherea convexa*, *Lucina crenulata*, and *Ostrea virginica*. Adding the numbers in the two lists and deducting these three, since they have been counted twice, we find there are, altogether, 52 molluscan forms, of which 3 are not specifically identified. Analyzing the remaining 49, we find their numbers range in geological time as follows:—

	M.	M. & P.	P.	M. P. & R.	P. & R	R. Totals.
From near Wallaceton		2		11	9	4=26
From near Suffolk......	3	1	1	7	6	8=26
	3	3	1	18	15	12=52
Deduct common to both localities..............				2	1	3
Totals.................	3	3	1	16	14	12=49

from which it will be seen that there are

Pliocene and pre-Pliocene forms	7 species.
Ranging from Miocene to Recent	16 species.
Both Pliocene and Recent	14 species.
Recent, including Pleistocene	12 species.

Judging from these proportionate figures alone, which show 42 forms still living, out of a total of 49, the writer would be inclined to assign the age of the beds from which these fossils were obtained as not earlier than late Pliocene time, while it may even possibly belong to Pleistocene time.

We may, however, more particularly note other reasons for this conclusion as to age.

Twenty-six, or fully one-half of the shells specifically identified, clearly have a post-Miocene aspect, including two forms, *Fulgur carica* and *Ostrea virginica*, which are the most numerous of the collection. The specimens of *F. carica* present a peculiarity of sculpture which distinguishes them from the shells now living upon the coast; the surface being densely scored by fine crimped or undulating spiral striæ, in fully adult, large individuals. In recent shells of similar size such striation is nearly obsolete or wholly wanting, even when the superficial coat has not been removed by erosion.

Sixteen other forms have a persistent range from the Miocene through the Pliocene and Pleistocene periods down to the present time.

If we include these 16 as representatives of recent time, we have, as noted above, 42; or, as pointed out by Dr. Dall in a letter from which we quote, " nearly all the species as recent."

One other form, *Arca limula*, is usually considered distinctively Miocene, but its presence may be accounted for by considering it as an introduction from the underlying Miocene beds, which are probably not over 50 feet from the surface in this region. Bearing upon this, the writer may say that he has in his possession artesian well borings recently made at Old Point Comfort and Norfolk, Va. At Old Point Comfort, at the depth of 50 feet, were a number of shells, among them such Miocene forms as *Dosinia acetabulum* and *Pecten madisonius*, while at Norfolk there were obtained, at the depth of 105 feet, a fragment of *Pecten madisonius*, at 115 feet a perfect shell of *Gnathodon clathrodon*, and at 175 feet a fragment of *Pecten eboreus*.

Respecting another form in the Dismal Swamp bed, *Arca plicatura*, or perhaps a variety thereof, Dr. Dall says, after an examination by him of a number of specimens of this species which we had sent him: "The *Arca* you send is one which occurs in the Duplin County Natural Well, North Carolina, and which was named by Conrad *Arca lineolata;* but as there was already a species of this name, D'Orbigny re-named it *sublineolata*. It appears to be a mutation of *A. plicatura*, to which I have referred it in my (MS.) work on the Tertiary Arcas of the United States. There was one Pliocene species in the fossils from the Jericho Canal,[3] and as the Duplin beds are at the very top of the Miocene, it would not be strange if *A. sublineolata* overlapped."

Bearing still further upon the entire subject, we further quote Dr. Dall from the same letter :—

"The species from your list[4] are all recent except *Arca limula* [and *Arca sublineolata*], but some of them are not now found so far north. Now we know that in Pliocene times some northward advance was made by the warm water species, such as *Gnathodon* and *Cyrena*. There are too many recent species (assuming that the fauna is not a mechanical mixture of shells of different ages) for the refer-

[3] This has reference to the bed near Suffolk, the forms from which appear in the second of the preceding lists.

[4] Reference is here made only to the first list, that from near Wallaceton.

ence of this fauna to the Upper Miocene—and we know that the extinct species [*A. limula* and *A. lineolata*] are not quaternary even in Florida—so, subject to the above assumption, I think we shall have to regard it as Pliocene. * * * * The Croatan beds are distinctively Pliocene, but these are more like the contact between the southern Pliocene and a more northern cold water fauna."

Corroborative of the views already advanced as to the age of this bed is the following, written by Prof. N. S. Shaler respecting the mollusks listed above from near the Jericho Canal: "The species determined by W. H. Dall, paleontologist of the U. S. Geological Survey, indicates in a general manner that the beds are of Pliocene age. Of the 29 species that appear in my collection, 24, according to Dr. Dall, belong to living forms and 5 are extinct. The extinct species are found in the so-called Pliocene of Florida, South Carolina and Virginia. There can be no question the deposit is of preglacial age."[5]

We now consider the evidence presented by the diatom flora which we think corroborates that presented by the mollusks for reasons which we shall note after the introduction of the following statement by Charles S. Boyer, A. M., made by him after a careful examination of a number of mounts prepared from the material which had been reliably cleaned, as already stated, by John A. Shulze, and to which we are well assured there has been no admixture of diatoms from any other source:—

"The following list includes all the forms, 31 in number, found in the slides of the Dismal Swamp material except a few fragments which were too small for accurate determination.

"In the middle column is noted the relative frequency and rarity of some of the forms in comparison with the rest as seen in the strewn mounts:—

"Of the above forms all but four are strictly marine. The exceptions are *Navicula major* and *Stauroneis Phoenicenteron*, which are fresh water, *Campylodiscus Echeneis* which is both brackish and fresh water, and *Melosira crenulata* var. *antiqua*, which is possibly also fresh water.

"I think I have named all on the slides at hand, except probably one or two forms of *Coscinodiscus* and *Navicula*, which were in fragments.

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[5] Tenth Annual Report, U. S. Geol. Survey, page 315.

"Of the 31 named, 2, *Actinoptychus Heliopelta* and *Aulacodiscus Rogersii* are distinctly Miocene; 4, *Coscinodiscus robustus, Stephanopyxis aculeata* and *Corona,* and *Triceratium semicirculare* are quite

Actinocyclus Ehrenbergii Ralfs	Common	Miocene and Recent
Actinoptychus Heliopelta Grun	Rare	Miocene only
Actinoptychus undulatus E	Common	Miocene and Recent
Aulacodiscus Rogersii (Bail) A. S	Not uncommon	Miocene only
Auliscus caelatus Bail		Miocene and Recent
Auliscus punctatus Grun		Miocene and Recent
Biddulphia Rhombus (E.) Wm. Sm		Miocene and Recent
Biddulphia Tuomeyi (Bail) Roper		Miocene and Recent
Campylodiscus Echeneis E	Not uncommon	Fossil in Deposits later than Miocene also Recent. Brackish and Fresh Water.
Cerataulus turgidus E		Later than Miocene, also Recent
Coscinodiscus apiculatus E		Miocene and Recent
Coscinodiscus Asteromphalus E		Miocene and Recent
Coscinodiscus bulliens A. S		Miocene and Recent
Coscinodiscus marginatus E		Miocene and Recent
Coscinodiscus radiatus E		Miocene and Recent
Coscinodiscus robustus Grev		Miocene
Craspedodiscus Coscinodiscus E		Miocene and Recent
Eupodiscus radiatus Bail		Recent
Although var. *antiqua* Cox is found in the Miocene		Later than Miocene
Goniothecium Rogersii E		Miocene and Recent
Hyalodiscus laevis E		Miocene and Recent
Melosira sulcata E		Miocene and Recent
Melosira crenulata var. *ambigua* Grun. Fossil in Hungarian deposit (Miocene?), as, however, there are numerous varieties which are recent, this may be so also		Fresh Water?
Navicula Gruendleri A. S		Recent, marine
Navicula major Kutz	Common	Miocene to Pleistocene, also Recent Fresh Water.
Plagiogramma Gregorianum Grev		Miocene and Recent
Pseudauliscus radiatus A. S		Miocene and Recent
Stauroneis Phœnicenteron (Nitzsch) E		Later than Miocene, also Recent Fresh Water.
Stephanopyxis aculeata E		Miocene
Stephanopyxis Corona (E.) Grun		Miocene
Triceratium robustum Grev		Miocene and Recent
Triceratium semicirculare Br		Miocene

characteristic of that period, while of the remaining 25, only 4, *Campylodiscus Echeneis, Cerataulus turgidus, Eupodiscus radiatus* and *Stauroneis Phoenicenteron* can be considered as distinctive of later deposits.

"In general, therefore, it may be said that the deposit can be considered as a mixture of Miocene and later deposits, though the latter need not necessarily have been so *very* recent."

From an examination of the above list of diatoms the present author would classify them as follows: Six forms characteristically Miocene, 19 forms that have survived from Miocene to present time and are now living, and 4 either Pliocene or Pleistocene, or both, and also now living. These 4 are the same as those noted above by C. S. Boyer as distinctive of deposits later than Miocene.

If the 19 survivals belong to present time, there are 23 that may be considered recent, or comparatively so. Respecting the exclusively Miocene forms it is probable that these have been brought down in post-Miocene times by the James River in its passage over the original beds from Richmond southeastward. It is probable also that some of the individuals of perhaps each of the 19 species having the more cosmopolitan range were also similarly introduced. We are confirmed in this view by the occurrence among the characteristic Miocene diatoms of *Actinoptychus Heliopelta*, a form which the writer has frequently found heretofore both in outcrops and in well borings, but always at or below the base of the great 300 to 400 feet Miocene diatomaceous clay bed of the Atlantic Coastal Plain. In Maryland it occurs at the base of this bed in well borings at Crisfield and in outcrops at and near Nottingham on the Patuxent River. In Virginia it has been found in outcrops at Petersburg and Bermuda Hundred. In New Jersey, owing probably to a thickening of the basal beds of the Miocene, it occurs some distance below the main diatom bed. It has thus been found in outcrops near Shiloh and in well borings at Asbury Park and Wildwood. At the latter place it was found in a thin seam of clay about 250 feet below the bottom of the great diatom bed. In each instance just cited its position is at or very near the base of the Miocene, either resting directly upon or only a short distance above greensands of Eocene Age. Many other borings have been made in New Jersey through or nearly through these beds, from which the writer has had complete series of specimens every 10 to 20 feet apart, all of which he has examined, but in none of them has he ever found *A. Heliopelta* stratigraphically higher than near the base of the Miocene. Now the diatom bed outcropping at Richmond, Petersburg and vicinity has been found by the writer in the Norfolk well boring at between the depths of 585 and 625 feet, while the continuation upward of the same clay contained sponge spicules up to about 400 feet from the surface. No diatoms or sponge spicules were found higher in this well excepting between the depths of 25 feet and 65 feet, where a stratum, probably the equivalent of the Dismal Swamp bed, contained these same micro-organisms, though, as in the Dismal Swamp deposit, very sparingly. The Miocene beds at Bermuda Hundred and Petersburg are rich in diatoms, and especially so in *A. Heliopelta*, and since the diatoms in the Dismal Swamp deposit were exceedingly meager, (perhaps not one per cent. of the entire matrix), and since *A. Heliopelta* and other Miocene species were scantiest in numbers of all the contained forms, we cannot, in view of all the facts, consider that the introduction of these Miocene forms has been by other than mechanical means in post-Miocene times. At what period that subsequent time was, three of the more recent forms, *Campylodiscus Echeneis*, *Cerataulus turgidus* and *Stauroneis Phoenicenteron*, shed much light. We will now particularly notice each of these forms.

In a mass of brick clay from a low terrace at Bridgeton, N. J., which terrace is assigned by the New Jersey State Geological Survey report to a very recent geological phase of the gravels of that State, the writer found a very considerable number of diatoms not at all Miocene in aspect, and among them a large number of the same species of *Cerataulus*.

Respecting *Campylodiscus Echeneis* it may be stated that this form has been recorded as living principally in brackish waters the world over, though Prof. C. S. Boyer informs the writer that he has found it in a fresh water reservoir at Philadelphia, supplied from the Schuylkill River. Though not, however, heretofore recorded, so far as we are able to learn, as fossil, yet the writer has so seen it in a low level clay from near Buckshutem on the Maurice River, below Millville, N. J., the stratigraphical position of which is the equivalent of the Bridgeton clay above referred to.

On a map of the surface formations of New Jersey in the annual report of the geological survey of that State for 1897 there is shown a low level formation on the shores of Raritan Bay and thence bordering the Atlantic Ocean from Sandy Hook to the Cape May peninsula, which it either entirely covers or nearly so, and thence extending up the Delaware River nearly to Trenton. This low lying terrace, which is stated in the text to have an elevation of 30 to 50 feet, extends inland along the courses of the following streams: some 20 miles up the Mullica and the Great Egg Harbor Rivers, about 25 miles up the Maurice River, and some 10 miles up the Cohansey River. These measurements were made in a direct line from the mouths of the rivers and not by following the winding courses thereof. The surface deposit of this terrace has been named by Prof. R. D. Salisbury the Cape May Formation. He describes it as a "thin body of loam, sand and gravel of lesser age than any" of the surface formations of the State described in the same paper "except possibly the drift of the last glacial epoch." He further says: "The strict contemporaneity of this formation with the drift of the last glacial epoch is not established, but it is probably at least partly contemporaneous with it, though its later portions may be still younger."[6] To this formation belong the diatom clays noted in the preceding paragraphs as at Bridgeton and Buckshutem.

Stauroneis Phoenicenteron has never been seen by the writer in any of the numerous specimens of Miocene diatomaceous clays which he has examined during the past ten years, nor has it, so far as he has been able to learn from consultation of the literature relating to it, been recorded by others as occurring in beds of that age. It has, however, a world wide distribution in freshwater deposits of decidedly later age. Ehrenberg, in the Atlas of his Mikrogeologie, notes it in various sands and black, white and gray earths at numerous localities (named below) most of which the writer would characterize from their position stratigraphically and geographically as decidedly post-miocene and some of them as clearly glacial and post-glacial. Thus Ehrenberg lists this diatom on page 19 of his Atlas as occurring in various earths and at different places, as follows:—in lake mud from Loka, Sweden; in Bergmehl from Degenfors and Lillhaggsjohn, Sweden, also from Santa Fiora, Italy, and from the south point of Tierra del Fuego, S. A.; in Blätterkohl from Westerwalde, Prussia; in white earth from Guatemala; in Kieselguhr from Andover, Pelham and Wrentham, Massachusetts; from Ceyssatt, France; from Down, Mourne Mountains, Ireland; from New Hampshire and from Earlton, Nova Scotia; in white marl (Mergee); from Farmington, Conn.; in Meteorpapier, from Rauden, Prussia; in tripoli and polishing powder, from Moscow, Russia; and in Weisenpapier, from Freiberg, Saxony.

[6] Annual Report Geol. Survey of N. J., 1897, page 19.

It has also been found fossil by Prof. C. S. Boyer, in specimens of clays obtained by the writer from the upper portions of two well borings, one on the beach at Wildwood,[7] Cape May Co., N. J., and the other at Rock Hall,[8] Md., on the eastern side of Chesapeake Bay opposite the mouth of the Patapsco river. The clays referred to occupied, at Wildwood, the interval between the depths of 79 and 181 feet, and at Rock Hall a similar interval between the depths of 50 and 130 feet. The clays at both localities contained a mixture of fresh-water and marine diatoms, the numbers of individuals of the fresh-water forms somewhat exceeding those of the marine. That these two deposits are probably synchronous in age appears probable from the similarity of their position next below the surface formation (Cape May formation?), also from the similarity of the assembled forms of diatoms, and from the occurrence in both of a unique diatom, *Polymyxus coronalis*, L. W. Bailey, not however, found in our examination of the forms in the Dismal Swamp bed. This form has not been heretofore known except as living off the mouths of the Para and Amazon Rivers in South America. That the two deposits are much later than Miocene in age may be inferred from the fact that the one at Rock Hall lies directly upon the Rancocas division of the Cretaceous, the Miocene itself resting at a higher level upon Eocene beds a few miles southward and eastward; while at Wildwood the top of the great Miocene diatom clay bed occurs nearly 200 feet deeper than the base of the deposit under consideration, or at the depth of 370 feet from the surface. The well borings, however, show that apparently the same Miocene clay, but without diatoms, commences at the depth of 294 feet.

These two deposits containing *Polymyxus coronalis* and *Stauroneis Phoenicenteron*, the writer suggests were probably laid down in the deltas of the ancient Delaware and Chesapeake Rivers at the time when the shore line of the Atlantic Coastal plain was many miles eastward of its present position and much of the now submerged portion of the plain was above sea level.

SUMMARY.

After considering the position of the Dismal Swamp bed, beneath a low lying terrace on the eastern margin of the Coastal Plain and evidently resting immediately upon fossiliferous Miocene beds which

[7] An. Report Geol. Survey of N. J. for 1894, page 165.
[8] In manuscript, not yet published.

can be traced westward along the James River some eighty miles or more to Richmond, Va., and after a careful study and analysis of the contained mollusks and diatoms the conclusion before stated has been reached that both the macroscopic and the microscopic fossils indicate a mechanical mixture of the Miocene and a comparatively recent fauna and flora[9] the Miocene forms having been contributed and brought down by erosion from the broad and somewhat higher and gradually rising Miocene belt to the westward, while the more recent forms lived and were deposited as the bed was laid down in a more recent geological time.

If we accept the conclusions of all the authorities we have quoted who have studied the Dismal Swamp deposit, we should have to refer this bed unequivocally to the Pliocene period. The writer, however, cannot resist inferring from the scantiness of Miocene fossils, which, as already noted, he views as mechanically introduced—from the wide range of many of the Pliocene mollusks, extending down to the present time—from the very decidedly recent aspect of many other shells—and from the even more decidedly recent aspect of some of the diatoms, a more recent date for the bed, and therefore considers that it cannot belong to a period earlier than the latest Pliocene, and that it may, indeed, even belong quite within Pleistocene time.

Specimens of all the mollusks listed from the Dismal Swamp Canal have been presented to the Academy of Natural Sciences by M. Homer, and are now arranged in its paleontological collection, while strewn mounts of the diatoms have been deposited in the cabinet of the Biological and Microscopical Section by the author.

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[9] Diatoms are now generally regarded as belonging to the plant kingdom.

September 6.

Professor Henry A. Pilsbry in the Chair.

Eight persons present.

September 13.

Mr. Benjamin Smith Lyman in the Chair.

Seventeen persons present.

A paper entitled "New Cretaceous Fossils from an Artesian Well-Boring at Mount Laurel, N. J.," by C. W. Johnson, was presented for publication.

September 20.

The President, Samuel G. Dixon, M. D., in the Chair.

Fifteen persons present.

The deaths of Wm. H. DeCamp and J. C. H. Crosse, Correspondents, were announced.

A paper entitled "Contributions to a Knowledge of the Hymenoptera of Brazil, No. 5, Vespidæ," by Wm. J. Fox, was presented for publication.

September 27.

The President, Samuel G. Dixon, M. D., in the Chair.

Thirty persons present.

A paper entitled "New Species of Odontostomus from Brazil and Argentina," by Henry A. Pilsbry, was presented for publication.

Thomas L. Montgomery was elected a member.

The following were ordered to be printed:—

HYALODENDRON NAVALIUM, A NEW GENUS AND SPECIES OF EUPLECTELLID SPONGE.

BY J. PERCY MOORE.

The type of this genus and species is one of a small collection of silicious sponges gathered in Japan in 1893 by Mr. Frederick Stearns, of Detroit, Michigan, and sent to the Academy of Natural Sciences of Philadelphia for determination. They were collected by native fishermen and brought into Yokohama harbor by the dredge boats. The single specimen of *Hyalodendron* is the only one which had been reported by the fishermen. Other than this, no data relating to the collection are available. The specimens are accompanied by a set of sketches by a native artist.

The species represented are, in addition to *Hyalodendron*, *Euplectella*, anchor spicules of probably *E. aspergillum* Owen, *Hyalonema reflexa* Ijima, a fine specimen of this recently described species and *Farrea occa* (Bowerbank) Carter, an unusually large example.

HYALODENDRON nov. gen.

Hyalodendron navalium n. s.

The general appearance of the type and only specimen is well shown on Plate XIX, reproduced from a sketch by a Japanese artist which accompanied the collection. The sponge was originally about 18 inches high, but is now slightly mutilated at the summit. It presents a firm base, above which rises a slender tapering body or stalk, ending in a sharp apex, and bearing numerous lateral branches of various sizes, at the bases of which the sponge wall is perforated by large crater-like openings.

The base is a thin, flat and spreading, encrusting layer, which has evidently conformed itself to the rocky bottom to which the sponge was adherent, some fragments of which are still attached. Its upper surface is uneven, but smooth and without any spines or processes. It is perforated by three or four small holes. It measures $3\frac{1}{4} \times 3\frac{3}{4}$ inches in diameter, and is from $\frac{1}{16}$ to $\frac{1}{8}$ inch thick. The spicules of this region are mostly slender, more or less curved, pointed diacts of various sizes, most of them being almost fibre-like. They cross one another at various angles and are firmly united into a hard stony mass by a secondary deposit of silica which encrusts and cements them, with the formation of numerous synaptacula (Plate XX, fig. 6). Regular or modified hexacts are occasionally found wedged in interstices, but the appearance is that the demalia and hypodermalia have been worn or decayed away from this region.

The sponge body or stalk rises from near the centre of the base to a height of 16 inches. Its summit is frayed out and must have been originally at least an inch higher. It is terete and tapers gently and regularly from the base, which is ${11 \over 16}$ of an inch in diameter, to the broken apex, $\frac{3}{8}$ of an inch in diameter. A well developed gastral cavity extends through the sponge body from base to summit, so that it is hollow throughout. Toward the base the walls are thick and firm, owing to secondary incrustations of silica, while above they are much thinner and quite friable.

The lower $3\frac{1}{4}$ inches of the body have a texture and appearance similar to the base, but the transition to the branched upper region is gradual. A very few short blunt spines are borne on the sponge wall, and these partake of the stony hardness and silicious incrustations which characterize the walls of this region. Two longer spines, having more of the character of the upper branches, are present, the first 1 inch, and the second $2\frac{1}{2}$ inches above the base. These are respectively $\frac{3}{8}$ and $\frac{1}{4}$ of an inch long. The former is situated just above the first crater-like opening in the sponge walls. This region of the sponge has a smooth hard surface, and like the basal portion lacks the superficial layers of spicules.

At about $3\frac{1}{2}$ inches above the base, loose flesh spicules become more plentiful and soon form a thick soft layer, looking very much like a covering of a fine cotton wool paste, or as if the specimen had been dipped into a thick soap lather, which had been allowed to dry on its surface. Coincident with this change in the character of the surface, spinous processes become more numerous and very much longer, but in this specimen the lower spines are imperfect. While in the lower portion ($\frac{1}{2}$) of the sponge the processes remain comparatively simple and unbranched, those which densely cover the upper half of the stalk are often very long (the longest nearly 5 inches and ${3 \over 16}$ of an inch in diameter at the base), much and complexly branched, sometimes to the third order. Wherever such branches cross they are united by secondary anastomoses, due to the concrescence of the parenchyma. The principal branches vary in diameter from ${1 \over 16}$ to ${3 \over 16}$ of an inch, but two may fuse at their bases and form a much larger mass. The smaller may be unbranched and reach a length of two inches, but are usually provided with a few small branches. The larger are complexly branched, the secondary branches usually forming angles of about 60° with the principal branches, which latter arise from the central trunk at angles of 80°–90°.

While the base and lower part of the stalk are perforated by only a few small pores, the upper part has numerous conspicuous oscula. They perforate the sponge wall between the larger bundles of fibrous spicules, the outer flesh layers rising ⅛ of an inch as 7 delicate crater-like rims, scarcely thicker than a sheet of paper. The oscula are usually elongated in the longitudinal direction of the sponge, and in that case have a length of 5 to 6 mm., by a width of 2 to 3 millimeters. In such the rim flares out somewhat at the sides and contracts at the ends, so that its outer edge has a nearly circular outline. Some few of the oscula are circular at their gastral ends. With regard to their distribution on the sponge walls, the lower-most is situated 2½ inches above the base, and its rim is thickened like the neighboring sponge walls. Most of them evidently stand in some relation to the larger branches. Three occur at precisely the level where the largest spine arises, and two near each of most of the other large branches. In many cases the oscula lie directly at the bases of the large branches, their crater-like rims being continuous on one side, most often above, with the substance of the branch. Looking through the oscula on to the gastral surface, this is seen to be formed of a fibrous network of spicules, without the woolly surface covering of loose spicules.

The specimen is a macerated one; as I was unable to dissect or section it, the arrangement of the chambers and the exact arrangement of the spicules could not be determined. The bulk of the skeleton of the sponge wall is, however, chiefly composed of bundles of long fibre like diacts of various sizes and characters. These are disposed in bundles which run longitudinally through the sponge body, but divide and reunite in such a way as to form a network, in the meshes of which the oscula open, and which raise more or less evident ridges on both gastral and dermal surfaces. In the upper part of the sponge these diacts remain free, but below they are cemented together as above described. They exist in great variety, but the majority have the form represented in Plate XX, fig. 1, in which the transverse rays are reduced to minute nodules;

in others they are much more evident, or may be entirely wanting. Some of this type are straight, but most are more or less curved, those surrounding the oscula being often semicircular. The ends may be simply pointed, or variously enlarged, and either smooth or roughened with minute spines as shown by a few examples in Plate XX, figs. 2, 3, 4 and 5. The dermalia consist of sword shaped hexacts, which are so numerous as to suggest the specific name of the species. Like the diacts, these differ much in the relative development of the several limbs, any of which may be straight or more or less curved or even sharply bent. Fig. 9 shows the most typical proportions, but the handle may be scarcely longer than the blade or not more than $\frac{1}{8}$ as long. The cross pieces may be straight or curved, or sharply bent upward (Plate XX, fig. 12). The handle differs most, being slender and pointed, club-shaped or knobbed, and usually sculptured throughout or at the tip only. The points of the other rays are also usually spinose. The sword handles support the skin, and are not furnished with floricomes at their distal ends; instead they are surrounded by bundles of minute acicular diacts, Plate XX, fig. 7.

The hypodermalia are regular hexasts, oxy-hexasters, which have the principal rays prolonged (Plate XX, fig. 8), rosettes which vary in the length of the principal rays, as shown by two examples in Plate XX, figs. 14 and 15, and discohexasters of great beauty and symmetry of form. One of the simplest of the latter is shown in Plate XX, fig. 16. This has the principal rays well developed, while each group of terminal rays has sixteen members, the pin-head shaped disks having again 16 marginal teeth. Other discohexasters have the number of terminal rays much greater, or the principal rays shortened, so that all appear to arise from a central sphere.

The gastralia are also sword-shaped hexacts without bundles of accessory acicular spicules. This sponge would appear to be the type of a new subfamily of Euplectellidæ.

Description of Plates.

Plate XIX. *Hyalodendron navalium* n. s. The type specimen as it appeared when first taken, from a drawing by a Japanese artist. x $\frac{5}{12}$.

Plate XX. Illustrating some of the forms of the spicules of *Hyalodendron navalium.*

Fig. 1. One of the smaller simple diacts of the kind which make up the interior skeleton of the spines and processes, and

which run in bundles through the sponge walls. x 56. 1 a, middle region of the same showing a slight enlargement, and the axial fibre with the two reduced transverse axes. x 250.

Fig. 2. A short, thick diact, with transverse limbs entirely suppressed, with slightly enlarged rounded ends, and axial fibre almost gone. x 56.

Fig. 3. A small, slender and straight diact, with transverse limbs indicated as rounded nodules, with ends pointed and roughened, and axial fibres complete. x 56. 3 a, one of the ends of the same. x 250.

Fig. 4. A small, slender, curved oxy-diact, with transverse limbs distinctly indicated as four nodules. x 56. 3 a, middle region of the same. x 250. 3 b, one of the ends of the same. x 250.

Fig. 5. A peculiarly modified end of a large diact, showing a zigzag course of the axial fibre. x 56.

Fig. 6. A portion of the sponge base showing the secondary union of spicules by the formation of encrusting and cementing deposits and numerous synaptacula. At a, the encrusting layers are represented as broken away, exhibiting the original diact. x 56.

Fig. 7. A group from one of the bundles of minute acicular diacts found in the superficial parenchyma about the handles of the sword-shaped hexacts. x 56.

Fig. 8. An oxy-hexaster in which the axial rays are continued beyond the place of branching. x 500

Fig. 9. One of the usual type of sword-shaped hexact. x 56. 9 a, b, c, are respectively enlarged views of the handle, tip of one of the cross pieces and the point. x 250.

Figs. 10, 11 and 12. Three of the sword-shaped spicules. x 56. 10 is short and regular; 11 has the blade bent and the cross rays rough, uneven and thickened; 12 is straight, with the cross pieces bent sharply upward toward the handle.

Fig. 13. A small, spiny, regular oxy-hexact. x 56. 13 a, one of the rays enlarged. x 250.

Fig. 14. A rosette in which the axial rays are continued beyond the disk, and the number of terminal rays is small and confined to the margin of the disk. x 250.

Fig. 15. A rosette with roughened axial or stem rays terminated by disks bearing a close brush of fine terminal rays. x 340.

Fig. 16. One of the simpler disco-hexasters with distinct stem rays, and sixteen terminal rays in each group. The disks or pin-heads have usually sixteen marginal teeth each. x 250.

ENVIRONMENTAL AND SEXUAL DIMORPHISM IN CREPIDULA.

BY EDWIN G. CONKLIN, PH. D.

I. The genus *Crepidula* Lam. is represented on our North Atlantic Coast by at least three species, viz.: *C. fornicata* Lam., *C. plana* Say, and *C. convexa* Say, while the species *C. adunca* Sby. and *C. navicelloides* are abundant on the Pacific Coast of the United States.

All these species are more or less completely sedentary, and they are usually, though not invariably, carried about by other animals with whom they are messmates and upon whom they are securely fixed. All the larger species of *Crepidula* are immovably fixed to one spot, e. g., *C. fornicata, C. plana, C. navicelloides,* while the smaller species *C. convexa* and *C. adunca* are able to move about to a limited extent.

Among these smaller forms the characters of the shell are fairly constant, but among the larger forms it is well-nigh impossible to tell what the normal or usual form is; this is especially the case with *C. plana,* where it is a rare thing to find two shells alike.

Even among the smaller species there are marked local varieties depending upon the immediate environment, e. g., *C. convexa* as found on *Illyonassa* and *Littorina* shells is deeply convex and very darkly pigmented. On oyster shells it is very much flatter and lighter in color, and is frequently mottled as shown in Plate XXI, Row 2. This local variety has been considered a distinct species, viz.: *C. glauca* Say; its anatomical and embryological characters show, however, that it is not specifically distinct from *C. convexa.* The same is true of Lea's species, *C. acuta,* which is merely a local form of *C. convexa.*

Among the larger and more sedentary species, *C. fornicata* and *C. plana,* the most remarkable differences in the shape of the shells may be observed due to the character of the surface upon which they are attached. "Upon a smooth, plane surface, the shell is regular and unusually broad and flat; on a convex surface it is deep and highly arched; on a concave surface it is concave; on a twisted surface, such as the columella of *Neverita,* it is twisted; on an irregular surface, such as a rough stone, it is irregular; if pressed upon from the sides, the animal and shell become long and narrow; if growth is limited in front, the shell becomes short and broad; if limited on all sides, the shell may increase greatly in thickness but remains small in area, completely filling the space in which it is found. In such cases, the lines of growth are crowded close together, and the very edge of the shell may be as thick as any other portion.

"The cause of these variations is not far to seek; the shape of the shell is conditioned by the shape and position of the mantle edge; the mantle is moulded over the surface upon which the animal rests; and consequently the shape of the shell comes to correspond in time to any sort of a surface upon which the animal is attached."[1]

Arnold Graf[2] has described a case in which a shell of *C. fornicata* was marked by radial folds corresponding to those of a *Pecten* upon which the *Crepidula* was attached. I have, myself, repeatedly noticed similar cases.

More recently, Bradney B. Griffin,[3] has called attention to a *Placuanomia* shell which was found attached to a valve of *Saxidomus*, and which was marked by lines and folds exactly coinciding with the concentric markings of the *Saxidomus*.

Griffin also remarks that many similar phenomena have been observed and commented upon by paleontologists in fossil shells, and he refers particularly to two papers by Keyes[4] on the modifications of *Platyceras* shells due to the surface of attachment.

All these modifications are similar to those which I have observed in *Crepidula*, and are, undoubtedly, due to the causes which have been mentioned.

Such irregularities of form could scarcely be called dimorphism, though they might properly enough be called environmental polymorphism. In no case which I have observed is there any evidence that any of these modifications of form are becoming hereditarily fixed, though they may be found in many individuals and have frequently been considered of specific value (e. g., *Crepidula glauca* and *C. acuta*).

[1] Conklin, The Embryology of Crepidula. Jour. Morph., Vol. XIII, 1897.

[2] A. Graf, Adaptation of the shells of *Crepidula fornicata* to the shell of *Pecten Jacobeus*. Trans. New York Academy of Sciences, April 3, 1896.

[3] Griffin, Adaptation of the shell of *Placuanomia* to that of *Saxidomus* with remarks on shell adaptation in general. Trans. New York Academy of Sciences, Feb 22, 1897.

[4] Keyes, The Sedentary Habits of *Platyceras*, Am. Jour. of Science, October, 1888, and On the Attachment of *Platyceras* to Palaeocrinoids and its effects in modifying the forms of the Shell, Proc. Am. Phil. Soc, Vol. XXV, 1888.

II. An interesting case of environmental dimorphism to which I wish to call attention is found in a race of dwarfs which is specifically identical with *C. plana* (Plate XXII, Rows 3 and 4).

This species is found most abundantly inside dead shells of *Neverita* inhabited by the large hermit crab, *Eupagurus Bernhardus.* In this position individuals grow to a large size, mature females frequently reaching a length of 2 inches and a breadth of 1¼ inches. On the other hand, the dwarfs referred to are found within dead shells of *Illyonassa* or *Littorina* inhabited by the little hermit, *Eupagurus longicarpus,* and never exceed ¾ inch in length by ⅜ in breadth, i. e., they are about ⅓ the linear dimensions of the larger form. I removed from their shells a large number of individuals of both the common and the dwarfed forms, and estimated the volume of the body in the following way: The individuals were first placed on blotting paper to remove any excess of water, and then a given number were dropped into a known volume of water in a finely graduated tube. In this way the average body volume could be determined with sufficient accuracy. The results of very many such measurements in which mature females of all sizes were taken without any conscious selection of large or small individuals show that the average body volume of a mature female of *C. plana* is ⅔ cc., while the average volume of a mature female of the dwarf variety is $\frac{1}{20}$ cc., i. e., the average body volume of the typical form is about thirteen times that of the dwarf. This disproportion in size would be much greater if comparison were made between the largest individuals obtainable in the two classes since the dwarfs are much more uniform in size than the type forms.

This difference in size is not due merely to differences in the age of individuals compared, since only sexually mature females were chosen for purposes of measurement; all the individuals measured were carrying egg masses, and unless we assume that sexual maturity appears much earlier in the dwarfs than in the giants, we must conclude that they were of approximately the same age. A careful study of the shells of the dwarfs and giants also strengthens the view that the former are, on the whole, as old as the latter; for while the dwarf shells are much smaller and more delicate than those of the giants, they are, in no sense, immature in shape or character; the lines of growth are closely crowded together, the margin of the shell is frequently thickened, and its general shape differs from that of an immature shell.

The dwarfs are perfectly formed in all respects, and all organs of the body seem to be reduced in size in about the same proportion.[5] Strangely enough, however, the cells composing the various organs of the dwarfs are not reduced in size. It must follow, therefore, that a smaller *number* of cells are present in the various organs and also in the entire body of the dwarf than in the giant. It is an almost impossible task to count the actual number of cells present, even in a very small organ. I have, however, been able to count the number of cells in a cross section of the rectum, and while the size of the cells here, as everywhere, is the same in both varieties, the number of the cells in the sections is greater in the giants than in the dwarfs. Of all the cells of the body the ova are most readily enumerated; they are laid in capsules which can be easily counted, and each of which contains a nearly constant number of eggs. Oft repeated observations show that, without exception, the fertilized but unsegmented eggs of the dwarfs are of exactly the same size as those of the giants, but are very much fewer in number; e. g., the following table of averages has been obtained from a large number of observations:—

	Diam. of egg.	No. of caps.	Eggs in caps.	Total No.
C. plana (type)	.136 mm.	51	176	9,000
C. plana (dwarf)	.136 mm.	48	64	3,070

It is notable that the number of capsules formed is nearly the same in the two varieties, though there is a great difference in the number of eggs inclosed in each capsule.

In *Crepidula*, therefore, the cell size is constant, and variations in the size of the body are due to variations in the number of cells present.

This conclusion leads naturally to an inquiry as to the cause of the smaller number of cells, and hence the smaller size of the body of the dwarfs as compared with the giants. In this connection it will be remembered that Semper[6] long ago observed that the pond

[5] It is worthy of note that certain organs, particularly the gill filaments, are reduced in *number* in the smaller individuals but not in size, e. g., the numbers of gill filaments in three different individuals were as follows:—

Mature female . . Vol. of body, .75 cc., Gill filaments, 204.
Immature female . Vol. of body, .05 cc., Gill filaments, 53.
Dwarf female . . Vol. of body, .05 cc., Gill filaments, 58.

[6] Semper, Ueber die Wachsthumsbedingungen der *Linnæuss tagnalis.* Arb. aus dem. Zool. Zoot. Inst. Würzburg, Vol. 1, 1874, also Animal Life as affected by the Natural Conditions of Existence, 1879.

snail (*Limnæa stagnalis*) remained small when grown in a small quantity of water, while the larger the quantity of water, up to 4,000 or 5,000 cc., the larger the snails reared in it. As the result of numerous experiments, Semper concluded that this difference in size was not due to differences in the quantity of food, inorganic salts or oxygen obtainable, and he suggested that some unknown substance must be present in the water which acts as a stimulus to growth without actually contributing to it.

More recently, DeVarigny[7] has repeated these observations, and concludes, as the result of several experiments, that the relative volume of the water, in which the snails are grown, is much less important than the relative amount of surface exposed. He holds that the larger the surface the more exercise the animals are able to take, and, therefore, the larger they become. His results show that Semper's conclusions are untenable, but they by no means establish his own. It is certainly not generally true, as he holds, that physiological or mechanical impedimenta to movement result in dwarfing. The larger forms of *C. plana* are as immovably fixed as the dwarfs; in this case, therefore, movement can have nothing to do with body-size.

In *Crepidula*, the dwarfed form is unquestionably correlated with the smaller size of the shell in which it has found lodgement. It is possible that the diminished size is due to diminished supply of food or oxygen; however, the following observation is opposed to this view: I have never found more than one mature female in a shell inhabited by the small hermit, whereas, from four to eight very large individuals may be found in the shell of a large hermit; under these circumstances, it seems very improbable that the difference in size is due to differences in the amount of food or oxygen obtainable. The most natural interpretation is that the dwarfing is due to pressure which limits growth in various directions; though it must be confessed that the shell of the dwarf remains thin and delicate, whereas, the shells of the common form which are limited in growth by surrounding hard parts grow thick and have a distorted appearance. The fact, also, that the males of all these species, and especially of *C. plana*, remain very much smaller than the females (as is pointed out in Section III), speaks against the view that the smaller size is due to a diminution of food or oxygen, since the males have

[7] DeVarigny, Experimental Evolution, 1891.

the same opportunities in this regard as the much larger females; and the fact that the males are in no case limited for space in which to grow, as are the females, makes against the view that their small size, as compared with the females, is due to pressure. On the whole, it seems to me, that some factor, other than those mentioned, is involved.

Whatever the cause of the dwarfed form, it will be noted that in *Crepidula* it operates by stopping cell-growth and division, and the real causes of so fundamental a phenomenon are worthy of a more extended study than I have, as yet, been able to devote to it.

There is good evidence that these dwarfs are not a permanent variety or race. In the first place there are no anatomical differences between the two varieties save size only; secondly, the eggs, embryos and larvæ of the two cannot be distinguished · thirdly, there is evidence that the dwarfs do not produce enough eggs to continue the variety in its present numbers, for since the type and rate of development are the same in the two varieties, it is probable that relatively no more individuals will come to maturity in the one case than in the other, and yet every giant female produces three times as many ova as are produced by a dwarf; the relative number of these two varieties remains practically constant from year to year, and, therefore, I think it must follow that the ranks of the dwarfs are continually recruited from the descendants of the giants. Both live together on the same beach under about the same conditions of food, temperature and water, the embryonic and larval development of both forms are identical, and it seems probable that the adults of both would be the same if one was not forced by the smaller quarters which it inhabits to remain smaller than the other. But what is still more conclusive is the following observation: A few specimens were found which showed by the shape and character of their shells that at one time they had been typical dwarfs; afterward, having been detached, they obtained a new foothold on a larger surface, and their shells increased in size, the new portions of the shell becoming shaped so as to fit the surface upon which they had found a new home. In every such shell one can recognize both the dwarf and the normal forms. The dwarfs are what they are by reason of external conditions, and not because of inheritance; they are, in short, a physiological and not a morphological variety. In such a case the shape and size of the body, as well as the number of cells in the entire organism, are greatly modified by the direct action of environment. But in this case, as in that of the irregular shells mentioned above, I have found no evidence that these modifications have become in the least degree heritable.

III. Marked as is the environmental dimorphism in *C. plana*, the *sexual dimorphism* is even greater. The average body volume of a mature male of this species is about $\frac{1}{22}$ cc., while the volume of an adult female is about $\frac{2}{3}$ cc.; that is, the average female is almost 15 times as large as the average male. In all species of *Crepidula* the males are smaller than the females, though the difference in size is greatest in *C. plana*. The following table gives the actual and relative sizes of males and females of the different species:—

Species	Actual vol. of body.		Relative vol. of body.	
	Male.	Female.	Male.	Female.
C. plana, . .	.046 cc.	.667 cc.	1.	14.5
C. adunca, .	.025 cc.	.208 cc.	1.	8.3
C. convexa, .	.01 cc.	.05 cc.	1.	5.0
C. fornicata, .	1.25 cc.	1.6 cc.	1.	1.34

These averages are derived from the measurement of at least 20 mature individuals of each sex.

In the case of the males as in that of the dwarfs, the smaller size of the body is due to the smaller number of cells present rather than to the smaller size of the cells. Careful measurements of cells of the intestine, stomach, liver, kidney, muscles of foot, epithelium of gill chamber, and epithelium of gill filaments show that the cell size remains the same in the male as in the female. Whatever the ultimate cause of the smaller size of the males may be, it operates in this case as in that of the dwarfs by causing a cessation of cell growth and division.

In all these species the males are almost invariably found mounted upon the shells of the females, and in *plana*, *adunca* and *convexa* they are able to move about more or less freely, but the full-sized males of *fornicata* are as immovably fixed to one spot as are the females. In such cases sexual union could take place only between individuals attached near to each other. On muddy bottoms *C. fornicata* has the habit of piling together, one individual on top of another, until there may be as many as ten or twelve individuals in a single chain; such chains are often found in which there is not a single male, and yet I have never found an unfertilized female. Again, perfectly isolated females with large numbers of fertilized eggs are of frequent occurrence. In such cases I was, for a long time, puzzled to know how the eggs came to be fertilized. I afterward found by a study of serial sections that in the females of all the species there is a seminal receptacle in the form of a convoluted tubule which opens into the oviduct, and in all mature individuals this is filled with spermatozoa. These spermatozoa are attached by their apices to the walls of the receptacle; it is probable that they receive nutriment from these walls just as they do in the seminiferous tubules of the male, and that they can live indefinitely in this position. Since there are myriads of these spermatozoa in the receptacle, and since they are carefully conserved, as is shown by the facts that polyspermy rarely, if ever, occurs, and that no superfluous spermatozoa are found in the egg capsules or oviduct, it might well be that one sexual union would suffice for a life time. In some such way as this must be explained the fact that perfectly isolated females of *C. fornicata* lay eggs which are always fertilized, though both the full grown males and females of this species are perfectly sedentary.

In the case of the other species named, the males are never immovably fixed to one spot, they are able to move about slowly upon the surface of attachment, and, if detached, can obtain a new foothold; their shells, also, are not distorted so as to fit irregular surfaces as is the case with the females. In all cases locomotion is limited to small individuals. The young of all species and of both sexes crawl about freely and rapidly. In *C. convexa* individuals of both sexes retain this power to a limited extent, but the large females of *adunca*, *navicelloides* and *plana* become firmly fixed, whereas the males of these species remain relatively small and retain, to a certain extent, their power of locomotion. The larger any individual becomes, the more limited are its powers of movement, and it is evidently in relation to this fact that the males are so much smaller than the females; because of this marked sexual dimorphism, the large and sedentary females may be repeatedly, or, in *C. fornicata*, perhaps once for all, visited and fertilized by the smaller and motile males.

In *C. plana* the shell of the male is more nearly round than that of the female, and is usually sharply pointed at the apex; it is thicker than an immature shell, the edges being thickened and the lines of growth crowded together as is the case with the dwarfs. These characters are so constant that it is usually easy to distinguish a male from an immature female, as is shown in Plate XXIII, where immature individuals are shown in the first row, mature males in the second, and an immature female at the right end of the third row. To the left of this immature female are shown a number of individuals in which the older part of the shell has the male characters, while the newer part has those of the female. "In such animals the penis is usually very small, and, in some cases, has almost entirely disappeared. Quite a complete series of stages in the degeneration of this organ was observed, from the fully-formed organ on the one hand, to a minute papilla on the other. Sections of such animals show that neither male nor female sexual cells are produced at this time. The evidence seems to favor the view that we have, in these cases, an example of proterandric hermaphroditism, but I am not able to assert that this is really the case, although I have spent much time in attempting to decide it."[8] Further, I have not studied a sufficient number of cases to be able to decide whether this is a regularly occurring phenomenon or only an unusual and abnormal approach to hermaphroditism.

Explanation of Plates.

The plates are from photographs of actual specimens, and are reduced about one-third in size.

Plate XXI. Row 1. *C. convexa* from exterior of *Illyonassa*. The shells are deeply pigmented and highly arched; 3d to 6th show males attached.

Row 2. *C. convexa* (*C. glauca* Say) from flat surfaces, some from exterior of oyster shells. The shells are unusually flat and broad, and those from the oyster shells are light in color and mottled with brown spots.

Row 3. First five shells are *C. adunca*, all with males attached. Remainder of row and all of

Row 4. *C. navicelloides*; many of the shells irregular in shape.

Row 5. *C. fornicata;* various sizes, shapes and colors.

Plate XXII. All shells on this plate are of *C. plana*.

Row 1. Interior views of shells of very different shapes, due to the characters of the surfaces of attachment.

Row 2. Exterior views of same.

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[8] Embryology of Crepidula, Jour. Morph., Vol. XIII.

Row 3. Exterior views of dwarfs (mature females) from interior of *Illyonassa* and *Littorina* shells inhabited by the small hermit crab.

Row 4. Interior views of same. Last five shells in row males and immature forms of dwarfs.

Plate XXIII. All shells shown are those of *C. plana*.

Row 1. Immature forms; not differentiated sexually.

Row 2. Mature males.

Row 3. First six, mature males; seventh to tenth, forms intermediate between males and females; last shell in row immature female.

Row 4. Mature females; a few with males attached.

CONTRIBUTIONS TO A KNOWLEDGE OF THE HYMENOPTERA OF BRAZIL, NO. 5.—VESPIDÆ.

BY WILLIAM J. FOX.

This paper relates solely to the social wasps, which are, in the present author's opinion, not only distinct in their habits from the solitary species, but differ also in having the middle tibiæ always with two spurs.

In stating the sex of a specimen throughout this paper I have not been quite sure whether certain specimens represented females or workers, and therefore, when the sex represented is other than the male, I have written female, *or* worker.

I understand it is the intention of Mr. Herbert Smith to contribute a memoir on the nests of these insects of which he has a large number. These are at present stored away in boxes and are unavailable. Therefore, for the descriptions of the nests of the new and other species noted herein those interested must await Mr. Smith's return from South America where he expects to pass two years collecting natural history specimens.

Mischocyttarus labiatus Fabr.

Rio de Janeiro, October, November; Mararu, April; Chapada, March, April; Uacarizal, February; Pedra Branca, April; Santarem. About 50 specimens.

Apoica pallida Oliv.

Rio de Janeiro, November; Chapada, January, April, October; Santarem. Fifteen specimens.

This is quite a variable species the body color running from entirely whitish-yellow to dark brown. The following forms are in the collection:

1. Entirely yellowish-white; antennæ white at tip; costal cell clear, wings whitish.

2. Yellowish-white, with vertex, dorsulum in part, sutures of thorax, legs, petiole at base, and apical margins of segments obscurely, pale brown; costal cell a little ferruginous, wings whitish.

3. Same as No. 2, but with dorsulum entirely brown, which color is well spread out over the entire thorax but in a very pale tint;

abdomen whitish above; costal cell quite ferruginous, the wings not whitish, dark subhyaline.

4. Head, thorax, legs and petiole quite brown, the cheeks, pronotum laterally, postscutellum, middle segment apically, and body of abdomen pale yellowish; wings colored as in No. 3.

5. Entirely brown; posterior margin of pronotum, two spots on scutellum and postscutellum, apical margin of segments 1–5, and greater part of sixth, yellowish wings as in No. 3. (=*arborea?*).

6. Dark brown, the thorax above black; first abdominal segment narrowly yellow at apex; wings as in No. 3; size large.

It is quite probable that *A. virginea* and *arborea* are only varieties of *A. pallida*.

Synoeca testacea Sauss.

Mararu, April, May; Santarem. Eight specimens.

Synoeca surinama Linné.

A large series from Chapada, January to April, October; Uacarizal, February; Rio de Janeiro, November; Santarem.

Synoeca cyanea Fabr.

Rio de Janeiro, November. Two specimens.

Synoeca azurea Sauss.

One specimen. Chapada, December. In addition to the bluer color and prominent tubercles of petioles this species is peculiar for its small head which is barely as wide as thorax.

The collection also contains a single ♂ specimen with the second submarginal cell greatly narrowed above, the distance between the first and second transverso-cubital veins at the top less than that between the recurrent veins on the cubital vein. The head is about as wide as thorax. Otherwise it is very close to *surinama*.

Polistes Ferreri Sauss.

A large series from Corumbá, Chapada, Santarem and Rio de Janeiro.

Polistes bicolor Lep.

Two specimens. Santarem.

Polistes versicolor Oliv.

About 75 specimens. Benevedes, July; Mararu, April; Rio de Janeiro, October and November; Chapada, April and October; Santarem. The maculation of abdomen varies from a simple yellow band at apex of first segment to forms with the abdomen almost entirely yellow.

Polistes carnifex Fabr.

Chapada, October, December, January; Rio de Janeiro, November; Corumbá, April; Santarem. Nine specimens.

Polistes ruficornis Sauss.

Chapada, February to April, June. About 35 specimens. The amount of red and black on thorax is variable. The prothorax and scutellum may be either color.

Polistes cinerascens Sauss.

Chapada, February, March, June; Rio de Janeiro, November. Ten specimens.

Polistes pacificus Fabr.

Mararu, April; Santarem. Six specimens.

Polistes acteon Hal.

One specimen. Rio de Janeiro, November.

Polistes subsericeus Sauss.

Sixteen specimens. Chapada, March and December.

Polistes thoracicus n. sp.

Brick red; sides of middle segment, metapleura and mesopleuræ sometimes, and four hind coxæ, more or less, black; wings yellowish. The following parts are obscurely yellow, or of a paler tint than most of body: head in front, cheeks, hind margin of pronotum, tegulæ, scutellum, postscutellum, apical margin of segment 1 and 2, and 3–6 entirely yellow.

♀.—Clypeus longer than broad, obtusely angular anteriorly; space between hind ocelli about equal to half that between them and eyes, the latter separated from base of mandibles by a distance equal to the fourth, fifth and half of sixth joints of antennæ; pronotum strongly margined; dorsulum nearly one-quarter longer than broad; middle segment with indistinct transverse striations. Length 16–17 mm.

☿.—Antennæ longer; striation of middle segment coarser.

Chapada, February to April. Related to *P. carnifex*, but is much smaller, with black sides of thorax, comparatively longer clypeus. It is larger than *P. ruficornis*, of which it might be taken for a variety, and the clypeus is much longer. The coloration is quite constant in the six specimens before me.

Polistes geminatus n. sp.

Head, dorsulum and abdomen black; mouth, antennæ beneath basally, thorax on sides and beneath, legs and base of first segment, reddish-brown; inner and posterior orbits, clypeus at sides and apically, inner margin of mandibles, scape beneath, line on pronotum anteriorly and posteriorly, tegulæ, line on anterior part of scutellum and postscutellum, two broad stripes on middle segment, a small spot near base on each side, spot at sides of scutella, and at top of metapleuræ, stripe on four hind coxæ, apex of middle segment, two spots on first segment of abdomen, its posterior margin, and posterior margin of segments 2 and 3, or 2–4, narrowly, yellow; wings light fuso-hyaline, costal cell somewhat yellowish; femora sometimes striped with yellow.

♀.—Clypeus about as broad as long, obtusely angular anteriorly, rather distinctly punctured; space between hind ocelli equal to nearly two-thirds of that between them and eyes, the space between the latter and base of mandibles not equal to the width of the latter; pronotum margined; dorsulum more than one-quarter longer than broad. Length 14 mm.

Var.—Clypeus entirely black; femora striped with yellow; lateral spot of first segment coalescing with the yellow at apex. Length 13 mm.

Chapada, March. Two specimens. Resembles *P. cinerascens*, but differs in color of wings. In the bi-spotted first segment it seems to have some resemblance to *P. biguttatus*, but that species is quite differently colored, judging from the description.

Polybia fulvofasciata DeG.

Chapada, January, April, September to December. Forty-three specimens.

Polybia fasciata Lep.

Chapada, February, March, June, September, October. About one hundred specimens.

Leipomeles lamellaria Möbius is colored precisely as *P. fasciata* judging from the description. Are they perhaps identical? *P. fasciata* is a *Polybia*, however.

Polybia fastidiosuscula Sauss.

Over 100 specimens. Chapada, April, September to November.

Polybia surinamensis Sauss.

Rio de Janeiro (July, November); Mararu (April); Santarem. Sixteen specimens.

Polybia occidentalis Oliv. (=*pygmæa* Fabr.).

About 250 specimens of typical *occidentalis*, and over 60 representing *pygmæa* Fabr., which I regard as a variety of this species. The large series before me shows that the two supposed species intergrade. Both forms seem to occur in the same localities simultaneously. From Chapada, Santarem and Rio de Janeiro, March, April, September, October.

Quite as large a series of individuals, having the head reddish, is also represented. This form is not distinct as a species from *occidentalis*. Occurs in the same regions and at same time as typical *occidentalis*.

Polybia oecodoma Sauss.

Rio de Janeiro and Chapada in November. Six examples.

Polybia scutellaris White.

Chapada, March, October, December. Nearly 100 specimens, of which 90 per cent., represent a variety with the head and part of thorax above, rusty-red.

Polybia pumila Sauss.

About 100 specimens from Chapada and Sebastiæ. March, April, October, November.

Polybia pediculata Sauss.

Chapada, October; Pará, June; Santarem. Over 60 examples.

Polybia rejecta Fabr.

Mararu, April; Chapada, January, April, September, October; Santarem; Sebastiæ, October. About 50 specimens, whose coloration is quite constant.

P. bicolor Smith is evidently synonymous with *rejecta*.

Polybia Jurinei Sauss.

Over 60 examples, not showing any variation of color. Chapada, January, September, December; Rio de Janeiro, November; Mararu, April; Santarem.

Polybia metathoracica Sauss.

Chapada and Mararu (April); Santarem. Three specimens of the typical form.

Polybia bifasciata Sauss.

Two specimens from Santarem.

Polybia rufidens Sauss.

Two specimens. Corumbá (April); Chapada (May).

Polybia atra Oliv.

Chapada, January, March–June, August, December; Santarem. About 250 examples.

Polybia dimidiata Oliv.

Chapada, January, April, October to December. Thirty-four specimens.

Polybia socialis Sauss.

A single specimen from Rio de Janeiro, November.

Polybia sylveiræ Sauss.

Three specimens, Rio de Janeiro, November. *P. enxius* Smith seems to be identical with *sylveiræ*.

Polybia pallipes Oliv.

The series before me shows that in coloration this species merges from the form figured by Saussure on Pl. XXV (fig. 2) of his work, abdomen brownish or blackish, into the species known as *fulvo-fasciata* DeGeer. The latter has the wings quite yellow, however, whereas in *pallipes* they are subhyaline.

About 45 specimens. Chapada, January, March, April, September, October, December; Corumbá, April, May; Pedra Branca, April; Rio de Janeiro, November; Santarem, February.

Polybia vespiceps Sauss.

Sebastiæ, October; Chapada. About 60 specimens.

Polybia liliacea Sauss.

A large series of this species from Chapada, March, April, September, October, December; Mararu, April; Santarem.

Polybia angulata Fabr.

Eleven specimens from Santarem.

Polybia carbonaria Sauss.

There is a single male in the collection from Rio de Janeiro, November, which I doubtfully refer to this species. Saussure described the female only.

Polybia angulicallis Spin.

Two specimens. Santarem.

Polybia lugubris Sauss.

Rio de Janeiro, November. One specimen.

Polybia flavicans Fabr. (=*testacea* Fabr.).

Mararu, April; Santarem. Eighteen specimens.

Polybia paraensis Sauss.

Same localities as *flavicans*. Five specimens.

Polybia chrysothorax Licht.

Chapada, January–April, October; Mararu, April; Santarem. About 40 specimens.

Polybia sericea Oliv.

Nearly 200 specimens from various localities. The coloration seems quite constant, no specimens of the variety with "abdomen brunatre," mentioned by Saussure, being present.

Polybia mexicana Sauss.

Four specimens from Rio de Janeiro in November, are perhaps this species, as near as can be judged from the description. The legs are apparently yellower and the body darker than in *mexicana*, which species, however, is quite variable according to Saussure.

Polybia infernalis Sauss.

Santarem. Two specimens. One has quite distinct abdominal fasciæ.

Polybia emaciata Luc.

Twelve specimens from Mararu, April, and Santarem, agree with the description of this species, except that the dark spot on vertex is wanting.

Polybia sedula Sauss.

Over 75 specimens. Chapada, March, September, October; Mararu, April; Sebastiæ.

Polybia latior n. sp.

♀ or ☿.—Black, with a silky pile; legs brownish the four hind coxæ striped with yellow, and a narrow yellow stripe on postscutellum.

Clypeus distinctly broader than long with tolerably strong punctures; ocelli in an equilateral triangle, the space between hind pair equal to considerably more than half that between them and eyes; latter almost reaching mandibles; flagellum subclavate, the first joint about as long as two following united; pronotum short, finely margined; dorsulum fully one-quarter longer than broad; middle segment short, not longer than scutellum and postscutellum, sulcate down middle, subconcave; petiole of abdomen slender, but broadened from beyond middle, so that it becomes somewhat infundibuliform, in length longer than hind femur; remainder of abdomen ovate; wings brownish basally and in the costal cell, otherwise dark subhyaline, with nervures and stigma brownish; third submarginal cell rhomboidal, higher than long, its outer nervure strongly sinuate. Length 12–13 mm.

Chapada, October. Three specimens. Belongs apparently to Saussure's IV Division My., and is allied to *P. constructor*. Viewed from above the shape of petiole greatly resembles the lower part of a horse's fore leg seen from the front, the swollen portion representing the hoof.

Polybia flavitincta n. sp.

♀ or ☿.—Black, with a dense silky, brown pile; flagellum, tegulæ and legs from tip of femora, ferruginous brown; a narrow line on pronotum posteriorly, and at apex of petiole, yellowish.

Clypeus a little broader than long, with a few large punctures anteriorly; ocelli in a high triangle, in consequence of the hind pair being much closer than they are to the anterior one; flagellum subclavate, the first joint a little longer than the two following united; eyes almost reaching the mandibles; pronotum tolerably well developed above, not margined or ridged; dorsulum broad and short, its length barely one-fifth greater than its width; middle segment short, almost perpendicular, strongly sulcate down middle, and with distinct separated punctures, and silvery pile apically; petiole of abdomen elongate, about as long as hind femur, slender basally and suddenly broadened beyond middle, so that it presents an infundibulate appearance; remainder of abdomen short-ovate; superior wings strongly yellowish anteriorly, otherwise the wings dark subhyaline, nervures and stigma yellowish; second submarginal cell quite triangular; third submarginal rhomboidal, higher than long, distinctly narrowed above, its outer nervure a little curved near the top. Length 14 mm.

Santarem. Two specimens. Allied to *P. lugubris.* In coloration it more closely resembles *P. angulicallis,* but the prothorax is not produced as in that species.

Polybia tinctipennis n. sp.

♀ or ☿.—Black, with brownish silky pile; legs and tegulæ brown; posterior margins of pronotum and petiole with an obscure narrow, yellow line; superior wings fuscous on basal two-thirds, especially in costal cell with dark nervures, the apical third whitish-yellow, with yellowish nervures and stigma.

Clypeus subcordate, nearly as broad as long, with large scattered punctures throughout; ocelli forming an almost equilateral triangle, the space between hind pair, however, slightly less than that separating them from the anterior one, and not nearly equal to half the distance between them and eyes; the latter not reaching base of mandibles, being separated from them at their closest proximity by a distance nearly equalling the length of fourth antennal joint; pronotum short, finely margined or carinated at the sides anteriorly, but not medially; dorsulum at least one-quarter longer than broad; scutellum, postscutellum and metathorax strongly punctured, all three more or less sulcate down middle, especially the middle segment which has the furrow much broadened apically; sides of thorax strongly punctured; petiole, distinctly punctured, shorter if anything than hind femur, somewhat clavate, being gradually broadened from before the middle, the basal third stem-like; remainder of abdomen cordate; second submarginal cell short, much higher than long and narrowed above; third submarginal rhomboidal, higher than long, somewhat narrowed above, the outer nervure sinuate. Length 13 mm.

Chapada, September and December. Two specimens. Belongs to Saussure's IV Division My. Its resemblance to *P. socialis* is only superficial. The shape of petiole is nearly as in *P. lugubris*, but is more slender.

Polybia chapadæ n. sp.

♀ or ☿.—Ferruginous; body of abdomen, sides of prothorax and mesopleuræ sometimes darker; two broad oblique marks uniting in V-form on front, and the occiput black; antennæ dark above; clypeus, mandibles except tips, inner and posterior orbits, two oblique lines on vertex behind ocelli, lines on pronotum anteriorly and posteriorly, two rather indistinct lines on dorsulum, scutellum and postscutellum anteriorly, tegulæ, spot at top of meso- and metapleuræ, two broad lines on middle segment, four anterior coxæ beneath, stripe on hind coxæ, spot at tip of all femora, (sometimes obscure), and apical margin of abdominal segments 1–3 or 1–6, or the first only, yellowish.

Clypeus about as broad as long, not distinctly punctured; ocelli forming an equilateral triangle, the space between hind pair a little less than that between them and eyes; the latter almost reaching mandibles; first joint of flagellum as long as the second, third and most of fourth; pronotum short, margined; dorsulum more than one-quarter longer than broad; middle segment broadly channelled, down middle almost concave; petiole of abdomen about as long as hind femur, elongate, tolerably slender, broadened gradually and gently from beyond middle; remainder of abdomen ovate; wings dark subhyaline, faintly yellowish in the costal cell; nervures and stigma brownish; third submarginal higher than long, the outer nervure curved, and just before its junction with the cubital nervure, angulate. Length 15 mm.

Chapada, February. Three examples. Belongs to Saussure's V, Division Kappa, and is apparently allied to *P. raphigastra.* The petiole is more broadened at apex than in *P. surinamensis,* and the body quite robust.

Polybia gorytoides n. sp.

♀ or ☿.—Blackish or dark brown; head, except a broad transverse stripe on vertex, thorax entirely on sides and beneath, pronotum except an oblique stripe on each side, two stripes on dorsulum, scutellum and postscutellum except posterior margins, middle segment except in longitudinal furrow, legs (tarsi darker), abdomen entirely beneath, first dorsal segment at sides and apex, apical margin of dorsals 2–6, yellow, that on second dorsal extending to base at sides.

Clypeus broader than long, with a few large punctures, its fore margin sharply angular; ocelli forming a rather high triangle, the space between hind pair less than that between them and anterior one, and not equal to half the distance between them and eyes; the latter almost reaching base of mandibles; vertex distinctly punctured; flagellum clavate, the first joint about as long as the two following united; pronotum indistinctly margined; dorsulum punctured, but not very strongly, about one-fifth longer than broad; middle segment broadly furrowed, rather flat, and sloping evenly from base to apex; first abdominal segment subcampanulate, much shorter than hind femur, not much longer than first hind tarsal joint; remainder of abdomen subpyriform, very broad at base, acute at apex; wings subhyaline, very faintly yellowish along costa; nervures and stigma yellowish; third submarginal cell longer than high, twice as long, or more, than second, a little narrowed above, the outer nervure gently sinuated. Length 10½ mm.

Var.—Reddish-testaceous, with the yellow marking obscure, the stripe on dorsulum wanting; black spot on vertex quite prominent.

Chapada, September; Santarem. Twelve specimens. Belongs perhaps to Saussure's II, Division Iota, but the third submarginal cell is longer than high; otherwise it agrees with the characteristics of that group. It has a strong superficial resemblance to some species of *Gorytes*. The variety mentioned comes from Santarem.

Polybia suffusa n. sp.

♀ or ☿.—Black; scape and pedicel, pronotum more or less, body of abdomen, and legs in part, obscure ferruginous-brown; mandibles, fore margin of clypeus, spot on inner orbits at base of clypeus and at bottom of cheeks, pronotum anteriorly and posteriorly, two spots on mesopleura, one at top of metapleura, scutellum, post-scutellum, middle segment except on sides, base of petiole and a fascia at its apex which is extended along the sides, and a fascia at apex of segments 2–5, yellow; head and thorax with a golden pile, not very dense, however.

Clypeus broader than long, not distinctly punctured, its fore margin acutely angulate; front with shallow punctures; ocelli form a high triangle; eyes barely reaching base of mandibles, at any rate they are more distant than in *P. pediculata*, to which *suffusa* is related; flagellum clavate, the first joint nearly as long as three following united; dorsulum about as broad as long; middle segment with shallow punctures, strongly furrowed down middle, more so than in *pediculata*; petiole, if anything, slightly longer than hind femur, slender, strongly dentate behind middle, and a little dilated from the teeth to apex; remainder of abdomen cordate; wings subhyaline, strongly iridescent; nervures and stigma dark brown; third submarginal longer than high, three times as long as second, slightly narrowed above, the outer nervure sinuous. Length 7–8 mm.

Chapada, May and October. About 60 specimens. This species is closely allied to *P. pediculata*, but differs in coloration, less triangular second submarginal, and generally more slender form. The petiole is shaped almost precisely as in *pediculata*.

Polybia frontalis n. sp.

♀ or ☿, and ♂.—Black; front, clypeus and most of scape, reddish-yellow; posterior orbits, narrow line on pronotum anteriorly and posteriorly, spot beneath wings, postscutellum except apex, tips of all femora, spot at tips of four anterior tibiæ, and a narrow line, sometimes wanting at apex of petiole, pale yellow; mandibles reddish.

Clypeus with shallow punctures, broader than long, obtusely angular anteriorly; ocelli forming a low triangle in consequence of the hind pair being nearly twice as far apart as they are from the anterior one, the distance between the hind pair about equal to that between them and eyes; the latter almost reaching base of mandibles; flagellum subclavate, the first joint about as long as the following two united; pronotum short, margined; dorsulum barely longer than broad, middle segment short, rather concave, with a narrow raised line down middle on each side of which there is a furrow; petiole shorter than hind femur, elongate and tolerably stout, gradually enlarged from near base, much more slender than in *P. socialis;* remainder of abdomen subovate; legs robust; wings subhyaline throughout; nervures and stigma dark; third submarginal cell higher than long, the outer nervure angulate before its junction with the cubital vein. Length 11–12 mm.

♂.—Colored like ♀ or ☿, but having the usual sexual differences; smaller clypeus, narrower front, antennæ longer and acuminate at tip; otherwise agreeing with the preceding description.

Chapada, October and November. Ten females (workers?), one male. Allied to *P. socialis,* but the more slender petiole excludes it from Saussure's II, Division Iota. These divisions are not natural, however.

Polybia marginata n. sp.

♀ or ☿—Thorax, petiole and legs reddish-brown, the first mentioned with thin golden pile; head, and body of abdomen black; sides of thorax and petiole apically dusky; line on inner orbits below emargination, on posterior orbits above, line on pronotum anteriorly and posteriorly, fore margin of postscutellum, two lines on middle segment, spot on four hind coxæ, and at tip of all femora, pale yellow.

Head subquadrate, not very transverse; ocelli forming an equilateral triangle; first joint of flagellum nearly as long as the three following united; pronotum sharply margined anteriorly; dorsulum about one-fifth longer than broad; middle segment concave medially; petiole elongate, slender, broadened from beyond middle, altogether more slender than *P. sericea,* in length greater, if anything, than hind femur; wings dark, paler apically, black in costal cell; breadth of second and third submarginal cells at the top nearly equal. Length 15 mm.

Chapada, September, October. Four specimens. Is the exact counterpart of *P. sericea* superficially, but differs by the squarer head, margined pronotum, more slender petiole, shorter dorsulum, etc.

Tatua morio Fabr.

Chapada, January, November, December; Santarem. About 40 specimens.

Chartergus apicalis Fabr.

Over 60 specimens. Sebastiæ, October; Chapada, October to December; Corumbá and Mararu, April.

Chartergus Smithii Sauss.

One example. Corumbá, April.

Chartergus ater Sauss.

Two specimens. Chapada, January; Santarem, April.

Chartergus chartarius Oliv.

Chapada, March and October; Santarem. Nearly 50 specimens.

Chartergus globiventris Sauss.

Sebastiæ, October. Two specimens (♀ ♂). The male closely resembles the female, but has the clypeus entirely, a spot on scape beneath, spot on all femora beneath near apex, and all the coxæ beneath, pale yellow; the clypeus is considerably smaller.

Chartergus fasciatus n. sp.

♀ or ☿.—Black; head below insertion of antennæ, cheeks, scape, pronotum except a blotch on each side, scutellum anteriorly, middle segment entirely, mesopleuræ except medially, legs including coxæ, a fascia on segments 1–3 at apex, segments 4–6 and ventrals entirely, yellow; flagellum black above, reddish-yellow beneath.

Differs from *C. Smithii* other than in coloration, as follows: dorsulum shorter, nearly as broad as long; scutellum and post-scutellum smaller, the latter not tuberculate medially; the wings are colored as in *Smithii*, but the superiors have a pale band crossing them and including the space between the apex of the costal, base of second discoidal, and base of third submarginal cells, the veins included in this region, and the stigma are whitish-yellow, elsewhere dark; neuration nearly as in *Smithii*. Length 7½ mm.

Mararu, April. One specimen.

Chartergus griseus n. sp.

♀ or ☿.—Black; head in front, cheeks, scape and pedicel of antennæ, orange; tibiæ and tarsi more or less brown, the anteriors palest; thorax and abdomen with a thin griseus pubescence, more obvious on middle segment; posterior margin of pronotum yellowish medially as a rule.

Clypeus obtusely angulate; flagellum scarcely clavate; ocelli forming a high triangle, the space between hind pair much less than that between them and the anterior one; pronotum with a tolerably long dorsal surface, much longer than in *C. ater*, sharply margined anteriorly, and, with the dorsulum, rather coarsely punctured, remainder of thorax similarly punctured; postscutellum not tuberculate; middle segment shallowly concave; abdomen ovate; wings subhyaline, the anterior margin of the superiors, including the marginal cell, fuscous; nervures and stigma black; second submarginal triangular, much narrowed above, the third rhomboidal narrowed above, the outer nervure nearly straight. Length 7½ mm.

Mararu, April; Santarem. Nine specimens.

CHARTERGINUS gen. nov.

Head flat, transverse, the development of cheeks varying in the different species, but less than in *Chartergus*. *Front long and rather narrow. Eyes long and narrow*, practically reaching base of mandibles. *Mandibles slender, contracted medially*, with four distinct teeth on inner margin ranging from the apex, which is not truncated as in *Chartergus* or *Polybia*, but shaped somewhat as in *Nectarinia*. Maxillary palpi 6-jointed, the first and last joints longest; labial palpi 4-jointed, the basal joint longest, the second and third shortest. Clypeus truncate or acuminate at tip; *antennæ inserted at base of clypeus*. Thorax truncate anteriorly, shaped throughout as in *Chartergus*, the scutellum scarcely raised above the level of postscutellum, *and not emarginate*. Middle segment concave, the sides not angularly produced or spinose; tibial spurs 1–2–2. Abdomen with *first segment campanulate*, practically sessile with second segment, *with a basal petiole* varying in length in the different species, in some species almost wanting. Neuration of wings as in *Chartergus*.

Type: *C. fulvus*.

Charterginus is intermediate between *Chartergus* and *Nectarinia*. It is more closely allied to the former genus, from which it differs by the slender mandibles, flatter head and differently shaped first abdominal segment.

Charterginus fulvus n. sp.

♀ or ☿.—Entirely fulvous; a broad stripe across vertex, flagellum above, and sometimes the suture between dorsulum and scutellum and a spot on second dorsal segment medially, black or blackish; clypeus paler yellow.

Clypeus much longer than broad, with large, shallow, scattered punctures, its fore margin broadly truncate; vertex with strong, separated punctures; ocelli forming an equilateral triangle, the space between hind pair about one-third less than that between them and eyes, the latter almost reaching base of manibles; flagellum clavate, first joint longer than second, but distinctly shorter than the combined length of second and third; occiput sharply margined posteriorly; pronotum medially with a distinct surface, transversely margined on each side; thorax strongly punctured; dorsulum a little longer than broad; postscutellum with a distinct tubercle medially; middle segment strongly swollen on each side posteriorly, not compressed; abdomen strongly punctured, first segment campanulate, with a basal petiole nearly as long as first hind tarsal joint, transversely impressed before apical margin; wings subhyaline, black along costal margin, as are also the nervures and stigma; second submarginal cell triangular, narrowed more than two-thirds above; third submarginal longer than high, subquadrate, narrowed about one quarter above. Length 7–8 mm.

Mararu, April; Santarem. Eight specimens. Judging from description, *C. fulvus* must greatly resemble *Chartergus colobopterus*, but the dorsulum is not black as in that species, which is apparently a typical *Chartergus*, with short first abdominal segment.

Charterginus fuscatus n. sp.

♀ or ☿.—Black, with brownish pile; line on inner orbits below emargination, continued along the sides of clypeus to apex, and narrower line on posterior orbits, pale yellow; first dorsal segment at apex narrowly and obscurely yellowish.

Head very flat, the cheeks scarcely developed; clypeus longer than broad, pyriform, acuminate at apex, finely punctured; front with shallow punctures; ocelli almost forming a curved line, the hind pair separated by a much greater distance than they are from the anterior one, and almost equal to that between them and eyes;

the latter narrow and long, fully reaching base of mandibles; thorax strongly punctured; pronotum very sharply margined anteriorly, with a distinct medial surface; dorsulum nearly one-quarter longer than broad; postscutellum not tuberculate, triangular, the posterior margin extended; middle segment strongly concave, more or less compressed laterally; abdomen strongly punctured, the first segment short, campanulate, the basal petiole scarcely evident; wings subhyaline, black in the costal cell; third submarginal much longer than high, narrowed about one-third above, the outer nervure strongly sinuate; nervures and stigma black. Length 8 mm.

Mararu, April. One specimen.

Charterginus cinctellus n. sp.

♀ or ☿.—Black; line on inner orbits below emargination, extending along sides of clypeus to apex, narrow line on posterior orbits, two short curved lines (sometimes wanting) on vertex, line on pronotum anteriorly, and a short one on posterior margin just before tegulæ, anterior margin of scutellum and postscutellum, and a fascia at apex of abdominal segments 1–5, pale yellow; scape reddish beneath.

Head about as in *fuscatus;* middle segment not as strongly margined, shorter medially; dorsulum shorter, not one-quarter longer than broad; postscutellum similar, but not as triangular; first dorsal segment short, campanulate, the basal petiole quite short, but still more evident than in *C. fuscatus;* wings subhyaline throughout; nervures and stigma black; third submarginal cell a little higher than long, narrowed about one-fifth above. Length 7 mm.

Chapada, October. Seven specimens. Has a superficial resemblance to *Chartergus chartarius*, but is smaller.

Nectarinia Lecheguana Latr.

About 50 specimens. Chapada, January, June, September to December; Corumbá, March; Santarem.

Nectarinia bilineolata Spin.

Chapada, January, March, May, November, December. Thirty-five specimens.

Nectarinia Augusti Sauss.

Chapada, same months as *bilineolata;* Santarem. Twenty-five specimens.

Nectarinia scutellata Spin.

Chapada, December. One example.

NEW CRETACEOUS FOSSILS FROM AN ARTESIAN WELL-BORING AT MOUNT LAUREL, N. J.

BY C. W. JOHNSON.

The following material was obtained by Mr. Lewis Woolman from the borings of an artesian well on the farm of Mrs. Samuel Shreeve, Mount Laurel, Burlington County, N. J. The well was put down on the 70 feet contour near the base of the southern slope of Mount Laurel. The following section, published by Mr. Woolman,[1] was given him by the contractor, Mr. Wm. C. Barr:—

Commenced in the bottom of a dug well at the depth of...		25 feet.		
Reddish-gray sand..............	31 feet =	56 feet.	Matawan clay marls.	Cretaceous.
Black clay.........................	175 feet =	231 feet.	Matawan clay marls.	Cretaceous.
A few *molluscan fossils* at about 100 feet.				
Numerous mollusks at 150 to 160 feet.				
Tough green clay...............	30 feet =	262 feet.	Matawan clay marls.	Cretaceous.
Dark-bluish clay................	42 feet =	304 feet.	Matawan clay marls.	Cretaceous.
Gray sand, *water bearing*......	2 feet =	306 feet.	Sewell water horizon.	Cretaceous.
Stopped on a whitish clay.				

Mr. Woolman states that: "The whitish clay on which this boring stopped is probably equivalent in horizon with certain alternating laminæ of whitish clays and sands that were found near the bases of the wells at the Wenonah Hotel and at Sewell. Beneath these laminæ, at the last two named localities, occur coarse sands and gravels with large pebbles, forming an open stratum from which an abundant and excellent supply of water is obtained. The water horizon reached at Mount Laurel may be considered as practically the same. We have designated this as the Sewell water horizon. Its position is at the base of the Matawan clay marls and the top of the Raritan plastic clay series, and has a thickness, if we may judge by the boring at Sewell, of at least forty feet."

A comparison of these fossils with those obtained by the writer for the Museum of the Wagner Free Institute of Science from the banks of the Chattahoochie River, below Eufaula, Alabama, shows that this

[1] Report on Artesian Wells in New Jersey, by Lewis Woolman, from the Geol. Survey of N. J. Ann. Rept. for 1897, p. 262.

fossiliferous stratum is equivalent to the Ripley bed of Alabama, Mississippi and Texas, which is also represented in North Carolina, especially at Snow Hill, Greene County.[2]

The following is a list of fossils obtained from the well :—

Ostrea plumosa Morton.
Exogyra costata Say.
Anomia tellinoides Morton.
Camptonectes burlingtonensis Gabb.
Pinna sp.?
Pteria sp.?
Trigoniarca cuneata Gabb.
Pectunculus sp.?
Nucula percrassa Conrad.
Nucula sp.?
Leda sp.?
Trigonia thoracica Morton.
Lucina cretacea Conrad.
Cardium eufaulense Conrad.
Veniella conradi Morton.
Veleda lintea Conrad.
Leptosolen biplicata Conrad.
Legumen sp.?
Corbula crassiplicata Gabb.
Corbula foulkei Lea.
Dentalium sp.?
Cinulia costata n. sp.
Pyrifusus subdensatus Conrad.
Alaria rostrata Gabb.
Anchura sp.? (expansion of outer lip only).
Anchura? *pergracilis* n. sp.
Pugnellus densatus Conrad.
Lunatia halli Gabb.
Trichotropis cancellaria Conrad.
Scalaria sillimani Morton.
Turritella vertebroides Morton.
Turritella quadrilira n. sp.
Tuba(?) *reticulata* n. sp.
Placentaceras placenta Dekay.
Hamulus squamosus Gabb.
Platytrochus speciosus Gabb & Horn.

Cinulia costata n. sp. (fig. 1).

Cinulia costata Johnson, n. sp. Annual Rept. Geol. Sur. N. J., 1897, page 264, name only.

Shell with four whorls, spire prominent, body whorl with from 12 to 13 revolving grooves, which form an equal number of smooth, flat, revolving costæ; these average about double the width of the grooves. In one specimen the third and fifth costæ from the suture are almost twice the width of the others, and the two lower costæ divided by a minute, impressed line. The first spiral whorl has six, and the second five, revolving grooves. Apical whorl smooth, suture deeply impressed. Aperture narrow, oblique, lip broad, thick and crenulated on the inner margin with eight small teeth-like projections, and extend-

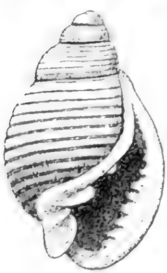

Fig. 1.

[2] Conrad, in Kerr's Geology of North Carolina, Appendix, Vol. I, 1875.

ing to the suture where it joins the callus of the peristome, which is continuous to the base of the columella; base with two oblique folds, above which is a prominent fold or plate extending at almost right angles to the columella; between this and the posterior angle of the aperture is a small, tooth-like projection.

Alt. 4, diam. 2½ mill.

Three adults and two juvenile specimens in the collection of the Academy of Natural Sciences of Philadelphia.

Anchura? pergracilis n. sp. (fig. 2).

Anchura sp.? (young). Annual Rept. Geol. Survey N. J., 1897, page 264.

Shell fusiform, whorls convex, the body whorl with about 18 and the spiral whorls with 15 equidistant, flexuous, longitudinal ribs; numerous fine revolving lines, more prominent between the ribs, and somewhat obsolete on the angles of the ribs, cover the entire shell; suture deeply impressed. The length of the largest specimen (including the two apical whorls, which are wanting), is about 20 mill.

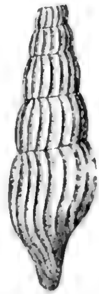

Fig. 2.

I would hesitate in describing this young shell if it were possible to determine the *shells* of this group from the figures and description of the casts that have already been described. This species can always be determined, but in identifying casts when the external characters are unknown, there is always more or less doubt, even when one has access to the types.

Anchura sp.?

This species is represented only by a fragment, the expanded portion of the outer lip. This resembles somewhat that of *Anchura abrupta* Conrad (Jour. Acad. Natural Sciences, 2d series, IV, 284, pl. 47, fig. 1), but has on the lower or anterior edge a small projection or angle near the base (fig. 3), but no downward projection at the end. It probably represents a new species. Length of specimen, 18 mill.

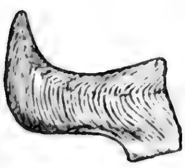

Fig. 3.

Turritella quadrilira n. sp.

Turritella quadrilira Johnson, n. sp. Annual Rept. Geol. Sur. N. J., 1897, page 264, name only.

This species closely resembles the *Turritella trilira* Conrad of the Ripley bed, but is at once distinguished by having *four* instead of three *equidistant* revolving liræ; it also differs in being perfectly smooth between the costæ, while the lens shows the interstices of *T. trilira* to have numerous, minute, raised revolving lines. The specimens are all greatly broken, the largest, showing five whorls, is 14 mill. in length, but the fragments indicate that it probably attains the size of the average *T. trilira*, about 50 mill.

Tuba ? reticulata n. sp.

Tuba ? reticulata Johnson, n. sp. Annual Rept. Geol. Sur. N. J., 1897, page 264, name only.

Whorls very convex, with four equidistant, revolving, raised lines, which are crossed by equidistant longitudinal ribs of a corresponding size, which form equal, quadrate interstices, except below the suture where the longitudinal ribs become obsolete. At the junction of the two series of raised lines are small tubercles throughout the entire shell. Owing to the imperfect apertures of the five specimens, its generic position remains doubtful, but its distinct sculpture will distinguish the species. Length of the largest specimens, 6 mill.; probably attains the length of about 10 mill.

Trigonia thoracica Morton.

Trigonia eufalensis Gabb.

There seems to be considerable confusion regarding these forms. That *T. eufalensis* Gabb is only the young of *T. thoracica* Morton can be readily proven by the large suite collected by the writer at Eufaula and Prairie Bluff, Alabama. Morton's type came from the latter locality. The species recorded from Reeve's clay bank near Lenola, N. J., is *T. thoracica*, not *T. mortoni* Whitfield.

October 4.

The President, Samuel G. Dixon, M. D., in the Chair.

Nineteen persons present.

October 11.

The President, Samuel G. Dixon, M. D., in the Chair.

Thirty-six persons present.

October 18.

J. Cheston Morris, M. D., in the Chair.

Thirty-four persons present.

A paper entitled "Some Cuban Species of Cerion," by H. A. Pilsbry and E. G. Vanatta was presented for publication.

A Memorial of Dr. Joseph Leidy.—Dr. Nolan presented to the Academy as a memorial of the late Dr. Joseph Leidy, five volumes of biographical notices, portraits, autograph letters and original drawings. The contents of the volumes in detail are as follows:

Volume I. 1. Biographical notices by J. Parrish, M. D., New Jersey Medical Reporter, 1853; Henry C. Chapman, M. D., Proceedings of the Academy, June 30, 1891; Wm. Hunt, M. D., before the Alumni and Students of the Medical Department of the University of Pennsylvania, Nov. 17, 1891; W. S. W. Ruschenberger, M. D., Proceedings of the American Philosophical Society, April 25, 1892; Dr. Persifor Frazer, American Geologist, January, 1892; Jos. Wharton, before the graduating class of 1891 at Swarthmore College; George A. Piersol, M. D., to the classes of the Medical and Dental Departments of the University of Pennsylvania, October, 1891; from the International Clinic, July, 1891.

2. Transcripts of the original manuscripts of the memorial addresses delivered at a special meeting of the Academy, May 12, 1891, in recognition of Dr. Leidy's long continued service to it.[1] They consist of papers by Dr. William Hunt on the personal history of the subject of the memorial, by Dr. Harrison Allen on his work in comparative anatomy, by Dr. H. C. Chapman on his work in invertebrate anatomy, by Professor Angelo Heilprin on his

[1] These papers were not published because of the appointment of Dr. Chapman to prepare for the Proceedings a biographical notice which, with much else, combined and epitomized the matter of the memorial addresses.

work in geology and paleontology, by Joseph Willcox on his work in mineralogy, by Dr. James Darrach on his work in botany, and by Dr. Edw. J. Nolan on his services to the Academy with comments on his personal character.

3. These are followed by a verbatim report of a conversation held with Dr. Nolan, October 29, 1867, when Dr. Leidy related in detail and with the exquisite candor and simplicity which were characteristic, the details of his life up to that time. The notes were made by Dr. Nolan immediately on the conclusion of the interview with fulness and accuracy, and form a most interesting autobiographical contribution to the volume, being much more intimate and detailed than the texts of the published notices.

4. Manuscript of the last paper contributed by Dr. Leidy to the Proceedings of the Academy, 1891, pp. 234 *et seq.*

5. Autograph letters, and "Notes upon daily scientific observations, commenced March 1, 1846."

6. Letter from Dr. Levick regarding Dr. Leidy's last illness.

7. Valedictory Address, March 27, 1858.

8. Detailed index.

VOLUME II. Botanical drawings and notes, including representations of plasmodia, algæ (Diatoms, Schizophytes, Desmids, Protococcus, Confervoids, Vaucheria), fungi, ferns and angiosperms.

VOLUME III. Zoological drawings and notes. Infusoria (Flagellata, Ciliata, Sectoria, Atricha, including forty-five originals of the figures in the *Freshwater Rhizopods of North America*, Rhizopoda), sponges, and one hundred and seventy-six unpublished illustrations of gregarines from twenty-one hosts, a most valuable contribution to a monograph of these parasites.

VOLUME IV. Zoological drawings and notes, continued. Hydrozoa, ctenophors, bryozoa, worms (Platyelminthes, Nematilminthes).

VOLUME V. Zoological drawings and notes, continued. Worms (Annulata), arthropods, (Rotatoria, Crustacea, Arachnoidea, Insecta), mollusks, fishes, reptiles, and mammals.

The botanical material has been arranged by Dr. J. W. Harshberger according to the classification of Warming's *Handbook of Systematic Botany,* while the zoological drawings have been placed by Dr. Nolan in accordance with Carus and Gerstaecker. Exhaustive indexes have been prepared and bound with the volumes.

Much the greater part of the drawings and notes have been contributed by Mrs. Joseph Leidy, to whom the thanks of the Academy are due for thus providing for the preservation of these interesting relics of her distinguished husband.

Dr. Leidy is unquestionably the most prominent figure in the history of the Academy. This distinction is due not only to the variety, extent and value of his scientific work, but also because of his long connection with the executive offices of the society, as fully set forth in the several biographical notices included in the first volume of the memorial.

It is, of course, through his scientific work that he will be known to succeeding generations, but the personal qualities of the man: his humility, his charity, his integrity, and his transparent truthfulness can only be fully appreciated by those who were thrown into daily communication with him.

It is fitting that these volumes should be placed in the Academy, where nearly all of Dr. Leidy's work was done, as an evidence of his artistic ability and the diversity of his scientific interests, for they not only contain exquisite specimens of draughtsmanship but the drawings belong to nearly every department of natural history from Myxomycetes to Man.

October 25.

The President, Samuel G. Dixon, M. D., in the Chair.

Forty persons present.

Dr. D. G. Brinton made a communication on the ethnology of the Philippine Islands. (No abstract).

Prof. J. Wharton James and Prof. Wm. Libbey, Jr. spoke of the Enchanted Mesa. (No abstract).

The following were elected members:

D. M. Barringer, George C. Thomas, Lincoln Godfrey, Henry Emerson Wetherill and Miss Emeline Maddock.

The following were ordered to be published:

NEW SPECIES OF DIATOMS.

BY CHARLES S. BOYER.

RHABDONEMA.

Rhabdonema Woolmanianum n. sp. Boyer.

Valve oblong, with sharply crenulate margin, punctate, the puncta in transverse rows, about 6 in .01 mm. Pseudoraphe indistinct. Septa perforate, connected with each other usually near alternate ends by straight transverse diaphragms.

L. of V. .155 mm. to .231 mm.

Fossil in the Miocene deposit from an artesian well at Asbury Park, N. J., at a depth of 40 ft. Not uncommon.

Approaches *R. hamuliferum* Kitton and *R. Musica* Brun., but it does not show either hooked septa as in the former nor curves resembling musical notes as in the latter. It also differs in the character of the margin and in size, being four or five times larger than either.

Plate XXIV, figs. 1, 1a, 1b.

BIDDULPHIA.

Biddulphia interrupta n. sp. Boyer.

Valve elliptical, with small, rounded processes. Surface convex, finely punctate, the puncta about 10 in .01 mm., radiating in scattered lines from the centre at which are three minute spines. About one-third the distance from centre to processes, at each end, a hyaline band produced by the interruption of puncta, crosses the valve transversely extending nearly to the sides.

L. of V. .112 mm.

Campeachy Bay. Rare.

Plate XXIV, fig. 2.

Biddulphia verrucosa n. sp. Boyer.

Valve suborbicular, convex. Processes very large, cylindrical, truncate. Surface coarsely reticulate, the reticulations unequal, irregular, about 2 in .01 mm. Within the reticulations are coarse puncta abont 3 in .01 mm.

L. of V. .138 mm.

Fossil at Redondo Beach, Cal. Very rare.

This form, which approaches the *Cerataulus* group, is distinguished by the incrusted or warty appearance of the surface.

Plate XXIV, fig. 5.

Biddulphia Keeleyi n. sp. Boyer.

Valve broadly rhombic-elliptical, rounded at the ends. Surface slightly convex, without depression, reticulated, the reticulations unequal, hexagonal, about 2 in .01 mm., with puncta within the reticulations about 8 in .01 mm. Three stout spines are placed on each side near the margin. Processes inflated at the base, small at the apex and placed not at the ends of the valve but obliquely opposite, near the ends.

L. of V. .148 mm.

U. S. S. "Tuscarora" Soundings, Lat. 36° 12′ N., Long. 123° 11′ W., 1,605 faths. Also coast of California. Rare.

Only two specimens have been noticed, one of which was found by Mr. F. J. Keeley on seaweed from California.

Plate XXIV, fig. 4.

Biddulphia Argus n. sp. Boyer.

Valve broadly elliptical, convex, with an elliptical depression at centre. Surface finely reticulate, the reticulations, more or less hexagonal, about 3 in .01 mm. at the border, and 5 in .01 mm. at the centre from which they radiate in curved lines. The central depression is encircled by from ten to twelve short spines. Processes rather short and obtuse.

L. of V. .165 mm.

Port Antonio, Jamaica. Not common.

Distinguished chiefly by the central spines and by the size of the reticulations, whence the name. It approaches *B. Roperiana* Grev.

Plate XXIV, fig. 6.

Biddulphia semicircularis Asburyana n. var. Boyer.

Valve arcuate with the ends produced and elevated into rounded processes. Surface not divided by costate lines, convex, punctate, the puncta rounded about 6 in .01 mm. near the hyaline excentric space from which they radiate irregularly, increasing in size to about 1½ in .01 mm. at the margin where they are irregular and occasionally confluent.

L. of V. .181 mm.

Fossil in the Miocene deposit from the artesian well at Asbury Park, N. J. at a depth of 40 ft. Not uncommon.

Quite distinct from *Euodia producta* Grun. and from *B. semicircularis* (Br.) in the irregularity of the produced ends, in their elevation into processes, in the size, shape and distribution of the puncta and in the absence of costæ.

Plate XXIV, fig. 3.

Biddulphia Shulzei n. sp. Boyer.

Valve elliptical, slightly raised toward the centre, with a large rounded process-like elevation at each end. Surface punctate, the puncta rounded, oblong, averaging 5 in .01 mm., but for the most part scattered, leaving numerous hyaline spaces, one of which appears as an indefinite, indistinct transverse band at the base of each process. Owing to the irregularity in the distribution of the puncta the circumference of the valve appears to show a scalloped border.

L. of V. .115 mm.

In the character of its markings it approaches *Tabulina Testudo* Brun. from which it is distinguished by having but two processes and in being without the hyaline lines which cross the valve in the latter.

Fossil in the artesian well deposit at Weymouth, N. J. I have seen but one specimen which was found by Mr. John A. Shulze who also discovered a variety having two processes at one end and one at the other.

Plate XXIV, figs. 7, 8.

There appears to be no special reason why either this form or that known as *Tabulina Testudo* Brun. should be separated from the genus *Biddulphia*. The hyaline lines are not always definite even in *Tabulina Testudo,* while the variety in which but three processes appear clearly indicates an approach toward the type of *Biddulphia*.

Explanation of Plate XXIV.

Fig. 1. Rhabdonema Woolmanianum Boyer, valve view. x 284.
Fig. 1a. Rhabdonema Woolmanianum, septum. x 284.
Fig. 1b. Rhabdonema Woolmanianum, zonal view. x 284.
Fig. 2. Biddulphia interrupta Boyer. x 310.
Fig. 3. Biddulphia semicircularis Asburyana Boyer. x 300.
Fig. 4. Biddulphia Keeleyi Boyer. x 300.
Fig. 5. Biddulphia verrucosa Boyer. x 302.
Fig. 6. Biddulphia Argus Boyer. x 330.
Fig. 7. Biddulphia Shulzei Boyer, var. x 475.
Fig. 8. Biddulphia Shulzei Boyer. x 475.

NEW SPECIES OF ODONTOSTOMUS FROM BRAZIL AND ARGENTINA.

BY HENRY A. PILSBRY.

The forms noticed below are mainly recent accessions to the collection under my charge, received from Dr. H. von Ihering, the Director of the young but progressive Brazilian institution, the Museu Paulista. Three of the species belong to the subgenus of *Odontostomus* called *Macrodontes*, a group characterized by the continuous peristome, spirally lirulate earlier whorls, and regular, fine striation of the later ones, with minute and shallow but close spiral incised decussating lines. This very distinct subgenus contained four species: *odontostomus* Sowerby, *fasciatus* Dohrn, *Grayanus* Pfr. and *cordovanus* Pfr. Dr. von Ihering's zoological explorations have already nearly doubled this number.

All of the species of *Macrodontes* hitherto known have the aperture obstructed by large teeth; but in two of the new forms, *degeneratus* and *Dautzenbergianus*, the teeth have degenerated to such a degree that they are probably no longer functional as barriers against predacious arthropods. In another, *paulista*, the teeth are more strongly developed than in any other *Macrodontes*.

Odontostomus (Macrodontes) paulista Pilsbry & v. Ihering, n. sp.

Shell lengthened fusiform; rather solid; reddish-chestnut, with irregular, lacerated and somewhat zigzag, obliquely longitudinal, hydrophanous, cream-tinted streaks. Surface dull, very minutely but sharply striated in the direction of growth lines, a strong lens showing much more minute and superficial, dense, spiral striation, the apical whorls spirally lirate. Whorls 6, the first turned in, the rest rather rapidly and regularly increasing, moderately convex, the last becoming free at the aperture, compressed behind the outer lip, the trench there impressed by five pits; base pinched into an acute, produced keel; and behind the columellar lip there are two pits and a deep axial pit, with another shallow pit behind the elevated parietal wall. Aperture slightly oblique, narrow, irregularly oblong, obstructed by eight pliciform teeth and a strong, deep-seated columellar lamina; peristome continuous, white, reflexed throughout, the outer lip with two large teeth situated like those in *O.*

odontostomus, with smaller teeth between them and another above the upper one; the teeth upon the columellar and parietal margins corresponding in position with those of *O. odontostomus.*

Alt. 37, diam. 12 mm. length of aperture (including peristome) 15, width 8 mm.

Iguape, prov. S. Paulo, Brazil (Dr. H. von Ihering).

This most beautiful of the *Macrodontes* species has hydrophanous cuticular markings somewhat like *Auris Hauxwelli* (Crosse). It differs conspicuously from the well known *O. odontostomus* in the more slender contour, basal instead of baso-peripheral position of the keel, and the longer and narrower aperture, which is consequently more filled by the large teeth. There is also one more tooth, and the striation is much finer. *O. Grayanus* differs strongly in the less tapering and quite differently shaped base, as well as in lacking the median tooth of the outer lip, etc.

Odontostomus (Macrodontes) Dautzenbergianus n. sp.

Shell oblong-ovate, thin, light chestnut with a golden sheen and sparse, narrow oblique or zigzag creamy hydrophanous markings (absent on some specimens); surface dull, with very minute but regular and sharp striation along the lines of growth, and much finer, shallower, close spiral lines; the apical 1¾ whorls delicately spirally lirulate. Whorls 5, the first with in-turned tip, the rest rapidly increasing, convex, the last becoming very shortly free at the aperture, somewhat compressed behind the outer lip, and with three small pits; the base pinched into a short keel, behind the columellar lip two-pitted, with a deep umbilical fissure. Aperture irregularly oblong; peristome continuous, reddish or flesh colored, narrowly reflexed, the upper margin with a small blunt tooth, outer lip with three small teeth within, the lowest low and wide, the upper two minute and acute, whitish; basal lip with one low, wide tooth, the columella with a strong oblique fold upon which a minute whitish denticle is placed, another one being situated below the columellar fold.

Alt. 26, diam. 11 mm.; length of aperture 12, width 7½ mm. (including peristome).

Raiz da Serra, Sao Paulo, Brazil (Dr. H. von Ihering).

This species, to which we have attached the name of a distinguished French conchologist, is obviously a member of the *O. odontostomus* group of *Macrodontes*, agreeing with those forms in the positions of the denticles; but in our species the armature of the aperture has degenerated to a series of very small denticles. For the rest, the form is fuller than any other known *Macrodontes*.

A specimen from Cubatad, Sao Paulo, differs from the type in being darker colored, of a dark reddish-chestnut hue, somewhat more solid, with the denticles on the outer lip and columellar margin subobsolete, hardly noticeable, and of the reddish color of the lip itself; the pits behind the lip are correspondingly obsolete, but there are two minute white denticles on the columellar fold. This shell measures: alt. 26, diam. 10 mm.; length of aperture 11, width 6½ mm.

Odontostomus (Macrodontes) degeneratus n. sp.

Shell oblong-turreted, minutely perforated, thin but moderately strong, pale yellowish-green tinted. Surface hardly shining, striated in the direction of growth-lines, the striæ hardly visible without the aid of a lens, under which they are seen to be thread-like, well raised, finely but rather superficially cut into beads by decussating spirals which crenulate the summits of the striæ. Spire convexly conic, the apex obtuse; whorls nearly 6, quite convex, the earlier 1½ densely spirally striated, the last whorl becoming free and somewhat descending in front, constricted and showing 3 small pits behind the outer lip, bicarinate at base, the keels short, outer one strongly pinched up, the inner low, rounded, a distinct depression between them. Aperture oblique, quadrangular-oblong, nearly ⅓ the total length of the shell, obstructed by a strong columellar fold which terminates below in a transverse lamella, and by 6 small, tuberculiform teeth: one upon the parietal margin close to its posterior termination, three upon the outer lip, the uppermost quite small, and with the parietal denticle, defining a small rounded posterior sinus or notch, the others low, removed from the lip-edge; basal tooth median; columellar tooth below the columellar fold. Peristome white, narrowly reflexed, continuous and free throughout. Alt. 21, greatest diam. 8·3, length of aperture 7 mm.

Palmeiras, Province of Paraná, Brazil (Dr. H. von Ihering).

The species here described differs so widely from all other known species of the group, that detailed comparisons are needless.

Odontostomus (Plagiodontes) Iheringi Pilsbry & Vanatta, n. sp.

Shell deeply rimate, pupiform with conic spire, rather solid, light olivaceous brownish with darker longitudinal streaks; somewhat shining, sculptured with fine, irregular growth-striæ. Last whorl subcylindrical or barrel-shaped, those above rapidly tapering, forming a rather short, conic spire. Whorls 6½ or 7, nearly flat, the last with a more or less distinct basal keel on its latter half, and having a small flattened tract within the keel behind the basal lip. Aperture slightly oblique, shortly, irregularly ovate, obstructed by three principal lamellæ and one or two smaller denticles or teeth ; one lamella well within on the parietal wall, bifid at its outer end ; one very obliquely entering lamella on the columella ; and a third lamella within the outer lip near its middle. Besides these there is a denticle or very small lamella on the basal lip near the foot of the columella, and another within the outer lip above the median lamella.

Alt. 19, diam. 9, length of aperture 8⅓ mm.

Alt. 20, diam. 9, length of aperture 8½ mm.

Sierra Ventana, Argentine Republic.

This species does not seem to be closely allied to any of the numerous Argentine forms described by Doering, a part of which have not yet been figured. Only one of the specimens shows the small denticle above the lamella on the outer lip.

SOME CUBAN SPECIES OF CERION.

BY H. A. PILSBRY AND E. G. VANATTA.

Since the publication of our catalogue of this genus,[1] the following species have been described:

Cerion (Maynardia) niteloides Dall, Bull. Lab. Nat. Hist. State Univ. Iowa, IV, no. 1, p. 15, pl. 1, f. 2 (Dec., 1896). Water Cay, Salt Cay Bank, on the north side of Cuba near the western end of the Bahama banks.

Cerion pillsburyi Pils. & Van., these Proceedings, November 23, 1897, p. 366, f. 5. Gun Cay, Bahamas.

Cerion fordii Pils. & Van., Ibid, p. 365, f. 1, 2. Bahamas (Abaco?).

1 2 3 4

5 6 7 8 9

The forms herein described were received from Mr. F. E. Blanes and Prof. de la Torre, bearing manuscript names; which we were requested to publish. As they are forms of considerable interest

[1] Proc. Acad. Nat. Sci., Phila., 1896, p. 315.

and undoubted distinctness, so far as specific distinctions can be said to exist in *Cerion*, we present them as a further contribution to knowledge of this peculiar genus.

Since writing upon this topic in 1896, we have been unable to procure living or suitably preserved specimens of *Cerion* for anatomical investigation; but we have no reason to doubt that such study, when it becomes possible, will justify our reference of the genus to the family *Urocoptidæ* ("*Cylindrellidæ*" of authors).

Respecting the extraordinary plasticity of the shell under the force of varying circumstance, something was said in our former communication; but as it would seem from questions put to us by various conchological friends, the case was not stated strongly enough. We do not seek paradox when we say that frequently the differences between individuals of a species are greater than the differences between species; so wide is the swing of racial and individual variation.

Cerion torrei Blanes. Figs. 1, 2.

Shell cylindrical, obese, strong, rimate and perforate, the lower two or three whorls of approximately equal diameter, those above forming a rather short cone with sides diverging at an angle of 85° to 90°. Whorls 10–11, the earliest 1–2½ white or corneous, several following finely and sharply striated, the remaining whorls nearly smooth; last whorl ascending in front, somewhat tapering below, and generally striated at the base. Brown, marbled with very irregular stripes and dots of white. Aperture short, showing a small short parietal tooth and a small columellar fold; peristome white, thickened and convex, reflexed and recurved, continuous, the parietal margin more or less calloused.

Alt. 23½, greatest diam. 13, length of aperture 11 mm.

Alt. 28, greatest diam. 12½, length of aperture 11 mm.

Alt. 24, greatest diam. 11½, length of aperture 10 mm.

Port of Vita, Cuba (Francisco E. Blanes).

This species resembles *C. dimidiatum*, differing in being of less rude texture, less squarely obese form, higher terminal cone, no trace of a keel defining the base, etc.

It has the coloration of *C. vulneratum*.

Var. **ornatum** P. & V. Figs. 3, 4.

Similar in form to the longer specimens of *C. torrei*, but strongly and regularly ribbed throughout, the ribs on the cylindrical portion

1–2 mm. apart, and decidedly narrower than the intervals; parietal margin of peristome more elevated.

Vita, Cuba.

This looks like a distinct species, but is merely the costate form of the preceding. It is more slender than the ribbed form of *C. dimidiatum*, with finer ribs, continued upon the terminal cone, and there is no basal keel.

Cerion sueyrasi Blanes. Fig. 6.

Shell cylindrical, solid, rimate, the lower three whorls of about equal diameter, those above forming a rather short, obtuse cone. Whorls 10, the first smooth, next finely costulate, the rest *very convex*, coarsely and *sharply ribbed*, the ribs high, angular, 15 to 18 in number on the last whorl; *numerous rather irregular spiral striæ* revolving about the middle of the lower two or three whorls. Color (of specimens some time dead when collected), creamy or fleshy white. Aperture small, with small teeth; peristome expanded, blunt, continued raised and straight across the parietal margin.

Alt. 21, diam. 8½, length of aperture 7¼ mm.

Alt. 22, diam. 9, length of aperture 8 mm.

Vita, Cuba (Francisco E. Blanes).

A fourth member of the group of *C. scalarinum*, decidedly stouter in the spire than *C. scalarinum* Gundl. or *C. johnsoni* Pils. & Van., and differing from *C. felis* P. & V. in the weak development of the teeth.

Cerion incanum saccharimeta Blanes. Fig. 5.

Shell much larger than typical *incanum*, with long, tapering spire and blunt apex. Whorls 13, the last frequently irregularly costate. Alt. 38, diam. 13, length of aperture 12 mm.

Sugar Loaf Key, Florida (F. E. Blanes).

Cerion crassiusculum Torre. Figs. 7, 8.

Shell rimate, cylindrical, rather solid, lusterless, light brown or yellowish-brown throughout. Latter three whorls of equal diameter, or wider above, those above tapering in a short cone with straight or slightly concave outlines; apex obtuse, rather mammillar. Sculptured with rather close, regular, strong riblets, which are somewhat oblique, varying from as wide to half as wide as the interstices, and about 28 in number on the antepenultimate whorl; becoming obsolete or partially so on the last whorl. Whorls nearly 10, but slightly convex, the last slightly ascending in front.

Aperture vertical, with a very small, short parietal tooth, and moderate axial fold; peristome blunt, expanded, subreflexed, the terminations distant, connected by a moderate parietal callus.

Alt. 20½, diam. 8½, length of aperture 7½ mm.

Alt. 20, diam. 9½, length of aperture 8 mm.

Cayo Juin, Baracoa, Cuba (Prof. de la Torre, F. E. Blanes).

There is a small form, alt. 13, diam. 6⅓, length of aperture 5 mm., having all the characters of the larger except that there are only 8 whorls.

The last whorl in this species is half the total length of the shell or a trifle more, and upon it the ribs are weak or wholly obsolete. Compared with *C. incrassatum microdon*, it differs in the concave instead of convex outlines of the terminal cone, and the color. It differs from *C. tenuilabre* in the coarser sculpture; and from both in the comparatively smooth last whorl.

Cerion sanzi Blanes. Fig. 9.

Shell rimate, solid and strong, cylindric-conic. White, very sparsely and inconspicuously mottled with grayish or brown; lusterless, the ribs rather glossy. Lower three whorls of about equal diameter, those above forming a rather long cone terminating in an obtuse apex. Whorls 10–11½, the first smooth, the rest ribbed; ribs rather strong, narrow, separated by far wider interstices, 20–27 on the penultimate whorl, frequently in part obsolete on the last whorl, split on the base into an irregular striation. Aperture irregularly oval, the throat brown; peristome reflexed, more or less thickened, the terminations joined by a heavy parietal callus. Parietal tooth deep within, strong and rather long; columellar tooth well marked.

Alt. 27, diam. 11½, length of aperture 10 mm.

Alt. 23½, diam. 10½, length of aperture 9 mm.

Confites Key, Nuevitas, Cuba.

This species has considerable resemblance to *C. mumia*, but differs conspicuously in the strong development of the parietal fold, the inner termination of which is not visible from the aperture. In some specimens the interior of the aperture is mainly white, the brown appearing far within. In one shell of the type lot there is a small accessory denticle to the left of the main fold.

NOVEMBER 1.

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

Twenty-eight persons present.

The death of John Shallcross, a member, was announced.

A paper entitled "Notes on the growth of the Hobblebush, Viburnum lantanoides," by Ida A. Keller, was presented for publication.

NOVEMBER 8.

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

Twenty-three persons present.

Papers under the following titles were presented for publication :

"The occurrence of Marcasite in the Raritan Formation." By S. Harbert Hamilton.

"Margarita Sharpii, a new Alaskan Gastropod." By Henry A. Pilsbry.

"The Bone Cave at Port Kennedy and its partial examination in 1894, 1895 and 1896." By Henry C. Mercer.

NOVEMBER 15.

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

Twenty-one persons present.

The death on the 11th inst. of Charles P. Perot, a member, was announced.

NOVEMBER 22.

MR. CHARLES MORRIS, in the Chair.

Twenty-four persons present.

Mr. Mercer's paper on the Port Kennedy Bone Cave was ordered to be printed in the JOURNAL.

The following minute of appreciation of the service of the late Charles P. Perot was unanimously adopted :

The Academy of Natural Sciences of Philadelphia has heard with great regret the announcement of the death on the 11th inst. of CHARLES P. PEROT.

He was elected a member in May, 1874. He served as Treasurer during the years 1893 and 1894 and was a member of the Finance Committee from 1890 to 1893 and again from 1895 until his death. He was Chairman of the Library Committee, and was continuously a member of the Council from his first election thereto in 1881 until his decease.

In all these positions Mr. Perot was a wise, liberal and devoted friend and supporter of the Academy. His services were given with fidelity and with high efficiency. In all these various relations Mr. Perot not only won the confidence of his associates but by his urbane manner and equable temperament he secured their personal friendship as well. He was a good type of those broad minded and sympathetic business men in Philadelphia and vicinity who have freely given their valuable aid to this institution and have contributed so largely to its usefulness and high standing.

The Academy of Natural Sciences of Philadelphia hereby expresses and places on record its appreciation of the value of Mr. Perot's efficient services to the institution and of the great loss which has been sustained by his death.

NOVEMBER 29.

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

Twenty-seven persons present.

Papers under the following titles were presented for publication:

"Some Observations on the Classification of Birds." By Dr. R. W. Shufeldt.

"A Study of the type Specimens of Birds in the Collection of the Academy of Natural Sciences of Philadelphia, with a brief history of the Collection." By Witmer Stone.

Occurrence of Oryzomys palustris in Southern New Jersey.—MR. WITMER STONE placed on record the capture of two specimens of the Rice-field Mouse, *Oryzomys palustris*, in southern New Jersey, on Nov. 21, 1898, by Mr. Henry W. Warrington.

The history of the species is of peculiar interest. It was originally discovered in 1816 by Dr. John Bachman at Charleston, S. C. but was not described until 1836 when a specimen and description were sent to Drs. Pickering and Harlan of Philadelphia for comparison with Ord's *Arvicola riparia* and for publication if the southern animal proved distinct.

Dr. Bachman named the mouse *Arvicola oryzivora*. Upon comparison with specimens in the Academy collection Dr. Harlan not only found that Bachman's mouse was quite distinct from *Arvicola riparia* but also discovered that a mounted specimen identical with it was already in the collection labelled from "Fastland" near Salem, N. J.

He thereupon ignored Bachman's manuscript and described the New Jersey specimen under the name of *Mus palustris*.[1] Baird subsequently established the genus *Oryzomys* for it, and it has since been known as *Oryzomys palustris* (Harlan).

Further explorations have shown that the Rice-field Mouse is distributed from North Carolina to Texas but until the present time no other specimens have been obtained from New Jersey. For some time past Mr. S. N. Rhoads has made persistent efforts to discover this animal and has trapped without avail in Cape May Co., Port Norris, and Salem.

As a result of the failures it seemed most probable that the original Harlan specimen had been wrongly labelled and that the Rice-field Mouse was not a member of the New Jersey fauna. This view had in fact been generally adopted.

Mr. Warrington's rediscovery of the animal in this State after a lapse of at least sixty-two years is therefore of great interest.

He states that the specimens were secured on the marshes bordering Delaware Bay about midway between Port Norris and Salem, and that they were inhabiting old Muskrat houses in which they had made their nests.

Mr. Stone stated further that steps would be at once taken to secure a satisfactory series of these mice for comparison with those of the Carolinas as there is a possibility of the latter proving a distinct subspecies.

The form inhabiting Florida has been already separated by Chapman as *Oryzomys palustris natator*.

The following were elected members:—

Charles Mohr, M. D., Henry L. Broomal, H. B. Gross, Miss Emily Lowber, Miss Ethel Smith, Mrs. Julia Stockton Robins, Miss Emily Williams Biddle and Mrs. J. Edgar Thomson.

The following were ordered to be printed:—

[1] Am. Jour. Sci. and Arts, XXXI, 385.

THE GROWTH OF VIBURNUM LANTANOIDES Michx.

BY IDA A. KELLER.

During a visit to Lake Ganoga, Sullivan County, Pa., last August, I found nothing more plentiful than the hobble-bush, *Viburnum lantanoides*. The long branches of this plant with their large round-ovate leaves, the brown naked winter buds, at that time already fully developed, and the clusters of the then red berries were everywhere conspicuous. There is something strikingly characteristic about the species. It is described in Gray's *Manual* as a "straggling bush" and in Britton & Brown's *Flora* as "a bush of irregular growth." On collecting and comparing a sufficient number of specimens I came to the conclusion that there is some peculiar tendency at the bottom of this apparent irregularity and that law and order prevail in the growth of this seemingly eccentric species. Although some shoots differ so widely from others that they seem hardly to belong to the same kind of plant it is by no means a difficult matter to find the necessary connecting links. The accompanying illustrations, although diagrammatic, are directly drawn from nature and by means of these I have endeavored to show that this so called "irregular growth" is chiefly due to a peculiar method of ramification on the one hand, and to a tendency to the suppression of the growth of the main axis on the other.

Plate XXV, fig. 1 represents a form frequently occurring in younger plants. A main axis and two lateral branches are conspicuously developed. The important point to observe is the continued growth of the main axis after ramification, which even surpasses that of the branches. It may be noticed incidentally at this point that the axis ends with three buds, which are represented on a larger scale in fig. 6. It must also be observed that the axes of the lateral branches cease to indicate vigorous growth after again branching. These axes terminate at a′. Attention must also be called to the fact that on the ends of the branches marked b′ there appear but two instead of three buds. Fig. 7, which represents these buds on a larger scale, is a repetition of fig. 6 with one of the lateral buds obliterated.[1] The lateral bud in each case shows a

[1] The suppressed lateral bud occurs occasionally as a rudiment. See figs. 8 and 9.

greater elongation of the stem than the central bud. It thus foreshadows the precedence which it takes in the future development of the plant. It can be readily observed that the suppressed lateral bud is the one next the main axis of branch b.

Comparing fig. 4 with fig. 1, a decided difference in the relative growth of the main axis and its branches is to be observed. This difference is still further emphasized by such shoots as the one represented by fig. 3.

From the foregoing, fig. 5 represents a striking contrast in some respects. Here we find a short axis terminated at a, with long lateral branches which are studded with branchlets along their upper side. Fig. 2 is the necessary connecting link. This was taken from a low bush with a very short main axis. The right lateral branch resembles fig. 5, while the lateral branch to the left is quite similar to the branches of fig. 1.

Plate XXV, fig. 5 explains itself if we recall the two buds of fig. 7. We can readily see that this effect is produced by the vigorous growth of the lateral bud with little or no growth of the main axis. The axes of the branches in their turn are suppressed when the next ramification occurs and the energy of growth is again transferred to the lateral branch of the next series. We have thus produced a so-called false axis, i. e. an axis which is successively formed from the lateral branches of the main axis, the latter continuing to exist with little or no growth. This is well known to botanists as the sympodial method of branching and is observable in many of our forest trees.

In making the drawings I was struck with their resemblance to the diagrammatic representations, found in many of our text books, of the cyme, in which the oldest flower terminates the stem while the main growth continues laterally. Compare, e. g., fig. 4, with the little axillary clusters of *Weigelia* or the inflorescence of the Caryophyllaceæ. Furthermore a peculiar modification of the cyme is well known as the monochasium in which there is but one lateral ramification. This finds its parallel in fig. 7. The monochasium repeats itself indefinitely and here also this peculiar method of branching has a decided tendency to continue until at times we have a false axis whose length is to be measured by the yard. It is curious that the lateral branch which carries on the growth is always on the same side of the axis and thus the case is further comparable to the helicoid uniparous cyme in which the flowers (here represented by a, a′, a″, etc.) always fall on the same side of the rhachis.[2]

I mention the similarity between this kind of inflorescence and the sympodial method of branching of this species particularly because the inflorescence of *Viburnum* belongs to the cymose type. The comparison is interesting if not of greater significance. To my knowledge it is not usual to look for, or to find; a correspondence between the method of branching of the vegetative system and that of the flowering system of a species.

From a comparison of the shoots of *Viburnum lantanoides* we may draw the following conclusions:

This species begins its career normally with a main axis ending with a terminal and two lateral buds.

A tendency soon becomes evident toward retarding the growth of the main axis while the chief growth energy is transferred to the lateral ramifications.

There is a further tendency to the complete suppression of one of the lateral buds which, however, may be present in rudimentary form.

In consequence we have the true axis often replaced by a false axis and we may regard *V. lantanoides* as a bush with a decided tendency to the sympodial method of branching.

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[2] Revisions to the original type of branching, represented by figs. 1, 3 and 4, are not uncommon and assist in producing the irregular effect. See figs. 11 and 12.

THE OCCURRENCE OF MARCASITE IN THE RARITAN FORMATION.

BY S. HARBERT HAMILTON.

The Gault formation of Folkstone near Dover, England, has long been known to produce the form of marcasite known as "spear head ore" from its apparent close resemblance to this weapon. So far as I can ascertain this form of marcasite has never been observed in this country where it occurs under similar circumstances as in England.

The beds of the Raritan formation at Sayreville, near New Brunswick in New Jersey, which are largely worked for clay and kaolin, contain a considerable amount of pyrite usually in the form of balls, and concretions, in many instances resembling coprolites. Imbeded in the plastic clays associated with these pyrite nodules were found perfect specimens of the spear head variety of marcasite, very closely resembling in size and appearance those from the foreign locality already cited. In some specimens the marcasite twins are implanted upon pyrite; again, crystals of marcasite were studded with minute cubes of pyrite illustrating the pseudo-morphism between these dimorphous ferric sulfides.

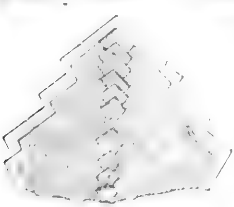


Fig. 1. x 2.

The specimens here described were obtained upon a joint excursion of the New York and Philadelphia mineralogists to this locality under the guidance of Mr. John A. Manley of New Brunswick, who collected the first specimens.

MARGARITA SHARPII, A NEW ALASKAN GASTROPOD.

BY HENRY A. PILSBRY.

Margarita Sharpii n. sp.

Shell thin, of low-conoid form, with extremely broad funnel-shaped umbilicus and very rapidly expanding whorls. Color, dull salmon or brick-pink, becoming ashy on the spire and within the umbilicus. Sculpture, numerous spiral cords and threads, which on the spire are strong, alternately smaller, then with a tertiary series intercalated, the whole becoming less pronounced on the last whorl, where by further intercalation of threads the spirals become very numerous in some individuals, and in others mostly obsolete; the base with close, strong spiral cords outside the edge of the umbilicus; the whole surface with fine, crowded and somewhat lamellar growth-striæ, the spire with some spaced coarser radial riblets. Whorls 4½, very rapidly expanding, the last at the aperture about three times the width of the preceding (seen from above); gently convex; periphery angular; base convex, the umbilical region broadly excavated, nearly as large as the aperture. Aperture large, very oblique, salmon colored within, with brilliant green reflections, but having a wide border within the lip appearing dull whitish from in front, but showing red and white reflections seen from below. Peristome thin, deeply excised in the umbilical region, above the excision produced forward as a low wall curving around the umbilical edge, continuing as far as the posterior termination of the outer lip. Alt. 7.5, greater diam. 14, lesser 11 mm.

Fig. 1.

Operculum concave externally, with about 8 closely coiled whorls with slightly free overlapping edges.

Dutch Harbor, Unalaska (Dr. B. Sharp, June 21, 1896).

The relations of this species are with *M. umbilicalis* Brod. & Sowb. and *M. corticifera* Dall.[1] The former of these is a Greenland species with the glossy surface and rounded whorls of the North Atlantic Margaritas. *M. corticifera* is found in the Aleutian Islands, and

[1] Manual of Conchology, XI, p. 288, pl. 59, f, 48–50,

was taken by Dr. Sharp at Unalaska. It resembles *M. Sharpii* closely in color, texture and sculpture, but differs from it in the following particulars of form: Seen from above the whorls of *M. Sharpii* increase in breadth very much more rapidly, the last becoming far broader near the aperture. The umbilical area in *M. vorticifera* is broad and excavated, but the umbilicus proper is comparatively small, round and deep; while in *M. Sharpii* the excavated area is not only much larger, but the entire cavity is widely open to its beginning. In *M. vorticifera* the columellar margin of the peristome is broadly concave along the margin of the "funnel," passing into a subtriangular dilation above (well shown in the front view of Dall's original figures), which impinges upon the circular umbilicus and to a small extent vaults it over, as in many Helices. In *M. Sharpii* the columellar margin is much more deeply excised, and its continuation above forms a raised wall curving around the entirely open and far wider umbilicus.

Types are No. 70, 554 of the conchological collection of the Academy of Natural Sciences of Philadelphia.

DECEMBER 6.

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

Thirty-three persons present.

The death of Redwood F. Warner, a member, Nov. 29, aged 81 years, was announced.

DR. FLORENCE BASCOM made a communication on petrographical methods of rock determination, illustrated by the Philadelphia belt of crystalline rocks. (No abstract).

DECEMBER 13.

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

Thirty-four persons present.

DECEMBER 20.

MR. CHARLES MORRIS in the Chair.

One hundred and thirty persons present.

A paper entitled "Synopsis of the United States Species of the Hymenopterous Genus Centris Fabricius," by Wm. J. Fox, was presented for publication.

PROF. ANGELO HEILPRIN made a communication, illustrated by lantern views, on the geology and physical geography of the Klondike Gold Mining Region, with incidents of a journey to Dawson City. (No abstract).

DECEMBER 27.

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

Twenty-nine persons present.

The following was ordered to be printed:—

OBSERVATIONS ON THE CLASSIFICATION OF BIRDS.[1]

BY DR. R. W. SHUFELDT.

In former papers of mine the classification of various groups of birds has been treated; their osteology, as a rule, being the anatomical system employed and referred to for the purpose. These investigations, as many are aware, have not been confined entirely to recent avifaunæ, but have also taken into consideration fossil material; the remains of birds that existed as far back as tertiary time.

So far as the United States ornis is concerned every family, or indeed, nearly every genus of the recent age has thus been dealt with, and some of the mss. presenting the details of these researches have been published, while the far greater proportion of them temporarily await a similar disposition. It is in this manner that such groups as the Passeres, the Swifts, the Humming-birds, the Goatsuckers, the Trogons, the Kingfishers, and many others have been gone over and issued in the form of memoirs in different publications, while upon the other hand the osteology of entire groups has been written out and illustrated, and will, when printed, fill in gaps that formerly existed. Among these last, extensive work has also been done with large and small groups of birds not occurring in this country, as the Penguins, the Ostriches, and others. These will not be taken especially into consideration in the present connection, for the reason that considerable unanimity of opinion exists among naturalists with respect to their taxonomy; though probably the Penguins form an exception to this statement. Commencing in the United States avifauna with the Pygopodes, however, and passing the various groups in review following their linear arrangement in the order in which they are usually printed, we meet not only with single species but with groups of species, the true taxonomic position of which, in the system, ornithologists entertain very diverse opinions. It is to these that it is my intention to refer in the present paper. They have all been closely studied by me osteologically, and in the

[1] Read by title at the Sixteenth Congress of the American Ornithologists' Union, at the United States National Museum, Washington, D. C. 17th of November, 1898.

case of many of them their general anatomy has been investigated, and their biology as a whole given weight. My views upon the classification and systematic position of some of these families or species now in my mind, have been briefly abstracted and published, either in *The Ibis* of the British Ornithologists' Union, or in the *Proceedings* of the Zoölogical Society of London. Others there are that have not been so noticed.

Prior to passing to the aforesaid subject-matter in chief however, it may be as well first to pay some attention to the morphological characters of birds with special reference to their use in determining a scheme for the natural classification of the Class. By the natural classification of *Aves* is meant an orderly arrangement of existing birds into major and minor subdivisions according to their true affinities as they actually obtain in nature. That a real relationship exists among certain and various tribes of birds, since the time they have, through their evolution, become differentiated from their remote reptilian stock, is a fact that it is feared those who attempt their taxonomy do not always keep impressed with sufficient strength upon their minds. Consequently we often hear of this classifier's arrangement, and that classifier's arrangement or scheme, just as though no real affinities existed, whereas it is the duty of each and every one attempting a taxonomic scheme to discover precisely how the avian tree has thrown out its branches and its twigs, and, if possible, determine the points from where they sprung. Equally useless is it to attempt a classification of birds by selecting for the purpose the ornis of any particular area of the earth's surface. Those that enter upon the task by applying to taxonomic ornithology the birds occurring within arbitrary political boundaries as mapped out by man will fail utterly, and such a piecemeal, provisional classification will, with the greatest certainty, be broken up the moment the first far-seeing taxonomer tests it with the morphological facts gathered from the entire class, both existing and extinct, as far as they are known to science. For this reason, we must consider all the classifications of birds up to the present time as being merely provisional, in as much as we are yet so far from possessing the necessary knowledge to define the true one, based upon the complete biological history of the Class. A study of the various classificatory schemes that have been presented within the last twenty-three centuries will convince any one that there has been just as much of an evolution in this field as there has been in the case of birds themselves. It must be remembered in this connection that even as early as Aristotelian time, birds were classified into groups, and Pliny, adhering to much that had been done five centuries before him, selected only the very obvious characters of the feet for the purpose, which threw all the birds known to him, into three divisions, of which a Hawk, a Hen, and a Goose were respectively representative. Thus were associated the Ducks and Cormorants,—the Rails and Robins,—and this is what the feet did. Ornithology was placed upon a scientific basis about the middle of the seventeenth century through the labours of Willughby and Ray. They were the first to use the two main divisions of Land and Water birds, and in subdividing, both the bills and feet were used as classificatory characters. For the most part Linnæus followed Ray, and in doing so kept many birds in taxonomic juxtaposition where the affinity was quite remote. Mergansers and Albatrosses were kept together, as were Divers and Gulls,—and so much for what bills and feet did in those days. Improvement over early authors was very evident, however, and many palpable errors were rectified. From such beginnings the science has grown up, authors and classifiers being more and more numerous with each succeeding generation. Some used one set of characters and some another, but it is to be distinctly noticed that the previous taxonomic schemes have always influenced their followers in later years. Merrem, who in 1812, was perhaps the first to publish a systematic arrangement of the groups of birds, was doubtless influenced by all that had been accomplished prior to his time, as the work of Nitzsch in pterylography, Cuvier in structure, and Linnæus and Ray in a number of external characters. His scheme was a solid contribution to the classification of birds, based as it was upon a variety of anatomical characters, as those drawn from the sternum, those from the feathers, those from the osseous system, and those from other parts, as the bills and feet. In fact Merrem took a long step in the direction of the truth, or rather in the discovery of the true relationships of birds in nature.

De Blainville quickly followed Merrem, and again rearranged the avian scheme of classification, fascinated as he was by the characters presented on the part of the body of the sternum. In some directions further advancement was evidenced, however, and this advancement later on was powerfully increased by the labors of Nitzsch who brought into play the arterial system, the song-muscles, the nasal glands, and other morphological features.

Thus from the time of Nitzsch down to the present day, the classification of birds has gone through many changes and many phases at the hands of the ornithologists of the succeeding generations as they have passed. The greatest advances have been made since the scientific demonstration of the law of organic evolution and the derivation of birds became known, and these by the men who have studied the subject from that standpoint. Were it possible for us now to know the complete biology of every bird-form that has existed upon the earth since birds as birds came into existence, there would be among ornithologists an agreement of opinion upon their classification, the world over, within a twelvemonth. If half the species that have existed were known, the scheme would almost work itself out. As it is, we probably see to-day in the world's avifauna but a paltry remnant of that enormous and unknown host, and it will be generations yet to come ere there will be a consensus of opinion upon the affinities of this puzzling and very homogeneous group of vertebrates. When compared with other major groups of animals, either vertebrate or invertebrate, the structural differences to be found among the forms making up the natural minor groups of existing birds are far less apparent than in any one of them. Taken in their entireties, the difference between an Apteryx and a Humming-bird morphologically, is not to be compared with what exists when thus contrasted, between such forms, for example, as a man and an Ornithorhynchus among mammals, or between a Lancelet and a Bass among fishes. Birds are an extremely compact group, and the disposition is altogether too prevalent in attempts to classify them, to accord too high rank to not a few of the divisions above the family. Were birds fishes, the entire congregation of them, would hardly make more than a respectable order. They are a lucky lot of closely affined volant feathered reptiles that have specifically multiplied at a wonderful rate since they sprang into existence, and as useful and as charming as the majority of them are in nature, their taxonomy nevertheless has puzzled the wits of many a man since Aristotle lived, and will doubtless continue to do so in the years to come. To arrive at their true affinities and a natural grouping of the class, it will be necessary to utilize every fact that we possess in regard to their biology; by this it is meant every palæontological fact; every fact referring to geographical distribution for all time; every morphological fact; besides all that is known of their biology, habits, and development. In so far as their anatomy is concerned some of the systems have undoubtedly proved to be of more value than others in the matter of classification. For example, in this particular the study of the skeleton teaches us more than a comparison of the dermal appendages, but the osseous system is by no means all-sufficient to meet the ends of taxonomy as some still seem to believe. With regard to this it is easy to agree with what Professor Alfred Newton has said, when commenting upon the value of the work left us by Nitzsch, for "there can be no part of a bird's organization that by proper study would not help to supply some means of solving the great question of its affinities. This seems to the present writer to be one of the most certain general truths in zoölogy, and is probably admitted in theory to be so by most zoölogists, but their practice is opposed to it; for, whatever group of animals be studied, it is found that one set or another of characters is the chief or favorite of the authors consulted—each generally taking a separate set, and that to the exclusion of all others, instead of effecting a combination of all the sets and taking the aggregate." Thus it is, that notwithstanding the relative value of the characters furnished on the part of any particular morphological system, as indicating interexisting affinities, that value is certain to be affected when the facts brought out by a study of another system, as the muscular system, for example, are applied to it. As evident as this is, however, we have not far to seek in order to discover avian classifiers who would be content to base their taxonomic scheme of the class upon some single character of some special system, as, for instance, De Blainville did in using only the body of the sternum for the purpose. Such a practice lands one not very far from the plane arrived at by Pliny in the first century.

Doctor Alfred Russel Wallace in criticising this memoir of Mr. Blanchard's in *The Ibis* for the year 1864, says very truly that we should make the greatest errors in classification by following the sternum alone, as "for example, the sterna of the Finches and the Flycatchers are scarcely distinguishable, notwithstanding the great dissimilarity in almost every part of the structure of these birds—their bills, their feet, their plumage, their habits, food, and digestive organs. On the other hand, the sterna of the several genera of the Caprimulgidæ differ from each other more than those of the most distinct families of the restricted Passeres. The Bee-eaters, the Barbets, and the Woodpeckers, again, are three very distinct families, which, in a classification founded upon all parts of a bird's organization, cannot be brought in close contact; and yet, their sterna, according to Mr. Blanchard, much resemble each other. It is evident, therefore, that the whole structure of a bird and its corresponding habits may be profoundly modified, and yet the sternum may undergo the important changes, while the general organization and habits are but little altered." So much for the value of single anatomical systems in avian taxonomy, and so much for the value of single characters in any system. Now as to the value of osteology as a whole in the classification of birds, no ornithotomist or classifier of this group of vertebrates will for a moment doubt. Employed in its entirety the osseous system of *Aves* stands far in advance of any other in settling the question of affinities and affording characters in classification. It has been almost entirely through our studies of the fossil skeletons of birds that we have been enabled to fix their origin in time, or to link them with their extinct reptilian ancestors.

The researches of the Parkers in the development of the embryological skeleton of birds; of Huxley in the skull; and the labors of Macgillivray, Nitzsch, Merrem, De Blainville, L'Herminier, Cuvier, St. Hilaire, Gervais, Blanchard, Eyton, Owen, Garrod, Forbes, Fürbringer, Gadow, Lucas, Beddard, and many others upon the general skeleton; while the study of palæontological osteology by Milne-Edwards, Cope, Marsh, and their colleagues in the same field, would, when taken in the aggregate go far toward establishing a natural classification, or rather toward indicating the true affinities of birds.

Still in face of all this we must believe, that osteology is by no means an all-sufficing guide, nor has it been in the mind of the present writer in his attempts to discover the true kinships existing among birds; their systematic positions; and the places the various natural groups should occupy in any scheme of classification.

On the contrary the aim has been to examine with care into the results of the anatomical and general biological investigations of birds by whomsoever they may have been undertaken and published, so long as those researches seemed to have any bearing upon the solution of the true affinities of the class. With this in view a very wide field of literature has been considered, and the works of a great many authors examined. All through this, osteology has held the main place, but constantly subject to subordination when factors drawn from other anatomical systems or from the general life-histories of the bird-groups, possessed beyond all doubt greater weight and significance.

Bearing this in mind, and from osteological premises, let us now proceed to examine into the probable affinities of certain birds or groups of birds and how we should classify them. An inquiry of this kind would hardly seem to require any apology, in as much as no two systematists of all those who have published a scheme of classification for *Aves*, since 1867 when Professor Huxley gave us his, agree upon the position in the system and the affinities of not a few of the natural avian assemblages. Take for example the Grebes and Loons. Huxley associated them with the Laridæ, Procellariidæ, and Alcidæ in his Group Cecomorphæ; Garrod placed them among the Ducks and Penguins, in the Anseres; Forbes included the Heliornitidæ with them, and created a new group Eretopodes; Dr. Sclater retained them as a family Colymbidæ with the Alcidæ in the order Pygopodes; Reichenow did the same, but added the Penguins to the group, and called the order Urinatores; they are a family of a superfamily, and associated with four other superfamilies, of the Cecomorphæ in Dr. Stejneger's scheme; Dr. Fürbringer giving still other new names for orders, suborders and genera, places them between the Flamingoes and the extinct Hesperornithidæ; we find them among the Galliformes in Seebohm's arrangement; and finally considered as two separate orders by Dr. Sharpe. Still other eminent taxonomers, as Cope, Professors Gadow and Newton, take different views of the subject. In 1890 Professor D'Arcy W. Thompson and the present writer pointed out quite independently of each other the fact that the Loons and Grebes were descendants of the Hesperornithidæ, an opinion previously expressed by Cope and Fürbringer. At great variance with this, Professor Newton, Lydekker, and Marsh, contended that these extinct cretaceous divers were some kind of a natatorial Ostrich. These so-called ostrich or "struthious characters" have been a stumbling-block in times past to more than one avian systematist, but I think their real significance is gradually coming to be better appreciated as time goes on. The great probability is, that there was a time in the former history of the Class, possibly at about the age when *Hesperornis* flourished, that all birds exhibited such characters in their skeletons. They are retained now only in a few and widely separated groups or families, as the Kiwis, the Tinamus, Ostriches and some others.

Now apart from a general and superficial resemblance a typical Loon and a typical Grebe are not, to judge from their osteology, as near akin as many seem to think. . Differences of a very marked character distinguish their skulls, their vertebral columns, their sterna, their pelves, and their limb bones. Still there is a greater similarity between the skeleton of a Loon and a Grebe than there is between a Loon and any representative of the Alcæ. About this fact I have satisfied myself after having compared, character for character, as they occur in the skeletons of several species of Loons with the corresponding ones in a number of Grebes and both with all the Auks found in our United States avifauna, save *Cerorhinca.* D'Arcy Thompson has shown, beyond all question in my opinion, in his paper, *On the systematic position of Hesperornis*, the affinity of our modern or existing Colymbi with that ancient diver. It would seem then that the time cannot be far distant when naturalists can at least agree upon the relations that these birds bear to each other and to kindred groups. To express this relationship, Loons and Grebes should be associated in one and the same suborder, and a superfamily created for either assemblage. In a linear classification, I believe their nearest relatives are the Penguins upon the one hand and the Auks upon the other, with the Heliornithidæ in the next place as a related branch, and one more nearly so than the Laridæ or the Procellaridæ. In part, this is believed by Dr. Stejneger, to be the relationship who, however, widely dissociates the Hesperornithidæ. While this last relationship is fully appreciated by Professor Fürbringer, that eminent authority nevertheless apparently, sees no special affinity, between an Auk and a Loon or Grebe, and so very widely separates the Colymbo-Podicipites and the Laro-Limicolæ assemblages.

Passing next to the anserine fowls, one would think that by this time there would be more or less unanimity of opinion among systematic ornithologists as to the affinities and position of such a homogeneous group. As a family, the existing Anatidæ can but contain the Mergansers, Ducks, Geese and Swans, while the outliers, either existing or extinct, are not as a rule very puzzling forms. The anserine affinities of *Palamedea* are now pretty generally recognized; and there can be no question as to the relationships of the extinct *Cnemiornis* or *Cereopsis.* Moreover the relation borne by the Flamingoes to the Anseres has been known for a good many years past, and yet notwithstanding all this we find almost as much diversity of opinion among the classifiers of birds as to where this very natural group belongs, as has already been pointed out in regard to the Pygopodes. After a careful examination and comparison of the skeleton of *Palamedea*, all of our United States Anseres except one or two species; the Flamingoes including the extinct ones, and Palæolodus; and a great many species and genera of Herons, Ibises, Storks, Scopus, and their allies near and remote; and finally an equal number of the Steganopodes, I was led to believe a year or two ago, that the duck tribe in its widest sense, with the allied suborders containing the Palamedeidæ, the Phœnicopteridæ and their fossil relatives, constituted a group, the nearest related branches to which were the Steganopodes upon the one hand and the Herodiones upon the other. An opinion, practically quite similar to this is entertained by Dr. Sharpe and Dr. Stejneger, while on the other hand, Dr. Gadow places the Anseriformes between the Falconiformes upon the one hand and the Crypturiformes upon the other,—which of course is an utterly different view of their relationships. To discuss these latter here, is obviously out of the question, as it would carry the present paper far beyond its limits.

FIG. 1

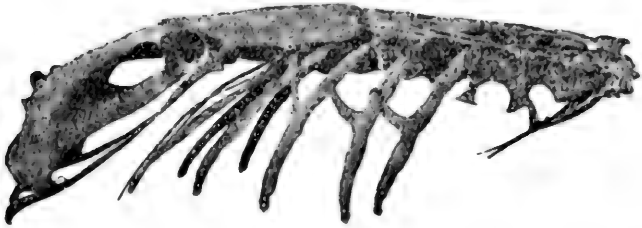


FIG. 2.

Fig. 1. (Upper figure) Right lateral view of the skull of *Dendrocygna autumnalis*, showing complete bony ring surrounding orbit. Pterygoids lost. From a photograph by the author. ⅞ nat. size.

Fig. 2. Right lateral view of part of trunk skeleton of same specimen. ⅞ nat. size.

Before turning from the Anseres, however, I desire to say that I have found some interesting osteological points in the skeleton of *Dendrocygna autumnalis*,—one of the tree-ducks. Although presenting several anatomical peculiarities, this genus is one containing several species of ducks, and ducks not so very far removed from either the Teals, or the Mallard, or perhaps *Spatula*. There is very little Goose, and still less Swan in the morphology of *Dendrocygna*, and for what reason the genus has been placed between *Philacte* and *Olor* in the *Check-List* it is difficult for me to understand. In the first edition of his *Manual* Mr. Ridgway places *Dendrocygna*, the last genus in the duck-series where the synopses of characters of the Anseres are set forth, while in the part devoted to the diagnoses of species and genera, these Tree-ducks are placed between the Swans and the Geese as in the *Check-List*. They have as I have just said some peculiar characters about them, and of these, one of the most interesting is the fact that they have complete bony rings surrounding the orbits, as is the case in several genera of parrots and some other birds. So far as I am aware it is the only genus of ducks that presents this character,—indeed, the only anserine bird that has it.

Coming to the Cranes and Rails we meet with an interesting form in *Aramus giganteus*. During the past few years I have compared the skeletons of several hundred species of birds, and written out the osteology of nearly every genus in this country, and among all these have been included the entire Crane and Rail group with all the North American birds in any way related to it. In this manner have *Grus, Aramus, Rallus, Porzana, Crex, Ionornis, Gallinula, Fulica,* and others been dealt with, and their skeletal characters arrayed in tabular form in great detail. Without entering upon the general taxonomy of this group, it is an interesting fact, that in so far as the skeletal characters are concerned, *Aramus* presents two for every one in favor of its affinity with *Grus* as compared with *Rallus*, yet in nearly all avian classifications we find this bird arrayed with the typical Rails. Four years ago I published in England, an abstract in which was incorporated some of the facts here stated, with part of a scheme for the classification of this group. Since then I have examined a number of forms at that time not available, and although they have not materially altered my original views, some changes will necessarily have to be made in order to include these facts which have since come before me.

Of recent years nothing has come to my notice that seems likely to again check the now growing opinion that the Woodpeckers, as another assemblage of birds, see their nearest relatives in the Passeres, and they do not possess those vestiges of lacertilian morphology in the bases of their crania that were formerly supposed to exist there. The double vomers that a few years ago were attributed to them, are now generally conceded to be nothing more than mesial edges of the imperfectly ossified palatines, as was pointed out by Garrod in 1872. In that year Garrod printed a brief paper in the *Ibis*, in which he claimed that *Gecinus viridis* and its allies possessed a median vomer, though it was differently formed from the bone as it occurs among some of the Passerine birds. Nevertheless Dr. Sharpe as late as 1891, in his extremely useful brochure, *Recent Attempts to Classify Birds*, still claims saurognathism for the *Pici*, although in the same paragraph he admits that in this entire suborder the "vomer is slender, pointed and split" (p. 84). It is not difficult to believe that all of the alleged saurognathous characters in the skull and associated bony arches of the woodpeckers are due to changes wrought in time through the special habits of this particular group of birds, rather than that they stand in evidence as structural remnants inherited from their ancient reptilian ancestors.

The following annual reports were read and referred to the Publication Committee:—

REPORT OF THE RECORDING SECRETARY.

With a view to supplying matters of interest for the meetings of the Academy and thereby increasing the attendance, the Committee on Instruction and Lectures has been charged with the duty of preparing an announcement of the programme for each month, postal card notices being sent accordingly to the members. By this means the average attendance has been slightly increased from 25 to 28, the largest number being 135 and the smallest, at the midsummer meetings, being 6. The communications presented and the discussions based on them have frequently been interesting, but, except in a few cases, they were not records of the results of original investigation and were not, therefore, prepared for publication in the *Proceedings* of the Academy. The speakers during the past year were Messrs Skinner, Goldsmith, Rand, Carter, Dixon, Ferrier, Heilprin, Keeley, Woolman, Pilsbry, Chapman, Holman, Stewardson Brown, Calvert, Stone, Frazer, Sharp, Palmer, Spiller, Mills, L. Witmer, Barr, Holman, Lyman, Vaux, U. C. Smith, Willcox, Conklin, Montgomery, Chas. Morris, Harned, J. Cheston Morris, Wells, Brinton, J. Wharton James, Libbey, A. E. Brown, A. F. Witmer and Miss Keller.

Six hundred and fifty-two pages of the *Proceedings* illustrated by twenty-seven plates have been issued. Twenty-five pages of the *Journal* with one plate and a large number of text illustrations have been printed and distributed in the form of an author's edition, the entire expense of publication having been defrayed by Mr. Clarence B. Moore, the continuation of his valuable work on the southern burial mounds constituting the subject matter of the issue.

It forms the first portion of the second number of Volume XI of the *Journal*, the continuation, on which the printer is now engaged consisting of Prof. Cope's posthumous paper on the fossils of the Port Kennedy Bone Cave, to be illustrated by four plates of the remains of the new species described, and one by Mr. H. C. Mercer on the general characters of the cave, the mode of making the explorations, and his methods of preserving and recording the results, with text illustrations. These papers, it is hoped, will be distributed early the coming year.

Fifty-six papers have been presented for publication during the past year as follows:—Henry A. Pilsbry 6, Henry A. Pilsbry and E. G. Vanatta 4, Gerrit S. Miller, Jr. 5, Clarence B. Moore 4, Samuel N. Rhoads 4, Robert Baird McClain 3, John Van Denburgh 2, William J. Fox 2, Chas. S. Boyer 2, William H. Dall 2, Edw. Goldsmith 1, Francis R. Cope, Jr. 1, Philip P. Calvert 1, Edw. J. Nolan 1, John B. Smith 1, Daniel G. Brinton 1, Alvin Seal 1, T. Chalkley Palmer 1, C. M. Barber and T. D. A. Cockerell 1, E. J. Letson 1, Gary de N. Hough 1, E. G. Conklin 1, John W. Harshberger 1, David Starr Jordan and J. A. Gunn, Jr. 1, J. Percy Moore 1, C. Hart Merriam 1, Charles W. Johnson 1, Ida A. Keller 1, S. Harbert Hamilton 1, Henry C. Mercer 1, R. W. Shufeldt 1, and Witmer Stone 1.

Five of these form a portion of the *Journal* before alluded to, three were returned to the author, one was withdrawn, one is now about going to press, and one has been held over until next year. The others have been printed in the *Proceedings*. It is gratifying to find in this connection that representatives of departments of the United States Government, and of several important educational institutions including the Agricultural College of New Mexico, the Leland Stanford, Jr. University, the Smithsonian Institution and the University of Pennsylvania have found it to their advantage to avail themselves of the facilities for securing early date of publication afforded by the mode of issue and distribution of the Academy's *Proceedings*. It is earnestly urged that as soon as the Academy's means will permit, the numbers as issued be distributed free of charge to all members of the society in good standing.

The Entomological Section (Am. Entomological Society) has issued 231 pages and 11 plates of the *Entomological News*, 128 pages and 2 plates of the *Transactions*, and 202 pages of special papers.

The publications of the Conchological Section during the year have consisted of 143 pages and 27 plates of the *Manual of Conchology*. This gives a total, exclusive of the Journal, of 1,356 pages and 67 plates issued since Dec. 1, 1897.

The present statistics of distribution of the Academy's publications proper are as follows:—

Proceedings, mailed to subscribers	81
" mailed to exchanges	100
" sent to exchanges through the International Bureau (Smithsonian Inst.)	444
Total,	625

Journals, mailed to subscribers	34
" mailed to exchanges	14
" sent to exchanges through International Bureau (Smithsonian Inst.) . .	52
Total,	100

The edition of the *Proceedings* is 1,000 copies, of the *Journal* 500.

The stock of the publications of the Academy had been removed in the fall of 1897 to the basement of the new building so as to make room for the office of the Executive Curator and for the growth of the library. Roomy and convenient storage cases had been provided, a new account of stock had been taken, and it was believed that this important part of the Academy's possessions was at last safely and permanently placed, with sufficient room for the additions of many years to come and without danger of being again crowded out by the growth of other departments. It was found later that the basement was not entirely free from suspicion of dampness and that the dust found its way through even comparatively air tight doors and would therefore be objectionable. These evils might have been remedied, but it was impossible to provide against the accident which has made another removal absolutely necessary.

It occurred on the third of last August in the form of the heaviest rain-fall ever known in this region. Its suddenness and volume was that of a tropical storm. Streets became rapid torrents, the fence on the south side of the Academy's premises was torn down, the excavated lot rapidly filled, with no outlet except through the basement of the new museum building, where the water in a few minutes reached a height of three feet. The publications on the lower range of shelves were soaked, and before they could be removed to the upper floors, where as rapidly as possible they were spread out to dry, they sustained further damage from the mildew consequent on the high temperature and humidity of the season. The recent illustrations by photographic processes will have to be replaced in both *Proceedings* and *Journal* as the peculiarly prepared paper has been welded by the dampness and pressure into masses of cardboard while the older lithographic plates printed on honest linen paper are comparatively uninjured. The damaged numbers have been placed in piles on the upper floors of the new museum building where they are at present safe from further injury except to some slight extent from dust; but the necessity for providing space for the entire stock of the back publications of the

Academy which will be at once permanent, safe and convenient is one that must be provided for immediately. The importance of this matter is paramount in view of the fact that the reputation of the Academy as a scientific institution depends more on the character of its publications, embodying as they do the notable work of its members during eighty-seven years of its existence, than upon the extent of its library and museum. Its publications keep it in communication with other scientific societies; they form the basis of its exchange in the intellectual markets of the world and place it on a far higher plane than that of a mere local club of naturalists.

Pending an arrangement of the damaged publications on shelves to be provided for them I have not been able to form estimate of the cost of repair. The electro-blocks of the plates which must be replaced have been preserved, so that the printing alone will have to be provided for.

Twenty-one members have been elected. The deaths of eleven members have been announced, four have been dropped and the resignations of nine have been accepted, as follows:—Julius F. Sachse, Charles P. Turnbull, Mrs. L. L. W. Wilson, Charles W. Dulles, Ellen W. Longstreth, Charles Coulter, Ruth Clement, J. Howard Breed and J. Lewis Crew. This leaves a net loss of three from the membership roll. The deaths of nine correspondents have been reported.

At the instance of the Secretary of the American Association for the Advancement of Science a committee consisting of Messrs. Meehan, McCook, Wilson, Skinner and Nolan was appointed early in the summer to secure the co-operation of the city authorities and representatives of educational establishments with a view to inviting the Association to meet in Philadelphia in 1899. The invitation was conveyed by a representative of a joint Committee but was not accepted, the place selected for the meeting being Columbus, Ohio.

The Hayden Memorial Medal was conferred, in accordance with the recommodation of the Committee on Award, on Prof. Otto Martin Torell, the Chief of the Geological Survey of Sweden.

A note of thanks was unanimously tendered to Miss Anna T. Jeanes for her munificent gift of $20,000 the income of which is to be expended for the improvement and increase of the museum.

The President of the Academy and Mr. William Wynne Wister, Jr. have been appointed Managers on behalf of the Academy of the Wistar Institute of Anatomy under the deed of endowment.

The President was authorized to memorialize Congress for aid in the establishment of a Floating Institute as defined in a communication from the 7th International Congress of Geologists held last year in St. Petersburg.

EDWARD J. NOLAN,
Recording Secretary.

REPORT OF THE CORRESPONDING SECRETARY.

During the past year, commencing Dec. 1, 1897, there have been received from eighty-five societies, museums, libraries, etc., one hundred and fifty-four acknowledgements of the receipt of the publications of the Academy, and from forty societies, libraries, etc., forty-nine notices that their publications have been forwarded to the Academy. Twenty-seven applications for exchange and for supply of deficiencies in sets of the Academy's publications, together with nine letters on miscellaneous subjects, fourteen circulars and invitations to the Academy to participate in Congresses or meetings, and several announcements of the deaths of scientific men have also been received and when necessary answered.

The deaths of the following correspondents have been reported:

Charles E. Beddome, of Hobart Town, Tasmania; elected 1883, died Sept. 1, 1898.

Ernest Candèz, of Liege, Belgium; elected 1877, died June 30, 1898.

Joseph Charles Hippolyte Crosse, of Paris, France; elected 1867, died Aug. 7, 1898.

James Hall, of Albany, New York; elected 1843, died August 7, 1898.

Rudolph Leuckart, of Leipzig, Germany; elected 1884, died June, 1898.

Jules Marcou, of Cambridge, Mass.; elected 1860, died April 17, 1898.

R. P. Montrouzier, of New Caledonia; elected 1867, died 1898.

Osbert Salvin, of London, England; elected 1867, died June 1, 1898.

Karl Ludwig Fridolin von Sandberger, of Wuerzburg, Germany, elected 1855, died April 11, 1898.

Six hundred and eighty-eight acknowledgements for gifts to the library and sixty-three for gifts to the museum have been forwarded.

Respectfully submitted,

BENJ. SHARP,
Corresponding Secretary.

REPORT OF THE LIBRARIAN.

The accessions to the library of the Academy during the year since the first of December, 1897, number 4,469 of which 3,946 were pamphlets, 517 volumes and 6 detached maps.

They have been received from the following sources:—

Societies	1,917
I. V. Williamson Fund	1,138
Editors	790
Authors	230
Angelo Heilprin	101
U. S. Dept. of Agriculture	53
James Aitken Meigs Fund	44
Estate of Geo. A. Rex	27
U. S. Department of the Interior	23
Department of Mines Victoria	20
Geological Survey of Sweden	14
U. S. Department of State	14
Wilson Fund	13
Ministry of Public Works, France	11
Geological Survey of India	7
U. S. Department of Labor	6
Comité Géologique Russe	6
Department of Mines, New South Wales	5
Department of Geology, Indiana	4
U. S. Commission of Fish and Fisheries	3
Secretary of State, Mexico	3
Chas. P. Perot	3
Geological Survey of New Jersey	3
University Geological Survey of Kansas	2
East Indian Government	2
Dr. D. B. McCartee	2
U. S. War Department	2
U. S. Treasury Department	1
U. S. Interstate Commission	1
U. S. Civil Service Commission	1
S. P. Langley	1
Queensland Government	1
Commissioners of Inland Fisheries and Game, Mass.	1
Librarian of Congress	1
Geological Survey of Canada	1
Geological Survey of Portugal	1
Department of Mines, Nova Scotia	1
Thomas Meehan	1
Trustees of the British Museum	1
Illinois State Bureau of Labor	1
Mrs. C. F. Palmer	1
Wm. J. Fox	1

M. E. Wadsworth,	1	The Editor Publishing Co., Cincinnati, O.,	1
Geological Survey of Mexico,	1	Smith, Elder & Co., London,	1
Iowa Geological Survey,	1	Estate of John H. Redfield,	1
H. A. Pilsbry,	1	Southern Rail Road, Co.,	1
T. D. Rand,	1		
Edw. J. Nolan,	1		

They were distributed to the several departments of the library as follows:—

Journals,	3,639	Medicine,	18
Geology,	196	Physical Science,	18
Botany,	120	Mineralogy,	17
General Natural History,	91	Herpetology,	16
Agriculture,	56	Helminthology,	15
Entomology,	37	Ichthyology,	14
Mammalogy,	37	Ornithology,	11
Anthropology,	30	Geography,	5
Conchology,	28	Chemistry,	1
Anatomy and Physiology,	27	Bibliography,	1
Voyages and Travels,	20	Miscellaneous (unclassified),	36
Encyclopedias,	18		

The decrease during the year in the number of accessions is partly due to a curtailment of the amount appropriated for the purchase of books and partly to the fact that deficiencies in the publications of corresponding societies, persistently asked for, had been in a great measure previously supplied, at all events as far as they are likely to be, except by purchase from second hand dealers.

The facilities for cataloguing have been greatly increased by the purchase of improved cases which not only accommodate the card entries of all the books and pamphlets now in the library but provide ample space for the growth of at least the next fifty years.

The necessity for increased shelf room, to which attention was called in my last report, becomes more pressing, especially in the department of Journals. In many instances the accessions are now packed away in such form as to be difficult of access, the disadvantage being greatly increased by the lack of means for necessary binding. It is strongly urged that both these need: more cases and a larger appropriation for binding, be supplied at an early date.

Some little relief in the way of additional room has been secured by the selecting out and packing away of a number of volumes of official documents, State executive reports, miscellaneous literature, and other material entirely unconnected with the Academy's function. It is suggested that these be disposed of to some library where they will not be so entirely out of place and where they are likely to be looked for by those interested in them.

A large collection of duplicate volumes and pamphlets numbering 1,096 titles have been arranged and catalogued. It is hoped that means may be furnished for the printing of the list. There is no doubt that the expense would be refunded by sales, while the books would be so distributed as to confer benefit on these acquiring them instead of lying, as now, useless in our storage room.

While the binding during the year of 174 volumes has been unusually small in amount, it has been unusually important in character, twelve volumes of Gould's folios, embracing the *Birds of New Guinea* in five volumes and the *Birds of Asia* in seven, have been bound in a manner befitting the artistic beauty of the works. The expense was defrayed from the Wilson Fund, to which the books themselves were credited, thus materially curtailing the amount available from that source for the purchase of additions. The unbound numbers had, however, been practically inaccessible to students since the completion of the works, whereas they now form an available portion of the ornithological library and a superb addition to the collection of finely illustrated folios which, thanks to the taste and liberality of Dr. Thomas B. Wilson, is one of our notable possessions.

A careful enumeration of the library during the year furnishes the following results:—

	VOLUMES.	PAMPHLETS.
Journals,	20,645	
Geology,	2,655	2,568
General Natural History,	2,641	810
Botany,	2,166	1,155
Voyages and Travels,	1,764	89
Anatomy and Physiology,	1,591	1,101
Anthropology,	1,263	695
Entomology,	1,144	1,188
Conchology,	1,004	691
Medicine,	819	1,122

Ornithology,	816	538
Encyclopedias, Dictionaries, etc.,	811	
Bibliography,	691	
Mineralogy,	520	490
Physical Science,	548	735
Geography,	336	46
Agriculture,	301	223
Ichthyology,	286	301
Mammalogy,	281	383
Helminthology,	264	367
Chemistry,	259	300
Herpetology,	172	217
Unclassified,	356	
Warner Library, mostly Mathematics,	1,090	627
	42,423	13,646
Volumes formed by collection of pamphlets,	958	
Volumes in library of Entomological Section (Am. Ent. Soc.),	2,864	
Volumes in James Aitken Meigs' library,	1,975	
Total,	48,220	

Nearly all the pamphlets above enumerated are bound, the entire collection forming, as noted, 958 volumes.

The library of the Entomological Section (American Entomological Society) comprises 2,864 volumes, many of them, however, being duplicates of those elsewhere credited.

The James Aitken Meigs' library of miscellaneous literature is entirely foreign to the province of the Academy, the scientific portions of it having been catalogued and placed when received with the special sections of the main library of which they now form a part. The miscellaneous portion is retained and kept together out of regard for the wishes of the donor John G. Meigs. A shelf list has been prepared but it has not been otherwise catalogued although there is a large amount of material in the collection of indirect interest, sufficient indeed to warrant the preparation of an author and subject catalogue when time can be secured from more pressing matters.

Excluding, therefore, if it be thought proper, the two sections last referred to, the working library of the Academy contained when counted last August, 43, 381 volumes. The last previous enumeration was made in 1888 when there were 30,831 volumes on the shelves; the addition of 12,550 volumes, therefore, in ten years, is a gratifying rate of increase in view of the strictly special character of the library.

In two lectures on the literature of natural history delivered in November as introductory to the Academy's Ludwick Institute courses for the year, I had the pleasure of commenting on some of the bibliographical treasures of the library while defining the scope and purpose of such a collection. The Academy is to be congratulated on the fact that there is probably no other in America from which the subject could be illustrated so amply.

It gives me renewed pleasure to again acknowledge my indebtedness to Mr. Wm. J. Fox for efficient assistance during the year.

Edw. J. Nolan,
Librarian.

REPORT OF THE CURATORS.

The Curators are able to report the collections under their care to be in an excellent state of preservation.

Besides the preparation and cataloguing of new material received during the year, it has been possible to devote considerable attention to the re-arrangement of several departments of the museum.

Following the plan adopted last year, about half of the wall cases were removed from the upper gallery of the old museum and erected in the new basement, thus completing the Alcoholic department as originally planned. All the remaining Alcoholics, comprising the Reptilia, Batrachia, Mammalia, and Invertebrata were transferred to these cases. The systematic arrangement of the Fishes and Invertebrata has been completed, the latter as well as the Reptilia and Batrachia having been catalogued during the year.

It might be added that the entire zoological collection of the Academy has now been catalogued, except a part of the Mollusca, the dry Invertebrate preparations, and the Osteological preparations of Fish, Reptiles, and Batrachians.

The magnitude of this work can be appreciated when it is learned that the combined number of catalogue entries of the vertebrates amounts to sixty-five thousand six hundred.

Fifteen half-upright cases were purchased during the year, in which it is intended to arrange the dried specimens of Lower Invertebrates, the duplicates being stored in closets, which have been provided underneath the cases. Part of this transfer has been already accomplished and when completed it will permit the removal of the remaining wall cases where the Invertebrata have been stored heretofore.

Two new museum cases have been placed in position on the mammal floor in which are arranged the higher Quadrumana and Carnivora. One of these was provided through the Mary Jeanes Fund, established this year by Anna T. Jeanes for general museum purposes. The fund will enable us to make much more progress in future in furnishing the new building and in accommodating our rapidly increasing collection. Another improvement in the Mammal department has been the placing on exhibition of the Pacific Walrus obtained by Dr. Sharp and Mr. J. M. Justice.

In the Archæological Department Mr. Clarence B. Moore has presented an upright case for the reception of some of the material which he has added to the Moore Collection during the year. Mr. Johnson has continued to devote much time to the arrangement of the Isaac Lea Eocene Collection, which has been largely increased during the year through the liberality of the Rev. Dr. L. T. Chamberlain. This collection now occupies four large double mahogany cases contributed by Dr. Chamberlain, and is undoubtedly the most complete and important series of American Eocene mollusca in existence, while it also contains the largest series in America of European Eocene shells. Mr. Johnson has also been engaged to re-arrange the Academy's series of Tertiary Invertebrates.

In the Botanical rooms a series of nine cases has been erected for the accommodation of the herbarium, which has outgrown its old quarters.

Temporary cases have also been fitted up in the Ornithological room for skins of large birds. Much time has been devoted by the several Conservators to the care of the specimens in their special departments.

The Curators regret to have to report that much damage was done to furniture and material stored in the basement by the severe flood of August 3rd. The extraordinary rainfall flooded the city sewers and filled the streets to the depth of eighteen inches, from which it forced a way into the cellars and basement. The damage has, however, been repaired so far as possible, and the actual loss of specimens seems to be very slight, though much time was consumed and important museum work seriously hindered.

Owing to the necessity for removal of the publications from the basement several closets in the new building as well as considerable space on the top floor have been devoted to their accommodation.

The additions to the museum during the year have been particularly noteworthy as will be seen by reference to the accompanying list. Most important are the valuable collections of Mammals, Birds, Reptiles and Fishes bequeathed to the Academy by the late Prof. Edw. D. Cope, which number about eight thousand specimens and include many of his types. The collection of vertebrate preparations formed Dr. Harrison Allen and presented by Mrs. Allen is another important accession. A valuable series of birds from Mongolia was received from Dr. A. D. Smith and the Messrs. Edward & George Farnum, and a number of Japanese plants and vertebrates from Miss A. Hartshorne. An important collection of over 300 South Australian invertebrates, mainly mollusks, has been obtained from Mr. W. T. Bednall. The Zoological Society of Philadelphia has presented numerous specimens during the year, which have been prepared in the taxidermical department. In the Botanical department the most important addition has been the entire collection of Lichens made by Dr. J. W. Eckfeldt, the well known authority upon this group.

Another accession of especial importance is a collection of Reptiles and Batrachians numbering several hundred specimens, presented by Mr. Arthur E. Brown.

Efficient service has been rendered by the Jessup students, Messrs. W. J. Gerhard, H. W. Fowler, S. H. Hamilton, E. G. Vanatta and A. F. Satterthwait in their several special departments.

During the year specimens have been loaned for study to the following: Dr. J. A. Allen, M. L. Fernald, Dr. C. Hart Merriam, H. C. Oberholzer, E. W. Nelson, F. L. Scribner, Elizabeth G. Britton, F. A. Lucas, W. H. Dall, H. T. Osborn, Walter Rothschild, Alfred Newton, G. S. Miller, Outram Bangs, Katharine J. Bush, Dr. G. N. Best, P. A. Rydberg, Dr. J. F. Whiteaves, G. D. Harris, Dr. G. M. Dawson and E. P. Bicknell.

HENRY C. CHAPMAN, M. D.,
Chairman of the Curators.

REPORT ON THE WM. S. VAUX COLLECTIONS.

The Curator of the William S. Vaux Collection begs leave to report that since November 30th, 1896 he has added to it by purchase one hundred and twenty-five specimens. Although the number is not as large as in former years, yet the quality of the specimens is better, a number of them being species new to the collection including several extra fine large crystals.

As reported by the Curators several fine new cases were purchased during 1897 for the display of the various large specimens which had formerly been exposed.

The collection now numbers 8,091 specimens all in good order with the exception of two marcasites which have decomposed.

There have been no additions to the Archæological Collection since my last report though it continues to attract much attention from visitors.

WM. W. JEFFERIS,
Curator.

REPORT OF THE BIOLOGICAL AND MICROSCOPICAL SECTION.

The Section has held ten meetings during the year. The new room upon the second floor has been partially furnished and the collections placed therein. It is expected that upon the completion of anticipated improvements the accommodations for biological investigations may be made of permanent value to the members and increase the interest of the stated meetings.

During the year numerous communications have been made, of which the following were presented at the meetings of the Academy:—

"On the Structure of Diatoms," by Mr. F. J. Keeley.

"Observations on Errant Frustules of *Eunotia major*," and "Conjugation of *Closterium acerosum*," by Mr. T. Chalkley Palmer.

"New Species of Diatoms," by Mr. Charles S. Boyer.

"On *Isthemia nervosa* in Hudson Strait," by Mr. John A. Shulze.

"Old and New Microscopes and Methods of Preparation," by Dr. J. Cheston Morris.

Other communications of interest were made by Dr. Morris, Mr. Holman and Mr. Woolman.

The Conservator reports the loan to the Section of two microscopes by Dr. Morris, which are of value as models of ancient and peculiar construction. Mr. Shumo presented numerous specimens brought by him from Jamaica.

The Section has lost by death Mr. Chas. P. Perot, for a long time our Treasurer and valued member. Resolutions of respect were passed and presented at the meeting of the Academy.

The following officers were elected for the ensuing year:—

Director, ...	J. Cheston Morris, M. D.
Vice-Director, ...	T. Chalkley Palmer.
Treasurer, ...	Lewis Woolman.
Conservator.	F. J. Keeley.
Corresponding Secretary, . .	John G. Rothermel.
Recorder, ...	Charles S. Boyer.

CHARLES S. BOYER,
Recorder.

REPORT OF THE CONCHOLOGICAL SECTION.

Work on the collection during the past year has been confined mainly to the reidentification of the Bulimulidæ and other groups monographed in the *Manual of Conchology*, the rearrangement of part of the fresh-water shells, and the renovation and cataloguing of the alcoholic mollusks.

The accessions to the conchological museum have been important, though no single collection of great size has been received. A large number of new species and species new to the collection having been secured. Additions to our North American series have been made by Messrs. J. H. Ferris, R. C. McGregor, E. H. Ashmun and P. B. Randolph, whose collections from the Great Smoky Mountains, northern California, New Mexico and Alaska respectively, are worthy of special mention among those of the large number of naturalists who have added to our American series. Dr. H. von Ihering has continued to send valuabe South American consignments, including a large series of alcoholic land snails from Brazil. The New Zealand collection received from Mr. H. Suter, and the Australian species from Messrs. W. T. Bednall and J. C. Cox, with a large number of land shells new to the collection, purchased by the Conchological Section and the Academy, materially augment the series of non-American mollusks.

Throughout the year the Conservator has been efficiently assisted by Mr. E. G. Vanatta.

The accessions of the year are enumerated in the list of additions to the Museum.

The following officers were elected at the annual meeting in December:—

Director, ...	Benjamin Sharp, M. D.
Vice-Director, ...	John Ford.
Recorder and Librarian, . . .	Edw. J. Nolan, M. D.
Corresponding Secretary, . . .	Chas. W. Johnson.
Treasurer, ...	S. Raymond Roberts.

HENRY A. PILSBY,
Conservator.

REPORT OF THE ENTOMOLOGICAL SECTION.

This has been a very busy year in the history of the Entomological Section. The collections have been well cared for with the assistance of Mr. W. J. Gerhard and Mr. Alfred Satterthwaite, and by individual members interested in special branches of entomology. The rearrangement of the American Coleoptera is nearly completed and valuable work has been done on the exotic species by Dr. H. G. Griffith. The unarranged material in the Horn Collection has been placed in safe receptacles preparatory to proper incorporation in the main collection. Special groups in this collection have been loaned to specialists for study and revision. Many families in the Diptera have been rearranged by Mr. C. W. Johnson, in new book boxes purchased for the purpose. Two large boxes of Hemiptera have been purchased, representing a large number of specimens, quite a number of them being new to the collection. The Membracidæ have been arranged by Mr. Gerhard with the aid of Dr. F. W. Goding, an authority on this subject. The Neuroptera, other than the Odonata, and the Orthoptera have been properly placed in new receptacles by the Conservator.

Prof. James S. Hine has studied and properly identified our material in the genus *Bittacus*, of which we now have a representative collection. Dr. Calvert has had the care of the Odonata; our collection in this branch is among the very finest in the world. In the Lepidoptera we are indebted to Prof. C. H. Fernald, of Amherst, Mass. who has studied and revised the Pterophoridæ, a very difficult group. The material has been returned in good condition. Mr. Gerhard, with the aid of the Conservator, has put in fine order the Hesperidæ of the world. This is a part of the Martindale collection. Much work has also been done on the other families in this fine collection. Mr. Satterthwaite is engaged in rearranging the exotic moths in this collection and has thus far finished the Sphingidæ. Fifty new boxes and a fine cabinet have been purchased to contain the Hymenoptera and Mr. E. T. Cresson is now engaged in their rearrangement. Mr. Fox has made some valuable contributions to science by his studies in this Order.

Numerous specimens have been added to the cabinet, the more important donations being a collection of American Coleoptera from Dr. Eckfeldt; 61 specimens of Honduras Lepidoptera by Dr. H. G. Griffith; 68 Hesperidæ from Colima, Mexico, from Henry Skinner; 124 Beetles, 10 Hemiptera, 3 Orthoptera, 1 Hymenoptera from Dr. A. D. Smith and the Farnum brothers, all from Manchuria; 9 Coleoptera by W. F. Bednall, from Australia.

Many valuable works have been added to the library; nine hundred and thirty-three have been the gift of the late Dr. Geo. H. Horn. One hundred and seventy works have been bound. Valuable books have been purchased, some of them not being represented in other libraries in this country, the amount expended being $529.93. The *Entomological News* has been continued and the ninth volume completed with 264 pages and 12 plates. The present space devoted to the Entomological Section is inadequate, owing to its rapid growth in all departments.

At the annual election held Dec. 22nd. the following persons were elected officers for the year 1899:—

Director, ...	Philip Laurent.
Vice-Director, ...	H. W. Wenzel.
Recorder, ...	Henry Skinner.
Treasurer, ...	Ezra T. Cresson.
Secretary, ...	Wm. J. Fox.
Conservator, ...	Henry Skinner.

Respectfully submitted,
HENRY SKINNER.
Recorder.

REPORT OF THE BOTANICAL SECTION.

The Botanical Section of the Academy reports a fair amount of progress as detailed in the Conservator's report, attached as part of this document.

The arrangement and fastening down of the specimens, begun by Mr. Redfield many years ago, has now been carried down as far as *Solanaceæ.* In this good work Mr. Uselma C. Smith has rendered valuable aid to the Director. If a salaried Conservator could be engaged to direct a number of volunteers this great work of the Academy might be completed within a short time.

The Section is out of debt with a small balance in the Treasury.

The officers for the ensuing year are:

Director, ...	Thomas Meehan.
Vice-Director, ...	Charles E. Smith.
Recorder, ...	Charles Schaeffer, M. D.
Corresponding Secretary, . .	Jos. D. Crawford.
Conservator and Treasurer, . .	Stewardson Brown.

Respectfully submitted,

THOMAS MEEHAN,

Director.

Report of the Conservator.—In presenting this report for the year 1898 the Conservator of the Botanical Section wishes to express his appreciation of the aid rendered by the Curators of the Academy in the furnishing of additional cases for the accommodation of the herbarium in the new botanical room on the Library floor formerly occupied by the Entomological Section.

These cases which were completed in the early part of the year, have rendered necessary the rearrangement of the herbarium, which has been accomplished through the aid of the Director of the Section, Mr. Thomas Meehan. The consolidation of the North American herbarium, formerly kept in the room on the gallery floor, with the general herbarium, will be found to be a great convenience to those making use of the collections. This latter work, which is necessarily slow, will be completed during the present winter.

The rearrangement of the collections, notwithstanding the additional cases furnished, has made it necessary to remove the specimens of vascular Cryptogams to the cases on the gallery floor formerly occupied by the North American Herbarium, the Phanerogams being disposed of in the cases in the two rooms on the library floor.

The work of arranging the collections deposited in 1897 by the American Philosophical Society has satisfactorily progressed, and, it is hoped, will be completed by the end of the coming year.

The mounting of the general herbarium has been somewhat retarded during the year owing to the enforced absence of the assistant in the herbarium, due to illness.

The herbarium of the Philadelphia Botanical Club has not heretofore been referred to, and I wish, therefore, to here call special attention to the excellent work being done by the members of this organization.

The plants comprising this collection are from points within a radius of about a hundred miles of the city, including Pennsylvania east from the Susquehanna River and south of the Blue Ridge, all of New Jersey south of the same range of mountains, and the northern counties of Delaware and eastern Maryland.

The lack of specimens of our local plants in the herbarium of the Academy, created the necessity of such a collection, which now numbers many thousand specimens from all sections of the district and it is hoped in time to make it the most complete collection of its kind extant.

The noteworthy additions to the herbarium during the year have been a collection of Japanese plants presented through Miss A. C. Hartshorne, a collection of South African plants purchased and presented by Mr. Thomas Meehan, and many plants our own continent presented by Messrs. Joseph Crawford, C. F. Saunders and Stewardson Brown.

Respectfully submitted,

STEWARDSON BROWN,

Conservator.

REPORT OF THE MINERALOGICAL AND GEOLOGICAL SECTION.

The Director of the Mineralogical and Geological Section of the Academy would respectfully report that meetings have been held regularly during the year, except during the summer; that the attendance has been good, and the interest manifested encouraging.

On May 21st the Section under the leadership of Prof. Fred. B. Peck of Lafayette College visited a number of interesting localities around Easton, Pa.

Additions to the museum have been valuable but not as numerous as in former years.

The following officers were duly elected for the coming year:—

Director,	Theodore D. Rand.
Vice-Director,	W. W. Jefferis.
Recorder,	Charles Schäffer.
Conservator,	W. W. Jefferis.
Treasurer,	John Ford.

Respectfully submitted,

THEO. D. RAND.

Director.

REPORT OF THE ORNITHOLOGICAL SECTION.

The work of the Section during the past year has been mainly devoted to the study collection. But little progress has been made in the rearrangement of the exhibition collection of birds owing to the need of cases on the third floor of the new building.

A synoptical collection has been arranged there, as promised in last year's report, but the main series of mounted birds is still in the old gallery. Though not displayed to advantage it remains in an excellent state of preservation.

The study collection has been carefully examined and better provision made for many of the large skins. Most of the Conservator's work this year has been devoted to a study of the types in the collection which have been carefully identified and arranged in special cases, the results of this work having been embodied in a paper which will appear in the *Proceedings.*

The Delaware Valley Ornithological Club has made many additions to the collection presented by it to the Academy so that it is now probably the most complete exhibition of its kind in existence. The meetings of the Club continue to be held at the Academy and do much to stimulate ornithological study.

The Section is also much gratified to be able to report that through its efforts the annual meeting of the American Ornithologists' Union will be held at the Academy in Nov., 1899. The importance of this meeting to local ornithologists and to the Academy will be readily understood.

During the year the most important accession has been the collection of bird skins bequeathed by the late Prof. E. D. Cope numbering nearly 1,000 specimens and containing the once famous collection of C. S. Turnbull.

Of great importance also is a small series of specimens from Manchuria received from Dr. A. Donaldson Smith and the Messrs. Farnum. Valuable specimens were also received from the Zoological Society of Philadelphia, Dr. J. E. Romig and others. .

The magnificient collection of North American land birds formed by Mr. Josiah Hoopes has been received on deposit.

At the annual meeting held Dec. 19, 1898, the following officers were elected :—

Director, ... Spencer Trotter.
Vice-Director, ... Geo. S. Morris.

Recorder, ...	Stewardson Brown.
Secretary, ...	Wm. A. Shryock.
Treasurer and Conservator, . . .	Witmer Stone.

Respectfully submitted,
WITMER STONE.
Conservator.

REPORTS OF THE PROFESSORS.

HENRY A. PILSBRY, Professor in the Department of Mollusca, reports that during the year he has delivered a course of lectures upon bivalve mollusks. Several special reports upon particular groups of mollusks, based upon material in the collection of the Academy, have been prepared and published in the *Proceedings* of the Academy. Progress in the classification of the collection has been made, the details of which may be found in the report of the Conservator of the Conchological Section.

DANIEL G. BRINTON, M. D., Professor of Ethnology, reports that during the year 1898 a course of lectures, free to the public, was delivered by him on various ethnological subjects, in the Hall of the Academy. They were well attended, and considerable interest was shown.

The collections in this department are well displayed and carefully looked after by the Curators.

HENRY SKINNER, M. D., Professor in the Department of Insecta, reports having delivered a course of six illustrated lectures on entomology in connection with the Academy's Ludwick Institute Course. He refers to his report as Conservator of the Entomological Section for a statement of other work accomplished during the year.

The election of Officers, Councillors and Members of the Finance Committee to serve during 1899 was held with the following result:—

President, . . .	Samuel G. Dixon, M. D.
Vice-Presidents, . .	Thomas Meehan.
	Rev. Henry C. McCook, D. D.
Recording Secretary, .	Edward J. Nolan, M. D.
Corresponding Secretary, .	Benjamin Sharp, M. D.
Treasurer, . . .	George Vaux, Jr.
Librarian, . . .	Edward J. Nolan, M. D.
Curators, . . .	Henry A. Pilsbry.
	Henry C. Chapman, M. D.
	Arthur Erwin Brown.
	Samuel G. Dixon, M. D.
Councillors to serve three years,	Charles E. Smith.
	Uselma C. Smith.
	John Cadwalader.
	William Sellers.
Finance Committee,. .	Charles Morris.
	Chas. E. Smith.
	Uselma C. Smith.
	William Sellers.
	Charles Roberts.
Councillor for unexpired term of two years, . .	Charles Schaeffer, M. D.

COUNCIL AND STANDING COMMITTEES FOR 1899.

Council.

Ex-officio.—Samuel G. Dixon, M. D., Thomas Meehan, Rev. Henry C. McCook, D. D., Edw. J. Nolan, M. D., Benjamin Sharp, M. D., George Vaux, Jr., Henry A. Pilsbry, Henry C. Chapman, M. D., Arthur Erwin Brown.

To serve Three Years.—Charles E. Smith, Uselma C. Smith, John Cadwalader, William Sellers.

To serve Two Years.—Charles Schaeffer, M. D., Dr. C. Newlin Pierce, Theodore D. Rand and Philip P. Calvert, Ph. D.

To serve One Year.—Thomas A. Robinson, Charles H. Cramp, Charles Morris, Isaac J. Wistar.

STANDING COMMITTEES.

Finance.

Uselma C. Smith, Charles Morris, Charles E. Smith, William Sellers, Charles Roberts.

Publications.

Thomas Meehan, Charles E. Smith, Henry A. Pilsbry, Henry Skinner, M. D., Edward J. Nolan, M. D.

Library.

Arthur Erwin Brown, Thos. A. Robinson, Henry C. Chapman, M. D., Dr. C. Newlin Peirce and Charles Schaeffer, M. D.

Instruction and Lectures.

Uselma C. Smith, Benj. Smith Lyman, Samuel G. Dixon, M. D., Philip P. Calvert, Ph. D. and Charles Morris.

Committee of Council on By-Laws.

Isaac J. Wistar, Theodore D. Rand, Arthur Erwin Brown and Benjamin Sharp, M. D.

ELECTIONS DURING 1898.

MEMBERS.

January 25.—D. M. Castle, M. D., Caroline A. Burgin, Charles G. Sower, Israel W. Morris.

February 22.—James Lane Pennypacker.

March 29.—Carroll Smyth.

July 26.—Charles M. Burk, M. D.

September 27.—Thomas Lynch Montgomery.

October 25.—Emeline Maddock, D. M. Barringer, George C. Thomas, Lincoln Godfrey, Henry Emerson Wetherill, M. D., U. S. A.

November 29.—H. B. Gross, Julia Stockton Robins, Ethel Smith, Emily Lowber, Mrs. J. Edgar Thomson, Emily Williams Biddle, Charles Mohr, M. D., Henry L. Broomall.

ADDITIONS TO THE MUSEUM.

MAMMALS.

Mrs. Harrison Allen. One hundred and thirty-five jars of mammalian preparations and dissections and a number of dry preparations of *Chiroptera*.

J. L. Buck. Skull of Baboon and Common Porcupine, *Erythizon dorsatus*, and skeleton of Timber Wolf, *Canis griseoalbus*.

Estate of Edward D. Cope. A large collection of alcoholic mammals. A collection of 298 skins and skeletons of Brazilian mammals formed by the Naturalist Exploring Expedition, 1882–3. A number of miscellaneous skins and skeletons.

J. L. Cox. Two skins of Newfoundland Caribou, *Rangifer novæterræ*, prepared for mounting.

J. Edward Farnum, George Farnum and Dr. A. Donaldson Smith. A small series of mammals from Mongolia.

Miss A. C. Hartshorne. Twelve skins and skeletons of Japanese mammals.

Purchased. Four skins of Fur Seals, *Callotaria ursina*. Young Orangoutan (since mounted), *Simia satyris*. Several skulls of Common Sheep, *Ovis aries*.

Dr. J. H. Romig. Six skins of Alaskan mammals.

George Vaux, Jr. Smooth haired St. Bernard Dog (prepared as skeleton).

Zoological Society of Philadelphia. The following mammals, which have been prepared as indicated. Mounted: Sable antelope, *Hippotragus niger;* Dorcas Gazelle, *Gazella dorcas;* Agouti, *Dasyprocta isthmica?* Capybara, *Hydrochærus capybara;* Chamois, *Rupicapra tragus;* Rocky Mountain Sheep, *Ovis cervina* and Red Monkey. To be mounted: Chevrotain Black Lemur two Monkeys and Javan Squirrel. Skins and skulls: *Antelope cervicapra*; *Nasua narica; Mustela martes; Cercopithecus ruber; Semnopithecus rubicundus; S. cephalopterus; Papio sphinx; Spermophilus franklini.* Skins: *Felis temmincki; Gazella muscatensis.* Skulls: Dorcas Gazelle, Arctic Fox, Agouti (*D. isthmica?*); Red Monkey. Disarticulated Skeletons: Capybara, Sable Antelope, Golden Cat, *Felis temmincki.* Rough Skeletons: Oscelot, *Felis pardalis;* Asiatic Elephant, *Elephas indicus;* Anubis Baboon, Wild Sheep, *Ovis cycloceras; Equus hemionus,* Also viscera and brain of Asiatic Elephant. Foetal Opossum and Young Vervet Monkey in alcohol.

BIRDS.

DR. W. L. ABBOTT. Skin of *Antrostomus carolinensis,* Cuba.

J. L. BUCK. Curassow sp. (skin).

Mr. BUCKNELL. Albino Robin, mounted.

ESTATE OF EDW. D. COPE. A collection of about 700 skins of North American Birds and several hundred Brazilian Birds in alcohol. A few miscellaneous skins and skeletons.

I. N. DEHAVEN. Golden Eye Duck, *Clangula americana,* and Forster's Tern, *Sterna forsteri* (skins), Cape Charles, Va.

DELAWARE VALLEY ORNITHOLOGICAL CLUB. A number of nests, eggs and birds presented by members of the Club, for the Club Collection. Male and female of the Red Shouldered and Broad Winged Hawks, *Buteo lineatus* and *latissimus,* received from Chas. S. Welles, Sooty Shearwater, *Puffinus stricklandi,* from Theo. L. DeBow.

J. EDWARD FARNUM, GEORGE FARNUM and DR. A. DONALDSON SMITH. A small collection of Birds from Mongolia.

H. W. FOWLER. Several mounted North American Birds.

C. R. HANSELL. Screech Owl, *Megascops asio.*

MISS A. C. HARTSHORNE. Six skins of Japanese Birds.

HOWARD T. JEFFERIES. Specimen of Krider's Hawk, *Buteo borealis krideri,* from Minnesota. *Dendroica,* Pennsylvania.

DR. J. C. KIRKPATRICK. Skins of Peacock and several small birds from Burmah.

SAMUEL N. RHOADS. Skin of *Passer domesticus.*

DR. J. H. ROMIG. Skins of ten Alaskan Birds, including two McKay's Snowflakes, *Passerian hyperborea.*

DR. PAUL J. SARTAIN. Mounted specimen of Bird of Paradise, *Paradisæa apoda.*

S. L. SHUMO. Three skins of Floridian Birds.

A. P. WILLETS. Two skins of Horned Lark, *Otocoris alpestris,* Beach Haven, N. J.

R. T. YOUNG. Several nests and eggs of North American Birds.

ZOOLOGICAL SOCIETY OF PHILADELPHIA. Specimens received in the flesh and preserved as follows. Skins and sterna: *Palæornis* *nepalensis, Agapornis canus, Polyteles melanurus, Bernardius bernardi, Trichoglossus novæhollandiæ, Crax fasciolata, Pelecanus crispus, Conurus carolinensis, Callœnas nicobarica, Chrysolophus pictus, Pseudogryphus californianus.* Flat skins: *Apteryx oweni* and *mantelli.* Skull and sternum: *Cygnus olor, Pelecanus erythrorhynchus, Anthropoides virgo;* Skeletons: *Sarcorhamphus gryphus, Anthropoides virgo, Apteryx oweni, Apteryx mantelli.*

REPTILES.

ARTHUR ERWIN BROWN. A collection of several hundred Reptiles and Batrachia mainly from North America.

MR. BRADDENBURG. Specimen of *Python reticulatus* (prepared as a skeleton).

ESTATE OF EDW. D. COPE. About 3,000 Reptiles and Batrachians including many types.

J. EDWARD and GEORGE FARNUM and Dr. A. DONALDSON SMITH. A small collection of Reptiles and Batrachia from Mongolia.

JOHN LUNKENHEIMER, JR. Skull of Green Turtle, *Chelone mydas.*

DAVID McCADDEN. Jar of *Plethodon erythronotus.*

HENRY A. PILSBRY. Jar of *Bufo americanus,* Cape May, N. J.

JOS. W. TATUM. Specimen of *Amblystoma punctatum.*

BENJ. WAINWRIGHT. Specimen of *Amblystoma punctatum,* Delaware Co., Pa.

ZOOLOGICAL SOCIETY OF PHILADELPHIA *Salamandra maculosa, Tupinambis teguexin, Varanus indicus, Pelophilus madagascariensis, Corallus madagascariensis, Testudo angulata* (two specimens). Two casts of snakes made in taxidermical department and one cast purchased.

FISHES.

ESTATE OF EDW. D. COPE. Several hundred jars of fishes including a number of types.

J. EDWARD and GEORGE FARNUM, and A. DONALDSON SMITH. Two jars of fishes from Mongolia.

STANLEY W. RUSH. Two Sea Catfish, *Æluricthys marinus,* Harvey-Cedars, N. J.

F. W. WALMSLEY. Three species of fish, Wood's Holl, Mass.

J. S. WITMER, JR. Two jars of freshwater fishes, Lancaster Co., Pa.

RECENT MOLLUSCA.

T. H. ALDRICH. Twenty-two species of marine shells from Sumatra.

DR. HARRISON ALLEN. One tray of *Pisidium* from Nantucket Island.

AMERICAN ENTOMOLOGICAL SOCIETY (ENTOM. SEC. ACAD.). Thirteen species from the collection of the late Dr. George H. Horn.

MRS. GEORGE ANDREWS. Seven species of land shells from Tennessee.

E. H. ASHMUN. Fifty-one species of land and freshwater mollusks from New Mexico and Arizona.

FRANK C. BAKER. Nineteen species of freshwater shells from Illinois.

C. A. BARKER. Three species of land mollusks from West Indies.

W. T. BEDNALL. Two hundred and ninety-eight species of marine shells from South Australia.

FRANCISCO E. BLANES. Seven species of *Cerion* from Cuba.

J. H. BRITTS. Four species of *Goniobasis* from Missouri and North Carolina.

F. L. BUTTON. Five species of marine shells from California.

R. E. C. CALL. One tray of *Pisidium* from New Mexico.

MRS. JULIA CHANDLER. *Pholas costata* Linné from Long Beach, Mississippi.

GEORGE H. CLAPP. Nine trays of land shells from Pennsylvania.

T. D. A. COCKERELL. Nineteen species of land and marine mollusks from West Indies and New Mexico.

M. COSSMAN. Four species of marine and land shells from Europe and Africa.

DR. J. C. COX. Three trays of marine shells from New South Wales.

DR. W. H. DALL. Four species of land and marine mollusks from California.

REV. A. DEAN. One tray *Zonites* from Florida.

MR. DESMOND. Fifteen trays of marine mollusks.

DR. SAMUEL G. DIXON. Two species of mollusks from Maine.

H. F. DORE. Two species of *Fluminicola* from Oregon.

J. H. FERRISS. Twenty-two species of land shells from the Great Smoky Mts.

JOHN FORD. Sixteen species of marine shells.

H. W. FOWLER. Four species of freshwater shells from the crop of a duck.

MRS. E. M. GAYLORD. Six species of marine shells from Oregon.

LIEUT.-COL. H. H. GODWIN-AUSTIN. Alcoholic specimens of *Acavus hæmastomus.*

A. F. GRAY. Two species of *Pupa* from Oregon.

R. C. MCGREGOR. Seventy-seven species of marine shells from Mexico and California.

E. HALL. One tray of *Strobilops* from Illinois.

S. H. HAMILTON. Three species freshwater shells from New Jersey.

A. W. HANHAM. Three species of land shells from Quebec.

HAROLD HEATH. Sixty-five species of mollusks from California.

S. W. HEATON. Seven species of marine shells from California.

CHARLES HEDLEY. Five species of mollusks from New South Wales.

PROF. ANGELO HEILPRIN. Two trays of shells from Algeria.

J. B. HENDERSON. Land mollusks from Enganio Island and Jamaica.

C. S. HOAGSON. One tray of *Strobilops* from Illinois.

HORN EXPEDITION. Twenty-nine species of Australian land shells.

T. VAN HYNING. Three species of marine shells.

H. VON IHERING. Seventy-one species of South American land shells.

C. W. JOHNSON. Three species of marine mollusks.

DR. R. J. KIRKLAND. Five species of *Ancylus* from Michigan.

MISS E. J. LETSON. Eighteen trays of marine shells.

H. LOOMIS. Five species of shells from Japan.

AUSLEY LUDLAW. *Fulgur perversum* Linné, Anglesea, New Jersey.

J. G. MALONE. Thirty-four species of land and freshwater shells from Oregon.

CLARENCE B. MOORE. Two species of mollusks from Callawassie Island, Ga.

WM. MOSS. Two species of shells from New Zealand.

C. F. NEWCOMB. *Tornatina eximia* from British Columbia.

J. W. PALMER. Three species of land shells.

H. A. PILSBRY. Four hundred and sixteen trays of American land and freshwater shells.

H. A. PILSBRY and C. W. JOHNSON. Seven species of shells from Florida.

H. A. PILSBRY and E. G. VANATTA. Twenty-one species of *Melania* and *Diplommatina* from Java.

E. Pleas. Twenty-one trays of *Pleurocera*.

Miss Sadie F. Price. Thirty species of freshwater mollusks from Kentucky.

P. B. Randolph. Seventeen trays of mollusks from Alaska.

W. J. Raymond. Seven species of marine shells from California.

Estate of J. H. Redfield. Sixty-five species of marine mollusks from Panama collected by Prof. C. B. Adams.

S. N. Rhoads. Five species of shells from Pennsylvania.

Dr. Wm. H. Rush. Thirty-one species of marine mollusks from West Indies.

G. F. Russell. Ten species of marine mollusks from British Guiana.

Jose N. Rovirosa. Nine species of mollusks from Tabasco, Mexico.

F. A. Sampson. One species, *Polygyra* from Missouri.

S. L. Schumo. Twenty-four species of land shells from Jamaica.

Ida M. Shepard. Twenty-one species of marine mollusks from California.

B. Shimek. *Pleurocera* and *Campeloma* from Alabama.

J. A. Singley. *Glandina* from Texas.

Uselma C. Smith. Two species of marine mollusks from New Jersey.

L. H. Streng. *Amnicola* from Michigan.

S. H. Stupakoff. *Polygyra* from Pennsylvania.

H. Suter. Twenty species of marine shells from New Zealand.

E. R. Sykes. Two species of *Chiton* from South Africa.

Prof. de la Torre. *Cerion torrei* Blanes, from Cuba.

E. G. Vanatta. Twenty-six species of American mollusks (see also under Pilsbry and Vanatta).

A. Vayssiere. Thirteen species of French marine shells.

H. Viereck. *Rumina decollata* from Philadelphia.

A. G. Wetherey. One tray of *Parastarte* from Florida.

Joseph Willcox. Five species of mollusks from Florida.

Lewis Woolman. Five species of marine mollusks from New Jersey.

CRUSTACEA.

Dr. W. L. Abbott. One bottle of specimens from Tso Kiagr Ladak.

W. T. Bednall. Six trays of specimens from South Australia.

C. E. Beecher. One tray of specimens from Wekiva River, Florida.

LESTER BERNSTEIN. One tray of *Balanus*.

H. W. FOWLER. One bottle of specimens from Tolchester, Maryland.

WM. J. FOX. Ten bottles and three trays of specimens from Jamaica.

R. C. MCGREGOR. Two trays of *Cypris* from Redding, California.

W. HAYS. One *Cambarus* from Big Creek, Kansas.

H. A. PILSBRY. *Balanus eburneus* Gld. from Betterton, Maryland.

DR. W. H. RUSH. Two trays of specimens from Uruguay.

FREDERICK STEARNS. *Lepas anatifera* from Japan.

MR. WHARTON. Two species from San Diego de Cuba.

OTHER INVERTEBRATES.

AMERICAN ENTOMOLOGICAL SOCIETY (ENTOM. SEC. ACAD.). Seven trays of corals from collection of the late Dr. Horn.

W. T. BEDNALL in exchange. Seven trays and four bottles of Echinoderms from South Australia.

DR. SAMUEL G. DIXON. Two bottles of Echinoderms from Islesboro, Maine.

H. W. FOWLER. One bottle of *Gordius* and two bottles of Jellyfish from Tolchester, Maryland.

HAROLD HEATH. Thirteen bottles of marine invertebrates from Pacific Grove, California.

REV. H. N. HYDE. One tray of invertebrates from Mexico.

JAS. N. PEARCE. One *Hipponoë esculata* Leske from Bermuda.

DR. W. H. RUSH. Two bottles of invertebrates from Cape de Verde Isles and Maldonado Bay.

S. L. SCHUMO. Two trays of invertebrates from Jamaica.

DR. B. SHARP. Thirteen bottles of starfishes from Alaska.

USELMA C. SMITH. Seven trays and one bottle of invertebrates from New Jersey.

F. W. WALMSLEY. Eight bottles of marine invertebrates.

LEWIS WOOLMAN. *Mellita pentapora* Gmel. from Avalon, New Jersey.

INSECTS.

DR. W. H. GRIFFITH. Fifty-seven butterflies and 7 moths.

C. FEW. SEISS. Collection of 108 local Orthoptera.

DR. J. W. ECKFELDT. Collection of 1,215 North American Coleoptera.

H. A. PILSBRY. Five trays, *Helicopsyche* from Arkansas, Iowa, Indiana and New York.

INVERTEBRATE FOSSILS.

AMERICAN ENTOMOLOGICAL SOCIETY (ENTOM. SEC. ACAD.). Collection of the late Dr. Horn. One tray.

G. BAUMAN. Two trays of mollusks from Greenland.

M. COSSMANN. Two trays of *Dentalium* from Biot, France.

PROF. ANGELO HEILPRIN. Forty-four trays of fossils from Atlas Mountains, Algeria.

M. HOMER. Thirty-four trays of fossils from Dismal Swamp Canal, Virginia.

J. E. IVES. One species from Lenola, New Jersey.

MISS M. E. LYNDALL. Eleven trays of specimens from Shiloh, New Jersey.

A. M. MERCER. Three trays of specimens from Centerville, Maryland.

CLARENCE B. MOORE. *Pecten* from Doctortown, Georgia.

J. A. MURPHY. Twenty species from Eureka Springs, Arkansas.

H. A. PILSBRY. *Chrysodomus stonei* Pils. from Cape May, New Jersey.

S. L. SHUMO. Collection of Invertebrate Fossils from Jamaica (not yet assorted).

J. A. SINGLEY. Two species of *Dentalium* from Galveston, Texas.

USELMA C. SMITH. One species from Lenola, New Jersey.

JOSEPH WILLCOX. Ninety-one trays of fossils from Florida.

CARBONIFEROUS PLANTS.

E. W. CLAYPOLE. Small collection.

MINERALS ROCKS, ETC.

HOMER DARLINGTON. Serpentine.

JOHN FORD. Zeolite.

ANGELO HEILPRIN. Gypsum.

GEO. H. HORN. Several specimens.

W. W. JEFFERIS. Altered Biotite, Rattlebox, Pyrite, Talc, Calcite.

FARNUM BROS. Opal Pebbles.

S. H. HAMILTON. Tourmaline.

EDW. LONGSTRETH. Several specimens of minerals.

WILFRED MCSORLEY. Conglomerate Geode, Mt. Holly, N. J.

W. E. MEEHAN. Chalcedony, Florida.

ADOLPH MUELLER. Quartz.

THEO. D. RAND. Meerschaum pseudomorph after Quartz from Radnor, Pa.

STUDENTS MINERALOGICAL CLUB. Chalcopyrite, Bornite, Cyanite, Calcite.

J. W. RIDPATH. Borings from wells, Philadelphia.

MINERALOGICAL SECTION. Calcite, Chrysolite.

PURCHASED for William S. Vaux Collection, twenty-one specimens.

ARCHÆOLOGY AND ETHNOLOGY.

GEO. FARNUM and J. EDW. FARNUM. Human Cranium, Mongolia.

MISS J. A. FLANIGAN. Indian Tanned deer skin, Western, N. A.

ESTATE OF GEO. H. HORN. Various specimens, Arrow points, etc.

EDW. LONGSTRETH. Several miscellaneous specimens.

CLARENCE B. MOORE. Various important additions to the Moore collection of mound implements, etc.

PLANTS.

STEWARDSON BROWN. Four hundred species, Pennsylvania plants; two hundred and fifty species plants from the Northwest coast; one hundred and fifty species plants herbarium of Wm. Boot.

JOSEPH CRAWFORD. Two hundred and fifty species of North American plants.

ANNA C. HORTSHORNE. Six hundred and seventy species of Japanese plants.

THOMAS MEEHAN. Eight hundred species of South African plants.

C. F. SAUNDERS. Two hundred and fifty species of Pennsylvania plants.

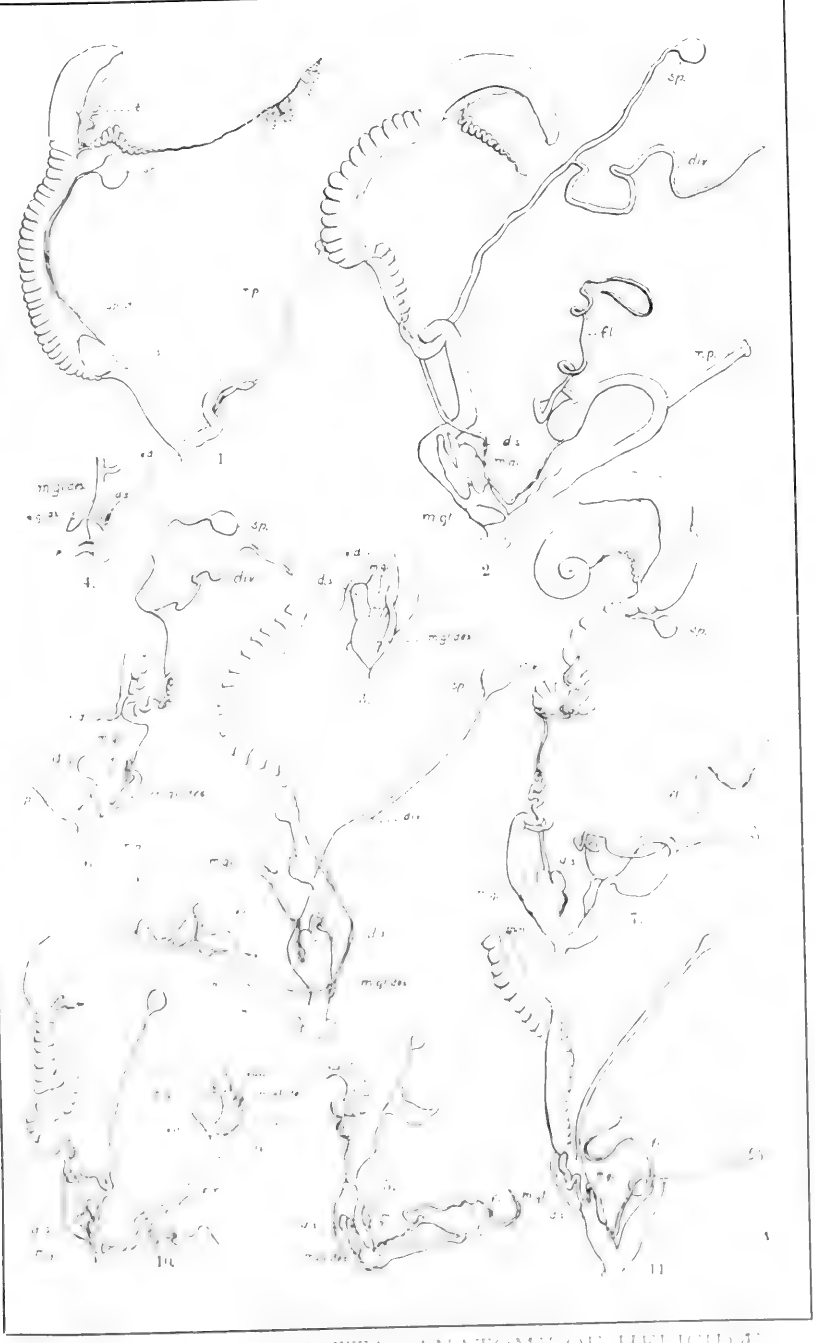
J. W. ECKFELDT, M. D. The entire Eckfeldt Collection of Lichens.

INDEX TO GENERA, ETC.,

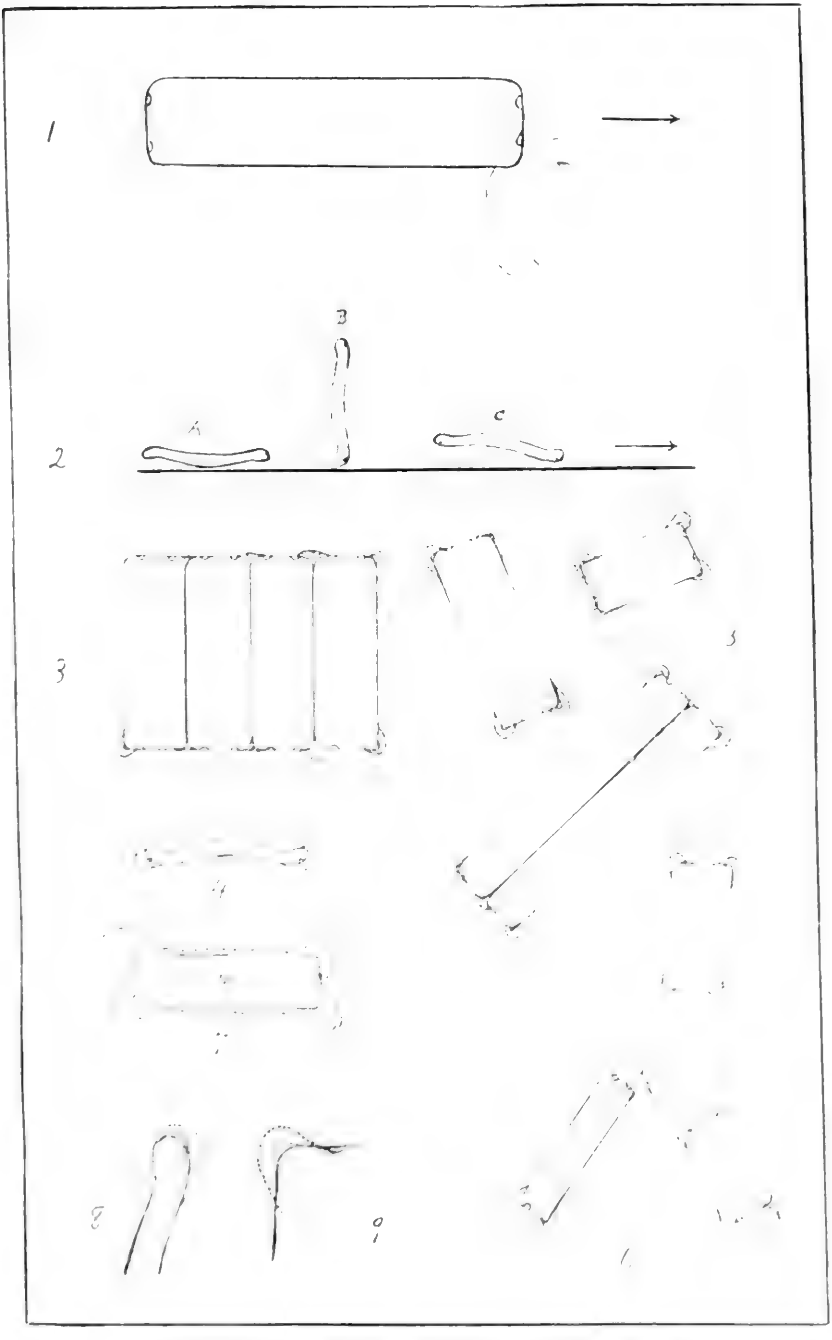
1898.

GENERAL INDEX.

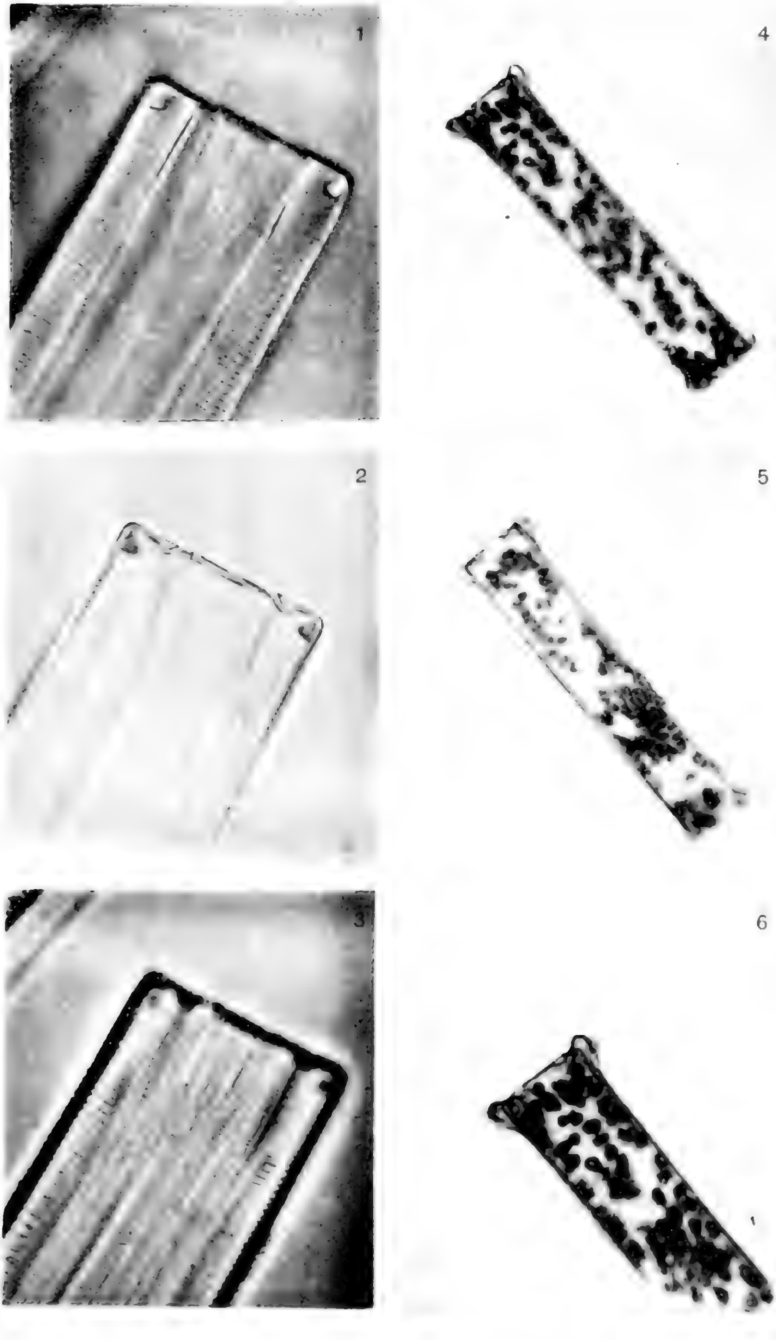
1898.



PILSBRY AND VANATTA: ANATOMY OF HELICIDÆ.

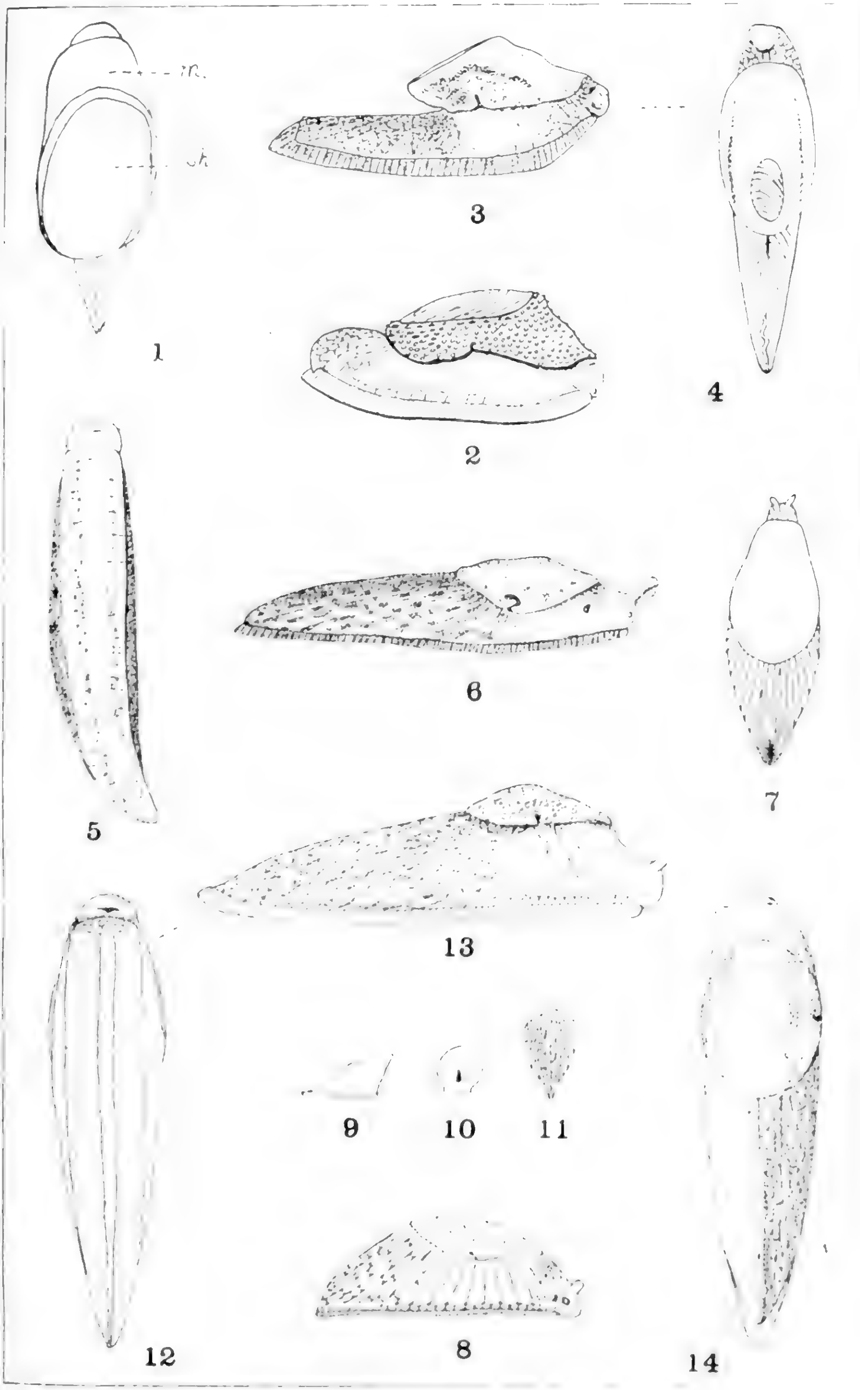


PALMER MOVEMENTS OF



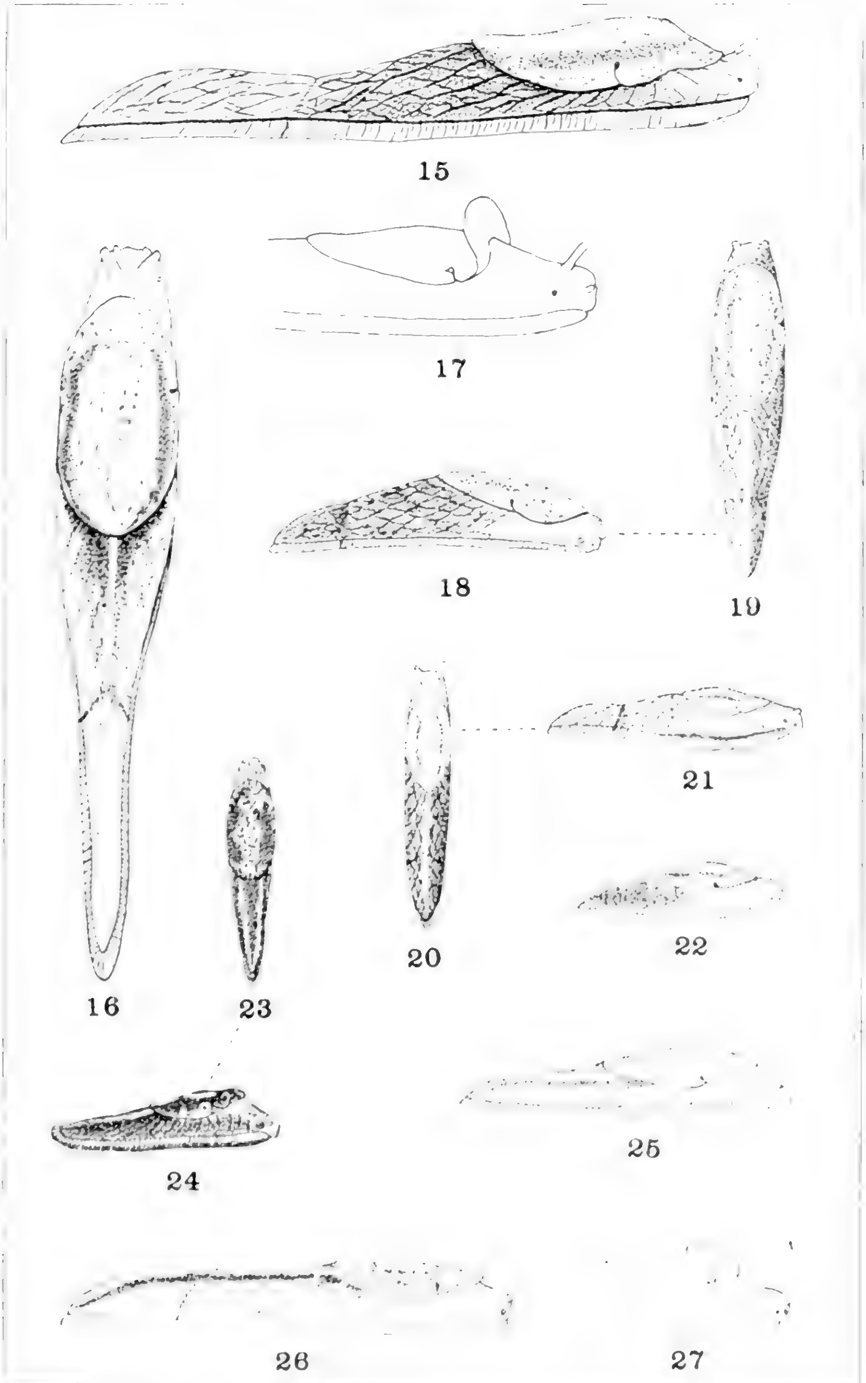
PALMER. MOVEMENTS OF EUNOTIA

TETHYS PILSBRYI, n. sp.



Pilsbry and Vanatta del.

PILSBRY AND VANATTA. NORTH AMERICAN SLUGS.



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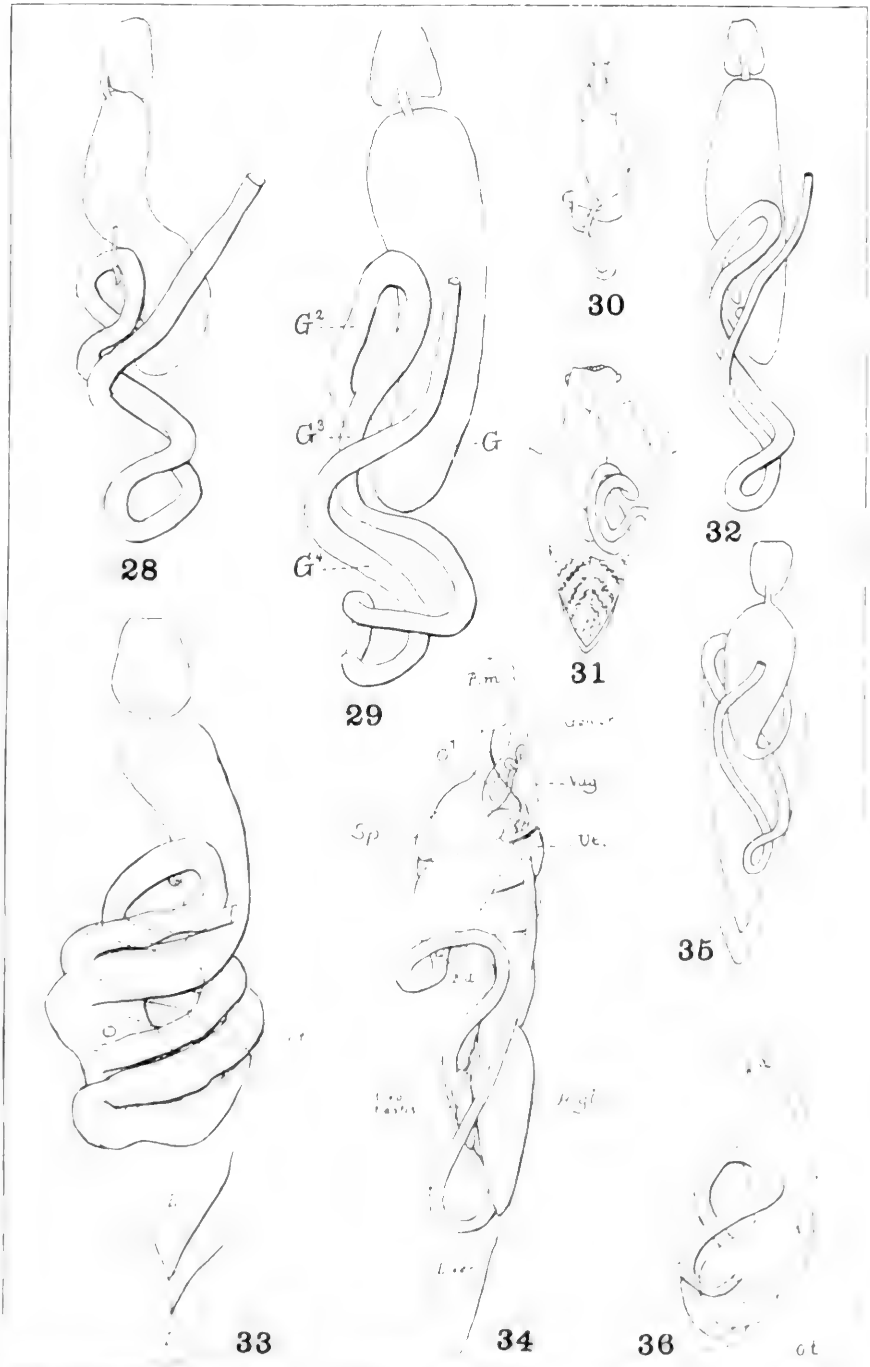

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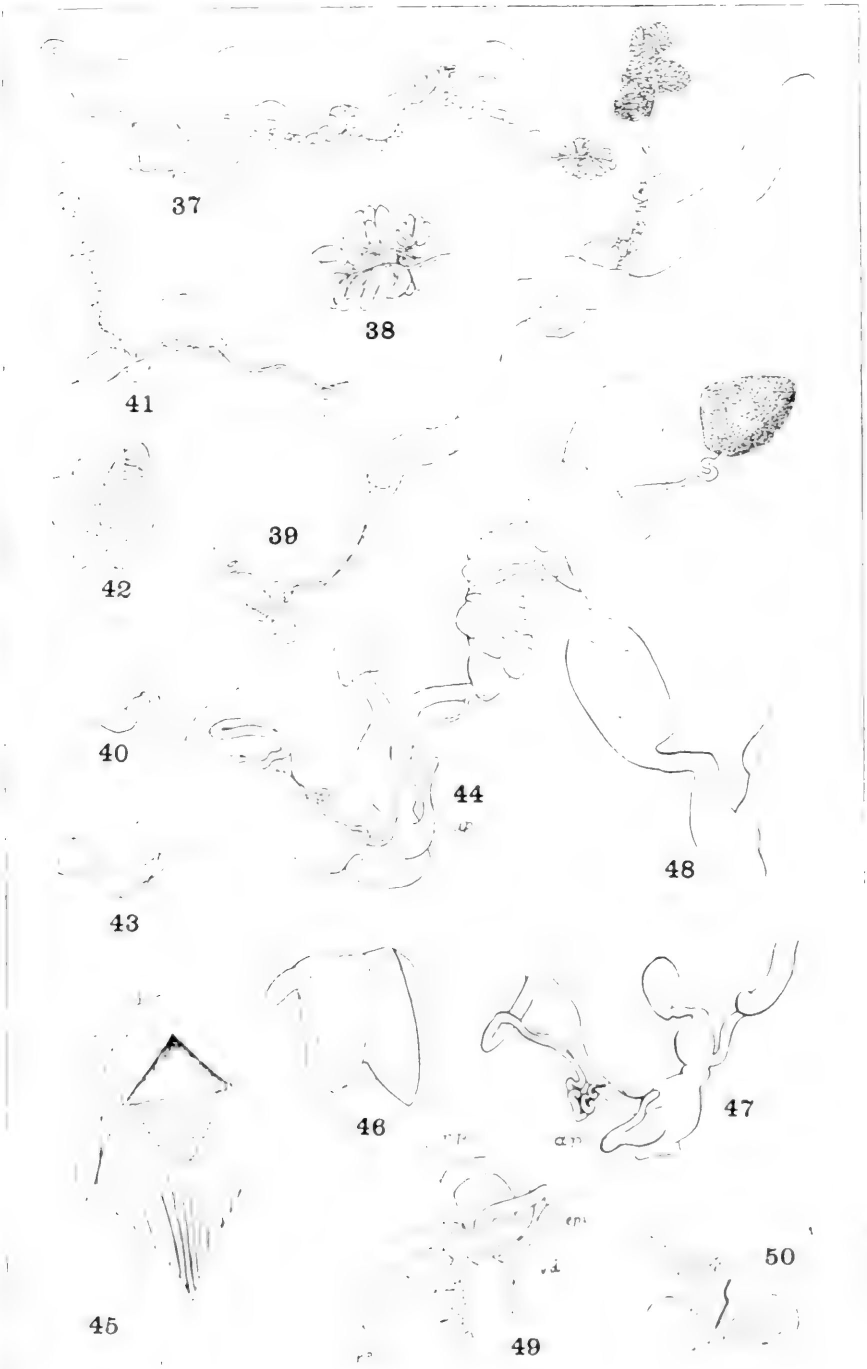

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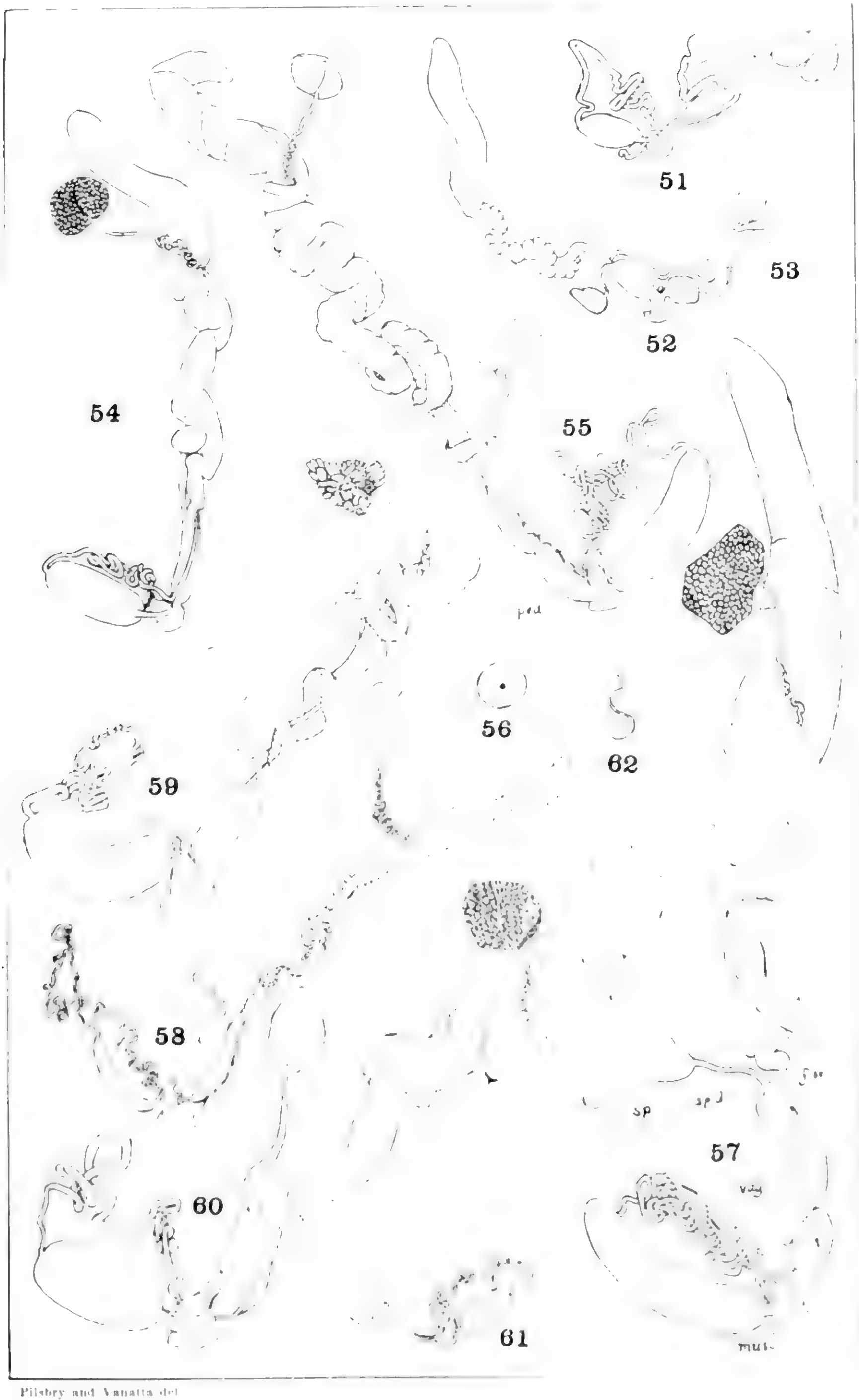
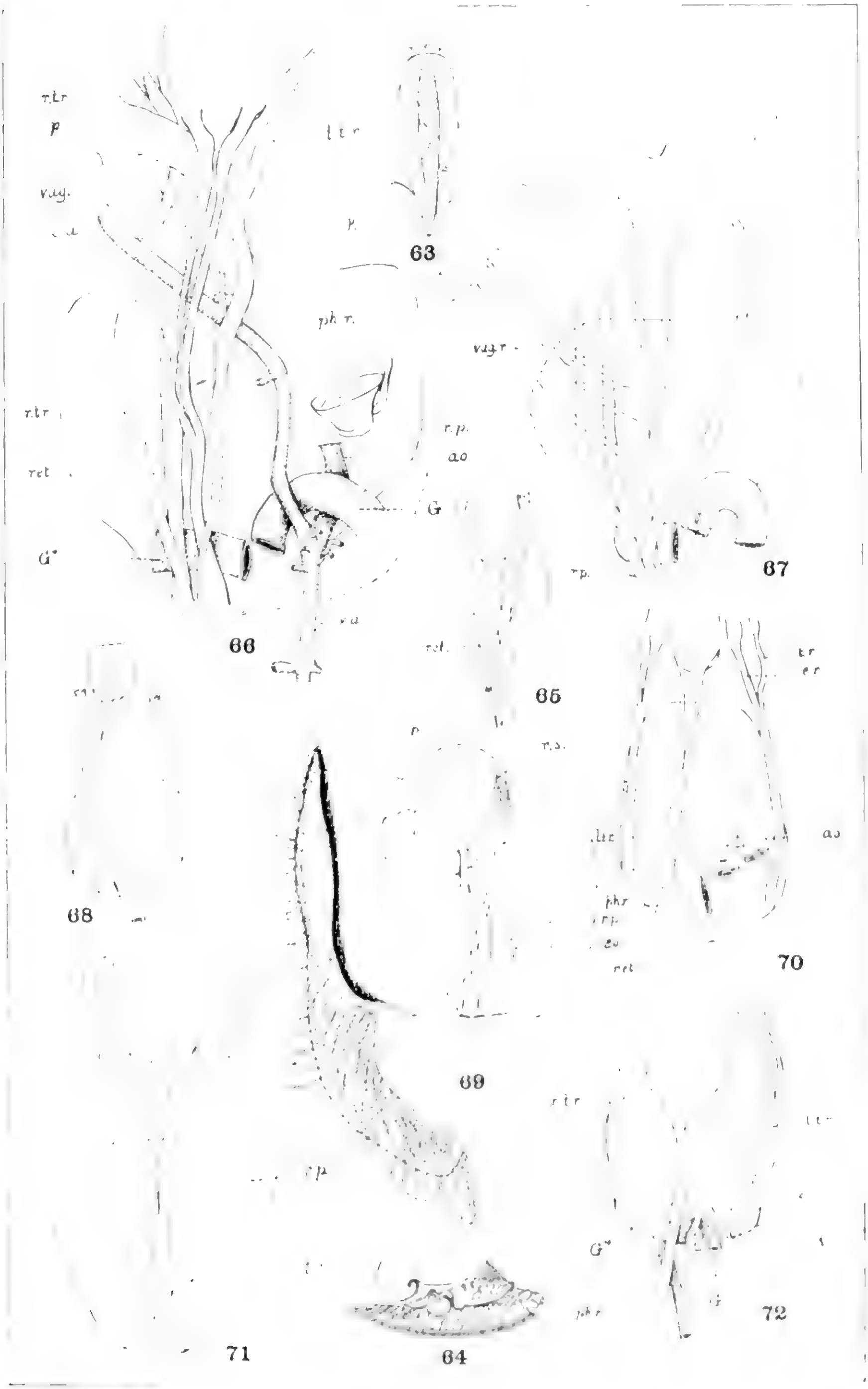


Pilsbry and Vanatta del.

PILSBRY AND VANATTA. NORTH AMERICAN SLUGS.



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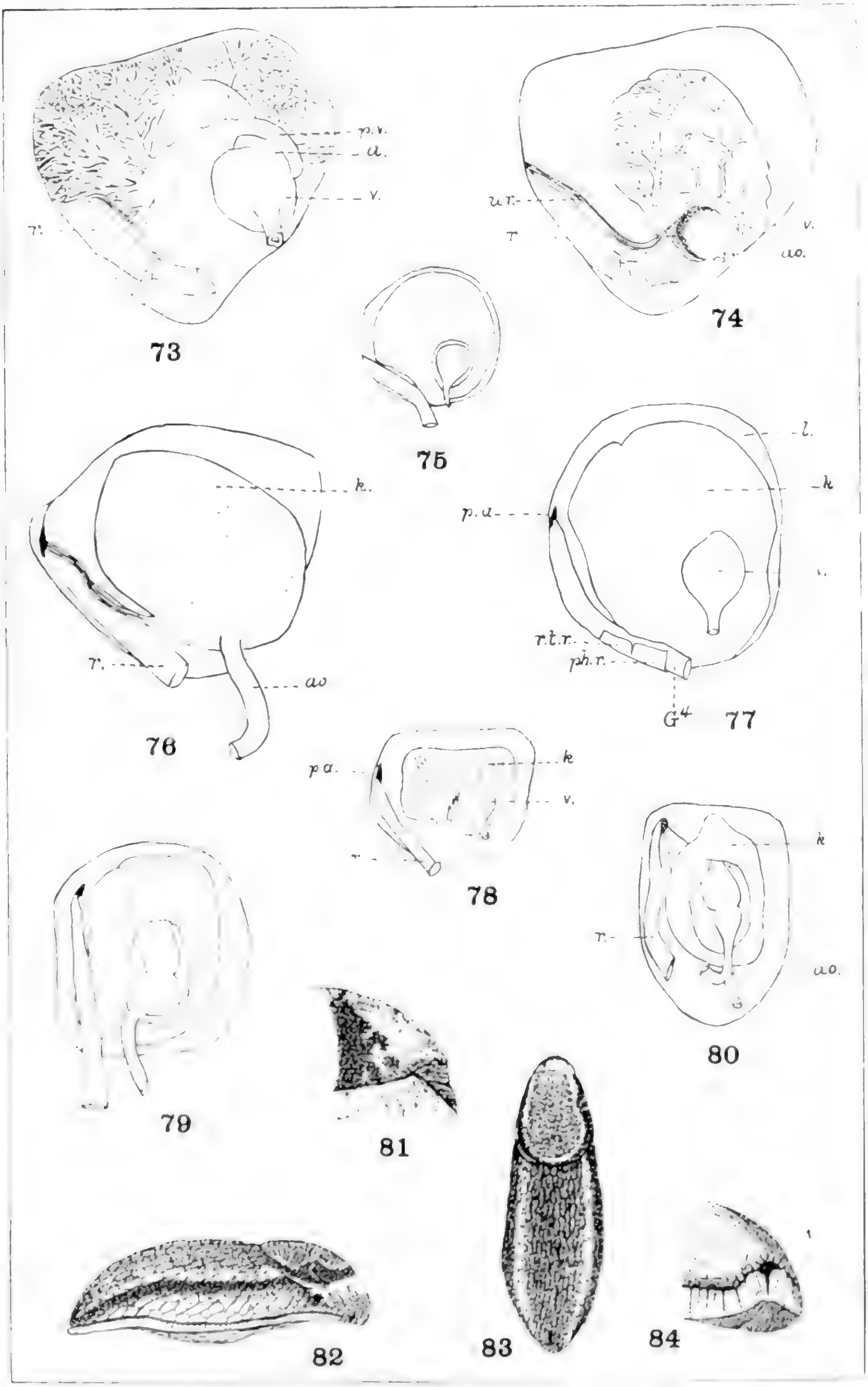

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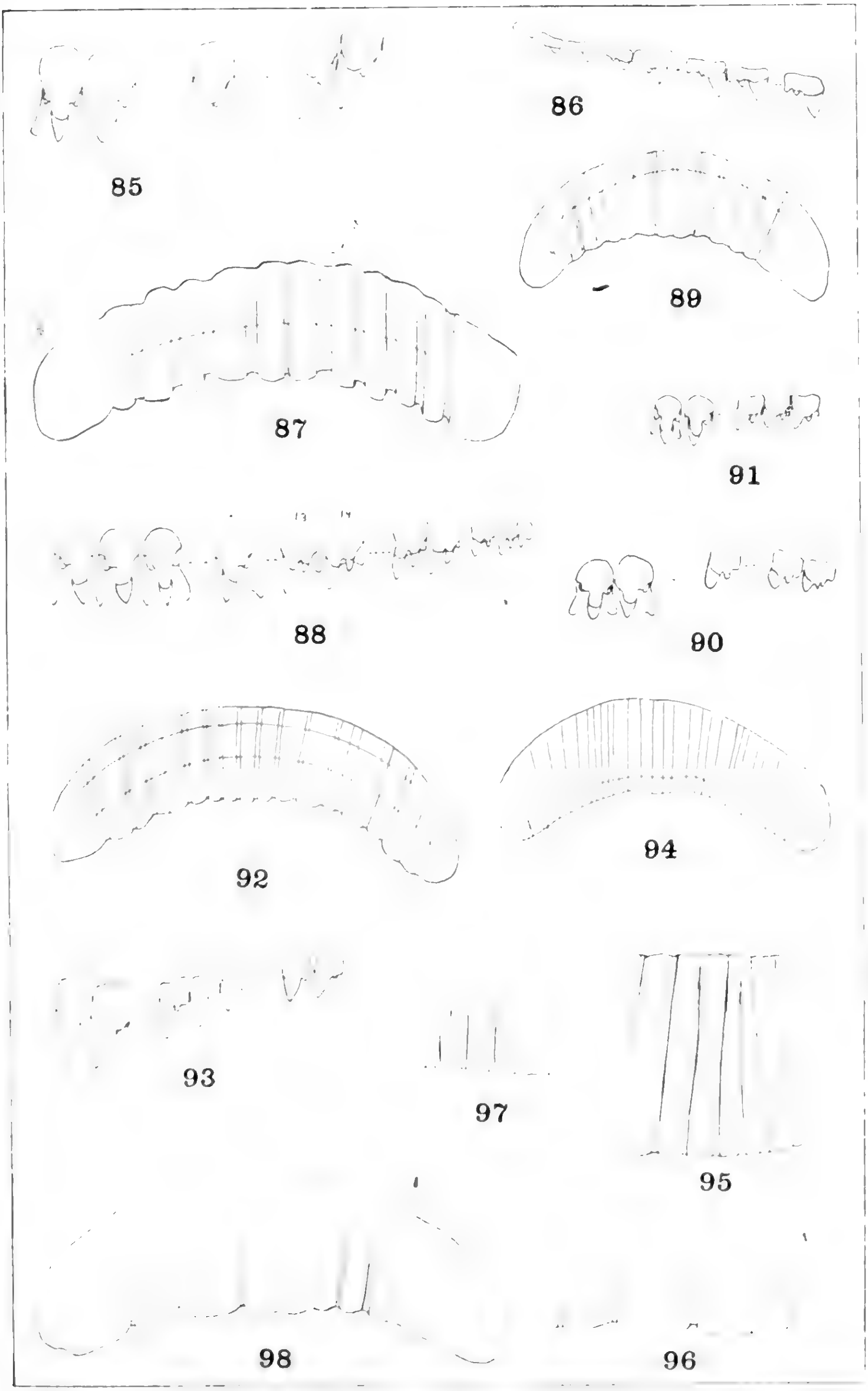

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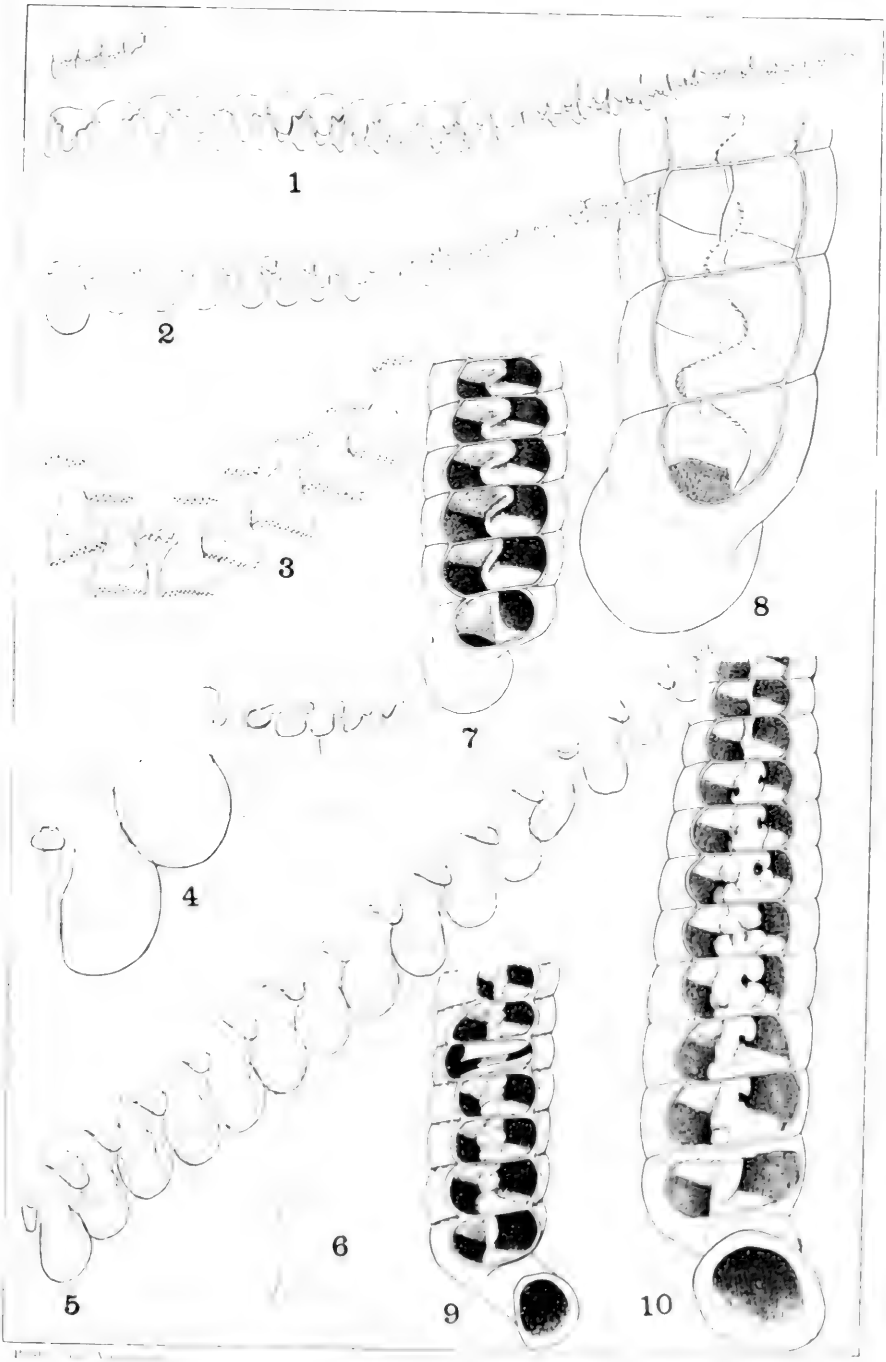
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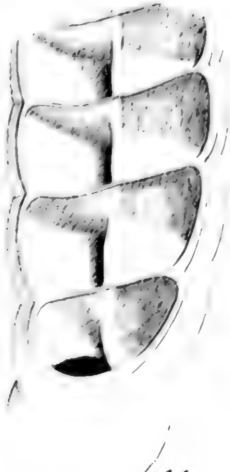

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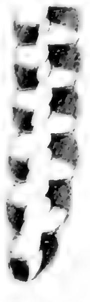

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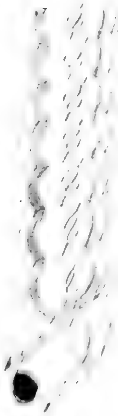

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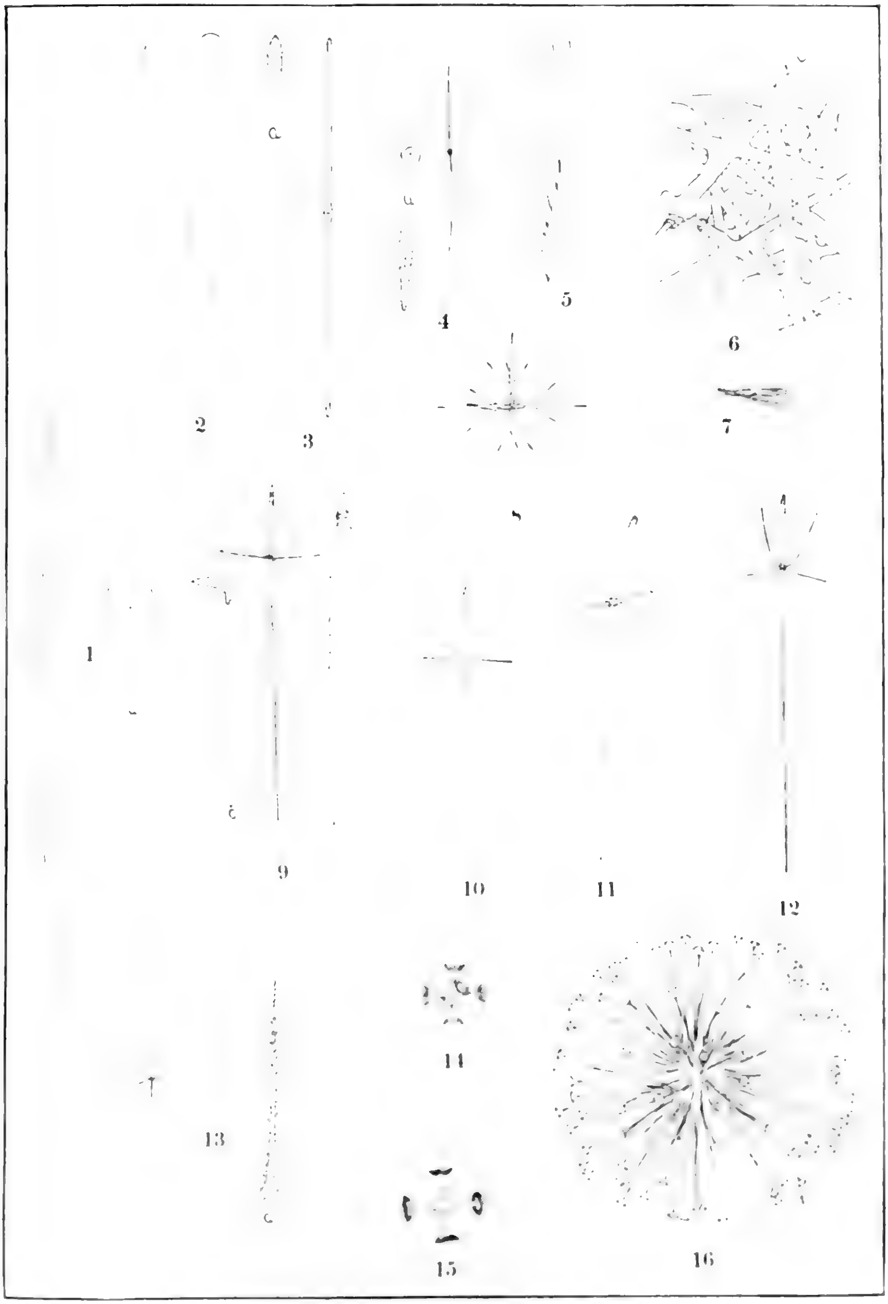

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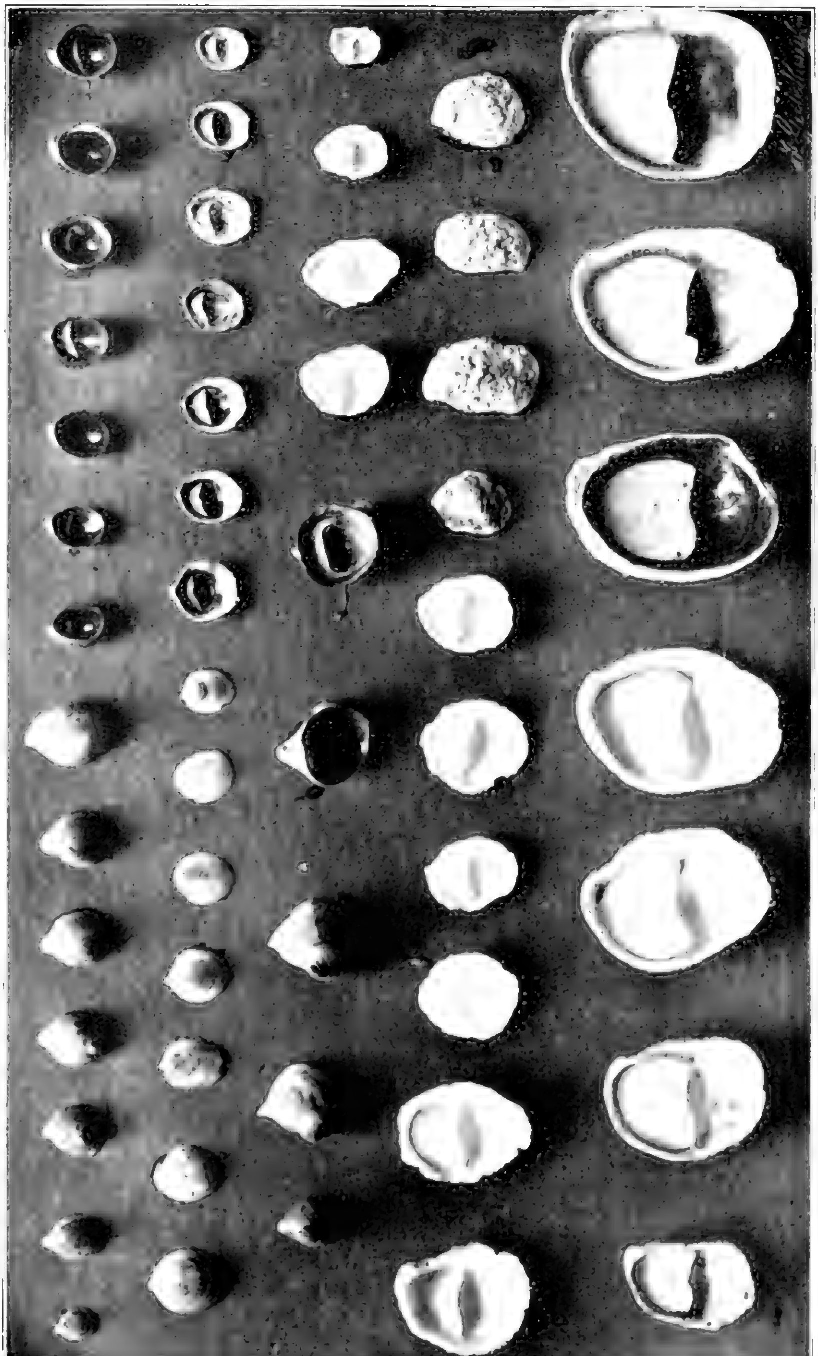

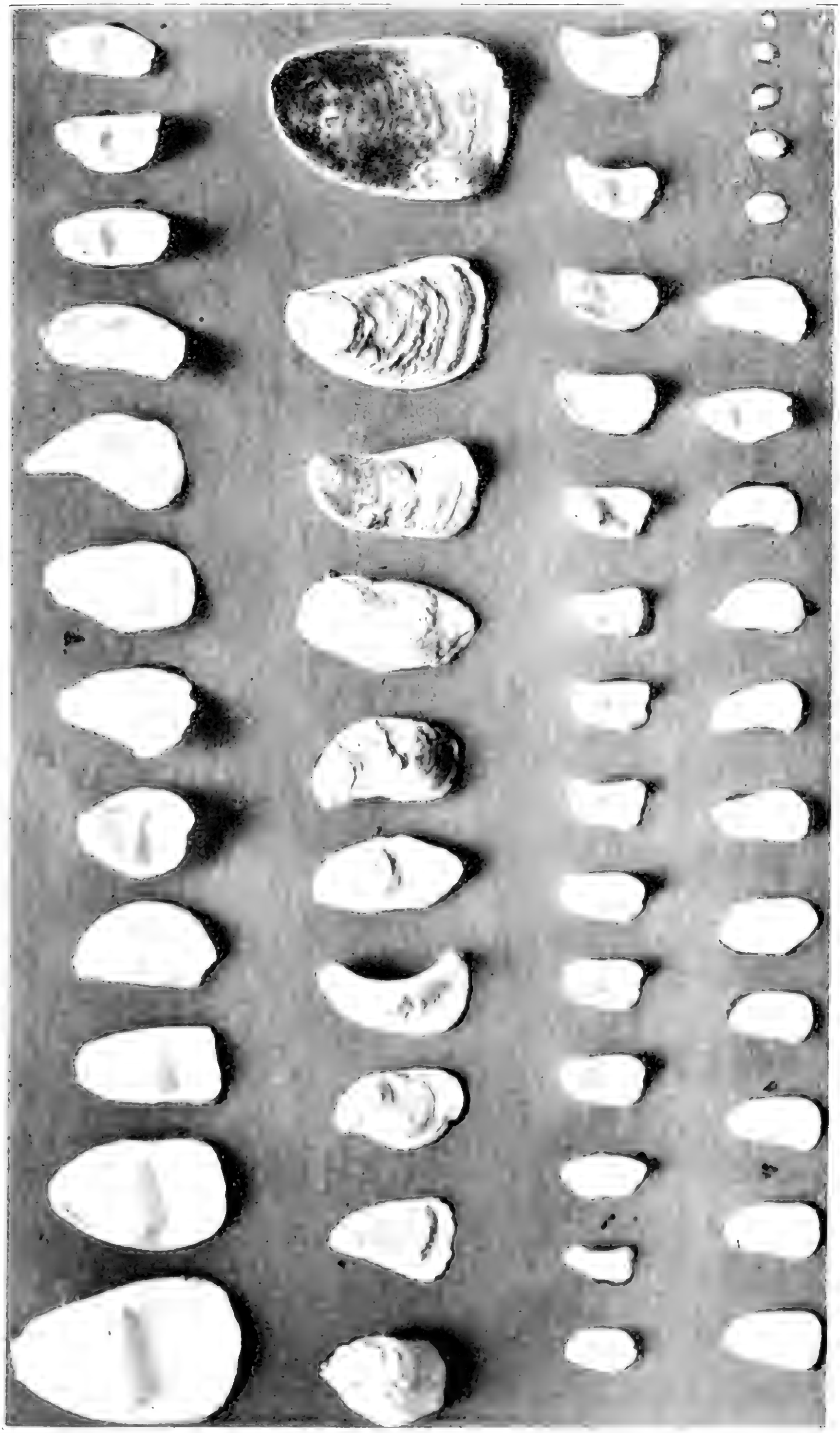

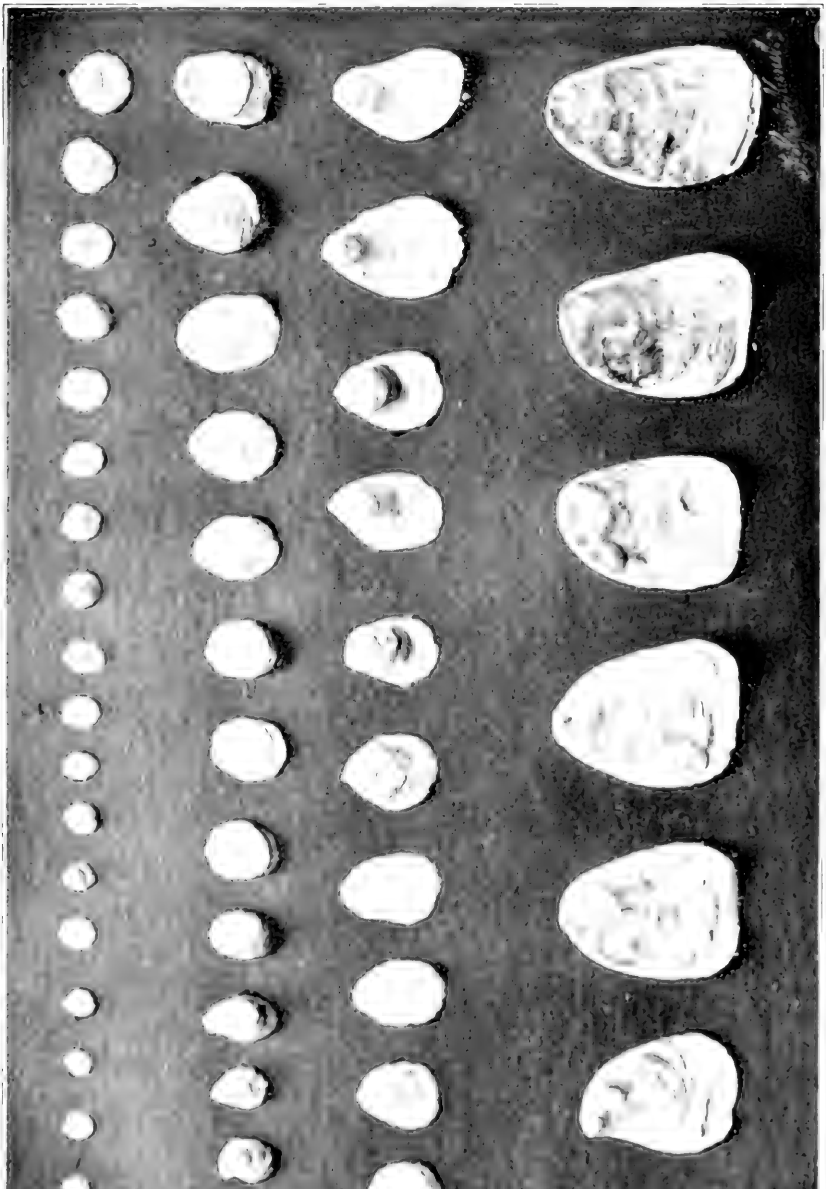

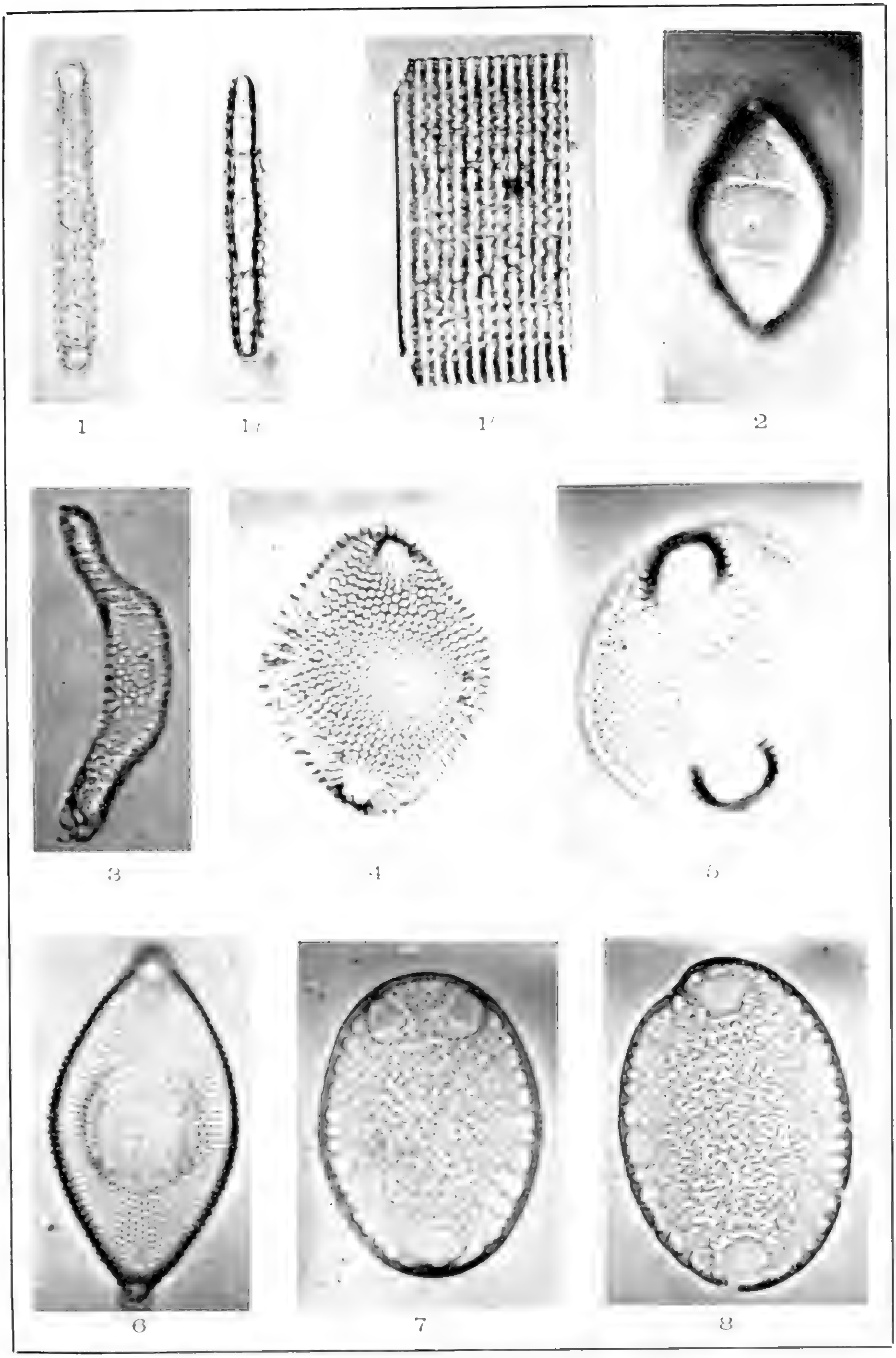

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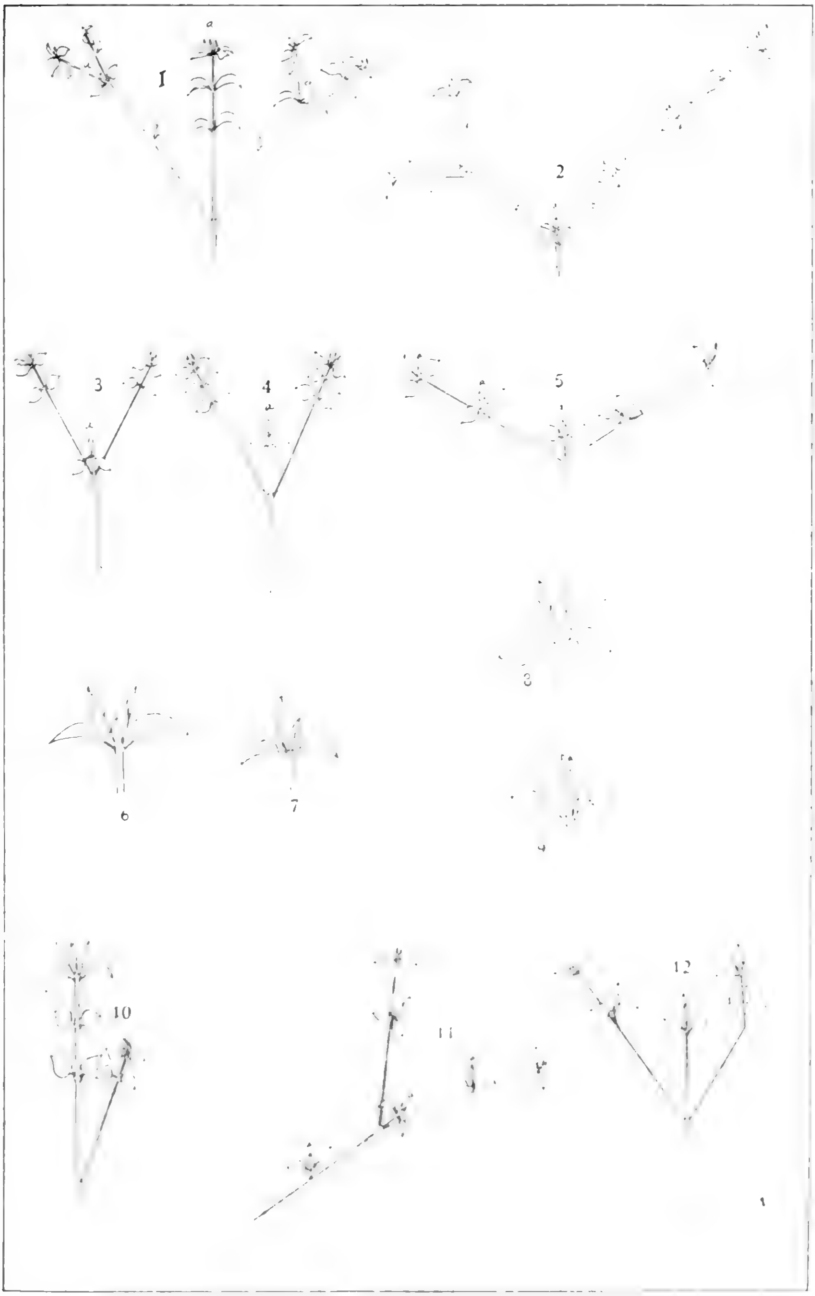

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