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PROCEEDINGS

OF THE

ACADEMY OF NATURAL SCIENCES

OF

PHILADELPHIA.

1880.

PUBLICATION COMMITTEE:

JOSEPH LEIDY, M.D., GEO. H. HORN, M.D.,
WILLIAM S. VAUX, THOMAS MEEHAN,
JOHN H. REDFIELD.

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PHILADELPHIA:
ACADEMY OF NATURAL SCIENCES,
S.W. Corner Nineteenth and Race Streets.
1881.

ACADEMY OF NATURAL SCIENCES OF PHILADELPHIA,
March, 1881.

I hereby certify that printed copies of the Proceedings for 1880 have been presented at the meetings of the Academy, as follows :—

Pages	9 to 56	March 23, 1880.
"	57 to 88	March 30, 1880.
"	89 to 120	April 6, 1880.
"	121 to 152	June 1, 1800.
"	153 to 200	July 27, 1880.
"	201 to 216	August 10, 1880.
"	217 to 232	August 17, 1880.
"	233 to 248	September 7, 1880.
"	249 to 280	September 28, 1880.
"	281 to 328	October 12, 1880.
"	329 to 352	November 9, 1880.
"	353 to 384	February 22, 1881.
"	385 to 416	March 1, 1881.

EDWARD J. NOLAN,
Recording Secretary.

PHILADELPHIA
W. P. KILDARE, PRINTER.

LIST OF CONTRIBUTORS.

With reference to the several articles contributed by each.

For Verbal Communications see General Index.

PROCEEDINGS

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ACADEMY OF NATURAL SCIENCES

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PHILADELPHIA.

1880.

JANUARY 6, 1880.

The President, Dr. RUSCHENBERGER, in the chair.

Forty-two persons present.

The following papers were presented for publication:

"On the Nudibranchiate Gasteropod Mullusca of the North Pacific Ocean, with special reference to those of Alaska," by Dr. R. Bergh, of Copenhagen. Part II.

"The Terrestrial Mollusca inhabiting the Cooks or Harvey Islands," by Andrew Garrett.

The deaths of Dr. S. S. White and Joshua T. Jeanes were announced.

JANUARY 13.

The President, Dr. RUSCHENBERGER, in the chair.

Forty-two members present.

On disarticulating branches in Ampelopsis.—Mr. THOMAS MEEHAN remarked that some species of *Ampelopsis* threw off their dead wood by disarticulation, as he pointed out some years ago to be the case with *Thuja* and *Taxodium* among coniferous trees. This was especially the case with *Ampelopsis quinquefolia*, and *A. bipinnata*. These, in common with many other climbing plants, produced some portions of their annual growth of so low a vital power, that they were soon killed when severe weather occurred. In the grape vine, for instance, the extreme ends of the strong branches and whole lengths of weaker ones died during the winter. These remained on till cut away by the pruner, or until they fell by natural decay. In the *Ampelopsis* named they were thrown off by an articulation, so that by spring no dead wood of the past season's growth would be found on the plants. Every node included in the dead portion, separated; so that under the plants the pieces may be gathered like the separate vertebræ in a skeleton.

The *Ampelopsis*, when running up a tree or wall, seldom sent out lateral branches till it reached the summit. When these side branches were produced, they appeared, after a few years, as thick bushy masses, having the look of a hedge annually pruned. It appears that in these cases the annual growth is disarticulated at just one node above that one made last year—the branch thus gaining but one node a year. A bushy branch of a dozen years old, will thus have but a dozen nodes of living wood.

The observations were of some interest just now, from the discovery of a species of *Vitis* in the South Pacific, which produced tubers at the end of the branches, which at the end of the season were thrown off by a disarticulation, and in this way aided in propagation and distribution. Though the disarticulation in the neighboring genus *Ampelopsis*, as now noted, results only in ridding the plant at once of useless wood, it showed a relation of powers in allied species that must be of service to those engaged in studies of derivation.

Geo. Vaux was elected a member of the Council to serve for the unexpired term of C. Newlin Pierce. Aubrey H. Smith was elected to serve for the unexpired term of Edw. D. Cope.

January 20.

The President, Dr. Ruschenberger, in the chair.

Forty persons present.

Notice of the Cruel Thread Worm, Filaria immitis, of the Dog.—Prof. Leidy directed attention to a specimen, presented by Mrs. Laura M. Towne, of Beaufort, S. C., consisting of the heart and part of one lung of a dog, containing thread worms. The right ventricle of the heart and the pulmonary artery contained a bunch of the parasites, and several also were contained in the lung. A similar specimen, with the ventricle literally stuffed full of worms, is preserved in the museum of the University of Pennsylvania. The parasite was described, thirty years ago, in the Proceedings of this Academy, under the names of *Filaria Canis cordis* and *Filaria immitis* (see Proc., 1850, 118; 1856, 2, 55), and since has been repeatedly noticed by observers as infesting the dog in Europe, India, China, Japan and this country.

The specimen presented is accompanied with a letter from Mrs. Towne, giving an account of the occurrence and symptoms of the parasite as follows:

"I lost several dogs of different breed, age and birthplace, with the same symptoms—a severe and peculiar cough being the principal one. A gentleman living on a neighboring island (the Sea Islands of South Carolina) lost over thirty hunting dogs in two or three years with the same symptoms. I watched my two remaining dogs closely. They were a large Newfoundland (mixed) and a small terrier. Both had the peculiar cough, which was excited by any movement, especially after sleeping. It always ended, after a few coughs, in a violent effort to bring something up from the throat. This did not seem nausea or sickness, and as the dogs never threw up anything, I thought it was due to hairs in the throat. The two dogs had another symptom. When they began to run violently, as at hogs, or a strange dog, they fell down, became stiff and insensible, but in a short time would get up and resume the chase.

"The little dog died with hemorrhage from the bladder or kidneys; but no post-mortem examination was made.

"The large dog soon began to cough up bloody phlegm, with considerable fresh blood at times. I found in the phlegm one morning two Filariæ alive, and at least six inches long. I sent word of this discovery to the owner of the hunting dogs, and when his next one died he had it opened, and found the heart and liver filled with Filariæ.

"My large dog grew so ill that I had him shot. His symptoms were drowsiness, sleeping with the upper eyelids raised, and the inner lining showing very red; holding his head to one side, one ear drooped; dragging of one hind leg; turning round and round whenever he attempted to go anywhere; and, finally, spasms, in which he rolled over and over and drew his head backward. He was fat and had a good appetite to the last.

"The sister of this dog was given to me. She had a slight cough, but it increased rapidly. After about three months' attempt to cure her, I had her shot before her sufferings became severe. Her heart is the one you have. She was fat when she died, and seemed in good health, except for short breath in running, the cough and unusual sleepiness.

"In the post-mortem of the first dog, I found one Filaria lying at full length in the windpipe, and in the large artery others stretched at length and crowded close. Upon cutting into the heart, the worms burst forth in bunches, slowly uncoiling themselves. They were white, stiff and wire-like, and not in the least stained with blood. They lived in water about twenty-four hours. The large blood-vessels of the lungs were filled densely, and even from the small ones long Filariæ were with some difficulty withdrawn. No worms were found in the kidneys."

JANUARY 27.

The President, Dr. RUSCHENBERGER, in the chair.

Nineteen persons present.

A paper entitled "Carcinological Notes, No. 2. Revision of the Gelasimi," by J. S. Kingsley, was presented for publication.

The death of Thomas M. Brewer, a correspondent, was announced.

Chas. W. Pickering, John S. Jenks, Wm. H. Jenks, A. R. Thomas, Ferris W. Price, John Wagner, Chas. P. Tasker, Henry F. Formad and George W. Biddle were elected members.

Angelo Heilprin, of New York, Dr. C. A. White, of Washington, Albert De Selle, of Paris, R. Hoernes, of Vienna, Georges Rolland, of Paris, and Victor Raulin, of Bordeaux, were elected correspondents.

The following were ordered to be printed:—

ON THE PACIFIC SPECIES OF CAULOLATILUS.

BY W. N. LOCKINGTON.

In the Proc. Acad. Nat. Sci., Phila., 1865, pp. 66-68, Dr. Gill enumerates four species of his genus *Caulolatilus*, one of them, *C. chrysops* (*Latilus chrysops*, Val.) from the Atlantic, the others from the Pacific Ocean.

These species are: *C. anomalus* (=*Dekaya anomalus*, Cooper), *C. princeps* (=*Latilus princeps*, Jenyns), *and C. affinis*, Gill. The first and second of these are stated to differ in the proportion between the length of the posterior dorsal spines and the distance between the dorsal fin and the lateral line; as well as in the length of the pectoral; while the third species (characterized from a specimen about three inches long) is described as follows: "Profile quadrant, in front almost vertical; Greatest height less than four times (.27) in the length (exclusive of the caudal), that of caudal peduncle about nine times. Head more than $\frac{3}{10}$ of the length, while its height is to its length as $22\frac{1}{2}$: 31. Diameter of eye equal to almost $\frac{1}{2}$ the height of the head. Preorbital very narrow. Teeth of preoperculum strong and distant; those of the middle directed obliquely upwards. Sixth dorsal spine equal to $\frac{1}{9}$ of the length. Anus behind the middle of the length. Caudal rather exceeding the height of the head. Pectorals equal to $\frac{1}{5}$ of the length. Ventrals shorter (.18) inserted beneath the base of the pectoral, its spine at the vertical of the upper axil. D., vii, 25. A., ii, 22. P., 18. Color reddish brown on head and back, lighter on the sides. A very distinct blackish spot above the axilla of the pectoral. Locality, Cape St. Lucas." Dr. Gill states his belief that the large eyes and the narrow preorbital are characters of youth; and, moreover, hints a doubt as to the specific identity of *C. princeps* and *C. anomalus*, but thinks it scarcely probable on account of the few species known to be common to Lower California and the Galapagos, the localities from which the types of *C. anomalus* and *C. princeps* were respectively procured.

As I have lately obtained two individuals of a species of *Caulolatilus* in the markets of San Francisco, I contribute a tolerably full description, embodying the characters of the two (which evidently belong to the same species) and notes upon the peculiarities of each. The difference in some of the proportions between these two individuals has almost convinced me of the identity of *C. princeps* and *C. anomalus*; and I am inclined to think it probable that the type of *C. affinis* is only a somewhat abnormal specimen of the same species. The chief differences between the smaller of my specimens and the type of *C. affinis* are the more quadrantiform outline and greater length of the head and the smaller number of dorsal spines and anal rays in the latter.

As, however, the form of the head differs so considerably in individuals evidently belonging to the same species, too much stress must not be laid on the former character; and the variation in the number of dorsal spines (viii-ix) and dorsal and anal fin-rays in specimens of undoubted *C. anomalus* on record, forbid us to think the latter a positive character.

It is quite possible that an individual may have acquired the form of head of the adult, while still of small dimensions. The dorsal spine may be expected (judging from the two specimens here described) to increase in their proportional length inversely to the size of the fish.

If my conjecture be correct (and I only give it as a conjecture), then there is only one Pacific species at present known, ranging at least from the Galapagos to the Bay of Monterey, near San Francisco; representing in this ocean the *C. chrysops* of the Atlantic, and varying somewhat according to age and locality. To thoroughly settle the question, a thorough examination of several specimens from the Galapagos, and a comparison of them with others from Lower and Upper California, will be necessary.

Presuming, for the occasion, that they are identical, the synonymy will be as follows:

Caulolatilus princeps (Jenyns), Gill.

Latilus princeps, Jenyns, Zool. Beagle, 52, pl. 11.
Latilus princeps, Günther, Cat. Fish. British Museum, II, p. 253.
Dekaya anomala, Cooper, Proc. Acad. Nat. Sci. Phil., 1865, p. 68.
Caulolatilus anomalus, Gill, Proc. Acad. Nat. Sci., Cal., 1865, p. 68.
Caulolatilus affinis, Gill, loc. cit.
Caulolatilus anomalus, Streets, Bull. U. S. Nat. Mus., No. 7, p. 48, 1877.

D. viii-ix, 25-26. A. ii, 24-26. P. 19-20. V. $\frac{1}{5}$. C. ac. 13-14. C. 13.

General Description.—Profile more or less decurved, the curvature increasing with age; posterior portion of dorsal outline nearly straight; abdominal outline regularly curved. Greatest depth slightly less than four to rather more than fives times in the total length; head, $4\frac{3}{4}$–$4\frac{5}{9}$ in the same. Greatest thickness about $2\frac{1}{3}$ in the greatest depth. Eye, 4–5 times; snout, 3–$3\frac{1}{3}$ times in the length of the head. Interorbital width, measured round the curve of the forehead, $2\frac{1}{7}$–$2\frac{2}{7}$ in the same. Caudal peduncle, 3–4 times in the greatest depth. Distance from the spinous dorsal to the lateral line, $1\frac{1}{5}$–$1\frac{1}{3}$ times in the height of the last dorsal spine. Nostrils conspicuous, on the horizon of the centre of the pupil, anterior with a valve posteriorly; posterior larger, simple, subcircular, distant from the eye about one-third of the diameter of the latter.

Eyes large, lateral, subcircular, their posterior margin nearer the tip of the operculum than that of the snout.

Mouth slightly ascending forwards; tip of the intermaxillary level with the lower margin of the orbit; posterior extremity of maxillary nearly vertical with the anterior orbital margin. Maxillary narrow throughout, its posterior portion free, but the greater part of its upper edge concealed behind the large preorbital in the closed mouth. Jaws equal in front in the closed mouth. Teeth in jaws in several rows in front, diminishing to a single row farther back on the sides, rather small, slender, acute, recurved at tip, but those in front of the mandible in the outer row inclined forwards. Teeth in front largest, those on the sides diminishing, but the hindermost tooth on each side of each jaw more or less developed as a canine, though still shorter than the anterior teeth.

No teeth on vomer or palatines. Upper pharyngeals set with sharp, irregularly spaced, cardiform teeth; lower pharyngeals with an outer and inner row of similar teeth, with some irregularly placed teeth between the rows. Lower pharyngeals entirely separate.

Gill-rakers of front of first branchial arch slender, rather stiff, about $\frac{1}{3}$ the diameter of the eye, all the others tubercular.

Hinder border of preoperculum vertical, very slightly curved, lower angle rounded, set with teeth which slightly increase in size at the angle, but do not extend along the lower border. Operculum ending behind in a broad flat spine.

Dorsal commencing above the upper pectoral axil, very long, the tips of its terminal rays reaching the caudal accessories; the length of its base about half the total length of the fish; spinous dorsal $3\frac{2}{3}$–4 times in the total length of the fin, and lower than the soft portion. First dorsal spine shortest, the others increasing rapidly to the fifth, more slowly to the eighth or ninth; the longest $6\frac{1}{4}$–8 times in the total length of the fin.

Soft dorsal continuous with the spinous portion, and almost equal in height throughout, the last ray excepted. Last ray much shorter than the others. Height of soft dorsal, in front $5\frac{1}{2}$–$7\frac{2}{3}$ times in the total length; many of the rays simple, some slightly bifurcate at the tip, the two or three last rays twice branched.

Anal commencing under fifth dorsal ray, its length about $\frac{2}{3}$ of that of the dorsal, with which it is coterminous. Anal spines very small, closely adpressed to the first rays; rays similar and about equal in length to those of the dorsal, the last much shorter than the others. Pectoral lanceolate, the seventh ray longest, the rays decreasing rapidly on each side, the lowest scarcely one-fifth as long as the seventh. Length to tip of longest ray $1\frac{1}{7}$–$1\frac{1}{9}$ in that of the head. Most of the rays twice branched, tip of the longest reaching a little beyond the anus. Base of pectoral slightly oblique.

Ventrals inserted under the hinder margin of the pectoral base, their tips not reaching to the anus; their length about $\frac{2}{3}$ that of the pectoral; the last four rays twice bifurcate.

Caudal about one-sixth of the total length, with numerous accessory rays, causing a widening of the caudal base; principal rays three times forked; hinder border deeply and triangularly emarginate, almost forked.

Lateral line indistinct, tubes simple; about 145 scales in its length, parallel or nearly so with the dorsal outline.

About forty scales between the ventrals and the lateral line, and thirteen above the latter. Scales of body almost rectangular, their longitudinal exceeding the transverse diameter, the free margin finely ctenoid. All the scales small, those of the abdomen rather smaller than the others, especially front of the paired fins.

Scales extending upon the cheeks and opercular apparatus, but the snout and forehead to above the centre of the eyes, the upper border of the orbits; preopercular margin, jaws and gill-membrane scaleless.

No scales upon dorsal or anal; caudal covered with small scales over the greater portion of its surface. Pectorals more or less scaly exteriorly near the base, the scales extending farther between the central than between the lateral rays.

Color leaden-gray, becoming darker above, but fading to a dirty creamy-white below. Vertical fins slaty-gray. Dorsal surface of head darker than the rest of the body.

The two specimens on which the above description is principally founded were procured in the market of San Francisco, and were brought from the vicinity of Monterey Bay. One is an adult, the other an immature individual, and the two present considerable variation in external form, and in the proportions of some of the parts, as will be evident by the dimensions and further description of each specimen here appended.

Dimensions of the Two Specimens.	No. 1.	No. 2.		
	INCHES.	INCHES.		
Total length, including caudal,	17.75	10.05		
Length without caudal,	14.65	8.30		
Greatest depth of body,	4.50	1.96	30½	23⅓
Greatest thickness of body,	2.38	.92	16	10½
Length of head,	3.74	2.08	25	24⅔
Circumference behind base of pectorals,	10.88			
Longitudinal diameter of eye,	.80	.52	5½	6
Length of snout,	1.25	.63	8½	7⅓
Interorbital width, round curve of forehead,	1.75	.76	12	9
From tip of snout to dorsal, along dorsal outline,	4.75	2.46	32½	29½
Length of base of dorsal fin,	8.96	4.95		
" " " spinous dorsal,	2.40	1.25	16	14⅔
From tip of lower jaw to anal, along abdomen,	8.00	4.39	54½	51½
Length of base of anal,	5.02	3.32	40	40
Length of pectoral base,	.87	.45		
Length of pectoral to tip of longest (7″) ray,	3.36	1.82	23	22
From tip of snout to insertion of ventrals,	4.46	2.42	30½	29
Length of ventrals,	2.30	1.20	15½	14
Height of first dorsal spine,	.25	.25	1⅔	3
" " second " "	.56	.40	4	5
" " third " "	.82	.55	5⅝	6½
" " fourth " "	.93	.68	6⅓	7
" " fifth " "	1.03	.70	7	8⅓
" " sixth " "	1.05	.73	7.2	8½
" " seventh " "	1.09	.75	7½	9
" " eighth " "	1.13	.77	7⅔	9¼
" " ninth " "	1.10	.70	7½	9⅓
Distance from 1st dorsal to lateral line,	1.50	.65	10	7½
Height of soft dorsal, in front,	1.30	.90	9	10½
Depth of anal,	1.30	.90	9	10½
Width of caudal peduncle,	1.12	.65	7⅔	7⅔
Length of lower jaw,	1.62	.82	11	9¾
" " maxillary, along its curve,	1.50	.75	10	9
Rays of dorsal,	ix-26	ix-25		
" anal,	ii-25	ii-25		

Further Description of No. 1.—Snout very declivous, dorsal outline in advance of the dorsal rising rapidly, owing to a great accumulation of adipose tissue about the upper part of the body; posterior part of dorsal outline regularly descending almost in a straight line; abdominal outline regularly curved.

Greatest depth a little less than four times; head, $4\frac{3}{4}$ times in the total length; greatest thickness, $1\frac{8}{9}$ in the greatest depth. Eye, $4\frac{27}{40}$; snout, 3, interorbital width (round curve of forehead), $2\frac{1}{7}$ times in the length of the head. Caudal peduncle, four times in the greatest depth. Distance from the spinous dorsal to the lateral line, measured along the curve of the side, one-third longer than the longest spine.

Denticulations of preoperculum rather blunt; opercular spine blunt.

Teeth somewhat irregular, canines less distinct than in the young.

Anal spines short and weak, but stiff, and distinctly recognizable as spines; the first very short, the second about half as long as the first ray.

Lateral line less conspicuous than in the young.

Upper part of the head and along the line of the back approaching a chocolate tint.

Vertical fins darker nearer the margin. No black spot above pectoral axil.

The whole fish is exceedingly oily, and the abundant exudation of this oil renders it exceedingly disagreeable to handle.

Further Description of No. 2.—Dorsal outline from tip of lower jaw to vertical from posterior margin of eye, much less convex than in the adult; rise from thence to the origin of the dorsal very slight; a gradual descent in an almost straight line from thence to the caudal peduncle. Abdominal outline regularly curved to caudal peduncle. Greatest depth, $5\frac{1}{8}$; length of head, $4\frac{5}{6}$ times in the total length; eye, 4 times; snout, about $3\frac{1}{3}$ times in the length of the head. Interorbital width, measured round its curve, about one-fifth more than the length of the snout, or $2\frac{5}{7}$ in the length of the head. Caudal peduncle, 3 times in the greatest depth.

Distance from the spinous dorsal, at its posterior part, to the lateral line, nearly $1\frac{1}{6}$ in the length of the longest spine, and less than one-third of the semicircumference of the body. Longest (9th) dorsal spine, $2\frac{3}{5}$ in the length of the head.

Forehead and occiput transversely much less arcuate than in the adult, the large deposit of fat on these parts in the latter being absent in the young.

Opening of mouth slightly less oblique than in the adult, the maxillary extending a little farther back. Teeth much as in the adult, but the hindmost tooth in each jaw, but especially in the upper, assuming more distinctly the proportions of a canine, though still smaller than the front teeth.

Denticulations of operculum proportionately more conspicuous, and more acute than in the adult, opercular spine ending in three denticulations.

Ninth dorsal spine, $6\frac{1}{4}$ times in the length of the fin, about $2\frac{1}{2}$ in the greatest depth. Rays of soft dorsal about $2\frac{1}{6}$ in the greatest depth, the antepenultimate ray slightly produced. Anal spines closely attached to the first ray, very small, flexible, and scarcely recognizable as spines.

A black spot above the upper axil of the pectoral; upper parts without the warm tint of the adult. No large development of adipose tissue.

Since the above paper was written, a third specimen of *Caulolatilus* from the same locality has come into the possession of the California Academy of Sciences. This example is about equal in length to the larger of the two described, but the development of fat upon the occiput is much less marked, so that its proportions are very nearly those of the type of *C. anomalus*.

Although I am perfectly aware that specimens from the Galapagos would be required to settle the question of the identity of *C. princeps* with *C. anomalus* and *C. affinis*, I believe that the comparison of these three examples, evidently all of one species, and sharing among them characters relied upon as specific, certainly throws great doubt upon the distinctness of the three described species. Dr. Bean (*in lit.*) doubts the specific identity of the two specimens described in this paper, and draws attention to certain differences of proportion, but the only differences of magnitude are those caused by the development of fat on the occiput.

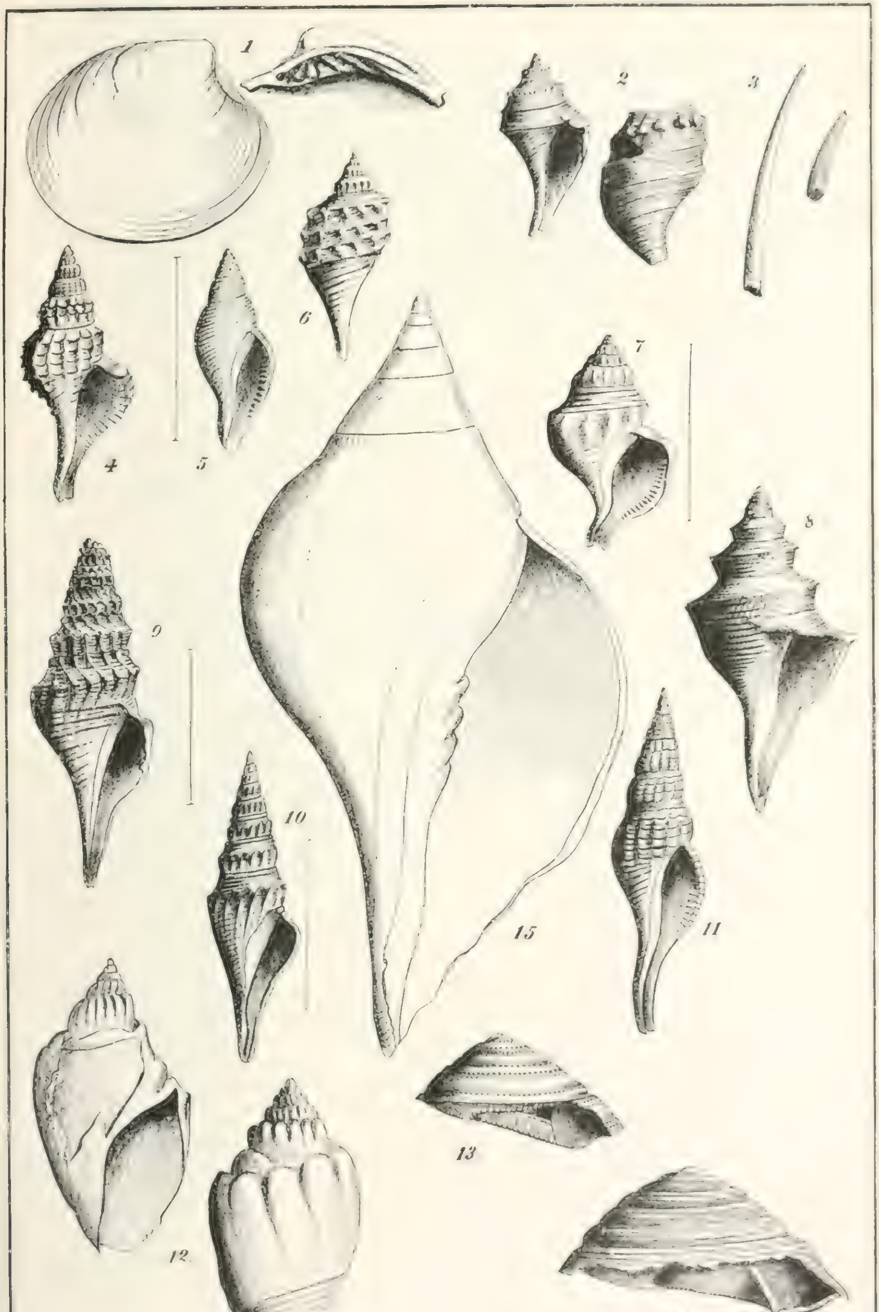
ON THE STRATIGRAPHICAL EVIDENCE AFFORDED BY THE TERTIARY FOSSILS OF THE PENINSULA OF MARYLAND.

BY ANGELO HEILPRIN.

The Tertiary deposits of Maryland have from time to time attracted the attention of investigators more or less eminent in their special lines of research, the results of whose observations, owing to the then imperfect state of American geological and paleontological science, only very gradually tended to unfold the true relations existing between the synchronous formations of the east-Atlantic and west-Atlantic countries.

Maclure, on the map accompanying his "Observations of the Geology of the United States" (1817), classed all the late superficial deposits of Maryland under the general term "Alluvial," which term was likewise applied to almost the entire border deposits of the Atlantic and Gulf slopes. In 1824 (J. A. N. S., vol. iv) Say described about forty species of fossil shells collected by Mr. Finch from the same state, but excepting some passing reflections on the nature of the deposit whence they were obtained, and on the great resemblance existing between some of the forms and forms still living on the coast, no special geological inferences were drawn from the collection. From a comparative examination of the contained fossils, Van Rensselaer ("Lectures on Geology," 1825, p. 261) subsequently referred the deposits in question to the Upper Marine formation, which view was concurred in by Morton in a paper read before the Academy of Natural Sciences of Philadelphia in June, 1828. In a previous paper ("Geological Observations on the Secondary, Tertiary, and Alluvial Formations," J. A. N. S., January, 1828), published conjointly by Vanuxem and Morton, no attempt was made to correlate the various divisions of the American and European Tertiary formations.

Conrad, who, more than any other American geologist, contributed to advance our knowledge of the geology and paleontology of this latest period, was the first to recognize the existence of at least three distinct post-Secondary formations in Maryland, the oldest of which he identified by a series of a few fossils found near Ft. Washington, on the Potomac, as belonging to the Eocene, and the newest, as exposed on the southeast extremity of the peninsula, to the Post-Pliocene (J. A. N. S., vol. vi, and Bulletin



HEILPRIN ON EOCENE FOSSILS.

of the National Institution, 1841). The intermediate deposits were classed as the Upper Marine, but subsequently under Lyell's designation of Miocene. Conrad's original observations were in general confirmed by his later researches, and the relations of at least a great portion of the Miocene of Maryland, as well as of almost the entire Atlantic slope, were clearly pointed out by Lyell in 1845 (Proc. of the Geolog. Soc., vol. iv, p. 547).

It is mainly in relation to this last formation that we wish to draw special attention, there being but little question concerning the original determination of the Eocene and Post-Pliocene (Pliocene?) deposits. That the great bulk of the deposits known as the Medial Tertiary of Maryland are not synchronous with the South Carolina deposits classed by Tuomey and Holmes as Pliocene, an assumed fact insisted upon by Conrad, and for which there appears to be no evidence, an examination of the following table of mollusca will clearly demonstrate :

Lamellibranchiata of the Medial Tertiary Formations of Maryland.

Anomia ephippium,*	Cardita protracta,	Leda concentrica,
Amphidesma carinata,*	" granulata,*	Lima papyria,
" subovata,	Cardium laqueatum,	Lepton (?) mactroides,
Arca callipleura,	" acutilaquea-	_Lucina anodonta_,*
(= A. dipleura?),	tum.	(=L. Americana),
" idonea,	" craticuloides,	" Foremani,
" incile,*	" leptopleura,	" subobliqua,
" subrostrata,	Corbula cuneata,*	" subplana,
" Marylandica,	" idonea,	" cribraria,*
" triquetra,	" elevata,	" crenulata,*
" centenaria,*	" inequalis,*	" _contracta_,*
" improcera,*	Crassatella Marylandica,	" _divaricata_,*
" stilicidium,	" turgidula,	Mactra incrassata,
Artemis acetabulum,*	" melina,	" ponderosa.
" concentrica,	" undulata,*	" fragosa,
(= _A. elegans?_),	_Cytherea Sayana_,*	" subcuneata,
Astarte vicina,	" albaria,*	" delumbis,
" cuneiformis,	(= C. idonea),	Modiola Ducatellii,
" obruta,	" Marylandica,	Mya producta,
" perplana,	" subnasuta,	Mytilus incurva.
" exaltata,	Isocardia fraterna,	_Ostrea Virginica_,*
" varians,	" Markoei,	" percrassa,*
" distans,	Leda liciata,	_Panopæa Americana_,
" planulata,	" _acuta_,*	" reflexa,*
" undulata,*	" (Yoldia) lævis,	" porrecta,
Cardita arata,*	" (Nucula) proxima,	(= P. Goldfussi?

Pecten Madisonius,	Perna maxillata,	Tellina lenis,
" Humphreysii,	Petricola centenaria,*	Venus tetrica,
" Jeffersonius,	Plicatula marginata,*	" *Mortoni,*
" concentricus,	Pholadomya abrupta,*	" alveata,
" Clintonius,	Pholas ovalis,	" inoceriformis,
" septenarius,*	(= *P. costata?*)*	" stamineus,
Pectunculus parilis,*	*Saxicava rugosa,*	" tridacnoides,*
" lentiformis,*	*Solen ensis,**	" *violacea,**
	Tellina æquistriata,	" Rileyi.*
" subovatus,*	" biplicata,*	

The species in *italics* are still living on the American coasts; those followed by an * are described by Tuomey and Holmes as occurring in the Pliocene formation of South Carolina.

[NOTE.—The preceding table has been compiled as accurately as possible from the various papers pertaining to the paleontology of the State, but owing to their number, and to the numerous publications in which they have been spread, it has proved impossible to collect them all, and no doubt some few species will be found occurring in the State which have escaped our notice. These will probably be very few in number, and will not materially affect the general conclusion. The following twenty-two species, mainly those described by Say from the collection of Mr. Finch (J. A. N. S., vol. iv), have no stated locality: *Arca centenaria*, *A. improcera*, *A. incile*, *Astarte distans*, *Crassatella undulata*, *Leda acuta*, *L. concentrica*, *L. proxima*, *L. lævis*, *Lucina contracta*, *L. divaricata*, *L. subobliqua*, *Panopæa reflexa*, *Pecten Jeffersonius*, *P. Clintonius*, *P. concentricus*, *P. septenarius*, *Pectunculus subovatus*, *Plicatula marginata*, *Tellina æquistriata*, *Venus deformis* (*tridacnoides*), *and V. Rileyi.*]

It will thus be seen, that of about one hundred species of bivalves, only thirty-six (36 per cent.) are common to about an equal number (105) from the South Carolina deposits; and further, that, whereas, of the preceding enumeration of Maryland mollusca only about *fifteen* per cent. are recent forms, no less than *forty* per cent. (or according to Tuomey and Holmes, nearly fifty per cent.) of the South Carolina Pliocene (Conrad's Miocene) bivalve mollusca are still living. There remains, therefore, no question regarding the relative ages of the two formations.

An examination of the fossiliferous strata exposed in sections at various points on the western shore of Chesapeake Bay, in

Anne Arundel and Calvert Counties, on the Patuxent River, near Benedict, and on the St. Mary's River, St. Mary's County, tend to show, moreover, that the series of deposits intermediate between the Eocene of Fort Washington and the Pliocene of the south-east extremity of the peninsula belong to two different periods of formation, an older and a newer; those belonging to the latter period being characterized by a fauna, the proportion of living forms in which is far in excess of that in the former. Sections of the newer deposits are exhibited in Calvert County, near Cove Point, on the Patuxent River, below Benedict, at about water level, on the same river, further north, in the deposits *above* the Perna beds, and more especially on the St. Mary's River, St. Mary's County. The older deposits are best shown in the oyster beds, rising a few feet above tide-water, at Fair Haven, Anne Arundel County (which point was considered by Conrad as the northern termination of the peninsular Miocene formation), in similar beds, also only a few feet above water level, at a point about twenty miles further south ("Colonel Blake's," of Conrad), in the sections exhibited by the Calvert Cliffs, and in the Perna beds on both banks of the Patuxent River. There is, further, strong, although not conclusive evidence, for considering the beds containing *Perna maxillata* and *Ostrea percrassa* as the lowest of the series.

The following tables exhibit as nearly as possible the distribution of Lamellibranchiata in the deposits of both periods, those of the newer being for convenience of comparison divided into the Patuxent and St. Mary's groups:

OLDER PERIOD.

1 Arca dipleura,
(= A. calilpleura ?),
2 " Marylandica,
3 " subrostrata,
4 " triquetra,
5 Artemis acetabulum,
6 Astarte varians,
7 " exaltata,
8 Cardium craticuloides,
9 " leptopleura,
10 Corbula idonea,
11 Corbula elevata,
12 Crassatella melina,
13 " turgidula,
14 Cytherea subnasuta,
15 Isocardia Markoei,
16 Leda liciata,
17 Lima papyria,
18 Lucina Foremani,
19 " subplana,
20 " crenulata,
21 Mytilus incurva,

22 Modiola Ducatelii,
23 Ostrea percrassa,
24 Panopæa porrecta (Goldfussi)
25 Pecten Humphreysii,
26 " Madisonius,
27 Pectunculus parilis,
28 " lentiformis,
29 Perna maxillata,
30 Pholas ovalis, (= *P. costata?*)
31 Tellina lenis,
32 *Venus alveata*,
33 " staminea,
34 " *Mortoni?*

NEWER PERIOD.—I. PATUXENT GROUP.

1 Anomia Conradi, (= *A. ephippium?*),
2 Arca idonea, St. M.,
3 Artemis acetabulum, St. M.,
4 Astarte undulata, St. M.
5 Cardita protracta,
6 Cardium laqueatum, St. M.,
7 Carbula idonea, St. M., E.,
8 Crassatella Marylandica, E.,
9 *Cytherea Sayana*, St. M.,
10 " Marylandica,
11 " albaria,
12 Isocardia fraterna, St. M.,
13 Lucina Americana, E., (= *L. Floridana*),
14 Mactra incrassata,
15 Mya producta,
16 *Panopæa Americana*,
17 " porrecta (Goldfussi), St. M.,
18 Pecten Madisonius, St. M., E.,
19 Petricola centenaria,
20 Pholas ovalis, (= *P. costata?*), St. M.,
21 Tellina biplicata, E.,
22 *Venus Mortoni?* St. M.

II. ST. MARY'S GROUP.

1 Amphidesma carinata,†
2 " subovata,†
3 Arca idonea,
4 " arata,†
5 " stilicidium,†
6 Artemis acetabulum,
7 Astarte undulata,
8 " planulata,† (= A. perplana?),
9 " vicina,†
10 Cardita granulata,†
11 Cardium laqueatum,
12 Corbula inequalis,†
13* " cuneata,†
14 Corbula idonea,
15 *Cytherea Sayana*,
16 " (*Artemis*) concentrica,† (= *A. elegans?*).
17 Isocardia fraterna,
18 Lucina cribraria,†
19* Mactra ponderosa,†
20 " subcuneata,†
21 " fragosa,†
22 " delumbis,†
23 *Ostrea Virginica*,†
24 Panopæa porrecta,
25 Pecten Madisonius,

* *Corbula cuneata* and *Mactra ponderosa* are also found in the newer deposits of Calvert County, near Cove Point.

26 Pholadomya abrupta,†	30 *Venus alveata*,
27 Pholas arcuata,	31 " *Mortoni*,
(= *P. costata*),	32 " tetrica,†
28 *Saxicava rugosa*,†	33 " *mercenaria*,†
29 *Solen ensis*?†	34 " inoceriformis.†

NOTE.—The italicized names represent species supposed to be identical with living forms; those (in the Patuxent group) followed by the letters St. M. and E., species common to St. Mary's and to Easton (Choptank River); and those (in the St. Mary's group) followed by a †, species peculiar to the locality.

A comparison of the foregoing lists will show at a glance, that of the thirty-four bivalves belonging to the older formations, *at most* only three (or 9 per cent.) are found to be living forms (*Pholas ovalis* [= *P. costata*?], *Venus alveata*, and *Venus Mortoni*), and that only six (18 per cent.) and seven (21 per cent.) are comcommon respectively to the Patuxent and St. Mary's exposures, viz.:

To Patuxent.	*To St. Mary's.*
Artemis acetabulum,*	Artemis acetabulum,
Corbula idonea,	Corbula idonea,
Pholas ovalis,*	Pholas arcuata (= costata),
Panopæa porrecta,	Panopæa porrecta,
Pecten Madisonius,	Pecten Madisonius,
Venus Mortoni,	Venus Mortoni,
	" alveata.*

* There appears to be much confusion regarding the species of *Artemis* found fossil in the Atlantic tertiary deposits, and their relation to the forms now living on the Florida coast. In 1832 ("Fossil Shells of the Tertiary Formations," p. 20) Conrad characterized the species *A. acetabulum*, which appears to have been until then confounded with the *A. concentrica*, Con., *non* Born (*A. discus*, Reeve, "Conchologia Iconica," vol. vi, sp. 9), inhabiting the southern coast. No mention is there made of its being found also in a recent state, but subsequently, 1838 ("Fossils of the Medial Tertiary Formations," p. 29), we find the following statement: "This fine species is very common in the localities named, and also occurs recent on the Florida coast." In the list of shells inhabiting the Florida coast, prepared by the same author in 1846 (A. J. Science, 2d series, ii, p. 393), only two species of *Artemis* are catalogued, *A. elegans* and *A. concentrica*, and it therefore appears highly probable that the statement considering *A. acetabulum* also as a living form was founded on a misconception, the more especially, as an examination of the recent shells in the

Deducting two or three species that are also found at Easton, we still have left twenty-three (or 68 per cent. of the whole number) that are not found in the later deposits.

Museum of the Academy fails to reveal anything answering to Conrad's original description. This species appears moreover to be identical with the *Venus concentrica* described by Tuomey and Holmes in their work on the Pliocene fossils of South Carolina (1857, p. 82), and to which Conrad, apparently without good reason, applied the specific name of *intermedia* (*Dosinia* [*Artemis*] *intermedia*) in his check list of Miocene fossils (Proc. A. N. S., 1862, p. 575). The *A. acetabulum* is found fossil in the tertiary deposits of Maryland, Virginia, North Carolina and South Carolina, and must be carefully distinguished from the *A. concentrica* of Born, to which it bears only a distant resemblance. Another fossil species is probably the *A. elegans*, Con. (living on the Florida coast); one almost perfect specimen, which agrees in all essential respects with the recent forms, is in the Academy Miocene collections, but, unfortunately, the locality whence it was obtained is not given. In his account of the geology and organic remains of the peninsula of Maryland (1830, J. A. N. S., vol. vi, p. 212), Conrad mentions the *Cytherea* (*Artemis*) *concentrica*, Lam., as occurring in the St. Mary's exposure, but as subsequently ("Fossils of the Medial Tertiary," 1838, p. 30), it is distinctly stated that the same does *not* occur in the Miocene formation, it is highly probable that the original observation was erroneous. Certainly nothing corresponding either to the species in question or to *A. discus* is to be found in the Maryland Miocene collection of the Academy.

The common species inhabiting the southern coast is *not* the *A. concentrica* of Born, with which it has been frequently confounded, and to which it bears only a very slight resemblance, but the *A. discus* of Reeve (*loc. cit.*). A third species, the *A.* (*Dosinia*) *Floridana* Con., is unquestionably very closely allied to the last, from which it differs essentially only in the greater obliquity of the pallial sinus. In other respects it agrees with the figures and minute description of Born's species as given by Agassiz in his "*Iconographie des Coquilles Tertiaires*" (*Nouv. Mém. de la Société Helvétique*, 1845, vol. vii).

I am disposed to consider the various forms of *Venus alveata* and *V. latilirata* as mere varieties of one and the same species, a series of intermediate stages seeming to link them together. The *V. athleta* constituted by Conrad to embrace the *V. athleta* of Say, *V. latilirata* of Tuomey and Holmes, and the *V. paphia* of Lamarck, appears likewise to be nothing but a variety of the same form. The *V. alveata* is included by Stimpson among the living mollusca of the Atlantic coast (Smithsonian Check Lists, 1860), but this fact appears very doubtful in the opinion of Tryon ("American Marine Conchology," 1873, p. 160). It must be confessed, however, that there exists a very striking agreement between the fossil shell and specimens of the *V. paphia*, Linn., from St. Thomas, the main

On the other hand, the fossils of the newer deposits as exhibited in the sections on the west bank of the Patuxent show a very decided similarity to those of St. Mary's, for out of the twenty-two species of bivalves occurring there, no less than eleven (or just 50 per cent.) are also common to the last mentioned locality. There can, therefore, I believe, be no reasonable doubt that the deposits exposed on the Patuxent River immediately above the *Perna* beds constitute a direct continuation of the highly fossiliferous strata bordering both sides of the St. Mary's River. These last number among their fossil fauna also about thirty-four species of Lamellibranchs, the same number as is found in what we have designated as the older group, but of these thirty-four, about twenty-two (or, deducting *Corbula cuneata* and *Mactra ponderosa*, twenty), or 65 per cent. are peculiar to the locality. Moreover, of the entire number, about nine (or 27 per cent.) are still living on the Atlantic coast. The dissimilarity of the two faunæ cannot fail to strike the least observant investigator, and Conrad has dwelt at some length upon this curious manifestation (A. J. Science, vol. xxviii, p. 282, and Bull. National Institution, 1841, p. 176). That paleontologist singularly enough (apparently not having made any exact numerical estimates either of the living forms, or of the forms found in one locality and not in the other) explains the differences as due solely to variable local conditions.[1]

difference being a tendency on the part of the latter to lose the full solidity of its ribs some distance before they reach the posterior slope. The *V. alveata* exhibits a similar tendency, but not quite to the same extent.

I have been unable to discover any description of the *Pholas ovalis*, Con., nor is there any mention made of it either in the Miocene check list prepared by Conrad in 1862, (Proc. A. N. S.), or in that of Meek, of 1864 (Smithsonian Miscell. Collections). I have, therefore, only doubtfully referred it to *P. costata*.

[1] Thus he states (A. J. S. *loc. cit.*): "If our coast were now suddenly elevated, we should find spots where the shells would consist chiefly of an immense number of *Modiola demissa* mixed with *Littorina littorea* and *Melampus bidentatus;* these are found on the margin of the lagoons at high water mark, the *Modiola* imbedded in a tenacious soil. At a little distance would be found *Venus mercenaria, Mya arenaria, Solen ensis, Solecurtus Caribeus;* among these would be *Ostrea Virginiana, Fusus cinereus*, and a few of *Pecten concentricus*. Such is the group existing on the sandy shore of the Estuaries. Hard by, would be a vast deposit of oyster shells with *Echinus*, and immense masses of *Serpulæ*. These live on the bottom of the lagoons, which is composed of a mixture of sand and

This interpretation might very satisfactorily account for the phenomenon as far as generic distribution alone is concerned, and, indeed, it would even hold good in its bearings on a limited number of species, but it would hardly apply to a case such as the present one, where the specific dissimilarity is so vast in such a comparatively very limited geographical extent.

Now, if the supposition that the deposits in question were deposited at two different periods be a correct one, and paleontological evidence goes far to prove that they were, we should naturally expect to find also some direct stratigraphical evidence afforded by the superposition of the strata themselves.[1] The following section was obtained by Conrad at a point on the Chesa-

mud. Then would be found another group of shells which live only in deep water, the *Astarte lunulata*, *Nucula limatula*, *N. proxima*, *Cardita borealis*, *Pholas costata*, in company with great numbers of *Mytili*. This deposit we should recognize as having been formed in harbors, like those of Newport and Charleston. . . . "

It will be observed, that in the above conception Conrad has confined himself entirely to generic and not specific distribution.

[1] It may as well be remarked, that, although in the foregoing examination of the molluscous fauna I have dwelt exclusively upon the *Lamellibranchiata*, the *Gasteropoda* offer equal, if not greater support to the general conclusion arrived at. On comparing the lists of geographical distribution given by Conrad in the Bulletin of the National Institution (pp. 181–7), it will be seen, that not a *single* recent form occurs among the eighteen enumerated from the Calvert cliffs at "Hance's;" and further, that only two species, *Voluta mutabilis* and *V. solitaria*, are common to the forty-two found at St. Mary's. Of these last eight (or 19 per cent.) were considered by Conrad to be recent forms :

Buccinum trivittatum,	Natica duplicata,
" lunatum,	Dentalium dentalis,
" quadratum,	Fusus cinereus,
Natica heros,	Scalaria clathrus.

Nearly all the species found on the west bank of the Patuxent also occur at St. Mary's, and the same can be said of those collected in Calvert county near Cove point the southern extremity. Singularly enough, that although three species of *Turritella*—*T. indenta*, *T. exaltata*, and *T. perlaqueata*—were collected from Calvert cliffs in the upper portion of the county, none of them appear to have been found near Cove Point, where "vast quantities" of a new species, *T. plebeia*, "the common species of St. Mary's River" (loc. cit. p. 182), appear suddenly to make their appearance.

peake, near "Beckett's," about twenty-eight miles south of Fair Haven:

Feet in Thickness.

5	Sand, without shells.
3	Sand, with innumerable shells.
20	Mingled sand and clay, without fossils, or very rare.
3	Same as below, less numerous.
4	Sand and clay, with a group of shells like that at Hance's.

The shells obtained at Hance's, about four miles further north, were the following:

Bivalves.

Astarte varians,
" exaltata,
Artemis acetabulum,
Arca subrostrata,
" dipleura,
Cytherea subnasuta,
Cardium leptopleura,
Crassatella melina,
Corbula idonea,
" elevata,

Bivalves.

Isocardia Markoéi,
Lima papyria,
Lucina Foremani,
" subplanata,
" crenulata,
Pectunculus lentiformis,
Venus latilirata,
" Mortoni?
" staminea.

Univalves.

Bonellia lineata,
Cancellaria biplicifera,
" engonata,
Dentalium thalloides,
Fissurella Marylandica,
Voluta mutabilis,
Infundibulum perarmatum,
Marginella perexigua,
Pleurotoma Marylandica,

Univalves.

Pleurotoma bellacrenata,
Scalaria pachypleura,
Solarium trilineatum,
Sigaretus fragilis,
Trochus peralveatus,
Turritella indenta,
" exaltata,
" perlaqueata,
Voluta solitaria.

It will be at once noticed that in addition to the lowest fossiliferous stratum, extending to about seven feet above water level, a second highly fossiliferous one manifests itself at a height of about twenty-seven feet, in which were recognized among other shells *Artemis acetabulum* and *Pecten Madisonius*. The mineral character of this upper deposit is described by Conrad as being a "quartzose sand, very incoherent," which is exactly what we meet with in the arenaceous deposits on the west bank of the Patuxent River, near Benedict, and which we have identified as equivalents of the St. Mary's deposits. They are described by Conrad as being composed of an "arenaceous, fossiliferous stratum," the sand of which is "quartzose and incoherent" (B. N. I., p. 185).

We have thus exposed in one section two highly fossiliferous strata, the upper of which shows a very decided analogy to what we have designated as the newer group, and the lower of which assumes a distinct personality for reason of its position, and the paleontological characters impressed upon it. Proceeding from this point southeastward, and therefore in the general direction of the dip of the beds, we should naturally expect to meet a point where our upper stratum, or its equivalent, would descend nearer to the level of the Bay, and in fact we do find just such a point near Cove Point, where "the group most characteristic of these tertiary deposits, imbedded in sand," descends to a height only about fifteen feet above water mark (B. N. I., p. 183). The fossils found here are also nearly all found at St. Mary's, and they are, moreover, "highly ferruginous, as much so as many of the crag fossils of Great Britain, which they greatly resemble, also, in other respects" (Conrad, loc. cit.). On the St. Mary's River, the southeasternmost extension of the formation, the same deposit sinks almost to water level, as might well be expected on following the general direction of the dip. Here, the Pliocene deposits, well characterized by their fossils, make their appearance.

On proceeding from our first point almost due northwards, and therefore at a considerable angle to the line of strike, we meet with just the reverse phenomena met with on our southern journey. At Fair Haven, where Conrad obtained the following section, *Feet in Thickness.*

50	Whitish Clay.
	Bones of Cetacea.
3	Clay, with siliceous casts of marine shells and fragments of bones.
5	Clay, with *Ostrea percrassa, Pecten Humphreysii.*

the highly fossiliferous stratum found at water mark, at Beckett's, is probably represented by a bed of clay three feet in thickness, commencing at a height of five feet, and which contains "great numbers of black, water-worn, siliceous casts of small shells, chiefly *Turritella*, the species not yet determined." Below this an entirely new deposit now makes its appearance, a bed of clay of five feet thickness, characterized by *Ostrea percrassa* and *Pecten Humphreysii.* This last, therefore, probably represents the most ancient post-Eocene deposit exhibited on the Chesapeake. *Ostrea percrassa* and *Pecten Humphreysii* were also found by Conrad at Huntingtown, Calvert County, where in a "*depression or small valley*" a race-way had been excavated through the fossiliferous "marls." The lowest member of the section was "quartzose sand, with casts of *Perna maxillata.*" On the east bank of the Patuxent River, moreover, near the mouth of St. Leonard's Creek, Conrad observed innumerable casts of *Perna maxillata* imbedded in a stratum of fine siliceous sand, and resting on the fragmentary rock considered by him as the "foundation of the peninsula" (B. N. I., p. 184).

We should naturally look for some deposit contemporaneous with that occurring on the west bank of the Patuxent, at some point northeast of that locality where a section may present itself. This we find at Easton, on the Choptank, where the molluscous fossil fauna corresponds very closely with that observed on the former river. The deposits of the older period, on the other hand, reappear in Cumberland County, New Jersey, in the "Miocene marl" of Shiloh, containing the following assemblage of fossils (Cook, "Geology of New Jersey," 1868, p. 297):

Bivalves.

Ostrea Mauricensis,	Astarte Thomasii,
" percrassa,	Venus Ducatellii,
Plicatula densata,	Periploma alta,
Carditamera aculeata,	Corbula elevata,
" arata,	Saxicava myæformis.
Crassatella melina,	

Four species of the above are also found in Maryland, three of which, *Ostrea percrassa*, *Crassatella melina*, and *Corbula elevata*, are found, I believe, exclusively in the deposits designated as those of the older period. None are recent forms.

The small percentage of living forms occurring in the "older deposits," as compared with that of the "newer," leaves little doubt for the inference that the deposits in question were formed at two different periods, the latest of which clearly belongs to the Miocene. A comparative examination of some of the peculiar fossil forms of the older deposits, together with the extremely low percentage of living forms, seems to indicate an age more nearly Oligocene than Miocene, although perhaps not a single Eocene species is represented. This last fact need not surprise us, however, as the relationship of the Oligocene to the Miocene appears to be greater in almost all the localities of its representation than to the Eocene. The Eocene, moreover, of Maryland is represented only by a very limited number of fossils, and Conrad, himself, has called attention to the fact, that there appears to exist a greater amount of difference between the Eocene and Miocene formations than obtains between the Secondary and Tertiary, or between the Devonian and Carboniferous systems (B. N. I., p. 177). The following comparison may serve to throw some light upon the relative age of the deposits in question:

Perna maxillata, Lam.

This species agrees thoroughly with the figure and description of the same given by Goldfuss in the "Pectrefacta Germaniæ" (vol. ii, p. 106), and to which the locality Weinheim (Oligocene) is assigned. The sub-Apennine species, formerly classed under the same name, is considered by Deshayes to be distinct, and he has applied to it the specific name of *Soldanii* (Lamarck, "*Animaux sans Vertébres*," 2d ed., vol. vii, p. 79). A second species of *Perna*, the *P. Sandbergeri*, Desh., also occurs in the Oligocene locality of

Weinheim (Sandberger, "*Conchylien des Mainzer Tertiärbeckens*," p. 367).

Mytilus incurva, Conr.

This large species of *Mytilus* may perhaps be taken as the representative of *M. Haidingeri*, Hörnes ("*Fossilen Mollusken des Tertiärbeckens von Wien*," *Abhand. d. k. k. geolog. Reichsanstalt*, iv, p. 356), found both in the Oligocene (Eggenburg) and Miocene divisions of the Vienna basin. Rolle (*Sitzungsberichte d. k. Akad. d. Wissenschaften*, 1859, p. 64) and Sandberger consider the *M. Haidingeri* as the equivalent of *M. Faujasi*, Brongn., occurring at numerous Oligocene localities of the Vienna and Mentz basins.

Isocordia Markoei, Conr.

This *Isocardia* is, it appears to me, erroneously referred by Hörnes (*loc. cit.*, p. 165) to the *I. cor*, L., from which it is very readily distinguished by its relatively much greater height, and greater development of the umbones. It is a singular fact, that this species of *Isocardia* was followed in the later period by the *I. fraterna*,* Say, which is barely distinguishable from fossil examples of the *I. cor* from Astigiana and Sicily.

It is worthy of remark, that Rolle (loc. cit., p. 81), as early as 1859, only four years after Beyrich first applied the term Oligocene to some of the middle Tertiary deposits of northern Germany, hinted at the possible existence of the same formation on the banks of the Patuxent, his conclusions being drawn from an examination, among other fossils, of specimens of *Lucina anodonta*, Say, *Arca idonea*, Conr., and *Cardium laqueatum*, Conr.

* On comparison with specimens from the English Crag this species will be found to differ very broadly from the *I.* (*Cyprina*) *rustica* of Sowerby, with which it has been confounded.

CARCINOLOGICAL NOTES No. I.

BY J. S. KINGSLEY.

It is the intention of the writer in this series of notes to give descriptions of new species, rectifications of synonymy, facts relating to geographical distribution, and other matters of importance concerning the Decapoda. Unless otherwise stated all specimens are in the collection of the Academy of Natural Sciences of Philadelphia.

Genus PSEUDOTHELPHUSA Saussure.

(*Potamia* Latr. et *Boscia* Edw. preoc.)

Pseudothelphusa latifrons.

Potamia latifrons Randall, Journal of the Academy of Natural Sciences of Philadelphia, viii. p. 120.

Carapax smooth, regions and sutures indistinct. Frontal crest very prominent, uninterrupted. Front reflexed, making with the surface of carapax an angle of about 45°, its margin undulating and its surface and margin granulate. From the front arise processes which all but join the inferior margin of the orbit. Superior margin of orbit crenulated. Anterolateral teeth more prominent than in any other of the genus and extending back to the posterior third of the carapax. Below, the carapax is everywhere granulate and especially so on the sub-branchial regions and near the mouth. Inferior margins of orbits denticulate. Chelipeds nearly equal. Anterior surface of meros granulate, as are the outer portions of carpus and upper portions of the hands. The dactyli with rows of small tubercles above.

The species is a true *Pseudothelphusa*, the antennæ being as in that genus, but the reflexed front gives it a peculiar appearance and with the larger anterolateral teeth will readily separate it from all other known forms. The emargination of the external margin of the orbit is no more marked than in *P. chilensis* (Edw. and Lucas) Smith, the type of which, by the way, is in the Museum of the Academy.

Pseudothelpusa sinuatifrons (A. M.-Edw.) Smith.

The locality of this species was not known to Alphonse Milne-Edwards. There are two males in the Academy's collection from San Domingo (W. M. Gabb).

Genus DILOCARCINUS.

Dilocarcinus pardalinus Gerstæcker, Archiv für Naturgeschich'e xxii. p. 148, 1856.

Gerstæcker gives doubtfully South America as the habitat of this species. There are specimens with the label "? Upper Amazon, Dr. Wilson."

Dilocarcinus spinifrons, nov.

Carapax regularly arcuate, regions obsolete, sides arcuate, armed with four spines besides the spiniform angle of the orbit; the margins of the spines finely serrate. Superior margin of the orbit obscurely crenulate, inferior denticulate with a strong spine near the interior angle. Front advanced, with about fourteen spines. A spine at the anterolateral angles of the buccal area. Chelipeds sub-equal, meros with two spines at about the middle of the posterior margin and a single one on the anterior margin at about the middle, and one on the distal portion of the upper margin: the spine on the interior surface of the corpus long, slender, acute. Hand with an acute spine above at the articulation of the dactylus, fingers with the denticulations fine but acute. Ambulatory feet less dilated than is usual in this genus. The spined front readily separates this from all other species.

Upper Amazon, Dr. T. B. Wilson.

Genus THELPHUSA (including Geothelphusa Stm.)

Of this genus forty-five species have been described. The localities from which I have examined specimens are marked with an exclamation point (!).

africana A. M.-Edw. West Africa.
anchietæ Capello. West Africa.
andersoniana Wood-Mason. Burmah.
angustifrons A. M.-Edw. Australia.
aubryi M.-Edw.
West Coast Africa (!); Natal (!).
aurantia Herklots.
pelii Herklots.
atkinsoniana Wood-Mason.
Northern India.
austeniana Wood-Mason. India.
bayonica Capello. West Africa.
bayonica var. *α* Capello. West Africa.
berardi Savigny.
Egypt, Nile (!); Red Sea.
chilensis (Heller) A. M.-Edw. Chili.
corrugata Heller. Madras, Java.
crassa A. M.-Edw. Australia.
cristata A. M.-Edw. East Indies(!).
dehaani White. Japan.
berardi DeHaan.
japonica Herklots.
denticulata M.-Edw. China.
depressa Krauss. Port Natal.
difformis M.-Edw. Red Sea.
edwardsii Wood-Mason. Burmah.
fluviatilis (Bosc.) Latr. Mediterranean Region, Greece (!), Gaarda Sea (!). (Museum Peabody Academy).
grapsoides White. Manilla.
? *subquadrata* Gerst.
goudoti M.-Edw. Madagascar.

guerini M.-Edw. India.
hispida Wood-Mason. Burmah.
hydrodromus Gerst.
indica Latr. India.
canicularis Westwood.
? *aurantia* Gerstæcker.
? *rotunda* Freycinet.
inflata M.-Edw. Pt. Natal.
jagori von Martens. Philippines.
lævis Wood-Mason. India.
larnaudi A. M.-Edw. Siam.
leschenaulti Edw. India (!), Mauritius, Tahita.
lugubris Wood-Mason. India.
margaritaria A. M.-Edw. West Africa.
nilotica M. Edw. Nile.
obesa A. M.-Edw. Zanzibar.
obtusipes (Stm.) A. M.-Edw. Japan, Philippines.
perlata Edw. South Africa, Pt. Natal (!).
philippena von Martens. Philippines.
picta von Martens. Philippines.
planata A. M.-Edw. Bombay.
= ? *guerini* M. Edw.
siamensis A. M.-Edw. Siam.
sinuatifrons M.-Edw. Unknown.
stoliczkana Wood-Mason. Penang.
subquadrata Gerst.
= ? *grapsoides*.
transversa von Martens. Australia.
tumida Wood-Mason. Burmah.

To this list I would add three more:

Thelphusa emarginata nov.

Carapax glabrous, longitudinally strongly arched. Post-frontal crest continuous, nearly straight, obscurely crenulate, epibranchial tooth obsolete, a tooth between the extremity of the post-frontal crest and the angle of the orbit. Protogastric region very short, front about one-fourth the width of carapax, slightly sinuate. External angle of orbit slightly emarginate. Anterolateral margin cristate; crest, however, soon becoming obsolete. Chelipeds sub-equal, meros with the margins tuberculate and with a strong spine on the distal portion. Upper and outer surface of carpus with indistinct squamæ, inner portion two-spined, the proximal spine exhibiting a tendency to become bifid. Hands with the upper margin obsoletely tuberculate, fingers roughened, not gaping. Ambulatory feet slender, compressed.

Is very near *T. depressa* Krauss, but differs from that species in the narrower and straighter front, the tooth just behind the angle of the orbit, and in the non-gaping fingers of the chelipeds.

Length 34 mm., breadth 56 mm.

West Africa, Du Chaillu; *Port Natal*, Dr. T. B. Wilson.

The name is proposed on account of the emargination of the orbit.

Thelphusa enodis nov.

Carapax smooth; post frontal crest wanting. Epibranchial tooth very small. Front narrow, strongly curved downward, its margin concave. Chelipeds unequal, hands with the inferior margin regularly arcuate. Is very closely allied to *T. lævis*, but differs in the flatter carapax, the concave front, and the regularly arcuate lower margin of the hands. In all other respects Mr. Wood-Mason's description and figures (Journal Asiatic Society of Bengal, vol. xl, p. 201, Pl. xiv, fig. 1–6) would well apply to it.

Ceylon.

Thelphusa rugosa nov.

Carapax depressed, cervical suture and post frontal crest well marked, the crest interrupted. Front nearly straight; protogastric region nearly smooth: epibranchial tooth small, directed inward, lateral portions of carapax with transverse rugæ as in many *Grapsi*, the margin of the anterolateral portion obscurely crenulate. Chelipeds subequal; the outer surface of meros and carpus with squamose rugæ, the rugæ on the hands indistinct. Carpal joints of the first three pairs of ambulatory feet with the sides cristate; dactyli pointed.

Ceylon.

Length 26 mm., breadth 32 mm.

This species is nearest *T. denticulata*, but will be readily identified from that species by the more crenulated margin between the orbit and the epibranchial tooth, and by the rugæ on the lateral portions of the carapax.

Acanthocyclus gayi Edwards and Lucas.

The type of this species is in the museum of the Academy.

DESCRIPTION OF A FŒTAL WALRUS.

BY HARRISON ALLEN, M.D.

The Academy is the possessor of a fœtal walrus, which was presented by Dr. I. I. Hays, and brought by him from the Arctic region of eastern North America. I have thought that a figure with measurements of this rare, if not unique, specimen would be of value.

The specimen is straight, or nearly so, and it is by this simple test distinguished from other embryos of Carnivora. There is neither flexure of the head upon the trunk, or the trunk upon itself. The limbs are folded close to the trunk, this feature being most pronounced in the inferior pair, which are inclined upward upon the ventral surface of the body, and carry between them the rudimentary tail. The median margin of the first toe of the anterior extremity bears a small, rounded membranous lobe, or lappet. The muzzle exhibits the future position of the vibrissæ by six rows of minute papillæ. The muzzle projects slightly beyond the line of the mouth. The position of the future nostrils is seen by two slightly convergent slits.

The vent is a semicircular slit-like opening upon the lateral and posterior surfaces of a rounded nipple-shaped organ, which is probably the future penis or clitoris.

The eye is closed, rather prominent, and presents a palpebral fissure, which is directed obliquely upward and forward.

The auricle is represented by a membranous fold laid close to the head. The slit-like opening defining its position lies $3\frac{1}{2}'''$ behind the eye, and extends slightly downwards and forwards. The auricle extends in advance of this slit to the distance of $1'''$, where it ends in a minute elevation. A probe can be readily inserted in the slit, and can be passed forward.

The color of the specimen is a dull white or waxy.

No trace of hair is anywhere visible.

Measurements.

Length of specimen, 1″ 9‴.

Length of head, 9″.

Width of body at widest part, 1″.

Length of anterior margin of anterior extremity, 4½‴.

Length of posterior margin of anterior extremity, 2‴.

Length of anterior margin of posterior extremity, 4‴.

Length of posterior margin of posterior extremity, 4‴

Distance between vent and navel, 7½‴.

ON THE NUDIBRANCHIATE GASTEROPOD MOLLUSCA OF THE NORTH PACIFIC OCEAN, WITH SPECIAL REFERENCE TO THOSE OF ALASKA.

BY DR. R. BERGH, COPENHAGEN.

PART II.

DIAULULA, Bgh.

Diaulula, Bgh., Malacolog. Unters. (Semper, Philipp. II, ii), Heft xiii, 1878, p. 567; Heft xiv, 1878, p. xxxv. Gattungen nordischer Doriden, Arch. f. Naturg., xxxv, 1, 1879, p. 343.

Forma corporis subdepressa. Dorsum minutissime villosum, holosericeum, molle. Tentacula digitiformia. Apertura branchialis rotundata, crenulata; folia branchialia tripinnata. Podarium antice bilabiatum, labio superiore medio fisso.

Aımatura labialis nulla. Lingua rhachide nuda, pleuris multidentatis, dentibus hamatis. Prostata magua; penis inermis.

In their general form the *Diaululæ*[1] somewhat resemble the *Discodorides* and the *Thordisæ*,[2] although their habitus still is peculiar. The back is villous, as in these genera and especially as in the *Thordisæ*, but finer and more velvet-like. The tentacles are finger-shaped, smaller than in the *Discodorides*, larger than in the *Thordisæ*. The branchial-slit is rounded, crenulated; the branchial leaves tripinnate. The anterior margin of the foot bilobed, the upper lip broader, with a median fissure. As in the *Thordisæ*, there is no armature of the lip-disk. The radula nearly agrees with that of the *Discodorides;* the rhachis is naked; on the pleuræ there is a rather broad series of plates of the usual hook-shape. The stomach is enclosed in the liver (not free, as in the *Discodorides* and in the *Thordisæ*). As in the *Discodorides*, there is a large prostate and an unarmed penis.

Only the following species appears to be hitherto known, from the northern Pacific.

1. *D. Sandiegensis* (Cooper).

[1] *Diaulus*, medicus, cf. Martialis, I, 48, p. 40.

[2] Cf. my Malacolog. Untersuch. (Semper, Philipp. II, ii), Heft xii, 1877, p. 518, (*Discodoris*); p. 540 (*Thordisa*).

1. **D. Sandiegensis**, Cooper. Plate V, fig. 3–9.

Doris (Actinocyclus?) Sandiegensis, Cooper, Proc. of the California Acad. of Nat. Sciences, ii (1862), 1863, p. 204;[1] iii (1863); 1868, p. 58.

Color corporis e brunneo lutescens, annulis nigris maculatus; vel brunneus.

Habitat. Oceanum Pacificum orient. (San Diego Bay; Santa Barbara; Sitka Harbor; Puget Sound).

According to Cooper, numerous specimens of this species were found from November to May among grass on mud flats in San Diego Bay, at or near low water mark; according to Cooper, it is a very "active" species; Cooper later obtained two specimens at Santa Barbara Island, on rocks at low water. During the expedition to Alaska a specimen was taken by Dall in Sitka Harbor, on algæ, in August, 1865, at the depth of six fathoms (another in August, 1873, in Puget Sound, by Dr. Kennerly, on algæ, at low water).

Through the kindness of Dall, I have seen the original (rather rough) drawings of this species by Cooper; a colored one represents the back bright chocolate-brown, with six black rings, of which there are two smaller ones between the rhinophoria; the rhinophoria, the gill and the foot seem bright-yellowish; one figure shows five, another six branchial leaves.

The length of the first specimen, sent to me preserved in spirits, was about 22.0 mm., the height reaching 9.0 mm., and the breadth 13.0 mm.; the breadth of the foot reached 10.0 mm., the height of the rhinophoria 2.0 mm., the branchial leaves 3.3 mm. The color was uniformly brownish-gray; nearly symmetrically on each side of the true back was an annular black spot.

The form of the rather soft body elongate-oval, not much depressed. The head quite concealed between the mantle and the foot; the outer mouth had the form of a vertical slit; at each side a short finger-shaped tentacle. The margin of the rather large rhinophor-holes rather prominent, crenulate; the rhinophoria strong, the club

[1] "Pale brownish-yellow, with large, annular, brown spots, irregularly scattered, varying from twelve to twenty, or entirely brown. Surface slightly rough; sometimes a little tuberculated. Dorsal tentacles conical, retractile; branchiæ large, rising in five parts, which become tripinnately divided, expanding so as to cover the posterior third of the body like an umbrella. Mouth proboscidiform, with two short lateral tentacles. Length, 3¼ inches; breadth, 2½ inches; height, ½ inch.—Cooper, l. c.

with about thirty leaves (on each side). The back all over minutely and densely villous (fig. 3). The margin of the rather wide (5.0 mm.), roundish branchial aperture like the margin of the rhinophor-holes, prominent, finely crenulate; the branchial leaves (retracted) six in number, very strong, tri- or quadripinnate. The anus strong, about 1.5 mm. high, cylindrical, closing the branchial ring posteriorly; the renal pore as usual. The edge of the mantle rather thick, projecting about 2.0 mm. from the body; the sides low. The genital opening as usual, with two distinct apertures at the bottom. The foot strong, broad, somewhat narrower towards both ends; in the anterior margin a strong furrow, towards the median line deeper and forming two lips; the superior broader and divided in the median line.

The cerebro-visceral ganglia kidney-shaped, the visceral larger than the cerebral; the pedal of roundish contour, scarcely larger than the visceral. The buccal ganglia of oval form, connected by a short commissure; the gastro-œsophageal roundish, short-stalked, in size about one-fifth of the former, with one very large and one large cell.

The eyes short-stalked, with black pigment and yellowish lens. The otocysts scarcely smaller than the eyes, overcrowded with otokonia of the usual kind. The leaves of the rhinophoria strengthened with long, perpendicular spicula, calcified at the surface. The tentacula with a mass of shorter, but otherwise similar spicules, lying irregularly. The villi of the back closely set with perpendicular spicula (fig. 3). The anal papilla with long, perpendicular spicules; the stalk of the branchial leaves with many shorter spicula, irregularly situated; in the leaves themselves were no spicules. In the interstitial connective tissue large spicules were seen rather sparsely.

The oral tube was about 1.5 mm. long, wide, with strong longitudinal folds. The bulbus pharyngeus only about 4.0 mm. long, by a height of 2.0 mm., and a breadth of 4.0 mm.; the rasp-sheath very prominent on the hinder part of the under side of the bulbus; the inner mouth with a yellowish, not thin, cuticula. The tongue with nine rows of teeth, in the rasp-sheath also eleven rows of developed and two of not quite developed teeth, the total number thus being twenty-two. In the posterior rows of the tongue the number of plates was twenty-eight or twenty-nine, on each side, and seemed in the succeeding rows not to surpass thirty. The color of the teeth horn-yellowish; the height of the outermost 0.06 to 0.08 mm., the height rising to about 0.18 mm. The form of the teeth as usual; the wing rather narrow; the innermost (fig. 5*aa*, *b*) not very different from the others (fig. 5, 6), the body of the outermost three or four (fig. 4*a*, 7), as usual, of reduced size.

The glandulæ salivales (5.0 or 6.0 mm.) long, in the anterior part about one-third larger than in the rest, measuring 1.0 mm. in diameter, yellowish; in the rest of the length much narrower, whitish.

The œsophagus is about 9.0 mm. long, rather wide. The stomach is included in the liver, not spacious. The intestine appears on the surface of the liver in the usual manner, passing forwards, forming a short flexure, and running straight backwards to the anal tube, which has in its interior many fine longitudinal folds; the total length of the intestine about 20.0 mm., with fine longitudinal folds through its whole length. The cavity was empty. The liver yellowish, about 17.0 mm. long, by a breadth of 8.0 mm., and a height of about 6.0 or 7.0 mm.; the anterior end truncate, the posterior end rounded; on the right side of the forepart a flattened impression for the anterior genital mass. The vesica fellea, as usual, behind and at the left side of the pylorus, elongate-pyriform, grayish, taken together with its duct about 2.5 mm. in length.

The heart as usual. The two gland. sanguineæ as usual, whitish; the foremost more triangular, about 3.5 mm. long; the posterior broader, about 2.0 mm. long.

The gland. hermaphrodisiaca with a rather thick yellow layer clothing the greater part of the surface of the liver (except the posterior end); in the lobules of the organ were rather large oögene cells and masses of zoösperms. The anterior genital mass large, compressed, about 10.0 mm. long, by a height of 6.3 mm., and a breadth of 3.0 mm. The ampulla of the hermaphroditic duct strong, grayish, when unrolled about 25·0 mm. long, somewhat coiled on the anterior end of the left side of the mass and on its inferior flattened edge behind the large prostate; it reaches a diameter of 1.2 mm. The male branch of the ampulla (fig. 8*a*) thin, white, passing into the narrow inferior end of the prostate, thus forms the fore-end of the whole genital mass. The prostate (fig. 8*b*) is of dirty yellow color, flattened and irregularly pyriform, the length about 6.3 mm., by a breadth of as much as 3.0 mm.; the spermatoduct (fig. 8*c*) issuing from the upper part of the posterior side of the gland, in its first thicker part nearly as long as the prostate; in the rest of its length thinner, making several coils and passing (fig. 9*a*) into the male organ. The retracted penis (fig. 8*d*) strong, about 2.5 mm. long, the preputium with fine longitudinal folds (fig. 9), from the aperture upwards and nearly filled by the glans, which had nearly the form of a human penis, with a well developed head with round aperture; this head seemed covered with very small, low and rounded, soft papillæ. The spermatotheca were whitish, spherical, of the diameter of about 2.3 mm., filled with epithelium, fatty matter and altered semen; the chief duct a little longer than the spermatotheca, gradually passing into the simple vagina, that was about half as much in length (and was filled with sperma). The spermatocysta of violet-gray color, somewhat flattened, of oval outline, of the length of about 2.3 mm., filled with sperma. The posterior half, or a little less, of the large mucous and albuminous gland, chalk-white; the anterior, more than half, of grayish or (on the left side) yellowish color; the structure as usual.

A variety of the species (according to Dall, it also belongs to this species) was, moreover, obtained by Dr. Kennerly, in August, 1873, on algæ, at low water, in Puget Sound, Washington Territory (fig. 6–9).

The single individual was rather large; the length 40.0 mm., by a breadth of 28.0 mm., and a height of 13.0 mm.; the breadth of the foot 15.0 mm., of the margin of the mantle 11.0 mm.; the height of the rhinophoria 5.0 mm., of the branchial leaves nearly 5.0 mm. The color of the upper side obscure olive-gray, with rather large (diameter about 4.0 mm.) black and blackish spots; the under side yellowish. The general form and the head, with the tentacles, as above described. The openings of the rhinophor-holes as above, the club with about twenty-five leaves. The branchial opening as above (diameter, 3.5 mm.); the retracted branchial leaves six in number; the anal tube nearly 3.0 mm. high. The back villous, as in the typical individual. The foot as above.

The peritoneum colorless, without larger spicula; but in the region of the ventricle of the heart the pericardium is brownish.

The central nervous system as above; the proximal olfactory ganglia bulbiform, a little larger than the buccal; the distal ones smaller than the proximal, at the root of the club of the rhinophoria. The buccal ganglia of oval form; the commissure between them being about one-third of the largest diameter of the ganglia. The eyes, the octocysts, the leaves of the rhinophoria and the villi of the back as above.

The oral tube large, of a length and diameter of 4 0 mm. The bulbus pharyngeus 4.0 mm. long, by a height of 4 and a breadth of 3.5 mm.; the sheath of the radula less prominent than in the former specimen; the cuticula of the lip disk as above. The tongue with ten rows of plates, further back eleven developed and two younger rows, the total number thus twenty-three. In the posterior rows of the tongue there were as many as thirty-four dental plates on each side of the rhachis; they resembled those above described (fig. 6, 7).

The salivary glands yellowish, ribbon-shaped. The stomach as above. The anteriorly proceeding part of the intestine 7.0 mm. long, by a diameter of about 2.0 mm.; the receding part about 20.0 mm. long, by a diameter of 1.5 mm. In the stomach and the rectum were pieces of a Keratospongia and different Diatomacea. The liver 23.0 mm. long, by a breadth and a height of 11.0 mm.; the anterior end truncate, with a median deep and narrow slit for the œsophagus and for the intestine; the right anterior half of the liver rather excavated, especially beneath; the substance of the liver yellow.

The foremost glandula sanguinea about 4.5 mm. long, by a breadth of 2.5; the posterior 4.0 mm. long, by a breadth of 2.5 mm.; both very flattened (about 0.8 mm. thick), grayish-yellow. The kidney with its whitish network, contrasting prettily with the yolk-yellow hermaphroditic gland; the urinary chamber not wide; the tube on its floor thin.

The hermaphroditic gland clothing nearly the whole liver (with its posterior end), as in the former specimen. The anterior genital mass about 11.5 mm. long, by a height of 9.5 and a breadth of 5.0 mm., the ducts also projecting 3.0 mm. The ampulla of the hermaphroditic duct yellowish-white, about 35.0 mm. long, by a diameter of 1.25 mm., running across the upper part of the left side of the genital mass, and forming several windings on the anterior part of the upper margin.

The large prostate as above (fig. 8*b*), dirty yellow; 7.5 mm. long, by a diameter at the upper end of about 4.0 mm.; the part (fig. 8*c*), from which the spermatoduct proceeds, much brighter than the rest of the organ. The thin spermatoduct forming (fig. 8) a little coil at the upper end of the penis; when unrolled about 12 mm. long. This last (fig. 8*d*, 9) organ strong, about 4.0 mm. long, by a diameter of 1.5 mm.; the prominent orifice in the vestibulum (fig. 8*e*) with strong longitudinal folds; the glans conical, filling nearly half (fig. 9) of the cavity of the organ, the surface (under a power of 350) smooth. The spermatotheca whitish, spherical, with a diameter of 3.5 mm.; the spermatocysta short, sausage-shaped, about 4.0 mm. long, of reddish-yellow color. The duct from the spermatotheca to the vagina rather thick, 3.5 mm. long; the vagina larger than the penis, 6.0 mm. long, by a diameter of 2.5; the inside with fine longitudinal folds, and with sperma in the cavity. The mucous gland large, 9.0 mm. long, by a height of 7.5 and a thickness of 4.0 mm.; whitish, yellowish chalk-white and yolk-yellow; the duct rather short, with the usual strong fold. The vestibulum with longitudinal folds.

JORUNNA, Bergh.

Jorunna, Bgh., Malacolog. Unters. (Semper, Philipp. II, ii) Heft x, 1876, p. 414, note. Gatt. nord. Doriden, Arch. für Naturges., xxxv, i, 1879, p. 346.

Corpus subdepressum; dorsum minutissime granulatum, sub-asperum, branchia e foliis tripinnatis formata; tentacula digitiformia; podarium sat latum, margine anteriore sulcatum, labio superiore latiore et medio fisso.

Armatura labialis nulla. Radula rhachide nuda, pleuris multidentatis, dentibus hamatis. Penis stylo armatus; glandula et hasta amatoria.

This genus was established by the author on the *D. Johnstoni* (1876) in reference to the results of the anatomical examination of Hancock and Embleton; he regarded it as nearly allied to the *Kentrodorides*, just founded by him.[1] After the present examination of the *D. Johnstoni* by the author he is not entirely certain of a generic difference between the *Jorunnæ*[2] and the *Kentrodorides*. The latter have been examined only from rather insufficient material, and the basta has not been seen in any of the species, only a papilla in connection with a peculiar gland; still the *Kentrodorides* are of a quite different habitus, very soft, and the upper lip of the anterior margin of the foot is more developed, while the innermost plate of the tongue is somewhat different from the others. If not identical with the *Kentrodorides*, the *Jorunnæ* are certainly very nearly allied to them.

The *Jorunnæ* are rather depressed; the back finely granulated, covered with equal minute papillulæ; the retractile gill formed of tripinnate leaves; the tentacles digitiform; the foot rather broad, deeply grooved in the front margin, and the upper lip of this larger and cleft in the middle line. The lip-disk not armed, covered with a simple cuticula. The rhachis of the radula naked, the pleuræ with many hook-formed plates. In the vestibulum genitale are four apertures:

[1] R. Bergh, Malacolog. Unters. (Semper, Philipp. II, ii) Heft x, 1876, p. 413 427, Tab. XLIX–LI.

[2] Jórunna, Björnis filia. Laxdäla-Saga. Hafniæ, 1826, p. 21.

one for the penis, which is armed with a stylus; another for a *hasta amatoria*, through which opens a peculiar gland (quite as in the genus *Asteronotus*);[1] a third for the vagina, and the fourth for the duct of the mucous gland.

Only one species of the genus seems hitherto known, belonging to the northern part of the Atlantic Ocean. The spawn of the species is known from Alder and Hancock, but nothing else is known of the biology of the animal.

1. *J. Johnstoni* (A. et H.).
Doris Johnstoni, A. et H. Oceanum Atlantic. septentr.

Jorunna Johnstoni (A. et H.). Plate VIII, fig. 19; Plate IX, fig. 1–11.

Doris Johnstoni, Alder et Hanc. Monogr. Part I, 1845, fam. 1, Pl. 5; Part V, 1851, fam. 1, Pl. 2. f. 8–11.

Doris Johnstoni, Hanc. et Embleton, Anat. of Doris. Philos. Trans. 1852, II, p. 212, 215, 216, 220, 233, Pl. XII, f. 2, 10; Pl. XIV, f. 9, 10; Pl. XV, f. 1–2; pl. XVII, f. 2–3.

Doris Johnstoni, Forbes and Hanley, Hist. of Br. Moll., III, 1853, p. 564.

? *Doris tomentosa*, Cuv., Fischer. Journ. de Conchyl., 3me Sér., x, 1870, p. 290–293; XV, 1875, p. 211, note.

? *Doris tomentosa*, C. Verany, catalogo. 1846, p. 16–21. Ver., Hanc. et Embleton, l. c. 1852, p. 220.[2]

? *Doris tomentosa*, C. Philippi, En. Moll. Sic. I., 183, p. 104; II, 1844, p. 79, Tab. XIX, f. 9.

Color flavescens, dorso interdum maculis fuscis seriatis ornatus; rhinophoria fusco-maculata; branchia albescens.

Hab. Oceanum Atlanticum septentr.

This species, that was first described by Johnston under the name of *D. obvelata* (Müller), was (1845) established by Alder and Hancock. Hancock gave a series of anatomical remarks upon this very interesting form and of figures referable to it. Since then nothing new seems to have been published about the species; but a few months ago I (l. c.) gave a short notice of the generic characters of the group.

Of this form I have only examined a single specimen, captured in March, 1870, in the neighborhood of Hellebæk, on the north coast of Seeland (Denmark).

[1] R. Bergh. Ueber das Geschlecht *Asteronotus*, Ehrbg. Jahrb. der Deutschen Malakozool. Ges., iv, 1877, p. 161–173. Taf. I–II.

[2] According to Hancock and Embleton (l. c., p. 220), the dart (hasta amatoria) in *Doris Johnstoni* is straight, in *D. tomentosa*, Ver., curved.

The specimen was of a uniform yellowish color; the rhinophoria finely dotted with brown (but not the branchial leaves). The length of the rather contracted and somewhat contorted individual was about 18.0 mm. by a greatest breadth of 10.0 and a height of about 7.0 mm.; the height of the (retracted) rhinophoria 2.5, of the tentacles nearly 1.5, of the (retracted) gill 2.5 mm.; the greatest breadth of the mantle-margin 3.5 mm., of the foot 5 0 mm.

The form is elongate-oval, the mantle-margin rather thick, not very broad. The back covered all over with very minute granules, sometimes, especially on the middle of the back, crowded in irregular and roundish small groups; the under side of the mantle-margin smooth. The (contracted) openings of the rhinophor-holes appear as a simple transverse slit, the granules of the back reaching forward to the opening, those in this neighborhood not larger than the rest. The club of the rhinophoria stout, with about thirty[1] broad leaves. The opening of the gill-cavity small, transverse, triangular-crescentic, with the convexity forwards (as contracted); the granules of the back reaching to the very margin of the gill-slit, but not larger than the rest. The gill consisting of eleven branchial leaves,[2] five lateral pairs and an anterior unpaired leaf; the anal tube low, truncate, nearly central; the renal pore at its right side. The head rather small; the tentacles digitiform, somewhat flattened. The sides of the body nearly imperceptible; the genital opening contracted.[3] The foot rather strong, somewhat pointed at the end; the anterior margin with a deep furrow, the superior lip rather strong and prominent, cleft in the median line.

The peritoneum with very fine dark points (brown-black) spread everywhere; entirely without true spicules.

The central nervous system showed the cerebro-visceral ganglia somewhat elongate, thicker and broader in the posterior part, nearly not excavated in the exterior margin; the pedal ones of oval form, larger than the visceral. The olfactory ganglia very short-stalked, bulbiform, a little smaller than the buccal; a small optic ganglion, the optic nerve short. At the inferior side of the posterior part of the right visceral (fig 1*a*) ganglion is a short-stalked (fig. 1*b*) ganglion genitale giving off several nerves, one of them has at its root another ganglion (fig. 1*c*). The common commissure not longer than the

[1] Alder and Hancock mention merely ten to fifteen leaves.

[2] Alder and Hancock mention fifteen leaves.

[3] The representation of the penis (?) (l. c. Pl. 5, f. 3) by Alder and Hancock cannot be correct.

transverse diameter of the pedal ganglion, rather strong. The buccal ganglia of roundish form, connected through a very short commissure; the gastro-œsophageal ganglia short-stalked, reaching scarcely one-quarter of the size of the former, with one very large and some smaller cells.[1]

The eyes with black pigment and shining, horn-yellow lens. The otocysts at the slight emargination at the outer margin of the cerebro-visceral ganglia, crammed with otokonia of the usual kind. The broad leaves of the rhinophoria stiffened in the usual way by long, much calcified spicula, perpendicular on the free margin of the leaves. The skin of the back crowded with spicula,[2] mostly very large and much calcified; in the rather low (height 0.5 mm.) granules (fig. 2) crowded erect spicules. In the interstitial tissue of the intestines true spicula are neither many nor large.

The mouth-tube about 2.0 mm. long, strong, rather wide, quite as usual. The bulbus pharyngeus 3.0 mm. long, with a height of 2.3 and reaching a breadth of 2.5 mm.; the rasp-sheath also projecting 1.0 mm. from the hindermost part of the under side of the bulbus. The form of the bulbus and its retractors as usual; the lip-disk whitish, clothed with a yellowish cuticula. The tongue of usual form; on the shining horny-yellow radula eleven rows of teeth, further backwards twelve developed and four younger rows; the total number of rows thus twenty-seven.[3] The teeth of yellowish color; the height of the outermost 0.06, of the next 0.08 mm.; the height reaches at most about 0.22 mm. The two foremost rows were rather incomplete, in the fourth row were twenty-four, and the number of teeth then increases to twenty-seven.[4] The rhachis (fig. 3*a*) rather broad. The plates of the usual form,[5] with the usual wing-like expansion of the exterior part of the body and of the root of the hook (figs. 4, 5); the first (fig. 3) with lower hook, which on the succeeding teeth slowly

[1] This representation of the central nervous system in most points agrees with that of Hancock and Embleton (l. c. p. 233, Pl. XVII, fig. 2, 3).

[2] Collingwood (Annals and Mag. of N. Hist., 3 Ser., III, 1859, p. 462) mentions the spicules of this species (from the estuary of the Mersey) as "very elegant, consisting of a broad embossed plate with a double and beautifully serrated edge, terminating abruptly in a blunt apex."

[3] Alder and Hancock mention twenty-four rows, whereof eleven were on the tongue.

[4] Alder and Hancock mention twenty-five plates in the rows.

[5] Cf. my Malacolog. Unters. (Semper, Philipp. II. ii), Heft XIV., 1878, (Asteronotus), p. 636.

increases in height; then the teeth keep the same height and decrease again in the outer part of the rows (fig. 5); the four to six interior teeth are more erect, with shorter body and thinner hook (figs. 5, 6).

The salivary glands long, thin, whitish.[1] The œsophagus about 6 mm. long, rather wide, with strong longitudinal folds.[2] The stomach small, included in the liver; the biliary apertures as usual.

The intestine issues through the liver behind the region of junction of the first and second third of the liver; the first anteriorly proceeding part lodged in a groove on the superior side of the liver, not passing beyond the anterior margin of that organ, about 2.5 mm. in length; the rest of the intestine about 10.0 mm. in length; the diameter of the intestine 0.8–1.3 mm.; the longitudinal folds rather strong.

The liver of yellowish color, more grayish on the surface; 9.0 mm. in length, by a breadth of 5.5 and a height of 4.0 mm.; the posterior end rounded; more than the anterior half of the under side, especially its right part, is excavated (for the anterior genital mass) and behind this is a deep transverse groove. The vesica fellea lying at the left side of the offshoot of the intestine, rather small, in height about 1.25 mm., reaching nearly to the surface of the liver, nearly cylindrical.

The heart as usual. The sanguineous glands whitish, rather flattened; the anterior obliquely triangular with the point, as usual, adhering to the under side of the junction of the two cerebral ganglia; in length 2.0 by a breadth of 1.5 mm.; the posterior transversely elongate-oval, with a breadth of 3.5 by a length of 1.5 mm. The renal syrinx melon-shaped, its largest diameter about 0.75 mm.; its free duct nearly three times as long; a strong continuation of it passing along the floor of the rather large renal chamber, to the region of the pylorus.

The hermaphroditic gland spread in large groups of ramifications over nearly the whole liver and by its brighter yellowish color somewhat contrasted with it; in its lobules were masses of zoösperms and rather small oögene cells. The anterior genital mass[3] in length 5.0 by a breadth of 2.5 and a height of 4.0 mm.; the right side rather convex, meeting the more flattened left side at the sharp superior margin,

[1] They are in this way also mentioned by H. and E. (l. c., p. 215, Pl, XII, fig. 2*cc*).

[2] The dilatation on the œsophagus mentioned and figured by H. and E. (l. c., p. 215, Pl. XII, fig. 2*d*) could not be seen in the specimen examined by me.

[3] Cf. the Pl. XIV, f. 9, of Hancock and Embleton.

the under side flattened. The ampulla of the hermaphroditic gland resting on the superior posterior part of the genital mass, whitish, making a large curve, about 5.0 mm. long, with a diameter of nearly 1.5 mm. The spermatoduct in its first part, as near as could be determined, rather thick than thin, not very long, forming (fig. 11*e*, 7*e*) a little coil on the upper end of the penis. The penis (fig. 7*f*) cylindrical, curved, about 2.5 mm. long, by a diameter of about 0.8 mm.; the inside with many longitudinal folds; at the upper end of its cavity a low truncated conical prominence (fig. 11*b*), with a rather wide aperture (fig. 11*b*), through which opens a little bag (fig. 11), whose inside was clothed with a thin yellowish cuticula, and contained a hollow, nearly colorless tube, that could be extended by tension; it was probably pointed (the point seemed broken off); its length was about 0.9 mm.; the spermatoduct opened (fig. 11*a*) in the upper part of this bag. Hancock has (l. c. Pl. XIV, fig. 9*c*, 10; Pl. XV, fig. 1, 2) seen the penis and the "stiletto," but he too seems (l. c. p. 220) not at all clear about these organs. At the side of the opening for the penis in the vestibulum genitale was another aperture which led into a bag, from whose bottom projected a hard, whitish, somewhat compressed conical spur (fig. 7*d*, 10), that under the influence of nitric acid grew more pellucid, but developed very little gas; through the axis of the organ down to the fine aperture on the point, passes a slender tube (fig. 10), the continuation of the fine coiled duct of the gland of the organ.[1] This gland (glandula hastatoria, fig. 7*c*, 8*d*) overlies the upper part of the vagina (fig. 7*a*, *b*); it is heart-shaped, of a transverse diameter (breadth) of 2.0, and a thickness of 1.0 mm.; the gland did not contain any larger cavity. The spermatotheca (fig. 8*a*) whitish, nearly spherical, having a largest diameter of 2.5 mm.; filled with fatty cells and detritus; the two ducts (fig. 8*c*, *e*) as usual, the vagina rather wide (fig. 7*a*, *b*), with longitudinal folds on the inside. The spermatocysta yellowish, spherical, 1.5 mm. in diameter (fig. 8*b*), filled with zoösperms; short-stalked. The mucous gland not forming quite half of the anterior genital mass, consisting of a smaller anterior biconvex part, and a large flattened wing-like posterior part; the space between them nearly filled by the spermatotheca

[1] These organs, the gland and the spur, have also been seen (l. c., Pl. XV, fig. 9) by Hancock, but he does not mention them (in the text, and explanation of the figures). In another of his figures (fig. 10*b*) the spur is designated (l. c., p. 248) as "male intromittent organ," and the (fig. 10*e*, *f*) true penis as "penis-like organ furnished with a stiletto."

and the spermatocysta, the color of the gland yellowish-white, on the left side of the anterior part a central yellow mass; the duct of the mucous gland rather short.

All the former genera of *Dorididæ* belonged to the large group of *Dorididæ cryptobranchiatæ*;[1] the following are to be registered in the group of *Dorididæ eleutherobranchiatæ* (*D. phanerobranchiatæ*). This section is also characterized by the non-retractility of the gill, by a sucking-crop connected with the bulbus pharyngeus and by a peculiar armature of the tongue, consisting usually of a single large lateral plate and a single or several outer plates. This group seems chiefly limited to northern climes, and contains at present the genera *Akiodoris*, *Acanthodoris*, *Adalaria*, *Lamellidoris*, *Goniodoris* and *Doridunculus*,[2] also *Ancula*, *Drepania*[3] and *Idalia*.

AKIODORIS, Bergh

Akiodoris, Bgh. Gattungen nordischer Doriden, l. c., 1879, p. 354.

Forma ut in *Lamellidoridibus*. Nothæum supra granulosum. Branchia non retractilis, e foliis tripinnatis non multis et ad modum ferri equini positis formata. Caput latum, veliforme; tentaculis brevibus, lobiformibus. Aperturæ rhinophoriales integræ.

Discus labialis sine armatura. Ingluvies buccalis bulbo connata. Radula rhachide quasi nuda; pleuris dentibus lateralibus depressis non multis; (12-13) quorum duo intimi fortiores, quasi subhamati. Penis glande uncis simplicibus, furcatis vel palmatis armatus. Vagina indumento valloso peculiari instructa.

The animals belonging to this group resemble externally especially the *Lamellidorides*. The back is finely granulated; the head large, veil-shaped, with short tentacles, which are lobate and pointed The openings of the rhinophor-holes with plain margins, surrounded by several larger papillæ. The non-retractile branchia nearly horseshoe-shaped, consisting of a mediocre number of leaves. The lip-disk

[1] Cf. my "Gattungen nordischer Doriden," l. c. p. 341.

[2] The genus *Doridunculus* of G. O. Sars (Moll. regionis arcticæ Norveg., 1878, p. 309. Tab. 27, fig. 2*a-d*, Tab. XIV, fig. 5), which externally approaches *Goniodoris* and other *Dorididæ eleutherobranchiatæ* in the character of the radula, is hitherto only known from the northeastern part of the Atlantic (Lofoten), and by a single species (*D. echinulatus*, S.).

[3] In the *Anculæ* and *Drepaniæ* the penis is armed as in so many *Dorididæ* with a series of small hooks.

without armature. The tongue with transverse thickenings of the rhachis; the lateral plates somewhat depressed; the two first different from the rest, larger and with a denticle at the root of the hook; the rest without any such, the external quite without a hook. A sucking-crop on the upper side of the bulbus pharyngeus, but sessile, depressed conical, and not consisting of two symmetrical halves. The large stomach free on the surface of the liver. The glans of the long penis with a strong and quite peculiar armature, consisting of strong hooks, partly simple, partly bifurcate and partly digitate, with strong digitations. The vagina with a peculiar armature of high palisades.

This interesting genus externally most resembles the *Lamellidorides*, both in reference to the nature of the back, to the form and size of the gill and in the want of armature of the lip-disk; the region of the openings of the rhinophor-holes differ in the want of a glabella and by the presence of a larger number of surrounding papillæ. The genital opening somewhat recalls the *Acanthodorides*, as do also the (tripinnate) branchial leaves and the sucking-crop, but this is not divided in two distinct halves as in this last genus. The armature of the tongue is very different from that of the *Lamellidorides*, *Adalariæ* and *Acanthodorides*; the large hook-formed lateral plates of these genera are wanting, and in their places are two large depressed lateral plates, with small hooks; the external plates somewhat recalling those of the *Adalariæ*; the rhachis rather broad, with transverse thickenings of the cuticula, corresponding to the rows of plates. In the very peculiar form of armature of the glans penis, and by the peculiar clothing of the vagina, the *Akiodorides* differ from all the above-cited genera.

Only a single species of the genus is hitherto known, the new one, that will be described below.

1. *Ak. lutescens*, Bgh., n. sp. Oceanum Pacificum.

1. **Ak. lutescens**, Bgh., n. sp. Pl. IV, fig. 3; pl. V, fig. 11–14: pl. VI, fig. 1–20; pl. VII, fig. 1–8; pl. VIII, fig. 1–2.

Color lutescens.

Habitat. Oceanum Pacificum septentrion. (Nazan Bay).

Of this form I have had a large single specimen for examination, obtained in August, 1873, by Dall, on stony bottom, at low water, in Nazan Bay, Atka Island, Aleutians.

According to Dall, the color of the living animal was "yellowish-white;" preserved in spirits, it was of a uniform dirty yellowish color.

The length was 32.0 mm., by a breadth of 19.0 mm., and a height of 13.0 mm.; the breadth of the foot 12.5 mm., of the mantle-brim 3.0 mm.; the height of the rhinophoria 3.0 mm., of the branchial leaves 2.5 mm.; the length of the genital opening 2.25 mm.

The form was elongate-oval, somewhat larger than that of the *Lam. bilamellata*. The papillæ of the back relatively smaller and more rounded than in that animal. The openings of the rhinophor-holes an oblique oval slit; the margins plain; several (six to eight) larger papillæ (of about 1.0 mm. in height) in the immediate vicinity of the holes; the club of the rhinophoria with about thirty leaves. The branchia with about ten leaves. The anal papilla low, with a stellate aperture; the renal orifice as usual; the interbranchial space crowded with rather pointed and high papillæ. The head and tentacles as in allied forms. The genital papilla of oval form, with a large, longitudinal, crescentic slit. The rather broad foot with the usual anterior marginal furrow. The peritoneum colorless, without spicula.

The central nervous system more flattened than in allied forms; the cerebro-visceral ganglia reniform, a little broader in the anterior part; the pedal ganglia less flattened than the former, larger than the visceral ones, of oval form, on the outside of the cerebro-visceral. The proximal olfactory ganglia a little smaller than the buccal ones, bulbiform; distal ganglia could not be found. The commissure not broad, not short. The buccal ganglia of oval form, closely connected; the gastro-œsophageal roundish, rather long-stalked, in size about one-sixth of the former, with one large cell and several (three or four) smaller ones.

The nervi optici rather long; the eyes with yellowish lens and black pigment. The otocysts in the usual place, filled with otokonia of the usual kind. The leaves of the club of the rhinophoria very richly furnished with thick (diameter, 0.04 mm.) and long spicula, more or less calcareous, and very often giving off a thick twig of greater or less length (Pl. V, fig. 12); for the most part set perpendicularly or obliquely on the free margin of the leaves. The axes of the organs and the short stalk stuffed with strong and very much calcified spicules. In the skin of the back a mass of spicula of the same kind (Pl. IV, fig. 13) as above, or still more hardened; the papillæ of the back solidified in the usual way (Pl. V, fig. 11). In the interstitial tissue fewer and smaller spicules.

The oral tube rather short, wide. The bulbus pharyngeus of usual form, about 5.5 mm. long by a height of 4.5 mm., (and at the upper part of the sucking-crop of 5.5 mm.), and a breadth of 4.75 mm.; the sheath of the radula projecting about 1.3 mm. backwards and downwards. The lip-disk large, clothed with a thick yellow cuticula; the true mouth forming a narrow vertical slit. The cap-shaped sucking-crop almost exactly as in *Ac. pilosa*, but more conical and without external signs of duplication: on the inside clothed with a yellowish cuticula, opening into the buccal cavity through a wide slit. The tongue rather broad; on the fine reddish-yellow colored radula seventeen rows of teeth, also on the point of the tongue were traces of six entirely vanished rows; the two first rows very incomplete, reduced to some external plates. Further backwards were seen forty-two developed and three younger rows, or, all in all, the animal presented sixty-two rows of teeth. The most external plate of each row is quite colorless, the next two or three pale yellowish, the following all of horny-yellow color; the rhachis colorless. The length of the most external plate about 0.035 mm., of the next about 0.05 mm., of the following 0.07 mm.; the length of the second large plate about 0.2 mm., of the first 0.022 mm.; the breadth of the rhachis about 0.22 mm. The rhachis thickened between the rows and forming arched elevations between them (Pl. VI, fig. 1*a*, 3; Pl. VIII, fig. 1*a*). The first two plates rather large (Pl. VI, fig. 1*bb*, *cc*, 4–6; Pl. VIII, fig. 1*b*, *c*); with a short strong hook and a stout denticle at each side of it, the outer denticle broader; the hook of the second plate somewhat larger than that of the first; sometimes a slight crenulation on the outer margin of the first plate (fig. 5). All the following ten or eleven plates (Pl. VI, fig. 2*e*, *f*; Pl. VIII, fig. 2*a*, *b*) of the same type, by degrees decreasing in size, consisting of a quadrilateral basal part, from which (Pl. VI, fig. 7–13), in most of them, rises a strong, short, broad hook; the two or three outmost plates (Pl. VI, fig. 2*f*; Pl. VIII, fig. 2) formed of the basal part alone; the rest with the hook gradually more developed.

The salivary glands yellowish-white, flattened, ribbon-shaped, of about 10.5 mm. in length, reaching to the cardia, where they are agglutinated one to another; the breadth in the foremost part about 0.75 mm., in the middle 1.5 mm., the posterior part again somewhat narrower; the duct of the gland rather short.

The œsophagus rather wide, about 13.0 mm. long, the inside with rather strong longitudinal folds; it opens into the stomach, which lies free in a cleft on the upper side of the liver. This organ (Pl. VI, fig. 17*a*) is of oval form, of about 6.5 mm. largest diameter; the inside with rather strong longitudinal folds; the pylorus (fig. 17) in the neighborhood of the cardia. The intestine advancing from the stomach to the fore-end (fig. 17*b*) of the liver, in this part about 10.0 mm. long; forming a knee and retrograding to the anal nipple in a length of 23.0 mm. The contents of the stomach were indeterminable animal matter, mixed with some diatomaceæ.

The liver 20.0 mm. long by a height of 10.0 mm. and a breadth of about 12.0 mm.; the posterior end rounded; a little more than the anterior half of the under side obliquely flattened (by the anterior genital mass) showing the cardiac end of the œsophagus and the root of the hermaphroditic duct. On the anterior part of the upper surface is a cleft for the stomach and for the biliary sac; the color of the surface and of the substance of the liver is grayish-yellow. The biliary sac (fig. 17*c*) lying before the stomach, on the right side of the intestine, large (as the stomach), somewhat flattened, grayish, of rounded outline and about 4.5 mm. largest diameter; the contents, as in the stomach.

The heart as usual. The sanguineous gland whitish, entirely covering the nervous system, about 6.0 mm. long, by a breadth of 4.5 and a height of only 1.0 mm.

The hermaphroditic gland yolk-yellow, covering the upper side of the liver with a thick layer; in its lobes large oögene cells and masses of zoösperms. The anterior genital mass large, about 14.0 mm. long by a breadth of 9.0 and a height of 11.0 mm., flattened and a little excavated on the left side, with an excavation on the fore side, the right side very convex. The hermaphroditic duct whitish, rather thin (diameter about 0.75–1.0 mm.), passing straight over the left side of the genital mass to its anterior end, without formation of any (distinct) ampulla. The first part of the spermatoduct whitish, forming several long windings on the upper part of the forepart of the mass and passing into the yellowish (Pl. VI, fig. 18*a*) continuation; this, with its numerous coils, forms a large flattened layer on the fore-end of the right side of the mass; it then rather suddenly passes into a much thinner whitish continuation (fig. 18*b*) about 6 mm. long, that slopes (fig. 18*c*) into the penis, which (retracted) was lying on the lowest anterior part of the right side of the mass. The penis was cylindrical, of the length of 11.0 mm. by a diameter of 1.5 mm.; the truncated, cylindrical, yellowish (under a magnifier nodulous) glans forming (Pl. V, fig. 13, 14) a prominence of the length of nearly 1.0 mm. in the vestibulum. This glans was partly covered on the outer side fig. 13, 14), but especially on the margin of the wide, gaping orifice and on its inside for a length of about 4.0 mm. (Pl. VII, figs. 2–4), with rather crowded and apparently irregularly set claws. The claws were very strong and for the most part broad and high (fig. 3, 4), even reaching a height of about 0.3 mm. (fig. 4). In the interior of the glans, especially in its posterior part (fig. 5c), the claws were less broad and simply uncinate or bifurcated, otherwise mostly broader and with digitations of the margin. The body of the claws was plain or curved; the end simply pointed, bi- or trifurcate or with digitations, sometimes very strangely formed. They consisted of a cuticula and its matrix; very often, especially on the outside of the glans, the cuticula was torn off and the (fig. 20) rounded or pointed naked matrix was left. The whitish spherical spermatotheca (Pl. VI, fig. 19a) was about 3.5 mm. in diameter, laterally communicating through a short petiolus adhering to the upper end of the vagina, with a sinuosity into which opens the elongate, yellowish spermatocysta (fig. 19b), which had a length of about 2.0 mm., and from which issues the long duct of the mucous gland (fig. 19c). The grayish vagina very strong (fig. 18e), about 7.0 mm. long, elongate-conical; the lowest part wide, having a diameter of about 3.25 mm.; the walls thick, with a very peculiar internal lining, consisting of cylindrical palisades (Pl. VII, fig. 6–8) of a height of about 0.4 by a greatest diameter of 0.07–0.08 mm.; between the larger were seen smaller and very small ones. The palisades seemed to be densely clothed (fig. 8) with cilia, and showed a nearly colorless axis (fig. 6, 8) up to their points; the axes were often denuded (fig. 6) after the sheath has been torn away. This lining continued up to the superior end of the vagina, but not beyond it.

The mucous gland large, whitish, and yellowish-white; the anterior half yolk-yellow, denuded on the fore-end of the genital mass; the duct short.

A variety (Pl. VI, fig. 14–20) of this species has also been found by Dall, in July, 1873, at low water, in Kyska Harbor (Aleutians). According to Dall the color of the living animal was "yellowish." The animal preserved in spirits was of a uniform light yellowish color. The length about 18.0 mm. by a breadth reaching 8.0 mm and a height of 6.0 mm.; the breadth of the foot at the fore-end 5.0 mm., the margin of the mantle freely projecting 1.5 mm.; the height of the rhinophoria 1.5 mm., of the branchial leaves 1.5 mm. Around the plain margins of the rhinophor-holes seven to nine large conical tubercles; the club of the rhinophoria with about twenty leaves Around the branchial ring, as well as in the centre of it around the vent, rather large conical tubercles 1.5 mm. in height; the branchial leaves, fifteen in number, as far as could be determined.

The oral tube strong, 4.5 mm. long, wide. The bulbus pharyngeus about 5.5 mm. long, by a height of 3.0, and a breadth of 3.75 mm.; the rasp-sheath about 1.75 mm., freely projecting, bent upwards. The cuticula of the lip-disk yellowish. The tongue with about thirty-five rows of plates (fig. 14–16); further backwards, twenty-five developed and four younger rows; the total number of rows sixty-four. On the posterior part of the tongue fourteen plates, the number increasing backwards to fifteen or sixteen. The five anterior rows very incomplete, only represented by 1, 7, 9, 10, 12 plates (on each side). The plates as above. The breadth of the rhachis reaching to about 0.17 mm. The glandulæ salivales 6.0 mm. long. The stomach (fig. 17*a*) about 4.0 mm. long. The contents of the digestive cavity a mass of sponge. The vesica fellea (fig. 17*c*) about 2.5 mm. high, with strong folds on the inside. The anterior genital mass quite as above, also the spermatotheca and the spermatocysta (fig. 19), the penis (fig. 18, 20), and the vagina (fig. 18, 19).

LAMELLIDORIS, Alder et Hancock.

Lamellidoris, A. et H., Monogr. Brit. Nudibr. Moll., Part VII, 1855, p. xvii.
Lamellidoris, A. et H., R. Bergh, Malacolog. Untersuch. (Semper, Philipp. II, ii), Heft xiv, 1878, p. 603-615.
Lamellidoris, A. et H., R. Bergh, Gatt. nörd. Doriden, l. c., 1879, p. 362-365.

Corpus vix depressum, nothæo granulato. Branchia (non retractilis) e foliis (multis) simplicita pinnatis, ut plurimum in formam ferri equini dispositis, formata. Caput latum, semilunare, angulis tentacularibus. Aperturæ rhinophoriales, margine integro; tuberculis anticis 2–3, calvitie postica.

Cuticula aperturæ oralis infra asserculis duobus incrassata, et ante annulus papillarum angustus. Lingua rhachide lamellis humilibus instructa; pleuris dente interno hamiformi permagno et externo compresso lamelliformi unco minuto prædito armatis. Ingluvies buccalis (suctoria) petiolo bulbo pharyngeo connata, tympaniformis.

Penis apice (glande) curvatus, non armatus. Vagina brevis.

The genus *Lamellidoris* was established (1855) by Alder and Hancock, to receive two small groups of *Dorididæ*, one with the *D. bilamellata* as type, to which especially the name of the group is here restricted; and the other, characterized by a more depressed form and the naked rhachis of the tongue, with the *D. depressa*, A. et H., as type. Hancock has given some anatomical remarks on the typical form (*D. bilamellata*, L.); but nothing else had been since made known about these animals[1] until my just cited notice and those of G. O. Sars.[2]

The *Lamellidorides* approach the *Acanthodorides*, but differ even here, externally, by the coarsely granulated surface of the back and by the larger number of the branchial leaves, which are set in the form of a horseshoe; the openings of the rhinophor-holes, the tentacles as well as the genital opening are also of a different shape. More notable still are the anatomical differences: the *Lamellidorides* want the armature of the lip-disk, which is found in the other group; the armature of the tongue is quite different (1, I—1—I, 1), and the buccal crop is connected with the bulbus pharyngeus by a stalk. The penis is quite different from that of the *Acanthodorides*, and without true armature; the vagina is short. After all the *Lamellidorides* are much more allied to the *Adalariæ*.

The form of the body, as in the *Acanthodorides*, not very depressed. The back covered all over with semi-globular and short club-formed papillæ. The openings of the rhinophor-holes with plain margins and

[1] According to H. & A. Adams (the Gen. of Recent Moll., II, 1858, p. 657), *Lamellidoris* is a synonym of "*Onchidoris*, Blv.," which name is employed by Adams for a group, whose type should be *D. pusilla*, A. et H. (that scarcely belongs to the true *Lamellidorides*). Cf. also Gray, Guide I, 1857, p. 207.

The genus *Onchidoris* of Blainville (Man. de Malac., 1825, p. 489, Pl. XLVI, f. 8.), ought to be rejected entirely, as founded very likely only on bad observation; the genus figures with nearly impossible characters, both in relation to the tentacles ("quatre tentacules comme dans les *Doris*, outre deux appendices labiaux") and to the anus ("médian à la partie inférieure et postérieure du rebord du manteau"). The type of the genus Blainville found in the British Mus. (London), where it seemed to have disappeared, at least it was not to be found in the collection of nudibranchiates which I looked over in May, 1873 (while, on the contrary, I found the long-lost type of the genus *Linguella*, Blv., in his original glass, and so have re-established the denomination *Linguella* for the much later (1861) *Sancara*, Bgh. Cf. my Malacolog. Unters., Heft vi, 1874, p. 248). Later, Mr. Abraham (l. c. p. 225) seems to have found the original specimen again.

[2] G. O. Sars, Moll. reg. arct. Norv., 1878, p. 306. Tab. XIII, figs. 5, 6; Tab. XIV, fig. 2, 3.

commonly two larger papillæ before and a bare space behind them. The gill (not retractile) consisting chiefly of several (usually 20–30) tripinnate leaves, set in the form of a horseshoe. The head large, veil-formed (semilunar), with produced and pointed side-parts, which are adherent to the foot nearly to the point. The genital openings not being a slit, but on a large tubercle.

The cuticula of the oral aperture is thickened below, near the median line, into a ledge; and on the outside is a ring of hard papillæ. The buccal crop, connected through a petiolus with the foremost part of the upper side of the bulbus pharyngeus, is drum-shaped; on the inside clothed with a strong cuticula. The tongue has on the rhachis short compressed lamellæ, on each side of these is a very large upright plate with large compressed body and a hook which on the inside is either plain or denticulated; at the outside of this plate is another, compressed but much smaller and with a little rudimentary hook. The salivary glands forming a short, coiled mass at each side of the root of the œsophagus. The œsophagus without diverticle at its origin. The spermatoduct (as in the *Acanthodorides*) very long; the penis short, its glans curved and clothed with a rather thick cuticula, but otherwise not armed. The spermatocysta imbedded in the mucous gland;[1] the vagina short.

About the biological relations of the animals belonging to this group very little is hitherto known. Where the species occur, they seem to be rather abundant in individuals (cf. about the *Lam. bilamellata*, Collingwood, in Ann. Mag. Nat. Hist., 3 S. III, 1859, p. 463). The spawn of several species (*L. bilamellata*, *L. diaphana*, *L. inconspicua*, *L. aspera*, *L. depressa*, *L. pusilla*) has been described by Alder and Hancock, and that of a single species (*L. muricata*) by Sars, Meyer and Moebius, etc. The first stages of the development of this last form have been followed by Sars.[2]

The group seems limited to the northern part of the Atlantic and of the Pacific. To the same belong with certainty some properly examined species, and, besides, several others mentioned in the literature can, with more or less probability, be referred to it.

[1] The spermatocysta has not been seen by Alder and Hancock. Cf. l. c., 1852. Pl. XIV, fig. 8 (p. 219).

[2] Archiv. für Naturges, 1840 p. 210, Tab. 7.

A.

1. *L. bilamellata* (L.). Oc. Atlant.
2. *L. varians*, Bgh., n. sp. Oc. Pacif.
3. *L. hystricina*, Bgh., n. sp. Oc. Pacif.
4. *L. muricata* (O. Fr. Müller). Oc. Pacif.
5. *L. diaphana* (Ald. et Hanc.). Oc. Atlant.
   D. diaphana, A. et H., Monogr. Part ii, fam. 1, Pl. 10; Part vii, Pl. 46 suppl. fig. 9.
6. *L. aspera* (A. et H.).[1] Oc. Atlant.
   D. aspera, A. et H., l. c., Part v, fam. 1, Pl. 2, fig. 15; Part vi, fam. 1, Pl. 9, fig. 1–9; Part vii, Pl. 46, suppl. text; Pl. 48, suppl. fig. 2.

B.

7. *L. sparsa* (A. et H.). Oc. Atlant.
   D. sparsa, A. et H., l. c., Part iv, fam. 1, Pl. 14; Part vii, Pl. 46, suppl. text.
8. *L. depressa* (A. et H.). Oc. Atlant.
   D. depressa, A. et H., l. c., Part v, fam. 1, Pl. 12, fig. 1–8; Part vii, Pl. 46, suppl. fig 12.
   ? *Villiersia scutigera*, d'Orb., Mag. de Zool., 1837, p. 15, Pl. 109, fig. 1–4.
9. *L. inconspicua* (A. et H.). Oc. Atlant.
   D. inconspicua, A. et H., l. c., Part v, fam. 1, Pl. 12, fig. 9–16; Part vii, Pl. 46, suppl. fig. 13.
10. *L. oblonga* (A. et H.). Oc. Atlant.
   D. oblonga, A. et H., l. c., Part v, fam. 1, Pl. 16, fig. 4–5; Part vii, Pl. 46, suppl. fig. 10.
11. *L. pusilla* (A. et H.). Oc. Atlant.
   D. pusilla, A. et H., l. c., Part ii, fam. 1, Pl. 13; Part vii, Pl. 46, suppl. text; app. p. iii.
12. *L. luteocincta* (M. Sars).[2] Oc. Atlant.
13. *L.* (?) *ulidiana* (Thomps.). Oc. Atlant.
   D. ulidiana, Th., Ann. Mag., Nat. Hist., xv, 18, p. 31.
   D. ulidiana, Th., Ald. et Hanc., l. c., Part vii, p. 42, app. p. ii.
14. *L.* (?) *tenella* (Agassiz). Oc. Atlant.
   D. tenella, Ag., Gould, Rep. on the Inv. of Massachusetts, ed. Binney, 1870, p. 229, Pl. xx, fig. 289, 290, 293.
15. *L.* (?) *pallida* (Ag.). Oc. Atlant.
   D. pallida, Ag., Gould, l. c., p. 229, Pl. xx, fig. 284, 287, 288, 291.

[1] According to Mörch (Synopsis Moll. mar. Daniæ, Vidensk. Meddel. fra naturh. Foren. i Kbhvn., 1871, p. 179) this species ought to be identical with the *D. muricata* of Meyer and Moebius; but this is, of course, impossible.

[2] The organs of the bulbus pharyngeus of this species have just been figured by G. O. Sars (Moll. reg. arct. Norv., 1878, Tab. xiv, fig. 3).

16. *L.* (?) *diademata* (Ag.). Oc. Atlant.
    D. diademata, Ag., Gould, l. c., p. 230, Pl. xxi, fig. 298, 300, 301–304.
17. *L.* (?) *grisea* (Stimps.). Oc. Atlant. Gould, l. c., p. 232, Pl. xx, fig. 292, 295.
18. *L.* (?) *derelicta* (Fischer). Oc. Atlant.
    D. derelicta, F., Journ. de conchyl., xv, 1867, p. 7.
19. *L.* (?) *tuberculata* (Hutton). Oc. Pacif. (Nova Zeland.).
    Onchidoris tuberculatus, Hutton, cf. Abraham, l. c., p. 226.
20. *L.* (?) *eubalia* (Fischer). Oc. Atlant.
    Doris eubalia, F., Journ. de conchyl., xx, 1872, p. 10.

1. **L. bilamellata** (L.), var. *pacifica*. Plate V, fig. 10; Plate XI, fig. 3–9.

Color albido-flavescens, maculis fuscis plus minusve variegatus.

Dentes laterales margine lævi.

Hab. Oc. Pacific. sepentr. (Mar. Beringi).

Six specimens of this variety of the Atlantic species were taken by Dall, in Bering Sea (Hagmeister Id.), in August, 1874, at low water, on a gravel beach. Three were sacrificed for the anatomical examination.

According to Dall, the color of the living animal was "yellowish-white with brown maculæ."

The length of the specimens preserved in spirits was 11–13.0 mm. by a height of 4.5–5.5 mm. and a breadth of 6–10.0 mm.; the height of the rhinophoria 1.75–2.2, of the branchial leaves 1–1.2 mm.; the breadth of the foot at the fore-end about 5–8.0 mm.; the margin of the mantle projecting freely about 1.5–2.0 mm. The color of the individuals on the back was yellow-white, marmorated with light reddish-brown, this marbling always occupying the spaces between the tubercles, which are nearly white (or light yellowish); the branchial leaves of the same reddish color; the club of the rhinophoria yellowish-white; the under side of the body yellowish-white or whitish.

The form was elongate-oval. The head flattened, nearly semicircular, with the tentacular edges a little prominent. The vicinity of the posterior margin of the rhinophor-holes plain, at the anterior two large erect tubercles; the club of the rhinophoria with about twenty leaves, the stem rather short. The back covered all over with semiglobular and short club-shaped rounded tubercles of different sizes, mostly small, mixed with many larger ones 0.75 mm. in diameter; the larger tubercles mostly showing a spinous surface (Pl. V, fig. 10)[1] when magnified.

[1] Cf. my "Malacolog. Unters." (Semper, II, ii) Tab. LXVIII, fig. 15–16.

The openings of the rhinophor-holes and of the branchial area (fig. *3bb*) surrounded by large and small tubercles which also were spread over the central part of it (fig. 3). The branchial leaves (fig. *3aa*) were about twenty-four or twenty-five in number, set in a transverse reniform ring; the leaves in the front part much larger than the rest. The anus as usual, scarcely projecting. The under side of the margin of the mantle quite smooth. The genital openings always quite contracted. The foot large, with a fine line along its anterior margin.

The cerebro-visceral ganglia short-reniform; the pedal ones not much smaller, of oval form, set nearly at a right angle to the inferior face of the former; the olfactory ganglia bulbiform or ovoid. The buccal ganglia rather flattened, of roundish contour, a little larger than the olfactory ones; the commissure between them very short; the gastro-œsophageal ganglia not very short-stalked, roundish, in size about one-quarter of the buccal ganglia, with three large cells. The three commissures very distinct, the sub-cerebral and the pedal connected throughout most of their length; the visceral thin, not giving off a genital nerve.

The eyes with black pigment, yellowish lens; the nervus opticus nearly as long as half the breadth of the cerebral ganglion. The otocysts as large as the eyes, crowded with otokonia of the usual kind. The leaves of the rhinophoria without spicules; the axis of these organs, on the other hand, were filled with such spicules, partly circularly and concentrically arranged. The tubercles of the back stuffed with ordinary spicules (fig. 10) in the usual way, the larger spicules mostly very prominent on the surface

The oral tube as usual. The bulbus pharyngeus of the usual form, about 2.0 mm. long; the lip-disk with a rather thick yellowish cuticula, and inwards with the same belt of (about ten to fifteen) rows of small denticles as in the *L. hystricina* (cf. below); the sheath of the radula somewhat bent upwards, freely projecting behind the bulbus for as great a length as that of the bulbus itself. The tongue (in the three individuals) with ten or eleven series of plates, in the sheath ten or eleven developed and three younger rows; the total number of rows being thus twenty four or twenty-five. The plates light yellowish in their thicker parts, otherwise nearly colorless. The length of the median plates reaching about 0.12 mm., the height of the external ones 0.10 mm. The median (fig. *7a*) and exterior plates (fig. *7b*) quite as usual; the large ones of the usual forms (fig. *7b*), sometimes, especially the foremost, with rather obtuse point (fig. 9). The buccal crop (fig. 4, 5) as large as the bulbus, of quite the usual form, rather petiolate.[1]

The salivary glands forming (on each side) a large, thick, whitish mass between the bulbus and the central nervous system (with the glandulæ sanguineæ).

The œsophagus rather wide. The stomach and the intestine as usual. The liver as usual, much flattened on the right anterior half.

The heart rather large. The gland. sanguineæ large, whitish, covering the upper side of the central nervous system, the foremost part in one individual very narrow. The renal syrinx about 1.0 mm. long, with strong longitudinal folds, its clothing as usual.

The anterior genital mass 4–4.5 mm. long by a breadth of 1.25–1.5 and a height of 3–3.3 mm., yellow-white, plano-convex; the anterior, and partly the superior portion formed by the coils of the whitish spermatoduct; in one individual one coil embraced the sheath of the radula. The first part of the spermatoduct strong, when unrolled about 25.0 mm. long; the succeeding part of the length of 4–5.0 mm., thinner; the rest about 7.0 mm. in length, stronger, nearly as in the first part. In the beginning of this last part the true spermatic duct was rolled up in tight coils, the remaining part of its length was nearly straight. The penis about 1.5 mm. long, with the usual glans in the interior. The spermatotheca (fig. 6*a*) spherical, its chief duct nearly twice as long as the bag, the vagina short (fig. 6*e*). The spermatocysta appeared pyriform (fig. 6*d*)

In color this form seems to differ from the typical one, as that is represented by Alder and Hancock (Monogr., Part vi, 1854, fam. 3, Pl. 9); in the anatomical relations no specific differences could be detected.

A specimen of another variety was obtained by Dall, on a gravel beach, at low water, in June, 1874, at Port Etches (Prince William Sound). According to Dall, the mantle was of "brown" color.

The specimen had a length of 13.0 mm., by a breadth of 8.0 mm., and a height of 5.0 mm.; the height of the leaves of the gill was about 1.0 mm. The color of the back was brownish and yellowish; that of the gill, as well as of the rhinophoria, yellowish. The number of leaves of the gill was about thirty.

The bulbus pharyngeus about 1.75 mm. long, by a height of 1.5 mm.; the sheath of the radula nearly as long as the bulbus; the buccal crop

[1] In one specimen the form of this organ was entirely as figured in my Malacolog. Untersuch. (Semper, Reisen). Tab. LXV, fig. 2.

a little larger than the bulbus. The radula brownish-yellow, with nine rows of teeth, further back fifteen developed and two younger rows, the total number being twenty-six. The teeth quite as above, dark, horn-colored in their thicker parts; the median ones reaching a height of 0.16 mm. The salivary glands as above-mentioned.

The biliary sac uncommonly small. The black contents of the rectum consisting of undeterminable animal matter, mixed with larger and smaller pieces of small crustacea. The liver much flattened on the right anterior half.

The anterior genital mass large, about 7.0 mm. long, 5.0 mm. high, and 3.0 mm. thick. The ampulla of the hermaphroditic duct whitish, forming a long ansa, about 5.0 mm. long. The spermatoduct shorter than in the other form, otherwise, with the penis, as in that form. The spermatotheca yellowish, short, sac-shaped, of a largest diameter of 3.0 mm.; the spermatocysts about 0.3 mm. long, pyriform. The mucous gland chalk-white and brownish-gray.

Of another variety, Dall, in August, 1872, obtained six specimens, in Sanborn Harbor (Shumagin Ids.), on stony bottom, at low water.

According to Dall, the color of the back of the living animal is "red-brown, with whitish papillæ." The color of the backs of the specimens preserved in spirits was rather uniformly, dirty brown-yellowish, commonly much lighter on the middle, the papillæ whitish; the gill and the rhinophoria of the color of the back; the under side of the whole body yellowish; more whitish on the mantle. The length of the animals varied from 18.0 to 25.0 mm., by a breadth of 11.0 to 16.0 mm., and a height of 8.0 to 12 0 mm.; the breadth of the foot 7.5 to 12.0 mm.; the height of the rhinophoria reaching 3.0 mm., that of the gill 2.0 mm. The form as usual. The horseshoe shape of the gill very pronounced, the number of leaves, twenty-eight to thirty. The gill was surrounded by higher papillæ, which, in the largest specimen, reached the height of about 2.5 mm.; the space inclosed by the gill closely set with similar papillæ, the largest (as large as the above mentioned) in the periphery. The gill can be so deeply drawn back in its groove, that these external and internal papillæ shut over and quite conceal it; the papillæ of the centre smaller; a crest or some few papillæ in the median line go from the anus backwards, between the incurved ends of the gill. The anus small, very slightly prominent; the renal pore on the right side. The openings of the rhinophor-holes as usual, before them the two usual papillæ, behind them a bare space. The papillæ of the back quite as in the previously examined form, the largest (in the largest specimen) reaching the height and the diameter of about 1.5 mm., those in the neighborhood of the gill somewhat larger.

Two smaller individuals were dissected, the larger being harder than these and not so suitable for that purpose. The peritoneum was colorless.

The central nervous system just as in the former specimens, but the buccal ganglia smaller than the olfactory, and the gastro-œsophageal short-stalked.

The eyes as above. The otocysts, under the glass, very distinct as chalk-white points on the hinder and outermost part of the cerebral ganglia. The leaves of the rhinophoria without spicula. The skin and the papillæ of the back as above or still more crowded with very hard spicula.

The oral tube large, (in both individuals) about 2.5 mm. long. The bulbus pharyngeus of the usual form, (in both individuals) about 3.0 long, by a breadth of 1.8 mm , and the height nearly the same ; the sheath of the radula projecting straight backwards 2.0 mm. The buccal crop, lying to the left side of the bulbus, somewhat compressed, of about 3.0 mm. largest diameter, the stalk nearly half as long as the largest diameter of the crop. The tongue with ten rows of teeth, further backwards also eleven or twelve developed and three younger rows, the total number thus being twenty-four or twenty-five. They were entirely as in the form first examined.

The salivary glands, the pyloric part of the intestine, with its biliary sac, and the liver as usual. The sanguineous gland whitish, much flattened, covering the whole upper side of the bulbus pharyngeus and the central nervous system ; a flattened cavity in its interior. The hermaphroditic gland, through its more reddish color, contrasting with the grayish color of the liver.

The anterior genital mass 11.0 to 12.0 mm. long, by a height reaching 7.0 to 8.0 mm., and a breadth of 4.0 to 4.5 mm. The ampulla of the hermaphroditic duct lying transversely on the lowest and most anterior part of the back of the mucous gland, rather straight or forming nearly a circle, about 5.0 to 7.0 mm. long, whitish. The spermatoduct making many coils on and before the anterior part of the mucous gland ; the first part about 35.0 to 45.0 mm. long, the second nearly 25.0 mm. long ; the penis about 1.5 to 2.0 mm., projecting freely from the vestibulum, conical ; the glans seemed rather short. The spermatotheca of about 3.0 mm. diameter, whitish. The spermatocysta (fig. 6*b*) quite imbedded in and concealed by the mucous-gland, only a part of its chief duct free on the surface of this last; the spermatocysta scarcely shorter than the spermatotheca, pear-shaped, incurved; the duct to the mucous gland (fig. 6*d*) passing from the end of the bag, the other strong, longer (fig. 6*e*), opening in the duct of the spermatotheca, where it begins to be wider (vagina); the vagina (fig. 6*c*) rather wide, but short. The mucous gland whitish, yellowish and dirty yellow.[1]

2. **L. varians,** Bgh. Pl. XI, fig. 13, 14; Pl. XIII, fig. 1.

L. varians, B. R. Bergh, Malacol. Unters. l. c., 1878, p. 613, 614.

Color cœrulescens vel albescens vel flavescens.

Dentes laterales margine interno denticulati fere usque ad apicem.

Hab. Oc. Pacif. (Ins. Kyska).

Of this species six specimens were taken by Dall, in July, 1873, at Kyska Island, on sandy ground, at a depth of 9–14 fathoms. Four specimens were sacrificed to the anatomical examination.

According to Dall the color of the living animal is "bluish." The animals preserved in spirits were of a uniform whitish color, so too the rhinophoria and the branchia. Their length was 9-12.0 mm. by a breadth of 5.3–7.0 and a height of 3–4.5 mm.; the breadth of the foremost part of the foot 3.6–5.0 mm. The height of the rhinophoria reached about 2.2 mm., of the branchial leaves 1.0 mm.

The form almost entirely as in the typical form and as in the *L. hystricina.* The head as in the last species; also the openings of the rhinophor-holes, with their (mostly three) larger tubercles, set with equal spaces; the club of the rhinophoria with about twelve to fifteen rather thick leaves. The tubercles of the back as in the *L. hystricina;* the number of larger ones much exceeding that of the smaller, which are scattered between them. The branchial disk as in the *L. hystricina,* also the branchial leaves, whose number did not surpass twelve to twenty. The foot as usual.

The central nervous system (fig. 1) nearly as in the *L. hystricina.* The cerebro-visceral ganglia of roundish or oval form, as also the pedal ones which were not much smaller than the former. The com-

[1] In my "Malacolog. Unters." (Semper, Philipp. II, ii, Heft xiv, 1878, p. 606–613; Tab. lxiv, fig. 13, 14–19; Tab. lxv, fig. 1-5, 6-13) I have given some anatomical remarks on the typical *L. bilamellata* and on the Greenlandic variety (*D. liturata,* Beck).

missura pedalia nearly as long as the diameter of the pedal ganglia; the subcerebral lying rather close up to the pedal; the visceral quite free, much thinner. A very short-stalked smaller ganglion (fig. 1*c*) connected with the under side of the right visceral ganglion, gives off a nerve that swells into a new ganglion, which sends out three nerves (N. genitalis). The olfactory ganglia short-stalked, spindle-shaped. The buccal (fig. 1*d*) and the gastro-œsophageal ganglia (fig. 1*e*), nearly as in the *L. hystricina*; the commissure between the first extremely short, the gastro-œsophageal somewhat smaller.

The nervi optici one to one and a-half times as long as the diameter of the cerebral ganglia; the eyes with black pigment, yellowish lens. The otocysts (fig. 1) lying rather backwards, a little smaller than the eyes; the otokonia of the usual form, in number about fifty. The leaves of the rhinophoria without spicula. In the skin were almost no spicula and no larger or calcified ones on the surface of the rigid papillæ of the back, which thus were rather smooth. In the interstitial connective tissue small calcified cells, but no larger spicula.

The mouth-tube as in the *L. hystricina*. The bulbus pharyngeus as in that species, but the sheath of the radula shorter and less prominent, bent upwards, sideways or down and forwards. On the interior part of the nearly colorless labial disk, the usual belt of (about twelve to fifteen) rows of small denticles. The tongue strong, rather long, with curved superior and nearly straight inferior margin. In the mature radula twelve to fourteen or sixteen rows of teeth, further backwards fifteen or sixteen to eighteen rows of developed, and three of partly developed teeth; the total number of rows thus thirty, thirty-one or thirty-five to thirty-seven. The median plates (fig. 14) of nearly the usual form, in the under side rather excavated, with thickened margins. The large lateral plates (fig. 13) formed nearly as in the *L. hystricina*, but larger, reaching a height of 0.12 mm.; the denticulation of the interior margin of the hook stronger, with more (about twenty) denticles and reaching farther out towards the end of the hook. The exterior plates nearly of the same form as in the last species, reaching to the height of about 0.6 mm.

The sucking-crop quite as in the former species.

The salivary glands much smaller than in the former species, reduced to a large, scarcely lobed, whitish mass on each side of the root of the œsophagus.

The œsophagus somewhat spindle-shaped. The stomach included in the liver. The intestine issuing from the liver behind its middle.

The liver of grayish-white color, of the length of about 9.5 mm. by a breadth of 4 and a height of about 3.75 mm.; the hinder end rounded, the fore-end rather truncated, the anterior one-third on the upper and right side flattened by the anterior genital mass.

The heart and the renal syrinx as usual; the median renal chamber continued to the fore-end of the liver. The sanguineous glands connected on the upper side of the central nervous system to a flattened whitish mass.

The glandula hermaphrodisiaca clothing the upper side of the liver, and scarcely distinct from it in color; in its lobules were large oögene cells. The anterior genital mass compressed, plano-convex; 4.0 mm. long, by a height of about 3.3 and a breadth of 1.2 mm. The albuminous gland on the left side of the mass and forwards, yellowish, very finely gyrated on the surface; the mucous gland whitish, pellucid. The spermatoduct as well as the (3.0 mm. long) penis as in the *L. echinata.* The spermatotheca rather small, spherical.

L. varians, var.

To this same species belonged certainly five specimens of a *Lamellidoris*, which were taken by Dall in July, 1873, at Unalashka Island (Aleutians), at the depth of sixty fathoms on mud and stones. Nevertheless, the color of these animals in the living state was, according to Dall, "yellowish-white."

The size and the particular measures accorded with those of the more typical individuals, referred to above.

The central nervous system as just mentioned, so even the eyes and the otocysts. The bulbus pharyngeus of the usual form; on the tongue eleven rows of teeth, farther backwards twenty-six developed and four not quite developed rows, the total number thus forty-one. The plates quite as formerly described. The sucking-crop quite as in the typical form, also the salivary glands. The whitish sanguineous gland entirely covering the central nervous system. The penis as usual.

Two specimens of another variety of this form were gotten by Dall, in July, 1873, at Kyska Island, on sandy bottom, and at a depth of nine to fourteen fathoms. In a living state they were, according to Dall, of yellowish color.

The length of the animals preserved in spirits was 8.5 to 9.0 mm., by a breadth of 6.0 mm., and a height of about 3.5 mm. The color was uniformly whitish or yellowish-white. One individual was dissected.

The central nervous system was as above mentioned, and also the eyes (their nervi optici rather long), and the otocysts (the number of the otokonia about one hundred). The bulbus pharyngeus as usual; on the tongue sixteen rows of teeth, farther backwards eighteen rows of developed and four of younger teeth; the total number of rows, thirty-eight. The plates as above; the length of the median plates 0.05 to 0 058 mm.; the height of the anterior large lateral plates about 0.14 mm., of the posterior about 0.17 mm.; the number of denticles on these plates mostly fifteen to twenty. The vesica fellea was at the left side of the pylorus.

3. **L. hystricina**, Bergh.

L. hystricina, Bergh, Mal. Untersuch., l. c., 1878, p. 614, Tab. lxviii. fig. 17–23.

Color cœrulescens.

Dentes laterales margine interno denticulati sed non usque ad apicem.

Habitat. Oceanum Pacificum (insula Kyska).

One specimen of this species was found by Dall, at Kyska Island (Aleutians), on rocky bottom, at a depth of ten fathoms, in June, 1873. According to Dall, the color of the living animal is bluish.

The specimen preserved in spirits was 9.5 mm. in length, reached a breadth of 6 0 mm., and a height of the true body (without the papillæ) of 3.5 mm.; the breadth of the foremost part of the foot was 5.3 mm., the height of the rhinophoria was about 2.1 mm., of the branchia about 1.2 mm., of the dorsal papillæ 1.2 mm. The color was uniformly whitish.

The form was oval, the back not very convex. The head rather large, formed like a velum, that is radiately folded, and has its side parts connected with the ends of the anterior margin of the foot; in the middle of the hinder part of the under side of the velum is a transverse slit, in which the small mouth-pore opens. The opening of the rhinophor-holes was nearly round, with the margin rather thin, here were three papillæ of the same kind as on the back; the rhinophoria stout, the club with about twenty leaves. The back covered all over with mostly stout, club-shaped papillæ, apparently set without order, and extending nearly out to the very margin of the mantle, which is thin and has on the upper side smaller, cylindrical or club-shaped papillæ. The papillæ all firmly adherent to the skin, the spicules shining through all over on the back and in the papillæ. The branchial disk rather large, at the margin set with about fourteen papillæ, irregularly alternating in size. The branchia composed of twelve small leaves of the usual kind. The centre of the disk and the anus as usual. The foot somewhat shorter and narrower than the back, broader in front, with the anterior margin rather straight, rounded posteriorly.

The cerebro-visceral ganglia showed the visceral part a little larger than the cerebral, the pedal somewhat smaller than the visceral; the four commissures as usual; the offshoot of the nerva genitalis could not be determined. The buccal ganglia rounded, connected through a short commissure; the gastro-œsophageal having about one-quarter of the size of the latter.

The eyes with very rich black pigment; the nervus opticus not short. The otocysts as large as the eyes, filled with otokonia of the usual kind. In the thin leaves of the rhinophoria no spicula. In the skin of the back and in the dorsal papillæ an enormous amount of irregular or rounded particles, often coalescing together in larger, irregular lumps, which very often were crowded together in irregular heaps; in the papillæ also were long, strong and very much calcified spicula, often of uneven surface, whose points, as usual, often projected on the surface of the papillæ. In the interstitial connective tissue, including the ends of the different ducts of the genital organs (vagina, mucous gland duct), masses of large and long (as much as 0.9 mm.), calcified spicula.

The mouth-tube was about 1.0 mm. long, rather wide, with strong, longitudinal folds. The bulbus pharyngeus of usual, irregular form, the bulbus proper of the length of about 1.75 mm.; the sheath of the radula, nearly as long as the bulbus, curved downwards. The labial disk oval, at the inner margin of darker color, and there showing (fig. 17) a narrow belt of small, yellowish denticles, of a height of 0.007 to 0.015 mm.;[1] this belt seems continued a short space up in the mouth that is otherwise, like the rest of the buccal cavity, clothed with a rather thick, yellowish cuticula. The tongue rather long and narrow, in the groove on its back sixteen rows of teeth, in the sheath eighteen developed and six undeveloped rows, the total number consequently forty. The color of the true lateral teeth yellowish, the others nearly colorless; the height of the outer pseudo-plates about 0.075 mm. The median pseudo-plates elongate, narrow (fig. 21); the true lateral

[1] In the outer mouth was found a little Caprella, of the length of 3.0 mm.

teeth strong, finely denticulated (with six to eight denticles) on the inner side of the hook, and with a strong, rounded prominence at the base of this (fig. 18*a*, 19, 20); the external pseudo-plates with the usual curved points (fig. 18*b*). Irregularities in the form of the last were often observed (fig. 23).[1]

The crop entirely as in the typical species, the largest diameter 1.3 mm.

In the stomach indeterminable animal matter and a little, undeterminable worm, of the length of 2.0 mm.

The hermaphroditic gland as usual; the lobules filled with sperma. The anterior genital mass rather large, measuring in length 4.5 mm., in height 2.5 mm., and in breadth 2.3 mm.; the left side flat or a little excavated, the right rather convex. The mucous gland, as well as the albuminous gland, white and yellowish-white. The spermatoduct not very long, but rather strong, continued in the very strong penis, that (retracted) forms the fore-end of the whole mass. The penis has a length of about 3.5 mm., by a diameter of 1.3 mm.; the inferior end rather constricted; the superior three-quarters of the organ compact, perforated through the axis by the dense coils of the spermatoduct proper; the inferior one-third hollow, including the curved and pointed glans.

2. L. muricata (Müller). Plate IX, fig. 18; Plate XI, fig. 10–12.

Doris muricata, O. F. Müller. Zool. Dan. Fas. III, 1789, p. 7, Tab. LXXXV, f. 2, 3, 4.

Doris muricata, Müller. Sars, (forma β) Lovén, Ind. Moll. Scand. 1846, p. 5.

Doris muricata, Meyer und Moebius. Fauna der Kieler Bucht, I, 1865, p. 73–75, Taf. Vc, fig. 1–8.

? *Lamellidoris muricata*, Müller. G. O. Sars, Moll. reg. arct. Norv., 1878, p. 307, Tab. XIII, fig. 6.

Color flavidus vel luteo-albus.

Dentes laterales magni hamo denticulato sed non usque ad apicem.

Hab. Oc. Atlanticum septentr.

The original specimen on which Müller founded his *Doris muricata* does not exist, and by his incomplete description it is now completely impossible with full certainty to determine what species was meant by his description. In future the species described by Meyer and Moebius

[1] From the presence of only one individual, the examination of the radula was extremely difficult and limited, as also that of the genital organs.

and by me ought to be called by that name. To the same is without doubt to be referred the second variety (β) of the *D. muricata* (Müller, Sars) of Lovén (the first being the *D. Lovéni* of Alder).

Of this form, and under that name, I have had two well conserved specimens for examination, kindly sent me by Mr. Friele, of Bergen, and caught in the neighborhood of that place.

The individuals (preserved in spirits) were of light yellowish color.[1] The length 9–10 mm. by a breadth of 5–6.0 and a height of nearly 5.0 mm.: the breadth of the foot reaching 3.5 mm.; the height of the rhinophoria 1.5, of the branchial leaves 1.0 mm. The form of the animal as usual; the warts of the back not large, mostly truncate, clavate. The openings for the rhinophoria as usual, with two tubercles before them, or one on each side; the club with about fifteen to twenty leaves.[2] The branchial leaves about twelve to fourteen, as far as could be determined;[3] the space inclosed by the gill covered with the usual tubercles; the anus presenting the ordinary features. The head rather large, the side parts adhering to the foot throughout their whole length. The genital groove with three openings; a foremost round, a median spalt-formed, and a posterior large and round.

Both individuals were dissected; the peritoneum was colorless.

In the central nervous system the cerebro-visceral ganglia appeared rather short, reniform; the pedal ones of roundish form, somewhat larger than either of the former; the commissures rather short. The olfactory ganglion short-stalked, nearly spherical, situated rather posteriorly on the upper side of the cerebral ganglia, and nearly as large as the buccal ones. The buccal ganglia of oval outline, connected by a short commissure; the gastro-œsophageal nearly spherical, in size about one-quarter of the former, short-stalked: a secondary ganglion lying above the last on the œsophagus.

The eyes not short-stalked; with rich black pigment and yellow lens. The otocysts a little smaller than the eyes, filled with otokonia of the common kind. In the leaves of the rhinophoria rather few but large spicula of the same kind as in the skin, more or less perpendicular on the free margin; the axes of the club like the stalk still more richly endowed with smaller and larger spicules. Under the glass the

[1] According to Lovén the color is yellowish; to Meyer and Moebius white or yellowish-white, the rhinophoria orange-colored.

[2] According to Meyer and Moebius the club of the rhinophoria has but nine or ten leaves.

[3] Meyer and Moebius mention eight leaves as nearly constant.

skin between the warts, as well as the warts themselves, showed the white spicules everywhere shining through; the spicules often projecting from the surface of the warts The spicules for the greater part very large, long, and reaching a diameter of at least 0.05 mm.; they were strongly calcified, mostly straight or slightly curved, the surface nearly even. In the interstitial tissue were rather many spicules, but (as in the rhinophoria) less calcified than in the skin.

The mouth-tube rather wide. The bulbus pharyngeus of nearly usual form, about 1.6 mm. long; the sheath of the radula, moreover, projecting backwards about 0.4 mm., bent somewhat upwards or downwards; the lip-disk with a rather thick yellowish cuticula; the sucking-crop large, larger than the true bulbus, to which it adheres by a very short petiolus. The tongue with nine rows of teeth, further back twenty to thirty-two developed and three younger rows; the total number of rows, thirty-two to forty-four.[1] The yellow median plates (fig. 10*a*) about 0.05 mm. long, of the usual form. The large lateral plates yellow, of about 0.12 mm. height; the form as usual; the hook with about fifteen to sixteen fine denticles, and a strong tooth at the inside of the base (fig. 10*bb*). The external plate colorless, about 0.04 mm. in height, with the usual rudiment of a hook (fig. 10*c*, 11*b*).[2]

The salivary glands white, rather thick, making two or three short coils at the sides of the œsophagus. The œsophagus as usual. The intestine emerging from the liver at about the middle of its length; the biliary sac (fig. 18) is at the pyloric part of it, situated deeply, scarcely showing itself on the surface of the liver and opening (fig. 18*a*) into the stomach close to the pylorus. The liver about 6.5 mm. long by a breadth of 3.0 mm. and a height of 2.0 mm., deeply excavated in the anterior third of its right side, and of light yellow color. The sanguineous gland much flattened, whitish, heart-formed, of about 1.5 mm. largest diameter. The renal chamber rather wide, the tube on its floor strong.

[1] Meyer and Moebius (l. c. p. 73) mention twenty-nine rows; Alder and Hancock thirty.

[2] The representations of the external plate by Meyer and Moebius (l. c. fig. 2, 6) are not natural. Alder and Hanc. (l. c., Part VII, p. ii, Pl. 46, supplem. text) mention two external plates in their *D. muricata* (as in their *D. diaphana*); either the *D. muricata* of A. and H. must be another species, or they must have fallen into error from the particular view which is sometimes had in certain positions of the hind ends of the large lateral teeth with the external ones.

The lobes of the hermaphroditic gland without developed sexual elements. The anterior genital mass about 2.5–3.0 mm. in length by a height of 2.0 mm. and a breadth of 1.0–1.5 mm. The ampulla of the hermaphroditic duct of yellowish color, rather thick (—0.75 mm. diameter), making a wide curve, about 2.5 mm. long. The spermatoduct long; its first part thinner, about 9.0 mm. long, then through a stricture of the length of nearly 1 mm., passing into the thicker part, which in its last half increases in thickness, and, all in all, has the length of about 6.0 mm. by a diameter of 0.75 mm.; the last part (fig. 12*c*) passes into the penis[1], in whose cavity (fig. 12*bb*) the glans (fig. 12*a*) projects as a short club, the proper seminal duct passing down to the gland in nearly continual cork-screw windings, and often shining through the walls of the external coat. The spermatotheca whitish, nearly spherical, of about 1.3 mm. diameter, filled with seminal matter and detritus; the spermatocysta elongate, nearly twice as long as the former, yellowish, deeply imbedded in the mucous gland, filled with ripe semen; its duct somewhat longer than the cysta. The vagina short.[2] The mucous gland yellowish and yellow.

The species approaches to the *L. hystricina* and *L. varians* (of the Pacific), but differs entirely in its colors; still the possibility cannot be denied that further investigations may show both the Pacific "species" to be merely varieties of the old *Lamellidoris muricata* of the Atlantic.

ADALARIA, Bergh.

Adalaria, R. Bergh. Malacolog. Unters. (Semper, Philipp. II, ii). Heft XIV, 1878, p. xl.

Adalaria, R. Bergh. Gattungen nord. Doriden, l. c. 1879, p. 360.

Forma corporis fere ut in Lamellidoridibus. Notha um papillulatum vel subgranulosum. Branchia (non retractilis) e foliis vix multis, in formam ferri equini ut plurimum dispositis formata. Caput ut in Lamellidoridibus, latum, semilunare, tentaculis vix ullis vel brevissimis lobiformibus. Aperturæ rhinophoriales integræ, tuberculis anticis 2-3, calvitie postica.

Discus labialis non armatus. Lingua rhachide lamellis depressis instructa; pleuris dente laterali interno hamiformi majore et seri

[1] The exserted penis is figured by Meyer and Moebius (l. c. taf. fig. 4) and mentioned as cylindrico-conical.

[2] The upper end of the vagina seemed to present a particular diverticle.

dentium externorum sat applanatorum præditis. Ingluvies buccalis bulbo pharyngeo petiolo connata.

Penis glande parva inermi. Vagina brevis.

The genus has been established by the author (1878) to receive the *D. proxima* and its allies. The *Adalariæ* externally approach nearest to the *Lamellidorides;* their branchial leaves are also disposed mostly in horseshoe form, but fewer in number. The head and the tentacles are more as in the *Acanthodorides.* The back is nearly as in the *Lamellidorides*, but the granules are sometimes more pointed. The opening for the rhinophoria as in the *Lamellidorides*, with plain margin; before them two to three tubercles, behind them the glabella. The lip-disk only covered by a strong cuticula. The armature of the tongue approaching to that of the *Acanthodorides.* The rhachis of the tongue carries depressed small yellow plates; at each side of these a large hook-formed yellow plate, and further outwards a series of smaller, nearly colorless plates, of which the inner ones are more compressed, the rest depressed. The sucking-crop as in the *Lamellidorides*, through a petiolus fixed to the bulbus. The salivary glands as in the *Lamellidorides.* The œsophagus wider at its root. The penis unarmed; the vagina short.

The *Adalariæ* are *Lamellidorides* with a tongue resembling that of the *Acanthodorides;* they form a sort of connecting link between these two groups.

Of the typical species, the spawn is known (through Alder and Hancock) and some few notices have been published about their biology (through Meyer and Moebius); Sars mentions[1] the swimming of *Ad. Lovéni.*

The genus seems to belong to the northern oceans; only five species seem hitherto known.

1. *Ad. proxima* (A. et H.). Oc. Atlanticus sept.
2. *Ad. pacifica*, Bgh., n. sp. Oc. Pacif.
3. *Ad. virescens*, Bgh., n. sp. Oc. Pacif.
4. *Ad. albopapillosa* (Dall). Oc. Pacif.
5. *Ad. Lovéni* (A. et H.). Oc. Atlant. sept.

1. **Adalaria proxima** (Alder et Hancock). Pl. IX, fig. 12–15.

Doris proxima, A. et H. Monogr. Part VI, 1854. Fam. 1, Pl. 9, figs. 10-16; Part VII, 1855. Pl. 46, suppl. f. 8.

Doris proxima, Meyer u. Moebius, Fauna der Kieler Bucht, I, 1865. P. 69-71; taf. V b, fig. 1-8.

[1] Sars, Bidr. til Söedyrenes. Naturhist. 1829, p. 17.

Color flavus vel e rubro flavus.

Dentes laterales (magni) hamo edentulo; externi numero 10.

Hab. Oc. Atlant. septentr.

Of this form I have had for examination three specimens of nearly equal size, kindly sent me by Prof. Moebius in Kiel, and caught in the neighborhood of that town.

The individuals were of a uniform whitish color, the liver shining reddish-gray through the foot. Alder and Hancock have already remarked this shining through of the liver. The length was 7.0–8.0 mm., by a breadth of 5.0–5.5, and a height of about 3.5 mm.; the height of the rhinophoria about 1.25, of the branchial leaves 0.75 mm. The form nearly as in the *Ad. pacifica*, also the tubercles (fig. 12) of the back and the surroundings of the rhinophor-holes; the branchial leaves nine to ten in number. The number of branchial leaves according to Alder and Hancock is eleven, according to Meyer and Moebius eight or nine. The rhinophoria with about fifteen to twenty leaves. The lateral parts of the head nearly connate with the foot, and only slight traces of true pointed tentacles. The foot as in the next species.

The three individuals were anatomically examined. The peritoneum colorless.

The central nervous system as in the *Ad. pacifica*, but less depressed. The eyes and otocysts as in that species; the last with about 200 otokonia of very varying diameter, reaching about 0.02 mm. The spicula of the skin as described by English and German authors; a rather large quantity spread in the skin of the head.

The bulbus pharyngeus (with the crop) of the length of about 1.5 mm., by a height of 1.5 and a breadth of 0.8 mm.; the crop making about half of the bulbus; the lip-disk with strong yellowish cuticula; the sheath of the radula a little prominent, bent more or less upwards. The tongue narrow and pointed, with seven to nine rows of teeth, further backwards thirty or thirty-one rows of developed and three of younger teeth; the total number thus amounts to forty or forty-three.[1]

The teeth as in the *Ad. pacifica*. The large lateral yellowish, the rest nearly colorless. The length of the median teeth about 0.025 to 0.03 mm. The large lateral (fig. 13*bb*, 14) showed the prominence

[1] Alder and Hancock notice forty-one, Meyer and Moebius thirty-nine rows of plates.

at the inside of the root of the hook quite as in the *Ad. pacifica*. The external teeth (fig. 15) only nine or ten in number,[1] fewer than in that species, always absent on more than half the tongue.

The salivary glands as in the next species, also the œsophagus, the stomach and the intestine. The liver also of nearly the same form, the inferior part of the posterior end continued as a little cone; the surface (especially of the back part) yellowish-white; the substance yellow. The vesica fellea in its usual place, small. The heart as usual, also the sanguineous gland. The renal syrinx and the urinary chamber as usual.

The anterior genital mass rather compressed, of angular-roundish outline, of about 1.75 mm. largest diameter. The spermatoduct seemed shorter than in the next species, especially the second part; the penis short. The spermatotheca pyriform; the spermatocysta of more oval form, having only about one-quarter of the size of the former, and filled with sperma. The mucous gland whitish and yellowish.

2. **Adalaria pacifica,** Bergh, n. sp., Pl. IX, fig. 17; Pl. X, fig. 1–3; Pl. XI, fig. 15.

Color lutescens.

Dentes laterales (magni) hamo edentulo; externi numero 15.

Habitat. Oceanum Pacificum (Unalashka).

Of this species Dall caught three specimens, in September, 1874, at Unalashka, on a bottom of mud and shells.

According to Dall, the color of the living animal is "yellowish;" the specimens preserved in spirits were of a uniform yellowish color. The length of the two larger specimens about 12.0 to 14.0 mm., by a breadth of 8.0 to 9.0 mm, and a height reaching 4.5 to 5.0 mm.; the breadth of the foot 6.0 mm., the height of the rhinophoria about 1.5 mm., of the branchial leaves 1.2 mm.

The form as in the *Ad. proxima*, a little broader anteriorly. The back covered all over with a mass of rather stout, subglobose and subpetiolate tubercles quite as in the typical species, mixed with much fewer smaller ones. The larger ones, under magnification, showing the perpendicular spicula shining through, while other spicula were detected irregularly scattered in the intervals between the tubercles. The rhinophor-holes nearly without projecting margin; the adjoining part of the back, behind, smooth; immediately before the holes, on

[1] The number of external plates is, according to Alder and Hancock, ten, to Meyer and Moebius, eight or nine.

the contrary, two or three larger tubercles; the club of the rhinophoria with about thirty leaves. The branchial area surrounded by larger tubercles. The branchial leaves in number, eleven or twelve; immediately before the two hindermost was the slightly prominent anus, and at its right side the renal pore; in the space between the anus and the branchial leaves, three or four larger and two or three smaller tubercles. The head large; the tentacles short, pointed. The foot broad, rounded behind, a little broader in front; the furrow on the anterior margin very indistinct. The three individuals were all dissected. The peritoneum was colorless.

The central nervous system rather flattened; the cerebral ganglia larger than the visceral, which were lying at their outer margin and were a little larger than the pedal ones; the proximal olfactory ganglia bulbiform, less large than the buccal ones, which were of short, oval form, connected through a very short commissure; the gastro-œsophageal ganglia short-stalked, rounded, nearly half as large as the former, with a very large cell. The subcerebral and the pedal commissures connected, the visceral free.

The eyes with coal-black pigment, yellow lens; the nervus opticus in one individual with black pigment. The otocysts, under a magnifier, very distinct as chalk-white points at the hinder margin of the cerebral ganglia, nearly as large as the eyes, filled with ordinary otokonia. In the leaves of the rhinophoria scanty, scattered spicules, perpendicular on the free margin, not much more calcified than in the skin; in the stalk of the organ the spicules larger and less scanty. The skin, especially its tubercles, with many long spicules and calcified cells and groups of such cells; the form of the spicules different from that of the *Doris proxima*, as figured by Alder and Hancock (Monogr., Part vi, fam. 1, Pl. 9, fig. 15), and by Meyer and Moebius (l. c., figs. 8, 9), much less calcified, more straight and of more uniform shape. In the interstitial connective tissue of the chief ducts of the anterior genital mass were scattered large spicules.

The mouth-tube wide, about 1.3 mm. long. The bulbus pharyngeus of rather compressed form, about 2.0 mm. long; the sheath of the radula strongly projecting from the hinder end, nearly as long as the bulbus, more or less curved upwards; the lip-disk oval, with a very strong yellowish cuticula. The tongue with ten or eleven rows of plates, further back twenty-nine to thirty-four rows of developed and three of younger plates; the total number thus forty-two, forty-three, forty-seven. The median plate (Pl. IX, fig. 17*a*; Pl. X, fig. 1, yellowish, of a length of about 0.045 mm., with a median furrow along the upper side and with thickened margins. The large laterals horn-yellow in color, reaching the height of about 0.1 mm. (Pl. IX, fig. 17*b*; Pl. X, fig. 2*aa*), hook-shaped, with a strong, rounded prominence at the inside of the root of the hook (fig. 17). On each side (Pl. X, fig. 2*b*, *c*) of the two large plates (in two individuals) constantly fifteen smaller, nearly colorless plates of a length of about 0.06 mm. These plates were all somewhat depressed; the five inner ones smaller, somewhat compressed (fig. 2, 3*a*, 15); the others (fig. 2, 3) broader, with the upper edge broad and irregularly toothed; the outermost (fig. 2*c*) a little smaller than the adjoining plates. The bases in each of these (fifteen) plates large, forming nearly half, or at least making more than a third of the size of the whole plate.[1] The crop of the bulbus of the usual form, as large or a little larger than the bulbus itself; with a very short stalk with strong longitudinal musculature, its aperture opening immediately behind the lip-disk.

The salivary glands large, white, very elongate, in their foremost part broader, and with several coils filling the space left between the crop, the bulbus and the œsophagus.

The œsophagus long. The stomach small, enclosed in the liver; the intestine rather short, forming its knee behind the fore-end of the liver. The large posterior visceral mass about 9.0 mm. long by a breadth of 4.3 and a height of 3.5 mm.; the posterior end somewhat pointed, though rounded; the fore-end broader, perpendicular, somewhat flattened on the right side; the color of the surface (hermaphroditic gland) ash-gray, the interior (the liver) brown or black brown, or quite yellow.

The heart as usual. The sanguineous gland irregularly reniform, situated somewhat more towards the left side, rather thick, whitish, covering the central nervous system and a large part of the bulbus pharyngeus from above. The renal syrinx as usual.

The hermaphroditic gland without developed sexual elements. The anterior genital mass proper rather small, compressed, of about 2.5 mm. largest diameter, but the loop of the spermatoduct (and the penis) nearly as large as the rest of the mass. The spermatoduct long, in its first part white, rather strong; nearly as long as the second in which it passes through a stricture; this last part is thicker, cylindrical, elongated, about 5.0 mm. long, passing without exact limits into the

[1] In both individuals the three to five foremost rows were without the smaller plates, and the following two or three very incomplete in this respect.

short penis. The spermatotheca pyriform, about 1.3 mm. long; the spermatocysta not having one-fourth of the size of the last; both empty. The mucous gland whitish and yellow-whitish.

This seems even externally to differ somewhat from the typical form, of which it nevertheless may prove to be but a variety. Neither Alder and Hancock, nor Meyer and Moebius saw more than eight to (nine) ten external plates on the tongue of *Ad. proxima*, while this Pacific form always presented fifteen.

3. Adalaria virescens, Bgh., n. sp. Plate X, fig. 4, 5.

Color virescens.

Dentes laterales (magni) hamo edentulo; externi numero 15.

Hab. Oc. Pacific. septentr. Unalashka.

Of this species Dall found four specimens at Unalashka, on gravel, in a depth of nine to fifteen fathoms, in September, 1874.

According to Dall the color of the living animal was "greenish," and the animals preserved in spirits showed remains of the same color as a uniform grayish green. The length of these was 11.5–12.0 mm., by a breadth of 8.0 mm. and a height of 5.0 mm.; the height of the rhinophoria about 2.0, of the branchial leaves about 1.0 mm.

The form, as well as the rhinophor-openings, were quite as usual; the club of the rhinophoria with about thirty-five leaves. The gill not large, with nine to twelve leaves; the space within the gill as usual, also the arms and the renal pore. The back covered with granulations and short clubs. The head, with the tentaculæ and the genital opening as usual.

Three individuals were dissected; the peritoneum was colorless.

The central nervous system showed the cerebral ganglia larger than the visceral, which were lying on the outside of and behind the former, very distinct from them; the pedal ones being intermediate in size between the cerebral and the visceral ganglia. On the exterior part of each cerebral ganglion a little short-stalked ganglion (gang. opticum?) was easily visible under a hand magnifier. The (proximal) olfactory ganglia bulbiform, short-stalked, a little larger than the buccal ganglia, which were short-oval, connected through a very short commissure; the gastro-œsophageal being about one-fourth to one-fifth of the size of the former. In the neighborhood of the penis a little oval ganglion (g. penis) having a largest diameter of about 0.25 mm. (fig. 5), containing only rather small cells.

The eyes with black pigment; the otocysts with not very many and not much calcified otokonia. No distal olfactory ganglion, as far as could be seen; no spicula in the leaves of the rhinophoria. The skin as in other species: the spicula projecting on the surface of the granulations of the back.

The bulbus pharyngeus about 1–1.5 mm. in length; the sheath of the radula projecting 0.75–1.0 mm., bent upwards; the sucking-crop a little larger than the bulbus itself, short-stalked; the lip-disk as usual. The tongue compressed, rather prominent, with six, eight, and nine rows of teeth, also further back twenty-four, thirty-two and thirty-three developed and three younger rows; the total number of rows thus being thirty-five, forty-one, forty-five. The median plates, the large lateral and the (fifteen) external ones scarcely different from those of the last species.

The salivary glands rather strong, with two or three short coils filling the space at the sides of the œsophagus (fig. 4), white. The œsophagus (fig. 4*a*) wide in its upper part, the rest narrow. The anteriorly proceeding part of the intestine 2.0 mm. long, the other retroceding part 8.0 mm. long; no biliary sac could be found either at the pylorus or higher up. The liver about 9.0 mm. long by a breadth of 4.2 and a height of 4.0 mm.; of brownish-gray color; the anterior end truncate, inclined downwards and backwards; the anterior one-third of the right side flattened for the anterior genital mass; the posterior end somewhat pointed, rounded at the point.

The sanguineous gland whitish, covering the anterior end of the bulbus pharyngeus and the foremost part of the central nervous system or this last and the hinder part of the bulbus.

The anterior genital mass about 3.5 mm. long by a breadth of 0.75 and a height of 1.5 mm., a very large part of it formed by the thick part of the spermatoduct. The ampulla of the hermaphroditic duct about 2.0 mm. long, rather thin, whitish. The spermatoduct long; the first part thinner, about 8.0 mm. long; the rest making a large curve, about 5.5 mm. long, about three times as thick as the first, with a diameter of 0.6 mm.; the spermatoduct proper making many coils in its interior course downwards to the penis, which shows a little unarmed glans in the bottom of its orifice; in one individual the penis was exserted as a conical prominence of the height of 1.0 mm. The spermatotheca pyriform, about 1.0 mm. long, of grayish color; the spermatocysta a little less large, spherical; the vagina rather short. The mucous gland rather small.

Even this species might perhaps be merely a variety of the former, still it is of a quite different color and the back much more coarsely granulated.

4 **Adalaria albopapillosa** (Dall), Pl. IX, fig. 16; Pl. X, fig. 9–11.

Alderia (? ?) albopapillosa, Dall, Amer. Journ. of Conch., vii, 2, 1872, p. 137.

Color pallide flavescens, papillis dorsalibus niveis.
Dentes laterales (magni) hamo basi denticulato.
Habitat. Oceanum Pacificum septentrion. (Sitka).

Of this curious animal Dall caught three specimens [in company with the *Doris (Archidoris) Montereyensis* and the *Æolidia (Hermissenda) opalescens*], in July, 1865, on algæ, at the depth of six fathoms, at Sitka (Alaska).

According to the drawings of Dall, the color of the living animal is very pale yellow,[1] the back all over covered with chalk-white papillæ; the length was 3, the breadth 2 lines. The three original specimens preserved in spirits were of a length of 5.5 to 7.0 mm., of a greatest breadth of 4.0 to 4.5 mm., and a height of 2.75 mm. The color was uniformly translucent grayish and yellowish whitish. The form of the animal was oval, the mantle a little larger than and hiding the rest of the body. The back convex, covered all over with a multitude of cylindrical or fusiform, relatively rather large papillæ, reaching to the height of a full millimetre, and with some few small ones spread between them. The rhinophor-openings at their usual place, having, as usual (with retracted organs), thin margins; before them always two larger papillæ, behind them a little naked space.[2] The club of the (yellowish) rhinophoria with about twenty-five leaves. The gill rather small; the branchial leaves (yellowish), as usual, set in horse-shoe form, lower or at least not higher than the dorsal papillæ, in number, ten to twelve; the anal papilla rather low, with one of the ordinary papillæ before and one behind it; the space between the

[1] "Of an opaque white, the remainder of the animal except the eyes, being translucent yellowish."—DALL.

[2] Dall did not detect the retracted rhinophoria ("tentacles none"); the "black eyes sessile on the anterior surface of the body, near the mantle margin," did not exist in the figure, but in one individual two black sand-particles were lying there. The true eyes of the animal could not be detected through the skin, and were lying more backwards.

branchial leaves and the anus otherwise naked.[1] The genital opening as usual. The foot rather large, with a very fine furrow in the anterior margin. The head as usual; the tentacles relatively rather large

The three individuals were dissected. The peritoneum was colorless.

The central nervous system quite as in the former species, the visceral ganglions lying outside of the cerebral; no distal olfactory ganglion could be detected; the buccal ganglia connected through a commissure at least as long as the diameter of the ganglion; the gastro-œsophageal ganglia and the eyes as in the former species. The otocysts could not be detected. In the leaves of the rhinophoria the spicula much more scanty. In the skin the same kind of not much calcified spicula as in the former species; the papillæ of the back very richly endowed with such, and commonly with a mass of them projecting with their points (Pl. IX, fig. 16) on the surface of the papillæ.

The bulbus pharyngeus as in the former species; the length about 1.5 mm., two-fifths of which is the straight, backwards projecting sheath of the radula; the cuticula of the lip-disk as usual; the buccal crop somewhat compressed, with rather long pedicel. The tongue with nine or ten rows of plates, farther backwards sixteen or seventeen developed and three younger rows; the total number of them, twenty-nine or thirty. The median plates (fig. 9*a*, 10*a*) nearly as in the former species, or a little shorter. The large lateral plates (fig. 9*b*, 10*b*) rising to the height of 0.12 mm., yellow; their form as in the former species, but at the inside of the hook at its root were three to six or seven to eight small denticles. The external lateral plates (fig. 10*cd*, 11) farther backwards, in number constantly eight; the outermost (fig. 11*a*) very small, the others as in the former species.

The salivary glands, as far as could be determined, were as in the last species; so also the œsophagus and crop; also the stomach and the intestine, which seemed to have the usual bag (pancreas, biliary sac) at the pyloric part. The sanguineous gland flattened, grayish, cordate. The liver of brownish-gray color.

In the hermaphroditic gland no ripe elements were found, and the anterior genital mass was very small

[1] According to Dall, the "anus is terminal under the edge of the mantle." This was erroneous. He did not see the gill, but regarded the dorsal papillæ as "branchial appendages."

The species is easy to distinguish from the former, by its color and especially by the denticulated hook of the large lateral plates.

5. **Adalaria Lovéni** (Alder et Hancock). Pl. X, fig. 6-8.

Doris muricata? O. F. Müller, Sars, Bidr. til Söedyrenes Naturh., 1829, p. 15. Tab. II, fig. 7, 8.

Doris Lovéni, Alder et Hanc. Ann. Mag. Nat. Hist., 3 Ser., X, 1862, p. 262.

Lamellidoris Lovéni, Friele et Arm. Hansen, l. c. p. 3.

Lamellidoris Lovéni, G. O. Sars. Moll. reg. arct. Norv., 1878, p. 364. Tab. XIV, fig. 1.

? *Lamellidoris muricata* (Müll. Abildgaard. Mörch, Faunula Moll. Ins. Färöens. Naturh. Foren. Vidsk. Meddel., 1867, p. 75.[1]

Doris muricata, Müller, Sars (α), Lovén, Ind. Moll., 1846, p. 5.

Doris muricata, M. Sars. Reise i Lofoten og Finmarken, 1851, p. 75.

Color dorsi et rhinophoriarum e brunneo lutescens, paginæ inferioris et branchiæ lutescens.

Dentes laterales (magni) hamo edentulo; externi (linguæ) numero 12.

Hab. Oc. Atlant. septentr.

This species was first noticed by Sars, who hesitatingly regarded it as perhaps the *Doris muricata* of Mueller. It is, moreover, the principal form of the *Doris muricata* ("Mueller, Sars") of Lovén (his second variety being the true *L. muricata*); has been established (1862) as a species by Alder and Hancock, and has as such been adopted by Friele and Hansen, as well as by G. O. Sars, who lately gave figures of the teeth on the tongue. The species has been much confounded with the "*D. muricata*," which is a *Lamellidoris*; it is certainly distinct from the *Ad. proxima*, and seems also to differ from the other described species.

Of this form I have had fifteen individuals for examination, kindly sent me by Mr. Friele, of Bergen, and dredged in the neighborhood of that place.

[1] According to Mörch (Rink. Grönland, I, 1857. Tillæg 4, p. 78), the *D. muricata*, Sars, should be the *D. liturata*, Beck; this last is a mere variety of the *Lamellidoris bilamellata*, and with this should, on the other hand, according to Mörch (Faunula Mollusc. Isl. Naturh. Foren. Vidensk. Meddel., 1868, p. 203), the *D. proxima* of Meyer and Moebius be synonymous, which belongs to the quite different genus, *Adalaria*. An example more—if such were needed—of the way in which the Nudibranchiata have been synonymized and systematized.

The color of the animals preserved in spirits was uniformly yellowish. The length was 13-15.0 mm., by a breadth of 8.5-9.5 and a height of 4-5.0 mm.; the breadth of the foot 6 mm.; the height of the rhinophoria about 2.5 mm., of the branchial leaves 1.0-1.3 mm.: according to M. Sars the height of the rhinophoria is four to five times that of the tubercles of the back. (l. c. p. 16, also in one of his figures fig. 7). The form as usual; the back covered all over with large rounded tubercles, which rose to the height of 1.5 mm., and were of a similar breadth; they were sessile or more or less subpedunculate, sometimes set in indistinct longitudinal rows; between the larger tubercles everywhere were smaller ones of different sizes; on the margin of the back were tubercles of middle size or smaller; the spicula rather indistinct between and in the tubercles. The rhinophor-openings as usual, two large tubercles before them; the club of the organs with about twenty-five leaves. The gill with eight to twelve leaves; according to M. Sars, the number of branchial leaves is ten—to Lovén, eight to ten. A large (high) tubercle between the hindermost leaves, before it the low anal papilla, and to the right side the renal pore; some few smaller papillæ were spread over the space between the anus and the branchial leaves. The head large, broad; the short tentaculæ pointed. The genital opening as usual.

Six individuals were dissected. The peritoneum was colorless.

The central nervous system rather flattened, especially the visceral ganglia, which lay on the outer side of and behind the cerebral ones, which were a little larger; the pedal ones larger than either of the other ganglia, situated perpendicularly upon the former. The proximal olfactory ganglia bulbiform, a little smaller than the buccal ones; no distal could be found. The length of the commissures equal to the largest diameter of the pedal ganglia; the subcerebro-pedal about three times as thick as the visceral. The buccal ganglia of oval form, connected through a short commissure; the gastro-œsophageal about one-sixth of the former in size, with one very large cell.

The eyes with black pigment, yellow lens; the nervus opticus about as long as the largest diameter of the cerebral ganglion. The otocysts of the same size as the eyes, situated externally at the junction of the cerebral and the visceral ganglia; with about fifty ordinary otokonia, but among them four to six larger ones, of a diameter of about 0.025 mm. The leaves of the rhinophoria nearly without spicula; in the axes, and especially in the stalks, on the contrary, an enormous quantity of large spicula, in great part transversely situated. In the skin a rather large quantity of spicula. The broad centres of the warts of the back chalk-white in transverse section, on account of the mass of strong spicula which ascend in bundles through the axes of the warts, their peripheral parts being free from spicula. The spicula, for the most part, staff-shaped or cruciate, reaching a diameter of about 0.08 mm.; small and large rounded ones were also very common; the spicula mostly very strongly calcified. In the interstitial tissue calcified cells were seen scantily.

The mouth-tube was 1.5 mm. long; the bulbus pharyngeus about 1.5 mm. long, the sheath of the radula projecting about 0.75 mm., bent upwards; the sucking-crop nearly as large as the proper bulbus, short-stalked. The lip-disk with the cuticula rather thick, especially at the inferior median line, here sometimes prominent and reminding one of the two blades in the *Acanthodorides*. The tongue (in the six individuals examined) with seven to nine rows of teeth; further backwards twenty-nine, thirty-one, or thirty-four (in three individuals) developed, and three younger rows; the total number of rows was thus forty-two to forty-six. The median plates (fig. 8*a*) and the large lateral (fig. 6*aa*, 7, 8*b*) ones quite as in the *Ad. Pacifica*, also the external ones (fig. 6*b*, 8*c*), but the number of those never surpassed ten or twelve;[1] frequently all gone from the tongue, and only existing in the two to four posterior rows; the height of the large lateral plates rising to about 0.09 mm.

The salivary glands, as usual, white. The oesophagus somewhat wider in its first part; the stomach as usual; the liver of usual form, its substance of yellow color; on the first quarter of the right side an impression for the anterior genital mass. The vesica fellea rather smaller, on the right side of and a little behind the pyloric part of the intestine, with its upper end appearing on the surface of the liver; the duct nearly as long as the bag, opening in the stomach.

The sanguineous gland of subquadratic form, the largest diameter about 2.3 mm., very much flattened, whitish. The tube on the floor of the renal chamber rather strong.

The hermaphroditic gland clothing the liver with a thin, whitish-gray layer. The anterior genital mass small, nearly undeveloped, much compressed, of about 1.75 mm. in length, the height a little less. The ampulla of the hermaphroditic gland thin, otherwise as usual.

[1] According to Friele and Hansen (l. c. p. 3) the number of external plates is twelve; the figure of these authors (Tab. II, fig. 1) is rather bad. G. O. Sars has eleven to twelve external plates in his figure.

The spermatoduct as usual, also the penis.[1] The spermatotheca and the spermatocysta as usual. The mucous gland very small, whitish and yellow.

ACANTHODORIS, Gray.

Acanthodoris, Gray, Figs. of Moll. Animals, iv, 1850, p. 103, Guide Moll. Brit. Mus. 1857, p. 207.

Acanthodoris, Alder and Hancock, Mon. Brit. Nud. Moll., vii, 1855, p. 43, app. p. xvii. G. O. Sars, Moll. reg. arct. Norvegiæ, 1878, p. 308, Tab. xiv, fig. 4.

Acanthodoris, R. Bergh, Gattung. Nord. Doriden, l. c., 1879, p. 356-360.

Forma corporis subdepressa. Nothæum supra sat grosse villosum. Branchia (non retractilis) e foliis tripinnatis non multis et in orbem positis formata.

Caput latum, veliforme; tentaculis brevibus, lobiformibus. Margo aperturæum rhinophorialium lobatus.

Discus labialis armatura e hamulis minutis formata et infra cuticula incrassata prominenti instructus. Lingua rhachide nuda; pleuris angustis dente laterali, hamiformi permagno et dentibus externis minutis (4–8).

Ingluvies buccalis bulbo pharyngeo connata.

Penis armatura e hamulis minutis formata instructus. Vagina longissima.

The genus *Acanthodoris* was established by Gray, to receive the *Doris pilosa* with its non-retractile gill. Alder and Hancock adopted the genus, made an anatomical examination of the typical form and gave it natural characters, which were then adopted by Gray. In several new malacological publications of a systematic nature the genus has been omitted, and in the last twenty years no new information has been published, until G. O. Sars lately gave some notes on the bulbus pharyngeus.

The *Acanthodorides* approach the *Lamellidorides*, yet differ externally in the scattered soft villosities of the back and in the smaller number of the leaves of the gill, which are arranged in a circle.

Internally they differ still more, in the presence of a strong, oral armature, in a different dentition (4+8+1+0+1+8+4), by a pecu-

[1] Sars (l. c. p. 16) mentions and figures (fig. 8) the penis as "a large, white, conical" organ.

liarly armed penis and by the imbedding in the pharyngeal bulbus of the buccal crop.[1]

The *Acanthodorides* are not much depressed. The back is covered with soft villi or papillæ; the openings for the rhinophoria have lobed margins. The gill is not retractile, and consists of several (generally seven to nine) tripinnate leaves, quite distinct from one another.[2]

The labial disk is provided with a densely set armature of small hooks, passing backward on the cuticula of the mouth. This last also, in the lowest part of the mouth, at each side of the median line is thickened and projects like two thin, lancet-shaped blades over the bare space left between the lower parts of the prehensile collar.[3] The form of the bulbus pharyngeus is as in the *Lamellidorides*, but the buccal crop is imbedded in the upper wall of the bulbus, opening into it through a slit, and is not connected with it by a short stalk.

The tongue is not broad, but nearly fills the buccal cavity, with a flat furrow for the radula. This last has a naked rhachis, with a low and narrow, longitudinal fold. The pleuræ contain a very large, compressed, upright, lateral plate, with a large body and a rather short, strong hook, denticulated or plain along the inner margin; at the outer side of the large plate are several (four to eight) small, external plates (increasing in number backwards). The salivary glands long, thicker in their foremost part. The œsophagus with a little, crop-like diverticle at its root. Above the pyloric part of the intestine opens a

[1] The genus *Calycidoris*, of Abraham (Notes on some new genera of Nudibranchiate Moll., Ann. Mag. Nat. Hist., 4th ser., xviii, 1876, p. 132; and Revision of the Anthobranchiate Nudibr. Moll., P. Z. S., 1877, p. 224), which is said to be allied to the *Acanthodorides* and *Lamellidorides*, still differs by its "subretractile" gill, with simple pinnate leaves, and does not possess external plates on the radula. The genus is very probably apocryphal; in the phanerobranchiate *Dorididæ* it often happens that the gill appears as if more or less retracted in a cavity. A single new species is mentioned, of unknown habitat, the *C. Guntheri*, Abr., l. c., p. 133, Pl. vi, fig. 1.

[2] Alder and Hancock mention and figure (l. c., Pl. 15, fig. 2, 3) the branchial leaves as "united at the base;" so do Meyer and Moebius (l. c., p. 65); this is not the case. The leaves are quite isolated, but there are usually one or two foliola standing between them, which might simulate a coherence of the leaves (cf. also Pl. xv, fig. 6, A. and H.).

[3] These thickenings of the cuticle have been regarded, both by Alder and Hancock, and more lately by Meyer and Moebius (l. c., p. 64, taf. v A, fig. 8, K 9), as "jaws," but have hardly anything in common with those organs properly so called.

little sac, which seems to be homologous with the biliary sac (pancreas, autt.) of other *Dorididæ*. Alder and Hancock, therefore, have denominated that part of the digestive tract as "stomach," although it in no essential respect differs from the rest of the intestine, and is just like that part in the *Chromodorides*, and should be undoubtedly regarded as the pyloric part of the intestine, when that sac opened lower down, as in the *Chromodorides*,[1] in the cavity, which is included in the liver, and seems to be the true stomach. The spermatoduct and the chief duct of the spermatotheca (vagina) are of very considerable length; the former consisting of two different parts, a superior softer, and an inferior very muscular part, internally clothed with an armature, which is continuous through the penis. This last is rather short, the superior part solid and projecting as an armed glans into the inferior, hollow part (præputium). The armature consists of rows of hooks continued in the interior of the organ, and, as mentioned above, farther upwards; quite like that of the *Polyceridæ*,[2] *Phyllidiidæ*[3] and *Doriopsidæ*.[4]

About the biological relations of these forms very little is yet known and that only with reference to the typical species, through Alder and Hancock, as well as Meyer and Moebius. The spawn is figured by Alder and Hancock (l. c., Pl. 15, fig. 9), and by Meyer and Moebius (l. c., fig. 13, 14); about the development nothing is yet known.

The few known species of this genus seem limited to the northern parts of the Atlantic and of the Pacific.

1. *Acanthodoris pilosa* (O. F. Müller). Oceanum Atlanticum et Pacificum.
   Doris pilosa, Cuv.
   Doris stellata (Gm.), Cuv.[5]

[1] Cf. my Malacolog. Unters. (Semper, Philipp., II, ii), Heft xi, 1877, p. 464–494; Neue Nacktschnecken der Südsee, ii, Journ. der Mus. Godeffroy, Heft viii, 1875, p. 72–82; *idem*, iv, l. c., Heft xiv, 1879, p. 1–21.

[2] Cf. my Malacolog. Unters. (Semper, Philipp., II, ii), Heft xi, 1877 (Trevelyana, Nembrotha).

[3] Cf. my Bidr. til en Monogr. af Phyllidierne, Naturh., Tidskr. 3, R. V., 1869; Malacolog. Unters. (Semper, Philipp., II, ii), Heft x, 1876, p. 377–387.

[4] Cf., l. c., Heft x, 1876, p. 384–387; Journ. der Mus. Godeffroy, Heft viii, 1875, p. 82–94.

[5] According to Fischer (Note sur quelques espèces du G. *Doris*, décrites par Cuvier, Journ de Conchyl. 3 sér. x, 1870, p. 290), the *Doris stellata*, Cuv., and the *D lævis*, Cuv., are identical with his *D. pilosa*, and this with the typical form of Müller.

The *D. stellata* of Philippi seems a quite different form, a *Platydoris*

Doris lævis, Cuv.
? *Doris fusca*, O. F. Müll., Zool. Dan. (descr.).[1]
? *Doris tomentosa*, Lovén, Index Moll. 1846, p. 4.

2. *A. subquadrata* (Ald. et Hanc.). Oceanum Atlanticum.
Doris subquadrata, A. et H. Monogr., Part. V, 1851, fam. 1, Plate 16, f. 1–3; Part VII, 1855, p. 43, and III, Pl. 46, Suppl. f. 14.
? (*D. stellata*, Cuv. ?). Lebert, Beob. über die Mundung einiger Gasteropoden. J. Müller, Arch., 1846, p. 444–446, Taf. XII, fig. 10–13.[2]
3. *A. cærulescens*, Bgh., n. sp. Oceanum Pacificum.
4. *A. ornata*, Verrill. Notice of recent additions to the mar. fauna of the eastern coast of North Amer. XXXVIII; Amer. Journ. of Sc. and Arts, XVI, 1878, p. 313. Oc. Atlant.
5. *A. stellata* (Gm.), Verr., l. c., p. 313, *D. bifida*, Verr. Oc. Atlant.
6. *A. citrina*, Verr., l. c., p. 313. Oc. Atlant.
7. *A. ? mollicella*, Abraham, l. c., 1877, p. 228, Pl. XXX, fig. 1–4. Oc. Pacificum.
8. *A. ? globosa*, Abr., l. c., 1877, p. 228, Pl. XXX, fig. 5–9. Oc. Pacif.

1. **Acanthodoris pilosa** (O. F. Müller). Plate X, fig. 12–15; Plate XI, fig. 1–2; Plate XII; Plate XIII, fig. 2–5.

Acanthodoris pilosa (O. F. Müller), Alder and Hancock. Monogr. Br. Nudibr. Moll., Part V, 1851, fam. 1, Plate I, f. 1, 3–5, 12; Plate 2, f. 2–6; Plate 15; Part VII, 1855, Plate 46; Suppl. Plate 48, f. 1.
Doris pilosa (O. F. Muller), Meyer und Moebius, Fauna der Kieler Bucht. I, 1865, p. 63–67 *c. tab.;* taf. V, A.

Color paginæ superioris corporis albus vel luteus vel fuscus vel griseus vel rubro-brunneus vel niger.

Dentes radulæ hamo pro parte denticulato.

Hab. Oceanum Atlanticum septentr., Pacific. septentr.

Platyd. Philippi, Bgh.). Cf. my Malacolog. Untersuch. Semper, Philipp. II, ii.). Heft. xii, 1877, p. 507.

[1] It is in most cases a quite useless task to try to elucidate the species of Dorides of the elder authors; their examinations were all too superficial and their descriptions don't contain the data necessary for their verification. The best way would be to wholly cancel these names (*D. fusca*, M.; *D. lævis*, L., etc.) which have given later authors so much trouble. On the *Doris fusca* of O. Fabricius, Mörch has even formed a genus *Proctaporia* (Rink. Grönland. I, 1857. Tillag. 4, p. 78), that must be cancelled, too.

[2] The short statements of Lebert about form and color of the animal examined by him can scarcely entirely prohibit the identification of it with the species described by Alder and Hancock. The figures of the (tongue) teeth given by Lebert, rough as they are, suffice, on the other hand, to secure the identification with the *D. subquadrata*, or at least with a nearly related species.

Of this species I have had a lot of specimens for examination, all preserved in spirits; partly (two) from the neighborhood of Bergen (Norway), kindly sent by Mr. Friele, partly (one) from the Frith of Kiel, sent by Prof. Moebius; but particularly (seventeen) from the coast of Denmark (Strüb, lille Balt.)

The individuals varied much in color. The variability of the color is noted by Alder and Hancock. They were whitish, or whitish sprinkled with brownish, or dark (bluish) gray, or yellowish, or brownish, or reddish-brown on the back, with whitish or yellowish sides and foot. The length reaching 12.0 mm., by a breadth of 8.0 and a height of 5.0 mm.; the foot then about 4.0 mm. broad, the branchial leaves reaching to the height of about 1.0 mm.

The back covered all over with the soft, slender, conical and pointed, erect (or curved) papillæ of very different sizes, most of them small; between these are larger ones;[1] some of the largest divided into two or three points, and some of them connate and forming small crests, divided above into two or three points. The margins of the sheaths of the rhinophoria rather prominent, divided into several (six to eight) smaller and larger pointed lobes; the club of the rhinophoria with about twelve to twenty leaves.[2] The branchia, in both Norwegian specimens, with eight tripinnate leaves, otherwise with seven to nine (as mentioned by Meyer and Moebius). The anal papilla low, with several papillulæ and a star-shaped aperture; on a low crest, issuing from its posterior, is a strong papilla. The head and the tentacles (Plate X, fig. 14*b*) as figured by Alder and Hancock (l. c., Plate 15, fig. 1). The anterior margin of the foot with a fine transverse furrow (Plate X, fig. 14*a*). The genital opening is a longitudinal slit (Plate XI, fig. 2).

The peritoneum was mostly of reddish-brown color.

The central nervous system showed[3] the cerebral ganglia rounded-triangular, not much flattened, a little larger than the more rounded visceral, which lie behind and on the outside of them and show a slight notch in the outside; on the inferior side of the visceral ganglia the pedal ones are set nearly perpendicular on the latter, connected by the

[1] Alder and Hancock, also Meyer and Moebius give eighteen to twenty leaves. Cf. the figures 7–8 of Meyer and Moebius.

[2] Collingwood (Ann. Mag. N. H., 3 ser. vi, 1859, p. 463) remarks that it "when not in motion, bears a great resemblance to a miniature hedgehog."

[3] The representation of the system given by Hancock and Embleton (On the anatomy of Doris, Philos. Transact. MDCCCLII, Plate 17, f. 8) is not very like nature.

three distinct commissures, which are nearly as long as the diameter of the ganglia. From the outer part of the right visceral ganglion issues a nerve nearly as long as the transverse diameter of the whole central nervous system and swelling to a rather large ganglion (gangl. penis) at the root of the penis; this ganglion contains only rather small cells and gives off three or four strong and several thinner nerves (Plate X, fig. 15). The part of the brain which gives off the nervus opticus, simulates a ganglion. The proximal ganglia olfactoria bulbiform, somewhat smaller than the buccal ganglia, but much larger than the distal ganglia olfactoria; the buccal ganglia flattened, rounded, connected by a rather short commissure; the ganglia gastro-œsophagalia rounded, having about one-fifth of the size of the last, containing one very large cell and a few smaller.

The eyes with black pigment and yellowish lens. The otocysts lying at the hinder part of the cerebral ganglia, as large as the eyes; with numerous small otokonia, which in the specimens from Kiel, were not much calcified. No trace of spicula in the leaves or other parts of the rhinophoria. The spicula of the skin were, so to speak, limited to the margins of the mantle and of the foot; in the last they were chiefly arranged perpendicularly or obliquely against the margin, except that in the foremost and hinder part of the sole some few spicula were seen scattered.

The amount of spicula in the skin seems to vary notably in the *Acanthodoris pilosa*, as seems to be the case in general in different forms of *Dorididæ*, especially, as far as hitherto known, in the *Polyceratidæ* (*Polycera*, *Ancula*). (Cf. Meyer and Moebius, Fauna der Kieler Bucht, I, 1865, pp. 52, 60.) Frey and Leuckart (Beitr. zur Kenntn. wirbellose Thiere, 1847, p. 145) described a very regular position of the spicula, but not, as it seems, in accordance with nature.

In the margin of the mantle the spicula were arranged as figured by Alder and Hanc., l. c., Part VII, Pl. 48, supplem. fig. 1, only more concentrically at the transition from the margin to the side of the body; a narrow belt of spicula crossed the back before the region of the gill. Some spicula were also seen in the tentacles. The spicula reached a notable length (at least 0.6 mm.), in old individuals they were more calcified than in younger ones. The skin was filled with unicellular glands, especially in the dorsal papillæ.[1]

The mouth-tube was wide and strong, about 1.5 mm. long; the bulbus pharyngeus in the largest individuals about 2.75 mm. long, by

[1] Cf. the (not very good) fig. 6 by Meyer and Moebius.

a breadth of 2.0 and a height of about 3.0 mm.; the sheath of the radula projecting backward nearly 1.0 mm.; the lip-disk sometimes surrounded by a ring of black pigment. The armature of the lip-disk entirely as shown (Pl. XII, figs. 1-4, 10-11) by me in the form from the Pacific, also the crop (Pl. XIII, fig. 2) of the bulbus.[1] The tongue in the eight specimens examined was provided with five, seven, eight, nine rows of plates, farther backwards also sixteen to twenty developed, and three younger rows; the total number amounting thus to from twenty-seven to thirty.[2] The large lateral teeth[3] yellow in the body, especially in the anterior-inferior part, with commonly five to eight denticles on the inside of the hook; sometimes, especially in the younger plates, the number of denticles rose from eleven to fifteen, sometimes the three to four outermost denticles were much larger than the rest, sometimes the denticulation was quite irregular; the height of this plate reached 0.4 mm. The outer plates (Pl. XI, fig. 1) commonly four to six, seldom seven to eight; in a series of four on the hinder part of the tongue, the outermost measured about 0.05, the next 0.09, 0.11, 0.125 mm.; they were quite colorless, compressed, with the upper side flattened, and rather erect.

The salivary glands as in the purple-colored form from the Pacific. No constant dilatation of the middle of the œsophagus (as figured, Pl. I, f. 12*g*, by Alder and Hancock), but a strong, particular one at the root as figured (l. c. Pl. I, f. 12*f*) by Alder and Hancock and by me (Gatt. nordischer Doriden, l. c. Taf. XIX, fig. 14*e*). The stomach as in the Pacific form; the intestine sometimes dilated in its first part, sometimes absolutely of the same caliber as the rest, and neither externally nor internally different from it; a little bag (biliary sac) which has been noticed by Alder and Hancock (l. c. Pl. I, fig. 12*k*), opening into the right side of this part of the intestine. The posterior visceral mass (liver) flattened and excavated on the anterior-inferior right half. The sanguineous gland whitish, convexo-concave, short and irregularly kidney-formed, with the excavation

[1] The first specimens of the Northern Atlantic left at my disposition being too small and too few for a thorough examination, I am obliged to refer to my examination given herewith of the form from the Pacific. Cf. moreover my figures in "Gatt. nord. Doriden," l. c. Pl. XIX, figs. 10, 11. The crop is rather well figured by Alder and Hanc. (l. c. Pl. I, f, 12*c*).

[2] According to Meyer and Moebius, the number of plates ("of the radula") is thirty-one, to Alder and Hancock, twenty-seven.

[3] Cf. my Gattungen nordischer Doriden, l. c. Taf. XIX, fig. 12.

forwards, transversely situated, with a largest diameter of 3.0 mm. The renal chamber and the syrinx as in the form from the Pacific.

The hermaphroditic gland as in this last variety, its white color contrasting with the hue of the liver. The anterior genital mass of short pyramidal form, with the point outwards, about 4.75 mm. long, the breadth and the height a little less. The ampulla of the hermaphroditic gland yellowish-white, forming a single ansa, about 4.0 mm. long, by a diameter of 0.75 mm. lying on the upper part of the back of the mucous gland. The spermatoduct yellowish, about 15.0 mm. long, constricted a little above the middle of its length; strong, sloping into the penis, which is about 1.0 mm. long. The armature of the penis entirely as in the form from the Pacific, continued backwards in the interior of the spermatoduct for a length of 6.0 mm.; the hooks rising to the height of about 0.035 mm., nearly colorless.[1] The spermatotheca (Pl. XIII, fig. 5*a*) spherical, of a diameter of about 2.0 mm., greenish or whitish; the spermatocysta (fig. 5*b*) much smaller, pyriform, yellowish; both filled with sperma. The chief duct (the vagina, fig. 5*dd*) very long, with several (four) longitudinal folds, which are folded again transversely; the structure seemed to resemble entirely the form from the Pacific; in the cavity was more or less sperma. The mucous gland yellow and yellowish-white; the fold of the duct with brownish-gray points, but no black pigment on the lower part of the vagina or penis.

One specimen of this typical form, with "brown mantle," and in all respects agreeing with the Atlantic, was dredged by Dall at Kyska, in June, 1873, on rocky bottom at the depth of ten fathoms.

An individual of a (in living state) "yellowish-white" variety was dredged by Dall in Popoff Strait (Shumagin Islands), on rocky bottom at a depth of six fathoms.

The animal preserved in spirits was 10.0 mm. long, by a breadth of 6.0 and a height of 4.5 mm.; the rhinophoria 1.5 mm. high, the gill 1.0 mm., the foot 3.0 mm. broad. The color yellowish-white. In the club of the rhinophoria about thirty leaves; nine branchial leaves; the anal papilla with three small protuberances; the renal pore very distinct on the right side. The genital opening very wide; the bulbus pharyngeus 2.0 mm. long; the tongue with seven rows of plates, the total number of these twenty-six (16 + 3); five external

[1] The armature of the penis has been first seen by H. Friele and G. Armauer Hansen (Bidr. til Kundsk. om de Norske Nudibranchiar. Christiania, Vidsk.-Selsk. Forh., 1875, extras, p. 4).

plates. The diverticle of the œsophagus nearly as large as the true bulbus. The spermatoduct and the penis as usual, also the vagina; the spermatotheca of 1.6 mm. largest diameter. No trace of pigment on the vagina or penis, and the peritoneum was colorless.

Another variety of the species, with "brown mantle and yellowish-white papillæ," was dredged by Dall, in Yukon Harbor (Shumagins), in August, 1874, on sand and stones, at a depth of six to twenty fathoms.

The individual preserved in spirits was 9.0 mm. long, by a breadth of 6.5 mm., and a height of 4.5 mm.; the breadth of the foot 4.0 mm., the height of the gill 1.5 mm. The back of the animal densely brown-dotted, especially the circumference of the gill and the free area left in the middle of the gill; the dorsal papillæ all whitish; the stalk of the rhinophoria and the inferior part of the club densely dotted with brown, also, in a somewhat slighter degree, the outside of the branchial leaves. The under side of the mantle and the upper side of the margin of the foot and, in a slighter degree, the sides of the body and the sole of the foot dotted with an enormous quantity of brownish-gray points. The form as usual. The gill with nine leaves, of which the two posterior were much smaller than the others.

The central nervous system as usual; the otocysts very conspicuous under the magnifier as chalk-white points. The mouth-tube 2.0 mm. long. The bulbus pharyngeus 2.0 mm. long; the sheath of the radula projecting 2.0 mm., bent downwards. The armature of the lip-disk (Pl. XII, fig. 10, 11) very like that of the var. *albescens* (cf. Pl. XIII, fig. 4). The buccal crop as usual. The tongue with nine rows of plates; the total number of rows, twenty-five (13+3). The large lateral plates as usual; the denticulations rather long and somewhat irregular. The number of the external plates (fig. 12) reaching to six.

The salivary glands, the œsophagus with its diverticle, the pyloric part of the intestine with its bag (biliary sac), and the liver, as usual. The sanguineous gland rather large, covering, besides the central nervous system, the whole of the bulbus pharyngeus.

In the lobes of the hermaphroditic gland, masses of zoösperms. The anterior genital mass of the usual form; the ampulla of the hermaphroditic duct somewhat larger. The spermatoduct as usual; so, too, the penis, with its armature; the length of the glans about 0.5 mm. The spermatotheca and the spermatocysta as usual; also the chief duct (vagina), the cavity of the last filled with sperma. The mucous gland yellowish-white and in the centre (albuminous gland) brownish-yellow. Very scanty black pigment on the inferior part of the vagina and of the penis; the peritoneum of the back, on the contrary, very dark brown.

2. Acanthodoris pilosa (O. F. Müller), var. *albescens*, Pl. X, fig. 14, 15; Pl. XI, fig. 2; Pl. XII, fig. 13–16.

Color flavescente-albidus.

Hamus dentium (linguæ) edentulus vel parce denticulatus.

Habitat. Oceanum Pacificum septentrion. (Aleutian Islands).

Two rather large specimens of this variety have been dredged by Dall, in June and July, 1873, at Kyska Harbor (Aleutians), on sand or on rocky bottom, at a depth of nine to fourteen fathoms.

According to Dall, the color of the living animal was "yellowish-white;" that of the specimens preserved in spirits was so, too, but very likely much more whitish. The length was 16.0 or 17.0 mm., by a breadth of 6.5 to 8.0 mm., and a height of 6.5 mm.; the height of the rhinophoria 2.5 to 3.0 mm., of the gill 3.0 to 4.0 mm.; the breadth of the foot 5.0 or 6.0 mm., the length of the genital opening 2.0 or 3.0 mm. The form as in the typical *D. pilosa;* the rhinophoria showed about twenty-five broad leaves in the club; there were nine branchial leaves; the anal papilla very low; the renal pore rather large.

The central nervous system as previously described. The distal olfactory ganglion small; a large (diameter, 0.4 mm.) ganglion penis (fig. 15). The eyes with rich, coal-black pigment; the otocysts visible under a lens as chalk-white points, with about one hundred and fifty otokonia.

The bulbus pharyngeus 3.5 mm. long, with the sheath of the radula projecting 1.3 to 1.5 mm.; the height of the bulbus, with the crop, 4.0 to 4.5 mm., its breadth 2.5 to 3.0 mm.

The older elements of the lip-plate (Pl. XII, figs. 13, 14) agreeing in form with those of the typical species, but oftener showing a granulated interior; the said elements reaching a length of about 0.04 mm. The diameter of the disk and mouth about 3.0 mm. The breadth of either half of the disk 0.66 mm.

The tongue showed nine or ten rows of teeth; the whole number of rows, twenty-nine (16 or 17+3). The large lateral teeth were as in the typical species, reaching 0.65 mm. in height (Pl. XII, fig. 15, 16), without or with only a very slight denticulation of the hook (fig. 15). The number of the outer teeth, three to five.[1]

[1] Cf. my Gatt. nordischer Doriden, l. c., Taf. xix, fig. 13.

The salivary glands deeply imbedded in the cavity for the œsophagus at the fore-end of the liver. The œsophagus with its rather large (1.5 mm. long) diverticle, the stomach, the intestine with its little (1.0 mm. long bag, as above. The liver 7.0 to 9.0 mm. long, 5.0 to 6.0 mm. broad, 5.0 to 6.25 mm. high, of yellowish-gray color. The sanguineous gland of irregular, oval form, of a largest diameter of 4.0 mm., by a thickness of 1.0 mm., and of grayish color. The renal syrinx about 0.75 mm. long.

The anterior genital mass 6.0 or 7.0 mm. long, 4.0 to 6.0 mm. high, and 3.0 or 4.0 mm. thick. The ampulla as usual; also the (about 40.0 mm. long) spermatoduct and the (nearly 2.0 mm. long) penis, with its armature; the hooks often set in pairs. The spermatotheca (diameter, 4.0 mm.) and the spermatocysta (diameter, 1.5 mm.) as above; the chief duct, with the vagina (about 23.0 mm. long, by a diameter of 0.4 to 1.0 mm.), as usual, and also its internal cellular clothing (Pl. X, fig. 13); the yellow nucleoli somewhat brighter; the cavity nearly filled with sperma. The mucous gland as usual. No black pigment on the inferior part of the vagina or on the penis.

3. **Acanthodoris pilosa** (O. F. Müller), var. *purpurea*, Pl. XII, fig. 1–9.

Color e purpureo brunneus et flavescente-albidus.

Habitat. Oceanum Pacificum septentrion. Insulæ Aleutianæ (Unalashka).

Only two specimens of this species were dredged by Dall, in September, 1871, on mud and stones, at a depth of about sixty fathoms.

The color of the living animal was, according to Dall, "purple-brown and yellowish-white." The length of the animals preserved in spirits was 24.0 or 25.0 mm., by a breadth of 9.0 or 10.0 mm., and a height of 7.5 mm.; the foot 6.0 mm. broad; the height of the rhinophoria about 3.0 mm., of the branchial leaves 2.3 mm. The color of the back reddish-brown; the stalk of the rhinophoria brownish, the club yellowish; the branchial leaves yellowish-white, the last brownish at the rhachis; the under side of the mantle margin, with the sides of the body, the head and the foot, yellowish-white, dotted with brownish-gray all over, the color much more scanty on the sides of the foot and still more so on the head and on the sole of the foot.

The form was somewhat elongate. The back covered all over with pointed, rather (0.75 mm.) high, digitiform, soft papillæ and with intermixed smaller ones. The margin of the rhinophor-holes with several pointed, projecting, digitiform processes; the stout club of the rhinophoria with about twenty leaves. The branchial leaves strong, in both individuals eight in number, the two hindermost separated by a narrow crest, which rises into a larger papilla; before this the anal papilla, covered with some papillæ, at its right side is the renal pore; on the space before it were several smaller papillæ. The under side of the free margin of the mantle (about 2.0 mm. broad) smooth. The head large, the tentacles short. The genital opening a rather large, crescentic orifice. The foot rounded behind.

The peritoneum was richly dotted on the back with brownish-red.

The central nervous system nearly quite as in *Ac. pilosa;* the proximal olfactory ganglia of oval form, true distal ones could not be detected in the root of the rhinophoria, but only a fusiform swelling of the nerve, with scattered nervous cells. The subcerebral and pedal commissures connected, the visceral isolated. The buccal ganglia larger than the olfactory, of oval form, connected by a commissure nearly as long as each ganglion; the gastro-œsophageal ganglia developed on the side of the nerve, which is a little longer than the ganglion, and in size about one-fifth of the former; the contents one very large cell, three or four smaller and several quite small ones. On the upper part of the penis the large ganglion genitale, of about the diameter of 0.3 mm., rounded, partly covered with black pigment, consisting of only rather small cells; in the first parts of the nerves given off from the ganglion, one or two rows of nervous cells of the same kind as in the ganglion.

The eyes with black pigment, yellow lens; the optic nerve rather long. As chalk-white points the otocysts were situated on the hinder part of the cerebral ganglia, where they touched the pedal ones; they were filled with solid, yellowish otokonia of about the usual form and size, but, in both respects, rather irregular. In the leaves of the rhinophoria no spicula. In the margin of the mantle and of the foot almost no spicula at all, but everywhere in the skin, especially on the back and the papilla, were an enormous quantity of large and small glandular openings. In the interstitial connective tissue were hardly any calcified cells at all.

The mouth-tube was about 2.3 mm. long, wide, with a glandular belt on the outside, not closed below; on the inside lined with a yellowish cuticula. The bulbus pharyngeus strong, about 4.0 mm. long, and the sheath of the radula projecting nearly 1.0 mm. from the posterior part of the under side, directed straight backwards or downwards; the height (through the buccal crop) 4.0 mm., the breadth 2.5 mm. The buccal crop making nearly half of the whole bulbus, and of the usual form; the walls very thick; the compressed and rather small cavity communicating through a long cleft with the anterior half of the small buccal cavity. The lip-disk (fig. 1) of rounded contour, clothed throughout its whole breadth (on each side to about 0.5 mm.) with the light, horn-yellow colored armature; the lowest part of this, as usual in the *Acanthodorides*, injured or wanting; the breadth of the belt decreasing towards the upper end, where it is interrupted in the middle line, also at the lower end. The armature (fig. 2*bb*, 3*b*, 4) composed of hooks, whose points are directed forwards (towards the opening of the mouth), nearly like, but still differing a little from those in the typical *Ac. pilosa*, reaching the height of about 0.04 mm., yellowish, with rounded, bifid or irregularly cleft points. The lancet-shaped (fig. 1*a*, 2*a*, 3*a*) blades at the inferior angle of the mouth as usual. The tongue with nine or ten series of plates, farther backwards thirteen to fifteen developed and three undeveloped series; the total number in this way, twenty-five to twenty-eight. The large lateral plates relatively larger than in the *Ac. pilosa*, and (fig. 5, 6) less thick in the anterior-inferior part of the body, with relatively larger hook; the denticulation of this last much weaker and much more irregular; in one specimen generally two to four denticles, sometimes only a few very insignificant ones or none at all (fig. 6); and this was the case with the other specimen, in which only some few plates showed two small denticles.[1] The outer lateral plates as in the typical form, scarcely more than from four to six.

The salivary glands whitish, rather strong at their short first part, in the rest of their length thin (fig. 7), accompanying the œsophagus to the cardia; the duct rather short (fig. 7*a*).

The œsophagus forming a little crop,[2] with thin walls and longitudinal folds on the inside; in the rest of its length rather thin. The stomach rather small, with the usual biliary apertures. The intestine (fig. 8*a*) somewhat inflated in its first part, with many rather strong folds and one particularly thick; a little over the point, where it appears on the surface of the visceral mass, on the right side, a little, scarcely pedunculated bag (fig. 8*b*), of the length of 1.0 to 1.25 mm., with fine, longitudinal folds; the rest of the intestine (fig. 8*c*) somewhat narrower; the total length of the intestine about 12.0 to 13.0

[1] Although very like the plates of the Atlantic form, they still bore a somewhat peculiar aspect.

[2] Cf. my Gattungen nordischer Doriden, l. c., Taf. xix, fig. 14.

mm., by a diameter of 1.0 to 1.5 mm. The contents of the stomach and of the intestine indeterminable animal matter, mixed with an enormous quantity of different and partly very handsome forms of *Diatomaceæ*, with some *polythalamia* and some small *copepoda*, and fragments of the same.

The liver about 9–9.5 mm. long by a breadth (at the forepart) of 6.5–5.5 and a height of 6.25–6.0 mm.; the posterior half somewhat pointed, the anterior notably flattened and excavated on the right side; around the cardia the liver appeared naked (not covered by the hermaphroditic gland) of (greenish) gray color, in sections it was yellowish.

The ramifications of the aorta nearly as in the typical *Dorididæ*,[1] the root of the posterior aorta still longer and the *Art. syringis renalis* stronger and more ramified. The sanguineous gland yellowish-white, rather flattened, of irregular triangular form, lobulated, about 3.5 mm. long.

The renal chamber large; the yellowish-white renal syrinx about 0.75 mm. long, its tube somewhat more than twice as long, immediately continuous with the tube on the floor of the renal chamber.

The hermaphroditic gland easily distinguishable from the liver through its more whitish color: the secondary (ovigerous) lobes rather small; in the lobes zoösperms and large oögene cells. The anterior genital mass of plano-convex heart-shape with the point down and backwards; the length about 5.0 mm. by a breadth of 4.0 and a height of 5.0 mm. The ampulla of the very thin and white hermaphroditic duct resting on the upper posterior part of the mucous gland, yellow, short and thick (4.0 mm. long by a diameter of about 1.25 mm. forming a simple ansa. The vas deferens yellowish, strong, resting upon the upper side of the genital mass with its large coils and freely descending before its anterior margin to the penis, constricted about the (fig. 9c) middle of its total length (30.0–35.0 mm.). The penis forming the end of the spermatoduct somewhat thicker, about 2.0 mm. long, somewhat curved; its lower part hollow, the rest solid and prominent in the cavity of the former as a cylindrical glans of the length of about 0.6 mm. The glans with about ten series of yellowish hooks, which from a rather large basis raised to the height of about 0.04 mm.; the continuation of the armature reaching through the interior of the glans and of the spermatoduct nearly up to the stricture of the last, but the

[1] Cf. my Malacolog. Unters. (Semper, Philipp.) Tab. XLVIII, fig. 11.

number of series here smaller, about five to eight. The spermatotheca whitish, forming an oval bag of 3.0 mm. largest diameter; the spermatocysta yellowish, of 1.3-1.5 mm. largest diameter, the ducts as in the typical *Ac. pilosa* The chief duct, too, very (about 25.0 mm.) long, rolled up in many coils, partly spiral, the diameter varying between about 0.3 and 0.75 mm.; the last fourth of the duct (vagina) with scattered black pigment, somewhat narrower and with a rather strong retractor muscle at its commencement; the interior of this duct with some few strong longitudinal folds, clothed with a cuticula, and under the same a very fine layer of round and angulated cells with a large round or oval nucleus of the diameter of about 0.4 mm. and a rather large yellow nucleolus (Pl. X, fig. 13). In the cavity of the vagina more or less sperma.[1] The mucous gland yellowish and white; the central mass (albuminous gland) yellow; the duct with scattered black pigment on the outside (also on the outside of the lower part of the penis), with the usual fold. The vestibulum genitale with black pigment on the folds, the same pigment was seen in the lowest part of the cavity of the penis and of the vagina and on the folds of the duct of the mucous gland.

A very similar animal, but "with brown mantle," was dredged by Dall in Kyska Harbor (Aleutians) in July, 1873, on sand, at a depth of nine to fourteen fathoms.

It was of large size; the length 21.0 mm., by a breadth of 11.0 and a height of 9.0 mm.; the margin of the mantle 2.0 mm. broad, the foot 6.0 mm. broad; the height of the rhinophoria and of the gill 3 mm.; the genital aperture 3.0 mm. broad. The color dirty brown on the upper side; the rhinophoria and the branchial leaves yellowish, dotted with grayish, especially on the stalk of the rhinophoria; the sole of the foot yellowish, the under side of the animal whitish; the under side everywhere with an enormous quantity of gray and black dots. The number of branchial leaves nine.

The peritoneum black-brown; the central nervous system, eyes, otocysts, as previously described. The bulbus pharyngeus of the length of 4.5 mm. by a breadth of 3.0 and a height (with the crop) of 4·75 mm.; the sheath of the radula projecting 1.25 mm.; the crop alone of the height of 2.3 mm. and 3.25 mm. broad. The lip-disk as above, the thickenings in the lowest part of the mouth 1.2 mm. long, of which nearly half freely projected. On the tongue nine rows of

[1] The length of the spermatoduct and the duct of the spermatotheca (vagina) was much more considerable than in the typical form.

plates, farther backwards eighteen developed and three younger rows, the total number thirty; the plates denticulated as previously mentioned, the height of the large plates rising to 0.7 mm.; the number of external plates four to five. The œsophageal diverticle of a largest diameter of about 3.0 mm. The pars pylorica of the intestine of about 4.5 mm. length, with higher folds than in the rest of the intestine, which had a length of about 15.0 mm.; the bag at the first part of the intestine 1.5 mm. long. The liver 12.0 mm. long by a breadth of 8.0 and a height of 6.0 mm. The sanguineous glands whitish, 5.0 mm. long by a breadth of 6.0 mm. and 2.0 mm. thick, convexo-concave, the fore-end flattened (by the buccal crop), the hinder end with two transverse furrows (produced by two coils of the spermatoduct; the anterior genital mass 8.0 mm. long by a breadth of 3.5 and a height of 7.5 mm. The ampulla of the hermaphroditic duct 5.0 mm. long, whitish. The coils of the spermatoduct and of the vagina in this individual covering the upper side of the mucous gland, and ascending to the back between the pharyngeal bulbus and the liver; a coil of the former embraced the sheath of the radula. The first part of the spermatoduct 12.0 mm. long, the last of the length of about 25.0 mm; the penis about 3.5 mm. long, the armature as usual. The spermatotheca nearly spherical, of 3.5 mm. diameter; the spermatocysta yellowish, round, with a diameter of 1.5 mm.; the chief duct (vagina) 33.0 mm. long with a general diameter of 1.2 mm.; the structure of the wall as above; the last, narrower part (from the m. retractor downwards), 5.0 mm. long. The vestibulum, as well as the inferior part of the vagina and of the penis, with very scanty black pigment.

4. **Acanthodoris cærulescens**, Bgh., n. sp. Plate XIII, fig. 6–7; Plate XIV, fig. 16.

Color paginæ superioris corporis cærulescens.

Dentes radulæ hamo per totam fere longitudinem denticulato.

Hab. Mare Beringianum (Nunivak Island).

One specimen of this species was found by Dall at the north end of Nunivak Island, Bering Sea, in July, 1874, on stony bottom, at the depth of eight fathoms.

According to Dall, the color of the living animal was bluish. The animal preserved in alcohol had the length of 14.0 mm. by a height of 5.0 and a breadth of 8.0 mm.; the length of the foot was 12.5 mm. by a breadth of 6.5 mm.; the height of the rhinophoria 2.0, of the branchial leaves 1.5 mm. The color uniformly yellowish-white, with the back of a slightly bluish hue.

The form elongate-oval. The back covered all over with irregular (the greatest height reaching about 1.5 mm.), conical, rather soft and flexible papillæ, in general larger than in the typical species. The margin of the rhinophor-holes thin, somewhat prominent, with two anterior strong tubercles and a posterior much smaller one; the stalk of the club rather low, the latter with about twenty-five to thirty leaves. The branchia consisting of nine to ten leaves, the adjacent border set with several strong tubercles; the branchial leaves quite isolated at their base, apparently simply pinnate. The anus prominent, before the same a small tubercle, behind it a much larger one. The margin of the mantle rather thin, on the upper side covered with a mass of smaller and larger papillæ and tubercles, the under side smooth. The head broad, flat, with prominent rounded, flattened tentacula. The foot broad, rounded behind.

The central nervous system as in the typical species; the buccal ganglia rounded, the commissure between them very short. The eyes with black pigment and yellow lens. The otocysts a little smaller than the eyes, with numerous otokonia of the usual form, and reaching a length of 0.03 mm. The leaves of the rhinophoria without spicula; in the axes of the organs large, molecularly calcified cells and groups of smaller calcified cells. In the papillæ of the skin of the back were no spicula at all, on their surface the usual large quantity of glandular cells; in the skin beneath the papillæ cells and groups of cells as in the case of the rhinophoria.

The mouth-tube rather wide, with strong cuticula. The bulbus pharyngeus formed apparently as in the typical species; the lip-plate composed of many rows of rather low (the height rising to about 0.02 mm.), very (fig. 6) finely striated columns. The tongue with ten rows of teeth; further back, twenty-six developed and three undeveloped rows; the total number thus thirty-nine. The lateral plates large, yellow, of usual form, with a series of denticles along nearly the whole of the inner margin of the hook (fig. 16*a*). The external plates colorless, eight in number; somewhat depressed (fig. 7, 16), obliquely rising from the cuticula of the tongue (fig. 7), of nearly equal size excepting the outermost (fig. 16*b*), which is much smaller.

The salivary glands seemed of the usual form. The œsophagus and the stomach as usual. The intestine issuing from the liver at the middle of its length on the left side, rather short. The liver of the length of about 9.0 mm. by a breadth and a height of about 4.2 mm.:

the right anterior half excavated (on account of the anterior genita mass); the color brownish-gray.

The heart and the sanguineous gland as usual, also the renal chamber and the renal syrinx.

The hermaphroditic gland by its yellowish color contrasting with the liver, clothing the under side, part of the left side, and its right anterior half. The anterior genital mass rather compressed, about 6.0 mm. long by a breadth of 2.0 mm. The ampulla of the hermaphroditic duct rather short, sausage-shaped, about 2.3 mm. long, curved and whitish. The larger part of the penis was gone, but hooks were seen in the remaining part as in the typical species. The spermatotheca rather large, bag-shaped, about 3.5 mm. long; the vagina rather wide, about 10.0 mm. long. The mucous gland white, and the albuminous gland yellowish-white.[1]

This species seems very distinct from the typical one, by its color and by the different form of denticulation of the large plates of the tongue.

POLYCERATIDÆ.

This large family, so rich in generic forms, was found represented in the northern Pacific only by two generic types, *Polycera* and *Triopha*.

POLYCERA, Cuvier.

Polycera, Cuvier, (1812?), Regne-anim., 1817, ii, p. 390.[2] Regne-anim., ed. 2, iii, p. 52.

Themisto, Oken, Lehrb. der Zool., 1815, p. 278.

Cufæa, Leach, Moll. Britann. Synopsis, 1852, p. 21.

Polycera C, Ald. and Hanc., Observ. on the genus *Polycera*, Ann. Mag. of Nat. Hist., vi, 1841, p. 337–342, Pl. IX.

Limacia, O. Fr. Müller, Zool. Dan., i, 1781, p. 65–68.[3]

Phanerobranchus, A. Frédol (Moquin-Tandon), Le monde de la mer, 1864, Pl. xii, figs. 1, 2.

[1] The anterior genital mass was so hardened and altered, that the nature of its different components could not be determined with certainty.

[2] According to a note of Hermannsen, under the genus *Themisto*, Oken, (Ind. Gen. Malacoz. primordia, ii, 1849, p. 572), the genus *Polycera* was established by Cuvier. 1812, [but this is probably a typographical error, since, under the genus *Polycera* itself, he indicates only the year 1817—Dall,] (cf., l. c., p. 314).

[3] *Limacia*, Hartm., Neue Alpina, i, 1821, p. 208 (*Arion*, Fér.).

Limbus frontalis digitatus vel tuberculatus. Branchia 5–7-foliata. Appendices dorsales (extrabranchiales) 1–3. Tentacula brevia, lobiformia.

Lamellæ mandibulares laterales fortes, sat applanatæ. Radula rhachide nuda; pleuris dentibus lateralibus hamatis duobus (margine lævi), interno minore, externo majore, et dentibus externus 4–8.

Prostata magna; pleuris ut in omnibus Polyceratis.

The genus *Polycera* was established by Cuvier (1812?), to receive the *Doris quadrilineata* of Müller and (in 1830) allied forms; a few years afterwards (1815), and not knowing the genus of Cuvier, Oken formed his *Themisto*, nearly identical with the *Polycera* of Cuvier.* The *Cufæa* of Leach (1852), is entirely congeneric with the genera of Cuvier and Oken, as is also very likely the *Phanerobranchus* of A. Frédol (Moquin-Tandon). The *Limacia* of O. Fr. Müller (1781), contains a whole series of different *Nudibranchiata*, among them the *D. quadrilineata*, and, as first-named species, the *D. verrucosa;* the name cannot therefore be employed here.

Although, through Cuvier and Alder (1841), their external characters were somewhat made known, still *Polycera*, like so many other *Nudibranchiata*, remained very superficially known, until the large monograph of Alder and Hancock,[1] that first really unveiled their external and internal structure, although Frey and Leuckart[2] had given some anatomical notices of these animals. Lately more light has been spread over the northern species of the group, through the investigations of Meyer and Moebius,[3] and of G. O. Sars.[4]

The true *Polycera* shows a form of body common to the whole family. The well-developed frontal margin is more or less curved in

* A careful search has failed to find any other ground for supposing that Cuvier described the genus *Polycera* in 1812, or at any date before 1817, so that the 1812 of Hermannsen is almost certainly merely a misprint. The name *Themisto*, of Oken, if congeneric, should therefore take precedence. —DALL.

[1] Alder and Hancock, Monogr. Brit. Nudibr. Moll., Part 2, 1846, fam. 1, Pl. 23; Part 4, 1848, fam. 1, Pl. 24; Part 5, 1851, fam. 1, Pl. 22; Part 6, 1854, fam. 1, Pl. 17 (anat. !); Part 7, 1855, Pl. 46 supplem. figs. 20, 21.

[2] Frey and Leuckart, Beitr. zur Kenntn. wirbellose Thiere, 1847, p. 66–70, taf. i, fig. 12, 13.

[3] Meyer and Moebius, Fauna der Kieler Bucht, i, 1865, p. 49–57, m. 2 taf. und taf. iv, A, B.

[4] G. O. Sars, Moll. reg. arct. Norv., 1878, p. 312, 313, Tab. xiv, fig. 14-16.

the middle, with its free margin tuberculated or digitate. The frontal veil is continued in a more or less tuberculated ridge, that limits the true back, and posteriorly ends in a single strong or in several smaller dorsal (branchial) appendices on the outside of and behind the region of the gill. The true back with longitudinal rows of more or less developed connected tubercles, sometimes forming low longitudinal ridges. The number of leaves in the club of the rhinophoria is not large. The gill is composed of a moderate number (five to seven) of leaves, which are either simply pinnate or composite (bi- or tripinnate). The tentacles are small, flattened or auriculate. The jaws or mandibular plates in form somewhat recall those of the *Æolidiidæ*, strong, flattened, sometimes with a peculiar superior process. The rhachis of the radula naked; on the pleuræ two large hook-formed lateral teeth, of which the outer is much larger than the inner; at the outside of the laterals are four to eight, somewhat flattened uncinæ. A large prostate gives the genital apparatus a particular feature; the armature of the penis is of the usual kind.

About the biological relations of *Polycera* very little is known, as usual among the *Nudibranchiata*. The spawn of the most common northern species is known, and a part of the developmental history has been investigated by Ray Lankester.[1]

A small number of species have been described by different authors in the course of years. Alder and Hancock (Monogr. part 7, 1855, p. 45, XVIII) established and rather well characterized two groups of *Polycera;* according to these authors Gray soon after (Guide I, 1857, p. 213) denominated these groups *Polycera* (typical) and *Palio*, which perhaps might be conserved as subgenera.

I. POLYCERA (stricte).

Margo limbi frontalis digitatus. Folia branchialia simpliciter pinnata; appendices dorsales (branchiales) singulæ majores.

Lamellæ mandibulares processu superiori alæformi.

1. *P. quadrilineata* (O. F. Müller). M. Atlanticum; Mediterraneum.
2. *P. horrida*, Hesse. Journ. de Conchyliol., 3 S., XIII, 4, 1873, p. 345. M. Atlanticum.

[1] Ray Lankester, Contrib. to the Developm. hist. of Moll., Philos. Trans., MDCCCLXXV, p. 29, Pl. 10, f. 1-9.

Meyer and Moebius have, moreover, given a figure of the shell of the embryo of their *Pol. ocellata* (l. c., fig. 10).

3. *P. plebeia*, Lovén. Index Moll., 1846, p. 6.[1] M. Atlanticum.
4. *P. doriformis* (Quatref.). Phanérobranche doriforme. Moquin-Tandon (*pseud.* A. Frédol) Le monde de la mer., 1864, Pl. XII, fig. 1. M. Mediterraneum.
5. *P. cantеriata* (Quatref.) Phanérobranche à chevrons. Moquin-Tandon (do) l. c., pl. XII, f. 2. M. Mediterraneum.

II. PALIO, Gray.

Margo limbi frontalis tuberculatus. Folia branchialia bi- vel tripinnata; appendices dorsales (branchiales) minores, complures.

Lamellæ mandibulares simplices (sine processu superiori).

6. *P. Lessonii* (d'Orb.). *Pol. ocellata*, A. et H. M. Atlanticum.
7. *P. pudica*, Lovén. Ind. Moll., 1846, p. 6. M. Atlanticum.
8. *P. pallida*. Bgh.. n. sp. M. Pacificum.
9. *P. dubia*, Sars. Bidr. til Söedyrenés. Naturh., 1829, p. 13. Tab. 2, fig. 5, 6. Lovén, Ind. Moll., 1846, p. 6. M. Atlanticum sept.
10. *P. ? Cookii*, Angas. Journ. de Conchyl., 3 S., IV, 1, 1864, p. 58; Pl. V, f. 6. M. Pacificum.
11. *P. ? Capensis*, Quoy et Gaim. Voy. de l'Uranie. Zool., 1824, p. 417; Pl. 66, f. 4. M. Capense.[2]

P. pallida, Bgh., n. sp. Plate XV, fig. 14; Plate XVI, fig. 1–9.

Color flavescens. Branchia sexfoliata.

Lamellæ mandibulares fere ut in *Pol. Lessonii*, sed magis elongatæ. Armatura lingualis fere ut in *Pol. Lessonii;* dentes externi 5.

Hab. Oc. Pacificum septentr.

Of this form Dall dredged a single individual in June, 1873, at Kyska Harbor (Aleutians), at the depth of ten fathoms on rocky bottom. According to Dall, the color of the living animal was "yellowish-white."

The length of the animal preserved in spirits was 7.0 mm., with a height of 4.0 and a breadth of 3.0 mm.; the height of the branchial leaves about 1.0 mm., also that of the rhinophoria; the breadth of the

[1] "Viridifusca, sulphureo maculata, papillis frontis 10, branchiali utrinque una postica majore; 11 mm. Bohus," Lovén.

This, as well as the other new *Polyceræ* of Lovén, has not since been seen (Cf. G. O. Sars, Moll. reg. arct. Norv., 1878, p. 313).

[2] Of the three (not too naturally represented) "Polyceræ" of A. Frédol (Moquin-Tandon), the one (l. c. Pl. XII, fig. 6) seems to be the *Pol. Lessonii*, the other two (fig. 3, 4) belong undoubtedly to the genus *Thecacera*.

foot 2.0 mm. The color of the animal whitish, that of the rhinophoria and the branchial leaves more yellow; the margin of the foot white.

The form as usual. The head rounded, with a prominence on the upper lateral part; the mouth a vertical slit. The margin of the rhinophor-grooves plain. The stalk of the rhinophoria nearly as high as the club, cylindrical; the club rather flattened, with about fifteen leaves; before the rhinophoria a low transverse frontal veil with scarcely more than two prominences; the veil continued backwards as a rather indistinct prominent line on each side of the smooth rounded back; the pericardial region a little prominent; behind the middle of the length of the back, the gill with six tripinnate leaves in a slight curve; behind them the quite low anal nipple, and towards the right side the renal pore; behind the gill a little flattened space with a slight crest on each side with three papillæ. The sides of the body rather high. In the region of the anterior angles of the foot the genital papilla with the everted penis (without its recurved point, 0.75 mm. high), and below it a folded lamella, the duct of the mucous gland. The foot rather narrow, of nearly the same breadth; the rounded anterior angles somewhat prominent; a fine furrow in the anterior margin.

The intestines indistinctly appearing through the walls of the body. The peritoneum colorless, nearly without spicula.

The central nervous system (fig. 1) very depressed; the cerebral ganglia of rounded-triangular form, a little larger than the more rounded visceral (fig. 1*a*); the pedal ones more pyriform, a little larger than the last; the (proximal) olfactory ganglia bulbiform, not quite as large as the buccal ones, which were (fig. 1*b*) of rounded form, connected by a not very short commissure; the gastro-œsophageal ganglia of about one eighth of the size of the former, rounded.[1] The three inferior (subcerebral, visceral, and pedal) commissures (or at least the visceral one) free.

The eyes (fig. 1) short-stalked, with black pigment and pale yellowish lens. The otocysts (fig. 1) in their usual place, very short-stalked, with about eighty otokonia of the ordinary kind. In the stalk of the rhinophoria some scattered yellowish thick spicula, of the same kind as in the skin of the back; none, on the contrary, in the leaves of the club. In the skin some scattered, yellowish, thick, straight or curved spicula, mostly of about 0.15–0.3 mm. in length, and of the usual form. In the interstitial tissue very few larger spicula.

[1] In the other species of *Polycera* I have examined, I never saw gastro-œsophageal ganglia, nor any in *Euplocamus* or in *Plocamopherus*.

The oral tube whitish, of about 1.0 mm. length, wide. The bulbus pharyngeus clear brownish-yellow, somewhat pyriform, with oblique flattened posterior end, in length about 1.6, by a height of nearly 1.3, and a breadth of 1.5 mm.; the sheath of the radula a little prominent downwards, and to the left from the hindermost part of the under side of the bulbus. The lip-disk clothed with a brownish-yellow cuticula, that is continued into the two mandibular plates behind the lip-disk at the entrance of the oral cavity, the form of the mandible could not be determined with certainty; a yellowish cuticula clothes the rest of the cavity. The tongue with ten rows of plates, further backwards six developed and two younger rows; the total number eighteen.[1] The rhachis (fig. 2) not very narrow. The plates yellow. The length of the first plate about 0.11, of the second 0.20, of the inmost of the external plates 0.14, of the following 0.12, 0.10, 0 08 and 0.06 mm. (all from the hinder part of the sheath). The first lateral plate (fig. 2*aa*, 5, 6) formed somewhat as in the *P. Lessonii*, the hook still smaller; the second of the same form, but larger (fig. 2*bb*, 3), the hooks much larger, especially the anterior, which is broader and excavated (fig. 7). More outwards five external plates (fig. 2*cc*), all with a crest, which is larger in the two innermost; adjoining the outermost of these plates several longitudinal folds of the lingual cuticula, which sometimes simulate one to two plates more (fig. 2).

The salivary glands whitish, elongate. The œsophagus rather wide, the stomach inclosed in the liver. The intestine appearing at the middle of the length of the liver a little to the left, at the bottom of a deep and large cavity in the upper side of the liver; the pyloric part

[1] According to Alder and Hancock (Monog. Part VII, 1855, Pl. 41 supplement, fig. 20, 21), the number of rows was fifteen in the *Polycera quadrilineata*, sixteen in the *P. ocellata*, thirteen in the *P. Lessonii;* Alder and Hancock saw (l. c.) four external plates in the *Pol. quadrilineata*, five in *P. ocellata*, and six in *P. Lessonii.* Meyer and Moebius saw five to seven external plates in their *Polycera ocellata*, whilst the number of rows (l. c. Pl. 50) is noted as thirteen to fifteen; in the *P. quadrilineata* they found four to five external plates and twelve to thirteen rows. In four specimens of *Pol. quadrilineata* I saw six to eight rows on the tongue, more backwards six to seven developed, and one not quite developed row; the total number of rows was fourteen to fifteen. In all specimens there were but four external plates. In four specimens of *Pol. Lessonii* I saw nine to ten rows on the tongue, more backwards eight to seven or five developed, and a single not developed row; the total number of rows was sixteen to eighteen. In all the specimens there were eight external plates.

of the intestine rather wide, its curve reaching to the bulbus pharyngeus. The liver about 5.0 mm. long by a breadth of 3.5 and a height of 3.25 mm.; the form conical, the posterior end rounded, the anterior much broader, flattened and adjoining another flattening on the inferior part of the right side of the organ; the color was yellowish.

The sanguineous gland of quadrangular form, of a diameter of about 1.5 mm., whitish.

The hermaphroditic gland with its yellowish-white lobes covering nearly the whole surface of the liver: in the lobes large oögene cells. The anterior genital mass of the length of about 4.0 mm. by a height of 3.0 and a breadth of 1.5 mm. The ampulla of the hermaphroditic duct resting on the inferior margin of the genital mass, whitish, straight, of the length of 3.0 mm by a diameter of about 0.5 mm. At the anterior end of the ampulla a flattened body (prostate) that freely projects before the anterior margin of the rest of the genital mass; it was of about the same length as the ampulla, but nearly twice as broad; the cavity of the organ rather large and the walls rather thin. The prostate slopes gradually into the thin but strong spermatoduct, which is about 6.0 mm. long and terminates in the penis, which was short, conical (fig. 8*a*, 9), about 0.75 mm. long, and terminated in a somewhat flexible, yellowish glans (fig. 8, 9, 14), of the length of about 0.37 mm. by a diameter at the base of about 0.09, and at the point of 0.037 mm.; through the largest part of its length it was covered with (in all about twelve) series of small chitinized crests, which did not surpass the height of about 0.0025 mm. (fig. 14): the armature only continued through a short part of the interior of the spermatoduct. The spermatotheca spherical; the spermatocysta pyriform, filled with sperma. The cordate mucous gland whitish and yellowish-white (fig. 8*b*).

This species approaches to the *Pol. Lessonii*, but seems even different in color from that and the other Atlantic forms, and also differs in the slight development of the frontal veil and of the lateral crests of the back, as well as in the number of the external plates of tongue, and[1] in the nature of the armature of the penis.

[1] The armature of the penis of *Polyc. quadrilineata* (hitherto the only species in which an armature has been described) as figured by Friele and Hansen (l. c. Tab. II, fig. 3) is very different from that of the Pacific species, and that difference has been confirmed by my examination of typical specimens.

TRIOPHA, Bergh, n. gen.

Forma corporis fere ut in Triopis, sicut quoque margo frontalis; margo dorsalis appendicibus nonnullis nodosis vel breve ramosis. Tentacula compresso-poculiformes (auriformia); rhinophoria retractilia, clavo perfoliato. Branchia quinquefoliata, foliis tripinnatis.

Os lamellis duabus fortioribus e baculis minutis compositis armatum. Lingua rhachide dentibus spuriis (4); pleuris dentibus lateralibus 3–4 (corpore processu alæformi et hamo applanato instructis) et serie dentium externorum (10-11) armatis.

Prostata?

This interesting form, that forms a link between *Polycera* and *Triopa* on one side, and the *Euplocami* on the other, approaches more nearly to the latter than to the former.

In the exterior, the *Triophæ*[1] resemble the *Triopæ*, but still differ in some points sufficiently. The appendices of the back are more composite; the tentacles seem different from those of the *Triopæ* (which have them folded lengthwise and obtuse at the end; see for comparison, Pl. XV, fig. 12); they are compressed cup-shaped or auriculate. The gill contains five leaves. Whilst the *Triopæ* want an armature of the true mouth,[2] the *Triophæ* are provided with two strong plates (composed of densely set staffs). Whilst the rhachis of the tongue in the *Triopæ* is naked, the *Triophæ* show four false plates, ("bosses" of Dall, simple thickenings of the base membrane of the radula), here; instead of the two peculiarly formed lateral plates on the pleuræ in the *Triopa*,[3] the *Triophæ* have three or four lateral plates (with a wing-like process of the body and a depressed hook); with, on the outside of these, a series of (ten to eleven) uncinal plates, nearly as in the *Triopæ*. After all, the *Triophæ* are closely allied to the *Colgæ*,[4] and essentially differ from these

[1] Having at first and rather superficially examined the exterior, I first regarded the animal as a *Triopa*, and called it so [s. part I, p. 128 (72), and the Plates (XIV, XV)].

[2] See for comparison Pl. XIII, fig. 19.

[3] See for comparison Pl. XIV, fig. 21, 22.

[4] The diagnosis of the *Colgæ* would be:

Forma corporis fere ut in Triopis. Vaginæ rhinophoriales calyciformes obliquæ; rhinophoria retractilia, clavo perfoliato. Tentacula auriformia.

only in the armature of the tongue, which in the *Colgæ* exhibits only a single series of (false) rhachidian plates and (on each side) two lateral plates in form approaching those of *Polycera*. The nature of the prostate is unknown; the armature of the penis not differing much from that ordinary in the large group of the *Polyceratidæ*.

Although somewhat approaching to the *Euplocami* in the form of the appendices of the back, in the armature of the true mouth and of the pleuræ of the tongue, the *Triophæ* still entirely differ in the form of the tentacles, in the number of the branchial leaves and very likely in the nature of the prostate.

The *Triophæ* have hitherto been only found in the Pacific Ocean.

1. *Tr. modesta*, Bgh. n. sp. Oc. Pacificum.
2. *Tr. Carpenteri*, Stearns. Proc. of the Cal. Acad. of Sci., April 7, 1873, p. 2, fig. 2. Oc. Pacificum (California).

Tr. modesta, Bgh. n. sp. Pl. XIV, fig. 17-20; Pl. XV, fig. 1-10.

? *Triopa Carpenteri*, Stearns. l. c. p. 2, fig. 2,

Color e flavido albescens. Appendices dorsales paucæ; folia branchialia 5.

Hab. Oc. Pacif. septentr.

Of this form Dall has obtained a single individual at Yukon Harbor (Shumagins), in August, 1874, at a depth of six to twenty fathoms, on a bottom of sand and stones. The color of the living animal was, according to Dall, "yellowish-white."

The animal preserved in spirits was of whitish color; the dorsal appendices, the gill and the rhinophoria more yellowish. The length of the animal 16.0 mm., by a height of 7.0 and a

Dorsum papilligerum, præsertim margo frontalis et dorsalis. Branchia pauci (4-5) foliata.

Mandibulæ triangulares, fortes. Radula fere ut in Polyceratis, dentibus lateralibus (2) et externis (7), sed præterea dentibus medianis (spuriis) instructa.

Merely one species of the genus is yet known, one of the first described *Nudibranchiata*, the *Doris lacera* of Abildgaard (Zool. Dan., IV, 1806, p. 23, Tab. CXXXVIII, fig. 3, 4), which has been found too on the coast of America (Cf. Verrill, notice of recent addit. to the Mar. Fauna of North Am., XXXVIII. Amer. Jour. of Sc. and Arts, XVI, 1878, p. 211).

breadth of 5.5 mm.; the height of the branchial leaves 1.25, of the rhinophoria 2.0 mm.; the breadth of the foot 3.5 mm.

The form as usual. The head flattened in front, semilunar; the tentacles compressed-cup-shaped, rather short (about 1.0 mm. long), truncated at the end, longitudinally folded and open at the outer side. The frontal margin not projecting much, with many smaller and larger short digitations and crenulations; in front in the median line were two small conical papillæ before the region of the rhinophoria. The margin of the rhinophor-holes somewhat projecting, smooth: the (deeply retracted) rhinophoria with rather short stalk; the club with thirty-five to forty rather broad and thin leaves.

The back rounded over from side to side, without certain limits between it and the sides of the body. At the lateral parts of the back (on each side) five appendices; the first standing a little behind the end of the frontal margin; the next about in the middle of the space between the first and third; this last a little before the region of the gill; farther backwards were also two similar ones. The appendices were club-shaped, with simple or composite nodosities spread upon their bodies, and especially at their bases; the third was the largest, reaching the height of about 2.5 mm.; all the others a little smaller, and all of about the same size. Much smaller, conical or club-formed simple papillæ were scantily and irregularly scattered on the back. The gill consisting of five strong, tripinnate, quite separate leaves, a single anterior and two lateral pairs. The anal nipple nearly in the centre of the posteriorly open branchial circle, a blunted, nearly cylindrical prominence, about 0.5 mm. in height; at its base on the right side and a little forwards was the very distinct renal pore. The sides of the body rather high and smooth; the genital opening a short longitudinal slit lying rather forwards, with two openings at its bottom. The foot not very narrow, of nearly the same breadth throughout its whole length; the anterior border emarginated in the middle, with a fine line.

The intestines did not shine through the integuments. The peritoneum was colorless, without spicula.

The central nervous system (Pl. XV, fig. 1) flattened; the cerebro-visceral ganglia (fig. 1*a*) reniform, a little narrower at the fore-end: the pedal ones (fig. 1*bb*) rounded, scarcely larger than the visceral; the large commissure (fig. 1) as usual; small optic ganglia (fig. 1). The proximal olfactory ganglia (fig. 1c) bulbiform, the n. olfactorii not very long; the distal olfactory ganglia inverse pyriform. The buccal ganglia (fig. 1*dd*) ovoid, connected nearly without commissure; the gastro-œsophageal ganglia small (fig. 1*e*), with one large cell.

The eyes (fig. 1) with coal-black pigment and yellow lens.[1] The otocysts at the usual place on the under side of the cerebro-visceral ganglionic mass, crowded with otokonia of the usual kind (fig. 1). In the leaves of the rhinophoria no spicula; in the axes and in the stalk, on the contrary, spicula of the same kind as in the skin or often larger. The skin with few and small spicula and calcified rounded cells, here and there lying in groups. The marginal dorsal appendices covered all over with above-mentioned nodosities; at their points perhaps a similar (but empty) bag as in the typical species (Cf. Pl. XIII, fig. 16. 17).

The anal tube large, 3.0 mm. long. The bulbus pharyngeus strong, of the length of 4.0 by a height of 3.0 and a breadth of 3.3 mm.; the radula-sheath projecting about 1.0 mm. from the hinder part of the under side of the bulbus. The lip-disk rather convex, with vertical oral slit (Pl. XV, fig. 2), clothed with a pale yellow cuticula, that behind the oral slit on each side is continued in a triangular, brownish-yellow lip-plate of a greatest breadth of 1.0 mm (fig. 3), narrow at the inferior end, broader at the superior, and composed of simple, somewhat curved, erect staffs (fig. 4, 5) about 0.18 mm. in height (fig. 4). The tongue broad; in the amber-yellow radula, thirteen rows of plates, further backwards in the sheath, six developed and two younger rows; the total number thus twenty-one. The three foremost rows of the tongue very incomplete, reduced to the outermost (four to five, six to seven, nine to eleven) uncinal plates. The rhachis rather broad, bearing two quadrangular thickenings of the cuticula (Pl. XV, fig. 6*a*) of the length of about 0.18-0.2 mm., more thickened and yellowish in the anterior margin, otherwise colorless. At the outer side of these median plates is a somewhat shorter and narrower plate (fig. 6*bb*), of yellowish color; in the posterior rows (Pl. XIV, fig. 20) much broader. The three succeeding plates brownish-yellow, hook-shaped, all nearly of the same form and of the same but outwardly slowly

[1] Alder and Hancock (l. c. part VI) also saw small optic ganglia in the *Triopa clavigera*.

decreasing size (Pl. XV, fig. 6*cd*); the fourth lateral plate, on the tongue especially, with a small hook (fig. 7*a*) that is more developed backwards, and in the four youngest rows is developed quite (Pl. XIV, fig. 17) as in the three plates mentioned. On the lateral parts of the pleuræ ten to eleven external (uncinal) plates, the four to five interior (fig. 7, 8*ab*, 10; 17*bc*) with a more developed crest, the rest (fig. 7*b*) narrower.

The salivary glands (Pl. XV, fig. 11*a*) nearly as long as the duct (fig. 11*b*); both together about 5.5 mm. long, descending along the whole back side of the bulbus pharyngeus; the gland whitish, smooth.

The œsophagus rather long (6.5 mm.), and wide especially in the posterior part (diameter 2.0 mm.), entering into the inferior part of the liver; with rather strong and numerous folds; the contents (as in the intestine) spongiary masses and different *Radiolaria* of a diameter of 0.09 mm. The intestine issuing from the liver a little before the middle of the upper side of this organ; the anteriorly proceeding part reaching the anterior margin of the liver and about 4.5 mm. long by a diameter of 1.5 mm.; the retrocessive part 7.0 mm. long by a diameter of 0.75 mm. The liver divided by a deep furrow from the right margin into two halves of nearly equal size; 6.0 mm. long by a breadth of 3.75 and a height of 3.4 mm.; the posterior extremity rounded; the anterior half of the inferior side obliquely flattened; the color yellowish-gray; the cavity of the interior rather small.

The pericardium of oval form, large, having the length of 3.5 mm. The sanguineous gland whitish, of the length of 2.5 mm. by a breadth (at the anterior end) of 2.5 mm. The renal syrinx short-pyriform; the tube of the organ strong.

The hermaphroditic gland not much developed, paler than the liver, with large oögene cells. The anterior genital mass small, about 1.5 mm. long by a height of 0.75 and a breadth of about 0.5 mm. The ampulla of the hermaphroditic duct yellowish, rather long, forming corkscrew-like windings. The spermatoduct not long, passing into the short penis. This, with its armature of very minute hooks, the spermatotheca, the spermatocysta and the vagina, as far as could be determined, as in the typical *Triopa*.[1] The gland whitish.

[1] See for comparison, Pl. XV, fig. 13.

This species may perhaps be the *Triopa Carpenteri* of Stearns; it has, like that, five branchial leaves, and does not differ much in the number of the dorsal appendices (six) or the form of the frontal margin; but the dorsal nodosities of the last species are orange-colored, and the rhinophoria, the dorsal appendices, and the branchial leaves tipped with orange. Through the great kindness of Mr. Dall I have seen a drawing of the animal of Stearns, from specimens secured after those he had described, but they do not give more details than the original description; and Stearns seems not to possess the original specimens, which very likely are lost forever. On the other side, it must be remembered that Sars (Beretn. om en i Sommeren, 1849, foretagen zoolog. Reise i Lofoten og Finmarken, 1851, p. 74) found "the young individuals of *Triopa lacera* (M.) entirely white, also on the tentacles and gills, merely the liver shines brownish through the skin."

EXPLANATION OF THE PLATES.

An asterisk denotes that the drawing is by camera lucida, the fraction denotes the magnification.

The serial numbers of the plates (Part I, plates i–viii, Part II, plates ix–xvi) are solely referred to throughout the text. As Part II appears in another volume of the Proceedings of the Academy, the plates of Part II have been for that reason renumbered with a second set of numbers, Plate ix being Plate i, Plate x being Plate ii, etc., in the new volume. The serial numbers referred to in the text, follow the new numbers for Part II in parentheses throughout this explanation.

Plate I (IX).

Jorunna Johnstoni (A. and H.).

1. *a*, stalk of the (*b*) *gangl. genitale; c*, *gangl. genit. secundarium*,* $\frac{200}{1}$.
2. Granules of the back, stiffened by spicula,* $\frac{200}{1}$.
3. Part of the middle of the radula, with the two innermost lateral plates; *a*, rhachis,* $\frac{350}{1}$.
4. The hook of a plate from the back,* $\frac{350}{1}$.

5. Outer part of two series of plates with 8 plates,* $\frac{350}{1}$; *aa*, outermost.
6. Outer part of another series with 3 plates,* $\frac{350}{1}$.
7. *a–b*, vagina; *c*, *gland. hastatoria;* *d*, opening of the bag of the spur; *e*, spermatoduct; *f*, penis,* $\frac{55}{1}$.
8, 9. Spermatotheca; *c*, its chief duct; *d*, *gland. hastatoria;* *b*. spermatocysta; *e*, duct to the mucous gland,* $\frac{55}{1}$.
10. *a*, Duct of the *gland. hastatoria;* *b*, the bag of the spur; *c*, opening of the bag,* $\frac{200}{1}$.
11. *a*. spermatoduct; *b*, opening of the bag at the bottom of the penis; in the interior a dart (?),* $\frac{350}{1}$.

Adalaria proxima (A. and H.).

12. Tubercles of the back.
13. A part of the rhachis from above; *a*, median plates; *bb*, large lateral plates,* $\frac{750}{1}$.
14. Part of the radula, obliquely, from the side, the hooks of the large lateral plates of both sides,* $\frac{750}{1}$.
15. Two series of (9) external plates; *a*, the innermost; *b*, the outermost,* $\frac{750}{1}$.

Adalaria albopapillosa (Dall).

16. Part of the surface of a tubercle of the back,* $\frac{350}{1}$.

Adalaria pacifica, Bergh.

17. *a*, median plate; *b*, large lateral plates from the side,* $\frac{350}{1}$.

Lamellidoris muricata (O. Fr. Müller).

18. The vesica-fellea; *a*, its duct.

Plate II (X).

Adalaria pacifica, Bergh.

1. Median pseudo-plate (or boss), from the upper side,* $\frac{350}{1}$.
2, 2. Part of the radula, with series of (5–7) lateral plates; *a–a*, 1–2 complete rows of (15) external plates, and 1–2 incomplete rows; *bb*, innermost plates of the row; *cc*, outermost,* $\frac{350}{1}$.
3. Outer part of a row with 9 erect plates; *a*, innermost,* $\frac{750}{1}$.

Adalaria virescens, Bergh.

4. *a*, œsophagus, with its dilatation; *b*, salivary gland; *c*, its duct.
5. *Ganglion penis*,* $\frac{200}{1}$.

Adalaria Lovéni (A. and H.).

6. Median part of the radula from above, with (*aa*) large lateral plates; *bb*, innermost part of two rows of external plates, with 1–5 plates,* $\frac{350}{1}$.
7. Large lateral plate, from the side,* $\frac{350}{1}$.
8. Piece of the left part of the radula;* $\frac{750}{1}$ *a*, two median pseudo-plates or bosses; *b*, large lateral plates; *c*, two incomplete rows, with 6–7 plates.

Adalaria albopapillosa (Dall).

9. *a*, (2) median pseudo-plates; *bb*, (2–3) large lateral plates of both sides,* $\frac{750}{1}$.
10. *a*, (3) median pseudo-plates; *bb*, (2–4) large lateral plates of both sides; *c*, innermost part of three (right) rows of external plates, with 3–4 plates; *d*, (left) row of 7 external plates,* $\frac{750}{1}$.
11. Four outermost plates of a row; *a*, outermost,* $\frac{750}{1}$.

Acanthodoris pilosa (O. Fr. Müller).

12. End of the everted penis; *a*, opening,* $\frac{350}{1}$.
13. Epithelium of the vagina,* $\frac{350}{1}$.

Acanthodoris pilosa, var. *albescens* (*Pacifica*).

14. *a*, anterior margin of the foot; *b*, edge of the tentacle.
15. *Ganglion genitale* from the penis,* $\frac{100}{1}$.

Plate III (XI).

Acanthodoris pilosa (Müller).

1. Three external plates; *a*, outermost,* $\frac{350}{1}$.

Acanthodoris pilosa, var. *albescens*.

2. The genital opening with its everted margin; *a*, the two foremost apertures.

Lamellidoris bilamellata (L.) var. *Pacifica.*

3. Part of the branchial area with (*aa*) some branchial leaves; *bb*, some of the larger surrounding tubercles. In the centre the anal nipple, the renal pore and interbranchial tubercles.
4. The sucking crop, from the edge.
5. The half of the same, from the inside; *a*, stalk.
6. *a*, *spermatotheca*; *b*, *spermatocysta*; *c*, duct of the last; *d*, duct to the mucous gland; *e*, vagina.
7. *a*, two median pseudo-plates; *b*, a lateral plate; *cc*, three external plates,* $\frac{750}{1}$.
8. External plate from the side,* $\frac{750}{1}$.
9. Two of the foremost lateral plates with blunted end,* $\frac{750}{1}$.

Lamellidoris muricata (Müller).

10. *a*, Median pseudo-plate shining through the left of the lateral plates, *bb*; *c*, three external plates,* $\frac{750}{1}$.
11. *aa*, Basal edge of three lateral plates; *b*, external plates,* $\frac{750}{1}$.
12. *a*, Glans penis; *bb*, præputium; *c*, spermatoduct,* $\frac{100}{1}$.

Lamellidoris varians, Bergh.

13. Lateral plate from the side,* $\frac{750}{1}$.
14. Median pseudo-plate, from above,* $\frac{350}{1}$.

Adalaria Pacifica, Bergh.

15. Innermost part of two rows of external plates,* $\frac{750}{1}$; *a*, two innermost; *b*, the third failing (in the anterior row); *c*, eighth.

Plate IV (XII).

Acanthodoris pilosa (O. F. Müller), var. *purpurea.*

1. Labial disk, with (*a*) the lancet-formed blades projecting in the lowest part of the mouth proper.
2. The lancet-formed blades (*a*) with the adjoining part (*b*) of the armature of the mouth,* $\frac{100}{1}$.
3. *a*. The right lancet-formed blade; *b*, the adjoining part of the armature,* $\frac{350}{1}$.
4. Elements of the armature,* $\frac{750}{1}$.
5. Lateral plate, from the side,* $\frac{350}{1}$.

6. The hook of a plate, from the side.* $\frac{350}{1}$.
7. Salivary gland; *a*, duct; *b*, posterior end.
8. *a*, *pars pylorica intestini; b*, *vesica fellea; c*, *intestinum descendens.*
9. Part of the *vas deferens*, with its stricture,* $\frac{100}{1}$.

Acanthodoris pilosa (M.) var. *brunnea albopapillosa.*

10. *ab*, Lancet-formed blades from the under side,* $\frac{100}{1}$.
11. *a*, Part of left; *b*, of right lancet-formed blade; *c*, adjoining part of the armature of the mouth,* $\frac{750}{1}$.
12. *aa*, Upper part of three lateral plates; *bb*, two series of external plates; from the sheath of the radula,* $\frac{350}{1}$.

Acanthodoris pilosa (M.) var. *albescens.*

13. Elements of the armature of the mouth,* $\frac{750}{1}$.
14. Isolated element,* $\frac{750}{1}$.
15. Upper part of a lateral plate, from the outside,* $\frac{350}{1}$.
16. Upper part of a lateral plate, from the inside,* $\frac{350}{1}$.

Plate V (XIII).

Lamellidoris varians, Bergh.

1. The central nervous system, obliquely, from the under side, * $\frac{55}{1}$; *a, ganglia cerebro-visceralia; bb, ganglia pedalia; c, gangl. penis* and *gangl. genitale; d, ganglia buccalia; ee, ganglia gastro-œsophagalia.* The eyes and the otocysts visible.

Acanthodoris pilosa (M.), var. *albescens.*

2. The bulbus pharyngeus, from the side; *a*, cuticula and the lancet-formed blades; *bb, mm. retractores bulbi; c*. the sucking-crop; *d*, salivary gland, above this the right buccal and gastro-œsophageal ganglion; *e*, the sheath of the radula *f*, the crop of the œsophagus; *g*, continuation of the œsophagus.
3. Lateral plates, from the outside,* $\frac{200}{1}$.
4. Part of the armature of the spermatoduct, with its hooks,* $\frac{35}{1}$

Acanthodoris pilosa (M.).

5. *a*, spermatotheca; *b*, spermatocysta; *c*, duct to the mucous gland; *dd*, duct to the vagina.

Acanthodoris cærulescens, Bergh.

6. Part of the armature of the mouth,* $\frac{750}{1}$.
7. External plates, from the side;* $\frac{750}{1}$ *a*, innermost.

Chromodoris Dalli, Bergh.

8. The upper part of a branchial leaf,* $\frac{100}{1}$.
9. Part of the lip-plate, from above,* $\frac{750}{1}$.
10. Elements of the lip-plate,* $\frac{750}{1}$.
11. Part of the rhachis, with three (bosses or) false plates,* $\frac{750}{1}$.
12. *a*, false plate, obliquely, from the side,* $\frac{750}{1}$.
13. The 13th plate, from the side,* $\frac{750}{1}$.
14. The 9th plate, from the side,* $\frac{750}{1}$.

Triopa clavigera (O. Fr. Müller).

15. Tubercles of the back.
16. Vertical section of one of the appendices of the back; *a*, bag at the point.
17. Elements of this last bag.
18. Spicula of the skin.*
19. Lowest part of the mouth, with its cuticula; *a*, the free margin,* $\frac{200}{1}$.
20. Hindermost part of the bulbus; *a*, tongue; *b*, sheath of the radula.

Plate VI (XIV).

Chromodoris Dalli, Bergh.

1. The buccal (*a*) and gastro-œsophageal (*b*) ganglia,* $\frac{100}{1}$.
2. Part of the median portion of the radula; *a*, false plates, on each side the 2–3 innermost (lateral) plates,* $\frac{750}{1}$.
3. Outer part of two series of plates with 11 plates; *a*, outermost; *b*, eighteenth,* $\frac{750}{1}$.
4. *a*, *spermatotheca*; *b*, *spermatocysta*; *c*, duct to the vagina; *d*, duct to the mucous gland,* $\frac{55}{1}$.

Chromodoris Californiensis, Bergh.

5. Hinder part of the body, from the under side, with 6 knots on the mantle-margin; *a*, foot,* $\frac{750}{1}$.
6. Upper median part of the true mouth,* $\frac{750}{1}$.
7. Part of 4 series of hooks of the lip-plate, from above,* $\frac{750}{1}$.
8–10. Elements of the same, in different positions,* $\frac{750}{1}$.
11. Three innermost plates; *a*, the first,* $\frac{750}{1}$.
12. One of the largest plates,* $\frac{750}{1}$.
13. Hook of 3 larger plates, obliquely, from the foreside,* $\frac{750}{1}$.
14. Four outermost plates; *a*, outermost,* $\frac{750}{1}$.
15. Two irregular outermost plates; *a*, outermost,* $\frac{750}{1}$.

Acanthodoris cærulescens, Bergh.

16. Series of plates; *a*, two lateral plates; *b*, the outermost of the external plates,* $\frac{200}{1}$.

Triopha modesta, Bergh.

17. Part of one of the hindermost series of plates (in the sheath), with (*a*) 4 lateral plates and (*b*, *c*) 2 external plates,* $\frac{200}{1}$.
18. *a*, second and *b*, third large lateral plates, from above and from the back,* $\frac{200}{1}$.
19. *a*, fourth; *b*, fifth plate (as in fig. 18 from the tongue),* $\frac{200}{1}$.
20. Outer false plate of the rhachis (from the sheath),* $\frac{350}{1}$.

Triopa clavigera (M.).

21. *a*, second lateral plate; *b*, two external plates,* $\frac{750}{1}$.
22. First lateral plate,* $\frac{350}{1}$.

Plate VII (XV).

Triopha modesta, Bgh.

1. Central nervous system,* $\frac{55}{1}$; *a*, *ganglia cerebro-visceralia*; *bb*, pedal ganglia; *c*, *ganglia olfactoria proximalia*; *dd*, buccal ganglia; *e*, *gangl. gastro-œsophagal.*
2. The labial disk with the true mouth.
3. Upper commissure of the lip-plates,* $\frac{55}{1}$.
4. Elements of the lip-plate,* $\frac{350}{1}$.
5. Upper ends of two elements,* $\frac{750}{1}$.

6. Median part of a series of the teeth; *a*, (false) median plates of the rhachis; *bb*, external plate of the same; *cc*, first lateral plate; *d*, third lateral plate,* $\frac{350}{1}$.
7. Continuation of the former; *a*, fourth plate; *b*, outermost plate,* $\frac{350}{1}$.
8. Four (inner) uncinal plates; *a*, the second; *b*, the fifth,* $\frac{350}{1}$.
9. First lateral plate,* $\frac{350}{1}$.
10. Seventh and eighth external plates,* $\frac{350}{1}$.
11. Salivary gland; *a*, gland; *b*, duct,* $\frac{55}{1}$.

Triopa clavigera (M.).

12. Tentacle.
13. Part of the armature of the penis.* $\frac{750}{1}$.

Polycera pallida, Bergh.

14. The glans penis,* $\frac{750}{1}$.

Plate VIII (XVI).

Polycera pallida, Bergh.

1. Central nervous system, from the upper side,* $\frac{55}{1}$; *aa*, visceral ganglia; *b*, *ganglia buccalia* and *gastro-œsophagalia*.
2. Part of the radula with two rows; *aa*, interior; *bb*, exterior lateral plates; *cc*, uncinal plates,* $\frac{350}{1}$.
3. Exterior lateral plate, from the side,* $\frac{350}{1}$.
4. Under side of the two lateral plates:* *aa* and *b*, as in fig. 2, * $\frac{350}{1}$.
5. First lateral plate, from the side,* $\frac{350}{1}$
6. The same, from above,* $\frac{350}{1}$.
7. Hook of the second lateral plate,* $\frac{350}{1}$.
8. Genital papilla and everted penis with its glans; *b*, prominent fold of the duct of the mucous gland.
9. Glans of the penis, with the end of (*b*) the spermatoduct,* $\frac{350}{1}$; *a*, point of the glans.

Archidoris Montereyensis (Cooper).

10. Large lateral plate, from the side,* $\frac{350}{1}$.
11. Outer part of two series of plates with 4 plates; *aa*, outermost,* $\frac{350}{1}$.

Aphelodoris Antillensis, Bergh.

(Cf. Malakozoölog. Blätter, N. S., i, 1879, p. 107–113).

12. *a, ganglia buccalia*, with *b, ganglia gastro-œsophagalia; c*, secondary ganglion,* $\frac{200}{1}$.
13. Median part of two series of plates; *aa*, innermost; *bb*, second plates,* $\frac{750}{1}$.
14. A large lateral plate,* $\frac{750}{1}$.
15. Outermost double plates of two series,* $\frac{750}{1}$.
16. Outer part of two series with two plates; *aa*, outermost,* $\frac{750}{1}$.
17. The sixth plate from the outer margin of the radula,* $\frac{350}{1}$.
18. Outer part of three series with 3 plates; *a*, outermost,* $\frac{350}{1}$.

Polycera Holbölli (Möll.).

19. The genital papillæ, from the front.
20. The same, from the side.
21. First lateral plate, from above,* $\frac{350}{1}$.

JANUARY, 1880.

ERRATA FOR PART I.

On account of the inability of the author to read the proofs, and from certain obscurities in the manuscript, some errors crept into the first part of this paper, and the arrangement of the paragraphs was somewhat confused by the printer.

The delicacy and beauty of the plates in their original state, having been destroyed by the printer, the present ones have been steel-surfaced, to avoid, if possible, a similar misfortune.

The specific name *Californiensis* (*Chromodoris*) was substituted in the printed text for *Calensis*, which appeared on the plate and in the manuscript under the idea that the latter was intended merely as an abbreviation.

The following list of errata has been received from the author: it is believed that the present concluding part of the paper is much less in need of such corrections.

Page 128 (72), line 15: *for Triopa modesta*, B., *read Triopha modesta*, B.
" 129 (73), line 22: *for* mandibulæ *read* . Mandibulæ.
" 130 (74), line 2: *for* genus *read* penis.
" 132 (76), line 30: a comma to be put before the parenthesis, and the comma after the parenthesis to be cancelled.

Page 135 (79), line 11 : *for* dentibus medianis denticulati *read* dentibus medianis denticulatis.
" 135 (79), line 18 : *for* caducous *read* not caducous.
" 135 (79), line 19 : a semicolon is needed before "the foot."
" 136 (80), line 5 : the comma after "laterales" to be cancelled.
" 136 (80), line 17 : a comma is needed after "1, 5"; the comma after "rhinophoria" to be cancelled.
" 138 (82), line 5 : *for* Plate I. fig. 9, *read* Pl I. fig. 9-12.
" 140 (84), line 39 : *for* (fig. 11, one to four) *read* (pl. I. f. 11 ; pl. II, f. 1-4).
" 141 (85), line 1 : *for* The intestines are *read* The intestine is.
" 141 (85), line 3 : *for* anal papillae *read* anal papilla.
" 141 (85), line 34 : *for* 2 w. pl. *read* w. 2 pl.
" 141 (85), line 35 : *for* 2te Heft *read* 2tes Heft.
" 141 (85), line 41 : *for* ab *read* ob.
" 142 (86), line 6 : *for* denticalis *read* denticulis.
" 144 (88), line 16 : *for* M. retractoris *read* M. retractor.
" 145 (89), line 9 : *for* 3 R. J. *read* 3 R. I.
" 145 (89), line 27 : *for* Dentes medianæ *read* D. mediani.
" 145 (89), line 27 : *for* altamen *read* attamen.
" 146 (90), line 22 : *for* mantle *read* muzzle.
" 147 (91), line 11 : *for* anal *read* oral.
" 150 (94), line 4 : *for* Animal *read* Color animalis.
" 150 (94), line 3 : *before* Dendron. Dalli, B., *insert* "2."
" 152 (96), line 27 : *for* side, the *read* side. The.
" 153 (97), line 17 : *for* Dalzell *read* Dalyell.
" 153 (97), line 27 : *for* Tr. glaucæ *read* Tr. glamae.
" 154 (98), line 15 : *for* cucculata *read* cucullata.
" 154 (98), line 19 : *for* Duvancelia *read* Duvaucelia.
" 155 (99), line 8 : *for* of the papillæ *read* of the papilla.
" 156 (100), line 11 : *for* is contracted *read* was contracted.
" 156 (100), line 16 : *for* The larger mucous gland *read* The larger opening of the mucous gland.
" 156 (100), line 19 : *for* before which *read* , below which.
" 156 (100), line 38 : *for* in the hinder, part *read* between the hinder parts.
" 159 (103), line 20 : *for* The cardia were wide, etc., *read* the cavity was, etc.
" 159 (103), line 26 : *for* but backward at the front and end *read* bent backward at the frontal end.
" 160 (104), line 1 : *for* Fig. 65 a *read* 15 a.
" 161 (105), line 33 : *for* bulbus, and *read* bulbus, or.
" 161 (105), line 38 : *for* Beitr. *read* Bidr.
" 162 (106), line 17 : *for* dentates *read* dentatis.
" 163 (107), line 33 : *for* leaves 80 *read* leaves 8.
" 163 (107), line 9 : *for* Fig. 6, 7, *read* Fig. 10, 11.
" 165 (109), line 25 : *for* Fig. 1-7 *read* Fig. 8-14.

Page 166 (110), line 19 : *for* Fig. 1 *read* Fig. 8.
" 167 (111), line 4 : *for* Fig. 2 *read* Fig. 9.
" 167 (111), line 6 : *for* Fig. 3 *read* Fig. 10.
" 167 (111), line 15 : *for* Fig. 4 *read* Fig. 11.
" 167 (111), line 16 : *for* Fig. 1 a *read* Fig. 2 a.
" 167 (111), line 16 : *for* Fig. 5 *read* Fig. 12.
" 167 (111), line 19 : *for* Fig. 4, 5, *read* Fig. 11, 12.
" 167 (111), line 23 : *for* Fig. 6, 7, 8, *read* Fig. 13, 14, 3 b.
" 168 (112), line 5 : *for* Plate XII *read* Pl. XIV.
" 168 (112), line 6 : *for* punctus *read* punctis.
" 170 (114), line 5 : *for* Fig. 13 *read* Fig. 15.
" 170 (114), line 24 : *for* latium *read* latum.
" 170 (114), line 26 : *for* minutissimus *read* minutissimis.
" 170 (114), line 33 : *for* the gills *read* the gill.
" 171 (115), line 34 : *for* Branchiæ *read* Branchia.
" 172 (116), line 17 : *for* Samso *read* Samsö.
" 173 (117), line 30 : substitute a semicolon for the period.
" 173 (117), line 31 : substitute a period for the semicolon.
" 175 (119), line 23 : *for* 1.3 *read* 13.
" 175 (119), line 23 : *for* 7 7.0 *read* 7-7.8.
" 175 (119), line 24 : *for* the light *read* the right.
" 176 (120), line 7 : *for* individual *read* individuals.
" 176 (120), line 21 : *for* leg *read* bag..
" 177 (121), line 1 : *for* branchiæ *read* branchia.
" 177 (121), line 32 : *for* of the right hand are *read* of the right hand one, is.
" 180 (124), line 10 : *for* spermatocysts *read* spermatocyst.
" 180 (124), line 33 : substitute a semicolon for the period.
" 183 (127), line 3 : *for c read a.*
" 183 (127), line 18 : *for* (F.) *read* (O. F. Müll.)
" 183 (127), line 21 : *for* inside *read* outside.
" 183 (127), line 23 : *for* the same *read* the same from the inside.
" 184 (128), line 13 : *for d read a.*
" 184 (128), line 16 : *for b read a.*
" 186 (130), line 12 : *for* of *read* f.
" 186 (130), line 26 : *for* 2. *read* 2, 2.
" 186 (130), line 33 : *for e read c.*
" 187 (131), line 27 : *for* to the twelfth *read* to *b*, the twelfth.
" 188 (132), line 12 : *for* cuticle *read* skin.

R. BERGH.

February 3.

Mr. Meehan, Vice-President, in the chair.

Twenty-one persons present.

February 10.

The President, Dr. Ruschenberger, in the chair.

Twenty-six persons present.

The death of Adolph E. Borie, a member, was announced.

Sartorius Muscle of the Gorilla.—Mr. Howard A. Kelly described the sartorius muscle in the right leg of the *Gorilla troglodytes* (young), from the Ogode river, West Africa, partially dissected, and described by Dr. Chapman in the Proc. Acad. Nat. Sci., Phila., 1879.

The muscle is 10 inches long, and $\frac{1}{2}$ inch broad. Tendinous for about $\frac{1}{2}$ inch at its origin, and its insertion. It arises from the iliac bone at the beginning of the middle third of the distance from between the anterior superior spine of the ilium, and the symphysis pubis. Its insertion is on to the inner face of the tibia (which is $5\frac{1}{2}$ inches long), 3 inches below the knee joint.

Six inches from its origin the muscle is reinforced by a muscular slip $\frac{1}{4}$ inch in breadth. This slip arises at the lower part of the middle third of the femur, between the origin of the quadriceps extensor, and the insertion of the adductors, it joins the sartorius muscle opposite the knee joint.

In consulting the literature on the myology of the Gorilla, no reference to any such slip has been found. Among all the numerous anomalies recorded of this muscle, in the human subject, no corresponding variation has been found.

February 17.

The President, Dr. Ruschenberger, in the chair.

Thirty-three persons present.

A paper entitled "Description of a New Crustacean from the Upper Silurian of Georgia, with remarks upon *Calymene Clintoni*," by Anthony W. Vogdes, was presented for publication.

Germination in Acorns.—Mr. Thomas Meehan referred to some interesting facts in the germination of *Quercus virens*, as brought to his attention by W. St. J. Mazyck, of Georgetown, South Carolina. It was generally known that in this species the cotyledon did not divide into two lobes as usual in acorns, but seemed to be of one solid mass, without any trace of a division. In germination, however, two petioles were developed as in other acorns, but instead of these being very short, indeed nearly sessile, as in the ordinary white oak, they were produced apparently in the much advanced specimens sent by Mr. Mazyck to $1\frac{1}{2}$ inches in length before the plumule and hypocotyledonary portions of the embryo commenced their growth. In respect to the latter, a small ovate, striate tuber, apparently as one might judge from the shrivelled specimens on hand, nearly one-fourth the size of the acorn was formed, and from this tuber the radicle proceeded, and, afterwards, the plumule on its upward growth.

Mr. Meehan said he had since examined sprouting acorns of *Quercus alba*, *Q. rubra*, *Q. arenaria*, and *Q. prinoides*, noticing a very slight tendency to a tuberous condition, only in the last named. But in regard to the lengthening of the petioles, he was surprised to find a variation in each species. In *Quercus prinoides*, the petioles were nearly an inch in length.

He believed the discovery would be of great value to systematic botanists in the determination of species in this very difficult genus, and should examine and report after an examination of many other species, but thought proper to call the attention of the Academy to the matter in this early stage that due credit might be recorded to Mr. Mazyck for his interesting discovery.

Mr. Edw. Potts, at the request of Mr. Meehan, had made sections of both the acorn and the spindle-shaped radicle, with the result of finding the cell structure of the latter an almost exact counterpart of that in the nut: *i. e.*, sub-spherical cells of uniform size, gorged with starch grains. So similar were they that it would be nearly impossible for an observer to say which he was examining but for the cortical tissue surrounding the root. It seemed that the food supply of the young plant had been thus withdrawn from a position exposed to hot sun and drying winds, to one protected by the earth and in the direct line of growth. No line of specialized cells could be discovered in the sections of the nut, indicating the possibility of a separation as in other species into two cotyledons; so that to all intents and purposes it might be called monocotyledonous.

February 24.

The President, Dr. Ruschenberger, in the chair.

Twenty-nine persons present.

A paper entitled "Carcinological Notes, No. 3," by J. S. Kingsley, was presented for publication.

The death of John Rice, a member, was announced.

R. S. Huidekoper, M. D., David Townsend, John B. Wood, Thos. Miles, Frances Emily White, M. D., and John S. Capp were elected members.

The following were elected correspondents:—Robert Caspary, of Konigsberg, Agostino Todaro, of Palermo, J. E. Bommer, of Brussels, Teodoro Caruel, of Pisa, H. T. Geyler, of Frankfort-on-the-Maine, Robert Schomburg, of Adelaide, and A. Inostranzeff, of St. Petersburgh.

March 2.

The President, Dr. Ruschenberger, in the chair.

Twenty-eight persons present.

The death of Wm. Maxwell Wood, M. D., a correspondent, was announced.

On a Filaria Reported to have come from a Man.—Prof. Leidy exhibited a large thread-worm, which had been submitted to his examination by Dr. J. J. Woodward, U. S. A. It was recently presented to the Army Medical Museum, at Washington, by Dr. C. L. Garnett, of Buffalo, Putnam Co., West Virginia. Accompanying the specimen, is the copy of a letter from Dr. Garnett to Dr. Woodward, from which the following is an abstract: "During the winter of 1876, a man, a common laborer, aged about fifty, presented himself to me for treatment having a gleety discharge from the urethra, with a burning sensation during and after micturition. Previously, he had been treated for gonorrhœa, and I prescribed accordingly. The patient not improving, applied to other practitioners. In April, 1878, he came to me with a round, vivid-red worm, twenty-six inches in length, (the specimen you now possess) which was alive and very active in its movements, instantly coiling up like a watch-spring on being touched. Having no work on helminthology for reference, the only description I found which appeared to answer to the worm was that of *Strongylus gigas*, in Niemeyer, vol. II, p. 47. The patient is an illiterate man, with no motive for deception. He informed me that he discovered the worm protruding from his penis and drew it out without pain or difficulty. He was in much agitation and alarm about the occurrence, fearing, as he said, that "there might be more behind that one." For a few days previous to its passage, his urine was of a milky hue and some time subsequently of a yellow cast and slightly tinged with blood and mingled with mucus. The man is truthful, and no doubt exists in my mind, or in the minds of his neighbors as to the correctness of his statements. I regret exceedingly that I did not appreciate the scientific interest of the subject, and send you the specimen in a fresh state, but the busy routine of a country practitioner's life leaves no time for the study of other than subjects of practical value in one's every day experience."

The worm preserved in alcohol is much coiled, of a clay color and opaque, or only feebly translucent, but more so at the head end. If it is really a human parasite, it appears to differ from all those heretofore described, and also seems different from other known parasites. It certainly is neither *Eustrongylus gigas*, nor is it the Guinea-worm, *Filaria medinensis*, though nearly related to this. Its characters are as follows: Body long, restiform, nearly uniformly cylindrical, smooth, shining, elastic, tough, without evident annulation other than transverse wrinkling, with the anterior extremity evenly tapering in the continuous head, the end of which is rounded and smooth or without appendages of any kind; the posterior extremity not tapering, with the caudal end incurved, bluntly rounded, without appendages and imperforate or without evident anal or genital aperture. Mouth a terminal pore without lips, papillæ, or armature of any kind. Pharynx cylindrical, and opening into a straight cylindrical intestine, apparently ending in a blind pouch. Generative organs unobserved. Length of worm, 26 inches, greatest thickness, 1·5 mm. Width of head just behind the rounded extremity, 0·375 mm.; opposite the commencement of the intestine, 0·625 mm.; at the middle, 1·5 mm.; at the incurved caudal extremity, 1·5 mm. Length of œsophagus, 1·125.

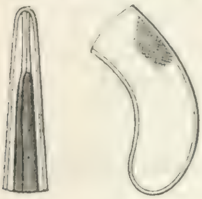


Fig. 1. Fig. 2.

1. Cephalic extremity; 2. Caudal extremity; the diagonal marking indicates the crossing of the fibres seen in the integument. Five diameters.

The worm, of exceedingly simple character, is clearly neither a *Gordius* nor a *Mermis*, and though apparently more nearly allied to *Filaria*, a more intimate knowledge of its structure may prove it to be different. For the present it was proposed to distinguish it with the name of FILARIA RESTIFORMIS.

On Rochelia patens.—Mr. J. H. REDFIELD remarked at the meeting of the Botanical Section, that *Rochelia patens* was founded by Nuttall, upon a plant collected by Wyeth on Flat Head River, in the Rocky Mountains, and was described in the Journal of the Academy, 1st series, Vol. VII, p. 44, in 1834.

Dr. Gray in the Synoptical Flora of North America, II, p. 197, remarks concerning the plant that it may be an *Eritrichium*, but has not been identified, nor was it in the Academy's Herbarium.

Mr. R. stated that this specimen had been recently found among the Academy's specimens of *Echinospermum*, and had been pronounced by Dr. Gray to be *Echinospermum floribundum*, Lehm., a species widely diffused in Western North America.

The following report upon the plants introduced through the medium of the Centennial Exhibition was read:

REPORT ON PLANTS INTRODUCED BY MEANS OF THE INTERNATIONAL EXHIBITION, 1876.

The committee appointed on the 10th of October, 1876, at the request of the United States Centennial Commission, to examine and report upon the subject of the introduction of insects* and plants through the medium of foreign exhibits, respectfully reports that it has delayed reporting on the plants till now in the belief that some solitary plants might be overlooked, which producing seed and increasing in following seasons, might be then discovered by their greater numbers. But only those named in the list have been found, and only in isolated specimens showing no disposition whatever to spread and remain with us. So far, therefore, as the object of the committee appointment is concerned, it may be said in effect that no plant has been introduced, to our knowledge, by the agency of the exhibition.

It is but justice to say that the plants have been collected by our esteemed fellow member, Mr. Isaac Burk, whose familiarity with the botany of Fairmount Park, rendered him particularly fitted to detect any new introduction. Some of the few plants named are from the western portion of our country, others from Europe, and a few from Japan.

Lepidium sativum, L.
Bunias Erucago, L.
Crepis tectorum, L.
Centaurea nigra, L.
Hypochæris radicata, L.
Desmodium tomentosum, D. C.
Cycloloma platyphylla, Moq.
Killingia pumila, Mx.
Fimbristylis miliacea, Muhl.
Cyperus diandrus, Torr.
Triticum villosum, Beand.
Triticum clavatum, Stedl.
Leucœa Langsdorffiana, Steudl.

Respectfully submitted.

John L. LeConte,
Geo. H. Horn,
Joseph Leidy,
J. Gibbons Hunt,
Thomas Meehan,

Committee.

* The report upon the insects was printed in the Proceedings of the Academy of Natural Sciences of Philadelphia, for 1876, page 267.

MARCH 9.

The President, Dr. RUSCHENBERGER, in the chair.

Twenty-three persons present.

Mammary Glands of Bats.—Dr. H. ALLEN exhibited specimens of bats dissected to show the position and peculiarities of the mammary glands. These bodies have been described as post-axillary and two in number. For *Desmodus* this account is correct. For *Phyllorhina*, *Nycteris* and the common red bat of this country (*Atalapha* (= *Lasiurus*) *noveboracensis*) it is incorrect. In the first two the glands answering to the axilla are low down and have their nipples on a line with the middle of the clavicle. In the common red bat the gland answering to the so-called post-axillary is outside and below the axilla, but on a line with it. It occupies, indeed, the lower third of the side of the chest and borders upon the inferior line of the chest. In addition to this there is constantly present a pectoral gland situated as in Quadrumana and the human species. These glands resemble one another in general appearance and size, being circular in form, without hair, of a dull yellow color, possessing a well-developed nipple, and measuring 3 lines in diameter.

It is interesting to observe that the specimens of non-lactating bats show no external signs of mammæ. The mammary regions are covered with fur of the same character as seen elsewhere. Neither in a female with embryos 2 lines in length is there any external development. If such a specimen be dissected, the locality of a rudiment of the gland can be detected by the position of a small circle of thin, dark skin with a central white spot, such structures representing the patch of modified skin and nipple ready to receive the future developing active gland. No mammary structure in this stage is anywhere visible, nor is there any subcutaneous fat. Dissection of the body of the lactating female on the other hand shows the mamma to be as large as the external conformation, and the pectoral and lateral thoracic regions to be occupied by a large but sharply limited mass of fat, which runs up into the axilla and encroaches upon the dorsal surface of the trunk. The rest of the under surface of the animal is without fat. It is likely that there exists in the bat the same provision noted in analogous structures of many lower animals,—namely, the presence of secondary sexual characters (among which the milk gland may be placed) which practically disappear in the periods between sexual activity.

MARCH 16.

Mr. VAUX, Vice-President, in the chair.

Thirty-five persons present.

A paper entitled "Carcinological Notes, No. IV," by J. S. Kingsley.

The death of Dr. Wm. M. King, U. S. N., a member, was announced.

MARCH 23.

The President, Dr. RUSCHENBERGER, in the chair.

One hundred and fifteen persons present.

The following papers were presented for publication:—

"On the Gestation and Generative Apparatus of the Elephant," by H. C. Chapman, M. D.

"On a New Species of Hemitripterus from Alaska," by W. N. Lockington.

The death of Hector Tyndale, a member, was announced.

MARCH 30.

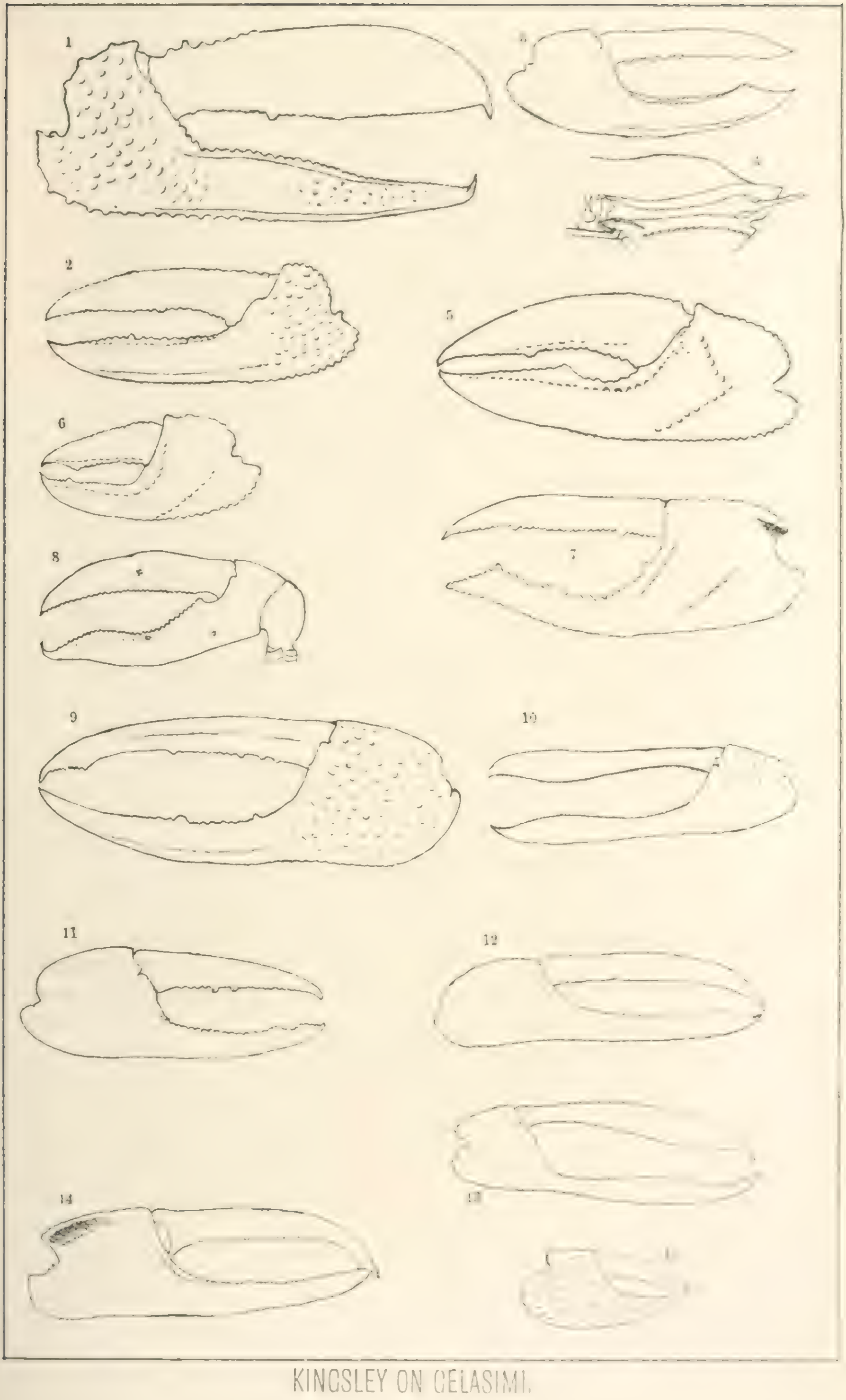
Mr. VAUX, Vice-President, in the chair.

Thirty-eight persons present.

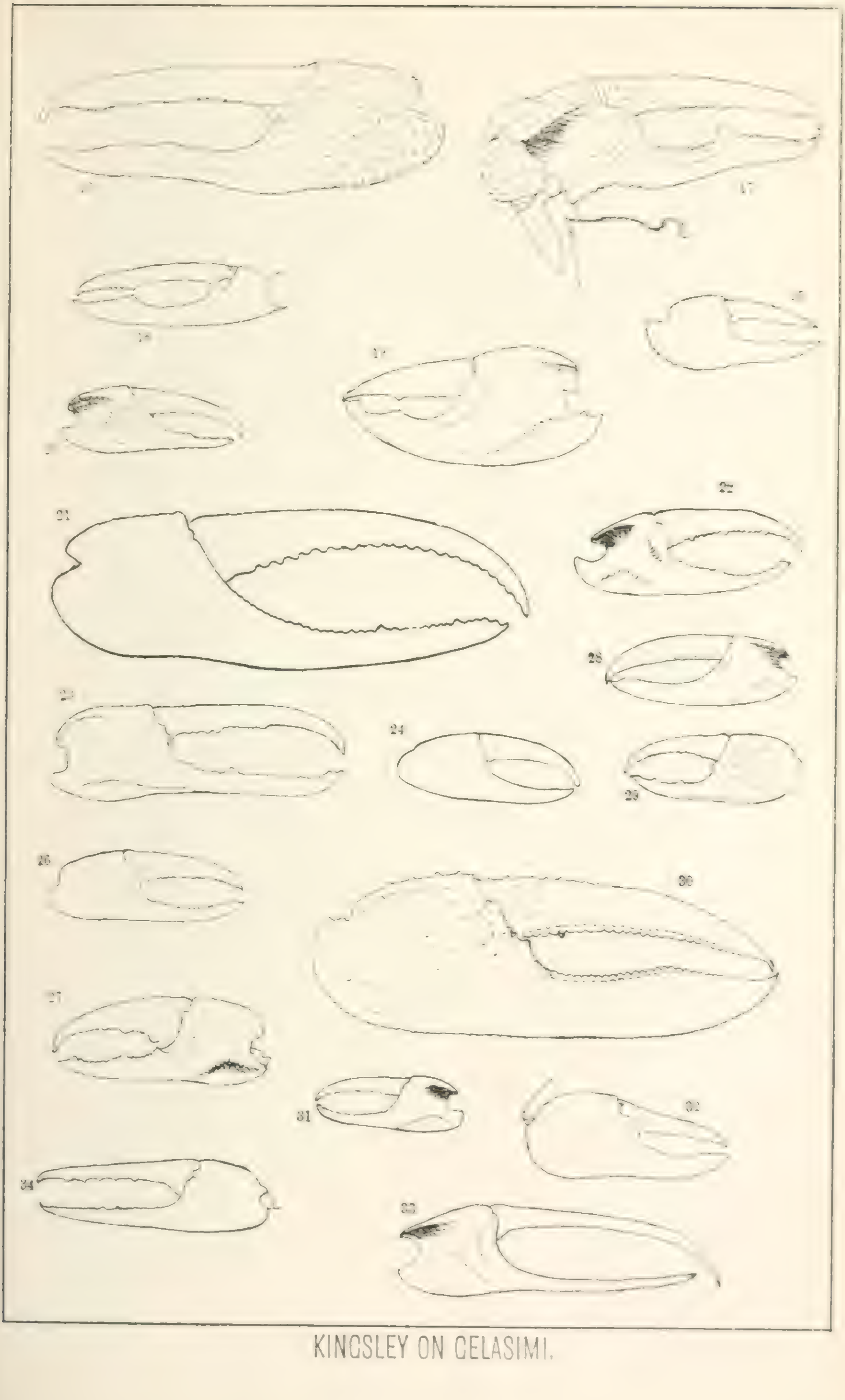
The death of Jacob Stauffer, a correspondent, was announced.

Paris Haldeman, Geo. B. Heckel and Emlen Physic, M. D., were elected members.

The following were ordered to be printed:—



KINGSLEY ON GELASIMI.



KINGSLEY ON GELASIMI.

CARCINOLOGICAL NOTES, No. II.—REVISION OF THE GELASIMI.

BY J. S. KINGSLEY.

I have endeavored in this paper to straighten out the species of the "Fiddler Crabs," basing my work on the large collections of the Academy of Natural Sciences of Philadelphia and of the Peabody Academy of Sciences at Salem, Mass. My material has been ample, embracing more than half the known forms, among which are types of Smith, Guerin, Eydoux, Leconte and Say, with other specimens from Guerin's collection which were identified by comparison with the types of Milne Edwards. I have reduced considerably the number of specific forms, and in so doing I have been actuated not by any desire to overturn the work of others, but merely to arrive at the true limits of the species. A similar reduction in other genera must be made, and will be made, by any one who attempts to study the forms of the whole world, and does not limit himself to those of a small portion of its surface. Among the important features of this paper is the extension of the range of many forms, which has been accomplished either by finding new localities among the specimens studied, or by a union of two or more so-called species which bore different names in different portions of the world.

I have endeavored to give descriptions and figures of all known forms of Gelasimi, and when possible I have taken them from the specimens themselves; when I had no specimens, I have given a description compiled from some other carcinologist, and have followed it by the initial of his name. The same remark will apply to the figures. Localities from which I have examined specimens are followed by an exclamation point (!), and the museum in which the forms are preserved is indicated by an abbreviation; these abbreviations are: Phila. Acad., Academy of Natural Sciences of Philadelphia, Pa.; Peab. Acad., Peabody Academy of Sciences, Salem, Mass.; U. C., Union College, Schenectady, N. Y.

Genus GELASIMUS Latreille.

Cancer (pars.) Linne, Herbst, Fabricius, De Geer. *Ocypoda* (pars) Bosc, Histoire Naturelle des Crustaces, ii, p. 240 (1828)[1]; Latreille,

[1] I have never seen a copy of the first edition of this work published in the "An X" of the first French Republic (1802-3 of accepted chronology), and my references are either quoted from the second edition by Desmarest, or at second hand from Milne Edwards, or some other author.

Histoire des Crustaces et de la Insects, vi, p. 27, "An. XI" (1803-4.) *Uca* Leach, Trans. Linn. Soc., London, xi, p. 309 (1815). *Gelasimus* Latreille, Nouvelle Dictionnaire d'Histoire Naturelle, xii, p. 517 (1817); Henri Milne-Edwards, Histoire Naturelle des Crustaces, ii, p. 49 (1837); Annales des Sciences Naturelles, III serie, xviii, p. 144 (1852); Dana, Crustacea of the United States Exploring Expedition, pp. 312 and 315 (1852); Hess, Archiv für Naturgeschichte, xxxi, Pt. II, p. 145 (1865); Alphonse Milne-Edwards, Nouvelle Archives du Museum d'Histoire Naturelle, xi, p. 271 (1873); *Gonoplax* (pars.) Lamarck, Histoire Animaux sans Vertebres, v. p. 253 (1818).

The genus *Gelasimus* belongs to *Cyclometopa* (*Ocypodoidea* of Dana), family *Macrophthalmidæ* (Dana), and sub-family *Ocypodina* of the same author. It is characterized by the rhomboidal carapax, broader in front, the elongate ocular pedicels, the eyes proper being placed at the extremity, and by the great inequality of the chelipeds in the male.

In my studies I have found the characters derived from the larger cheliped of the male to be the most constant, while the relative proportions of the carapax, the front and the margins of the orbit, are of but slight importance and very variable.

But two species ever referred to this genus by authors, are now referred to other genera; *Gelasimus cordiformis* forming the type of the genus *Helœcius* of Dana, and *Gelasimus telescopicus* Owen, which belongs to the genus *Macrophthalmus*.

The genus may be divided into two groups, possibly of subgeneric value, according as the front between the eyes is wide or narrow, and the wide fronted section again according as the male abdomen is seven or five jointed.

§ A. *Front very narrow between the eyes.*

1. **Gelasimus maracoani** Latreille. Pl. ix, f. 1.

Ocypoda maracoani Latreille, Hist. Crust. et Ins., vi, p. 46 (1803). *Gelasimus maracoani* Latreille, Dict. d'Hist. Nat., xii, p. 519 (1817); Desmarest. Consid. (*pars*) p. 123 (1825); Edw., Hist. Nat. Crust., ii, p. 51 (1837); Ann. Sci. Nat., III, xviii, p. 144, pl. III, f. 1 (1852); Dana, U. S. Ex. Ex. Crust., p. 318 (1852); White, List. Crust. Brit. Mus., p. 35 (1847). *Gonoplax maracoani* Lamarck, Hist. An. Sans Vert., v, p. 254 (1818). *Gelasimus armatus* Smith, Trans. Conn. Acad., ii, p. 123, pl. ii, f. 5, pl. iii, f. 4 (1870); Report Peabody Acad. Sci., iii, p. 91 (1871).

Regions distinct, each branchial ornamented with a longitudinal ridge, from which branch off smaller ones. Ischium of larger cheliped with a prominent tooth below; meros with a tooth on posterior margin at the articulation with the carpus, otherwise smooth and rounded, its upper and lower margins with spiniform teeth which are more prominent above; carpus elongate, with indistinct tubercles. Hand very large, compressed, externally tuberculate on the basal portion, above with several teeth like those of meros, inferior margin proximally tuberculate, outer surface of thumb with large shallow punctæ, the lower portion being marginate. Occludent margin with three rows of tubercles, the middle one forming a prominence at the basal two-fifths, the other rows undulating, extremity contorted, acute; inner surface nearly smooth, with a tubercular ridge running from the articulation of dactylus to the middle of lower margin of the palm; dactylus lamellate, externally granulate, lower margin nearly straight, upper margin arcuate, basally tuberculate, tip acute and nearly at right angles with occludent margin, inner surface nearly smooth, somewhat concave, with a longitudinal tuberculate ridge near the occludent margin.

Bahia, Brazil! Dr. Wilson. *Natal!* [?] Dr. Wilson (labeled *G. natalensis*). *South America!* (Phila. Acad.) *West Coast of Nicaragua!* McNiel (Smith's types in Peab. Acad.). *Cayenne* (Latr. Edw.), *Brazil* (Latr. White), *West Indies* (White), *Rio Janeiro* (Dana).

The only differences between Smith's types and specimens from other localities, are the more crowded spines on the upper border of the meros and the more sparse tuberculation of the basal portion of the hand, characters surely not of specific importance.

2. **Gelasimus heterocheles** Kingsley. Pl. ix, f. 2.

Seba, Thesaurus, iii, pl. xviii, f. 8 (1758); *Cancer vocans major* Herbst, Naturgesch. Krabben und Krebse, pl. i, f. 1 (after Seba) (1790). *Ocypoda heterocheles* Bosc, Edit. I, "tom. ii, p. 197, 1802" (teste Auct.); Edit. II, i, p. 250 (1828); *Cancer uka* Shaw, Naturalist's Miscellany, XIV, pl. 588 (after Seba).[1] *Gelasimus maracoani* (pars) Desmarest, l. c., p. 123 (1825). *Gelasimus platydactylus* Edw., Hist. Nat. des Crust., ii, p. 51 (1837); Ann. Sci. Nat., III, xviii, p.

[1] I have been unable to ascertain the date of this volume. The first volume of the series bears the date 1790, the twenty-fourth (and last) 1813, but no others are dated; it would, however, seem probable that the fourteenth volume appeared in 1803, while the "An X," in which Bosc's first edition appeared, embraced parts of 1802 and 1803.

144, pl. iii, f. 2 (1852); Saussure, Revue et Magazin de Zoologie, II, v, p. 362 (1853); Smith, Trans. Conn. Acad., ii, p. 122 (1870). *Gelasimus princeps* Smith, l. c., p. 120, pl. ii, f. 10, pl. iii, f. 3-3e (1870); Report Peab. Acad., iii, p. 91 (1871); Lockington, Proc. California Acad., vii, p. 145 (1877).

Carapax transversely nearly flat; meros of larger cheliped rounded posteriorly, its lower margin crenulate, its upper produced into a broad, arcuate, laminiform, dentate crest; carpus elongate, externally tuberculate, inner margin crenulate, the inner surface with one or two tubercles. Hand large, compressed, palmar portion swollen, upper and lower margins tuberculate, external surface of palm tuberculate, of thumb smooth, except a crenulated ridge below. The inner surface smooth, with a tuberculate ridge running from the lower margin at the base of the thumb obliquely upward and backward, and meeting a similar ridge from the base of the dactylus; occludent margins of thumb with three rows of tubercles, (the middle the most prominent) and somewhat angulated beyond the middle. Dactylus with the upper margin and outer basal portion tuberculate, the occludent margin rather prominent in the middle.

Mexico! (Guerin-Meneville). *Jamaica!* (Dr. Wilson) Phila. Acad. *Cayenne*, Edw. *W. Coast Nicaragua!* (McNiel, Smith's types Peab. Acad.). *Lower California* (Lockington). *Mazatlan* (Saussure).

Seba's figure represents the carapax as granulate and the front rather broad (in these respects he has been followed by Herbst and Shaw), otherwise his figure answers well. Bosc says that the species is black! Smith's types agree well with the Jamaica specimens which I have seen, except that the meral crest in the Nicaraguan specimens is more distinctly dentate.

3. **Gelasimus bellator** White. Pl. ix, f. 3.

Petiver, Opera, i, Pl. 78, f. 5 (1767); *Gelasimus bellator* White, Catalogue British Museum Crustacea, p. 36 (1847); (sine descr.) Voyage of H. M. S. Samarang, Crustacea, p. 49 (1848); Edw., Ann. Sci. Nat., III, xviii, p. 146 (1852).

Carapax arcuate, front but little enlarged below the eyes. Meros of larger cheliped posteriorly with an oblique rounded ridge, its upper and lower margins crenulate, the former even denticulate; carpus externally polished, above granulate, inner margin denticulate, outside of palm and basal portion of dactylus granulate, inside of palm granulate but without tubercular ridges except a short curved one near the occludent margin; thumb externally margined below, its occludent margin forming a prominence at the distal third; dactylus with the margins nearly parallel, the occludent one with scattered larger tubercles, tip acute.

Australia! (Dr. T. B. Wilson) Phila. Acad. *Luzon* (Petiver) *Philippines* (White).

4. **Gelasimus styliferus**, Edw. Pl. ix, f. 4.

Gelasimus platydactylus Edw., Ill. Edit. Regne Animal, Crustaces, pl. xviii, f. 1 a (without date). *Gelasimus styliferus* Edw., Am. Sci. Nat. III, xviii, p. 145, pl. iii, f. 3, (1852); Smith, Trans. Conn. Acad., ii, p. 118, (1870).

A species very near *G. platydactylus*, but having the marginal crest of the arm less developed and the eye stalks terminated by a small stylet as in the *Ocypodas* (Edw.). Is possibly but a variety of *heterochelos*.

Guayaquil, Equador, (Edw.).

5. **Gelasimus heterophthalmus** Smith. Pl. ix, f. 5.

Gelasimus heterophthalmus Smith, Trans. Conn. Acad. ii, p. 116, pl. ii, f. 6, pl. iii, f. 1 (1870); Rep. Peab. Acad. Sci. iii, p. 91 (1871).

Meros of larger cheliped with posterior margin rounded, the inferior crenulate, superior with a broad crest, carpus with the upper outer surface granulate, elsewhere smooth. Hand inflated, basal portion of palm externally granulate, thumb punctate, with an external elevated ridge. Inner surface of palm smooth, with two rows of tubercles much as in *G. heterocheles*. Fingers compressed, the thumb with a deep emargination at the base and a prominent tubercle just beyond, occludent margin of finger nearly straight.

Gulf of Fonseca, West Coast of Nicaragua! McNiel (Smith's types in Peab. Acad.).

This species is closely allied to *G. heterocheles*. When I examined the specimens, the prolongations of the ocular peduncles described by Prof. Smith were broken off.

6. **Gelasimus heteropleurus** Smith. Pl. ix, f. 6.

Gelasimus heteropleurus Smith, Trans. Conn. Acad., ii, p. 118, pl. ii, f. 7, pl. iii, f. 2 (1870); Rep. Peab. Acad., iii, p. 71 (1871).

Carapax but slightly convex, one side produced laterally. One eye with a stylet about as long as the cornea, similar to those found in certain *Ocypodæ*. Meros of larger cheliped with the margins denticulate, the upper one produced distally into a crest, carpus granulate above. Hand externally granulate on the basal portion, the upper and lower margins denticulate; the inner surface of the palm has an oblique line of tubercles running obliquely upward and backward from the lower margin at the base of the thumb to near the articulation with the carpus. Fingers short, compressed, the thumb with the lower margin regularly arcuate; the upper margin of dactylus nearly straight as are the occludent margins of each.

Gulf of Fonseca! McNiel (Peab. Acad., Smith's types).

7. **Gelasimus cultrimanus** White. Pl. ix, f. 7.

Gelasimus vocans Edw., Annales des Sci. Nat., III, xviii, p. 145, Pl. III, f. 4 (1852); Stimpson, Proc. Phila. Acad., 1858, p. 99 (1858); Heller, Reise der Novara, Crustacea, p. 37 (1865); Hilgendorf, in van der Decken's Reise, p. 83 (1867); Alphonse Milne-Edwards, Nouv. Arch. du Mus. d'Hist. Nat., ix, p. 272 (1873). *Gelasimus cultrimanus* White, Catalogue Brit. Mus. Crust., p. 35, sine descr. (1847); Voyage of the Samarang, Crust., p. 49 (1848). *Gelasimus nitidus* Dana, U. S. Expl. Exped. Crust, p. 316, Pl. X, f. 5 (1852).

Carapax smooth, arcuate. Meros of larger cheliped with an oblique ridge on the upper posterior surface which gradually disappears before the articulation with the carpus; the inner margin somewhat cristate, distally with a prominent tooth and sometimes traces of a second; carpus externally granulate, a portion near the articulation with the meros smooth, inner surface with a strong spiniform tubercle. Palmar portion of hand swollen and externally granulate, granules larger below. On the inner surface there is an oblique tubercular crest near the lower margin but not extending to it, and a second near the occludent margin. Thumb with an impressed line on the outer surface, the lower margin granulous, the occludent margin broadly excavate; this excavation is sometimes regularly curved, but generally shows traces of a division into two sinuses; the distal fourth bends abruptly downward to meet the inferior margin. Finger granulate above near the base, occludent margin nearly straight.

Philippines? Dr. T. B. Wilson (Phila. Acad.); *Moreton Bay, Australia!* E. Wilson (Phila. Acad.); *Coast of Malabar!* Guerin's Collection (Phila. Acad.). This specimen (labelled "G. crassimanus Coll. Mus.") has the excavation of the thumb of the larger cheliped plainly divided into two parts. *Java, Malabar* (Edw.); *Nicobars* (Heller); *Zanzibar* (Hilgendorf); *New Caledonia* (A. M.-Edw.).

There is a considerable confusion regarding this species. Edwards considers this as the *Cancer vocans* of Linne. Linne in his tenth edition (p. 626, 1757) quotes Rumphius, Pl. XIV, f. E.; and Catesby's Carolina, ii, Pl. XXV. Rumphius' figure (of a specimen from Amboina) represents a form with the fingers regularly tapering, and resembling *G. tetragonon* more nearly than any other species with which I am acquainted, but the figure is not accurate enough to have any systematic value. Catesby's figure is the well-known *Ocypoda arenaria* of North America. Linne (in the Amœnitates Academici, vi, p. 416) gives a description, which does not at all apply to this species, and quotes in addition Marcgrave, Piso, Rumphius, Catesby, and Seba, in the order given, showing a still greater confusion. In his 12th edition, p. 1041, Gronovius and Petiver are added to the list, but no hints showing what should be regarded as the *Cancer vocans*. As there exists such confusion, it is impossible to apply the name *vocans*, with certainty, to any species, and for that reason I have thought it best to allow it to lapse into synonymy and take the first recognisable description for this species.

8. Gelasimus marionis Desmarest. Pl. ix, f. 8.

Gelasimus marionis Desm., Consid. sur le Crust., p. 124, Pl. XIII, f. 1 (1825); Edw., Ann. Sci. Nat., III, xviii, p. 145 (1852).

Carapax smooth, and with each margin terminated by an acute angle directed forward; an H-shaped impression on the carapax. Ocular peduncles slightly enlarged at the extremity, and without a terminal point. Inferior border of the orbit crenulate. Right hand greatly larger than the left, greatly compressed, basally granulate; finger straight, its sides smooth, its occludent margin granulate; thumb arcuate below, with its internal border broadly excavate in the middle, and armed with fine teeth. Length, 8 lines; breadth, one inch (Desmarest).

Manilla (Desm.). *Malabar* (Edw.).

I have not seen any form corresponding to this description or figure.

9. Gelasimus dubius Stimpson.

Gelasimus dubius Stm., Proc. Acad. Nat. Sci., Phila., 1858, p. 99.

Carapax and front as in *G. cultrimanus*. Inferior margin of orbit crenulate, externally angulate. Meros of larger cheliped spinulose, hand stout, externally granulate or tuberculate; internally with crests as in *G. cultrimanus*, but less prominent. Digits rather broad, externally sulcate; inner margin nearly straight, irregularly dentate, two or three teeth larger than the others (Stm.).

Loo Choo (Stm.).

10. Gelasimus forcipatus White. Pl. ix, f. 9.

Gelasimus forcipatus White, Catalogue Brit. Mus. Crust., p. 36, *sine descr.* (1847); Voyage Samarang Crust., p. 50 (1848). *Gelasimus coarctatus* Edwards, Ann. Sci. Nat., III, xviii, p. 146, Pl. III, f. 6 (1852); Heller, Crustaceen Sud. Europas, p. 100 (1863); Alph. Milne-Edwards, Nouv. Arch. du Mus. d'Hist. Nat., IX, p. 272, Pl. XII, f. 4 (1873).

Carapax convex, narrowed behind. Meros of larger cheliped externally granulate, its margins denticulate. Carpus granulate, inner margin produced but without a prominent tooth. Palm externally granulate, its upper border slightly margined, its lower tuberculate; on the inside a few tubercles in a curved line near the base of the dactylus, and an oblique line from the lower margin runs up to the articulation with the carpus, dactylus granulate at the base, otherwise the hand and fingers are smooth. Thumb regularly tapering, with an external impressed line, its occludent margin regularly arcuate, with generally a prominent tubercle near the middle. Dactylus with a prominent distal dentate lobe.

[?] *Odessa!* Guerin (Phil. Acad.). *Philippines!* Drs. Wilson and Burroughs (Phil. Acad.). *Australia!* E. Wilson (Phil. Acad.). *Borneo* (Adams and White). *Odessa* (Edw.). *New Caledonia* (A. M.-Edw.).

I have united these two nominal species from an actual comparison of specimens. In the collection of Guerin-Meneville now in the possession of the Philadelphia Academy, is a specimen labelled "*Gelasimus coarctatus* Edw., Cat. Mus., Paris, Odessa," and which was probably one of the original specimens which was the foundation of Edward's description. I am strongly inclined to doubt of the authenticity of the locality "Odessa," as I have been unable to find any other authority than that of Edwards. Marcussen in his Fauna of the Black Sea (Archiv. für Naturgeschichte xxxiii, pp. 358-363, 1867) does not mention it. His subsequent paper and that of Uljanin, I have not seen. Heller merely quotes from Milne-Edwards.

11. **Gelasimus arcuatus** De Haan. Pl. ix, f. 10.

Ocypode (*Gelasimus*) *arcuata* De Haan, Fauna Japonica, Crustacea, p. 53, Pl. VII, f. 2 (1835). *Gelasimus arcuatus* M.-Edw., Ann. Sci. Nat. III, xviii, p. 146 (1852) ; (?) Krauss, süd Afrikanische Crustaceen, p. 39 (1843) ; A. M.-Edw., Nouv. Arch. du Mus., ix, p. 273, (1873).

Carapax with sides carinate, carina acute, scarcely granulate; inferior margin of orbit granulate. Meros of larger cheliped, above concave, below flat; internally with an acute granular ridge. Carpus externally convex, above flat, hand twice the breadth of the carapax, fingers compressed, smooth, externally longitudinally sulcate (De Haan).

Japan (De Haan). *New Caledonia* (A. M.-Edw.). [?] *Natal Bay* (Krauss).

12. **Gelasimus tetragonon** Ruppell. Pl. ix, f. 11.

Seba Thesaurus, iii, Pl. XIX, f. 15. *? Cancer serratan* Forskal, Descr. Animalium, etc., p. 87 (1775). *Cancer tetragonon* Herbst l. c., i, p. 257, Pl. XX, f. 110 (1790). *Gelasimus tetragonon* Ruppell, Beschreibung und Abbildung 24 Krabben des rothes Meeres, p. 25, Pl. V, f. 5 (1830) ; Edw., Hist. Crust., ii, p. 52 (1837) ; Ann. Sci. Nat. III, xviii, p. 147, Pl. III, f. 9 (1859) ; White, Cat. B. M. Crust, p. 36 (1847) ; Guerin, Voyage Coquille, p. 10 (1839[1]) ; Heller Reise der Novara, p. 37 (1868) ; Hilgendorf in van der Decken, p. 84 (1867) ; Kossman Reise nach rothen Meeren, p. 52 (1877). *Gelasimus duperreyi* Guerin, l. c., Pl. I (1826) ; Dana, U. S. Ex. Ex. Crust., p. 317 (1852). *Gelasimus desjardinii* Guerin, MS. *Gelasimus tetragonon var spinicarpa* Kossmann, l. c., p. 52. Kossman gives a reference to a paper by Poulson, but as the title is written in Russian I have not been able to verify it.

Carapax strongly arcuate, front not expanded below the eyes. Meros of the larger cheliped with the upper margin terminating distally in a strong spine, carpus smooth, the inner margin acute, its basal portion sometimes expanded into a strong tooth. Hand compressed, externally finely granulate, a shallow pit with coarse punctæ near the base of the thumb; internally granulate but without tubercular ridges; thumb with two prominences on the distal half; the finger regularly tapering.

Mauritius! Dr. Wilson, Guerin's Collection; *Tongatabou!* Wilkes Expedition; *Tahiti!* A. Garrett; *Sandwich Is!* Dr. W. N. Jones

[1] The title page of the volume bears the date 1830, but the introduction to the Crustacea and Arachnida is dated "15 Novembre, 1838," so that it is probable that the volume did not appear complete until 1839. The plates bear date 1826.

(Phila. Acad.); *Tahiti* and *Sandwich Is.!* A. Garrett (Peab. Acad.); *Red Sea* and *Nicobar Is.* (Heller); *Zanzibar* (Hilgendorf); *Bourbon* (Edwards); *New Caledonia* (A. Milne-Edwards).

13. Gelasimus acutus Stm.

Gelasimus acutus Stm., Proc. Phila. Acad., 1858, p. 99.

Carapax narrowed behind, anterolateral angles prominent, acute. marginal line distinct. Front narrow, not constricted, inferior margin of orbit crenulate, externally acute, internal suborbital lobe convex; a crest on the sub-hepatic region parallel to the inferior margin of the orbit, the included surface smooth. Larger hand coarsely granulate, a tubercular ridge on the inner surface. Fingers not longer than the palm, externally sulcate, inner margin dentate, median tooth larger, but no sub-terminal tooth (Stimpson).

Macao (Stimpson).

14. Gelasimus forceps Milne-Edwards. Pl. ix, f. 12.

Gelasimus forceps Edw., Hist. Nat. des Crust., ii, p. 52 (1837); Annales des Sciences Naturelles, III serie, tome xviii, p. 148, Pl. III, f. 11 (1852); White Cat. Brit. Mus. Crust., p. 36 (1847).

Carapax narrowed behind, lateral angles prominent, acute; orbits below with two denticulate margins. Meros and carpus smooth, the lower margin of the meros crenulate, upper cristate, finely dentate; hand smooth or indistinctly granulate, fingers long, slender, finely denticulate, the thumb with a distal lobe (Edwards).

Australia (Edwards, White).

I have not forms referable to the two foregoing species.

15. Gelasimus longidigitum (nov.). Pl. ix, f. 13.

Closely allied to *forceps* in shape of carapax, orbits below with a simple smooth margin. Meros and carpus smooth, the inner margin of the carpus acute, crenulate. Basal portion of the hand externally obscurely granulate; internally with an oblique tubercular ridge, and a few tubercles near the base of the fingers. Fingers compressed, long, finely denticulate, and narrower near the base than at the middle point.

Moreton Bay, Australia! E. Wilson.

16. Gelasimus smithii (nov.). Pl. ix, f. 14.

Carapax gibbous, front narrow; meros with a strong, oblique ridge on the upper outer surface, the inner upper margin produced into a prominent vertical crest. Carpus externally nearly smooth.

the inner margin slightly produced and denticulate. Palm externally granulate above, smooth below, its upper margin granulate and indistinctly indicated by an impressed line on the outer surface, and its inner surface smooth, without tubercular ridges, except one at the base of the fingers. Fingers long, slender, slightly compressed and regularly tapering, the extremity of the dactylus somewhat expanded and excavate.

Natal! E. Wilson (Phila. Acad.).

Named in honor of my friend Prof. S. I. Smith, of Yale College, who has monographed the American species of this genus.

17. Gelasimus urvillei M.-Edw. Pl. ix, f. 15.

Gelasimus urvillei M.-Edw., Ann. Sci. Nat., III, xviii p. 148, Pl. III, f. 10 (1852).

Resembles closely *G. forceps*, but has the medio-frontal sulcus nearly linear, and the fingers shorter, the anterior border of the meros of the larger cheliped obtuse and granulate (M.-Edw.).

Vanikoro (M.-Edw.).

18. Gelasimus dussumieri M.-Edw. Pl. x, f. 16.

Gelasimus dussumieri M.-Edw., Ann. Sci. Nat., III, xviii, Pl. IV, f. 12, (1852)? Hilgendorf in van der Decken's Reise in Ost Afrika, Crustaceen, p. 84, Pl. IV, f. 1 (1867); Alph. M.-Edw., Nouv. Arch. du Mus. d'Hist. Nat. IX, p. 274 (1873).

Resembles closely *G. urvillei*, but the accessory sub-orbital lobe is less marked, the median sulcus of the front entirely linear and the anterior border of the meros of the larger cheliped denticulate. Chela very large, *G. rubripes* is closely allied, but appears to be distinguished by the form of the fingers of the larger hand, the larger tubercles of the carpus, etc., (Ex. auct.).

Malabar and *Samarang* (Edw.); *New Caledonia* (A. M.-Edw.); *Zanzibar* (Hilgendorf).

19. Gelasimus rubripes Jacq. and Lucas. Pl. x, f. 17.

Gelasimus rubripes Jacquinot and Lucas, Voyage des Astrolabe et Zelee Crustacea, p. 66, Pl. VI, f. 2 (1853); Heller, Reise der Novara Crustaceen, p. 38 (1867).

Orbits granulate above and below, carpus of larger cheliped with the external portion granulate, its margins finely denticulate. Hand prominently granulate, internally smooth except fine granulations at the origin of the thumb; below strongly dentate, finger smooth except at the base where it is granulate; the inner margin of the thumb with three large teeth, the intervals between which are finely denticulate. Thumb smooth below its inner margin with several rows of granulations and a prominent tooth near the middle (J. et L.).

Unknown (J. and L.) *Nicobars* (Heller).

20. Gelasimus signatus Hess. Pl. x, f. 18.

Gelasimus signatus Hess, Archiv für Naturgeschichte, xxxi, p. 146, Pl. VI, f. 6 (1865).

"Front between the eyes not so small as a *G. variatus*, cheliped one and a half times the breadth of the body; arm, carpus and hand bright red, fingers white. Arm below with two rows of pearly tubercles, fingers with an elevation at the middle of the inner border, distally arcuate and pointed" (Hess).

Sydney, Australia (Hess).

21. Gelasimus crassipes White. Pl. x, f. 19.

Gelasimus crassipes White, Cat. B. M. Crust., p. 36, sine descr.; Adams and White, Voyage Samarang Crustacea, p. 49 (1848).

? *G. brevipes* Edw., Ann. Sci. Nat., III, xviii, p. 146 (1852).

"Carapace very much arched, suddenly narrowed behind, front with a lobe without narrow stalk. Four hind pairs of legs thicker and stronger than in the other species" (Ad. and White).

Philippine Islands (White).

There have been described three other species * belonging to the narrow-fronted section, one of which has been made the type of the genus *Acanthoplax* by Milne Edwards. A fourth species from Bahia, Brazil, is in the collection of the Philadelphia Academy. So far as I am aware these are all females and are represented by only a single specimen each, and as I am strongly inclined to consider them the females of well-known forms I omit descriptions of them.

* *Gelasimus insignis* Smith, Trans. Conn. Acad., ii, p. 126 (1870). *Acanthoplax insignis* Edw., Ann. Sci. Nat., III, xviii, p. 151, Pl. IV, f. 23 (1852); Archives des Museum, vii, p. 162, Pl. II, f. 1 (1854).—Chili (Edw.).

Gelasimus ornatus Smith, Trans. Conn. Acad., ii, p. 125, Pl. II, f. 9, Pl. III, f. 5 (1870); Report Peabody Acad. Science, iii, p. 91 (1871).—West Coast Nicaragua! McNiel (Peab. Acad.).

Acanthoplax excellens Gerstäcker, Archiv für Naturgeschichte, xxii, p. 138 (1856).—No locality.

§ B. *Front broad between the orbits.*

* Male abdomen seven-jointed.

22. **Gelasimus vocator** Martens. Pl. x, f. 20.

Cancer vocator Herbst, Bd. iii, h. iv, p. 1, Pl. LIX, f. 1 (1804).

Gelasimus vocans Edw., Hist. Nat. Crust., ii, p. 54 (1837); Ill. Edit. Règne Animal, Crustacea, Pl. XVIII, f. 1 (no date); White, Cat. B. M. Crust., p. 36 (sine synon.), 1847.

Gelasimus vocans (pars) Gould, Invertebrata of Mass, p. 325 (1841).

Gelasimus vocans var. a Dekay, N. Y. Fauna Crustacea, p. 14, Pl. VI, f. 10 (1844).

Gelasimus palustris Edw., Ann. Sci. Nat., III, xviii, p. 148, Pl. IV, f. 13 (1852); Stimpson, Annals N. Y. Lyceum Nat. Hist., p. 62 (1860); Smith, Trans. Conn. Acad., ii, p. 127 (1870).

Gelasimus pugillator Leconte, Proc. Acad. Nat. Sci., Philadelphia, 1855, p. 403.

Gelasimus brevifrons Stimps., Ann. N. Y. Lyceum, vii, p. 229 (1860); Smith, Trans. Conn. Acad., ii, p. 131 (1870); Lockington, Proc. Cal. Acad., vii, p. 147 (1877).

Gelasimus sp. Saussure, Memoirs Société Phys. et Hist. Nat. Genève, xiv, p. 440 (1858).

Gelasimus vocator Martens, Archiv für Naturgesch., xxxv, p 1 (1869; xxxviii, p. 104 (1872); Kingsley, Proc. Phila. Acad., 1879, p. 400.

Gelasimus pugnax, mordax et *rapax* Smith, Trans. Conn. Acad., ii, pp. 131, 135, 134, Pls. II, f. 1, 2, 3, IV, 2, 3, 4 (1870).

Gelasimus affinis Streets, Proc. Phila. Acad., 1872, p. 131.

Gelasimus crenulatus Lockington, Proc. Cal. Acad., vii, p. 149 (1877).

Carapax smooth, meros of the larger cheliped with its margins denticulate or tuberculate, carpus externally granulate, internally with an oblique tubercular ridge. Hand tuberculate, its inner surface with a ridge running up from lower margin to carpal groove; in front of this are scattered granules. Thumb straight, extremity obliquely truncate, finger strongly arcuate, longer than the thumb.

East Coast of America, from *Cape Cod!* to *Para, Brazil! West Indies!* and *Aspinwall! West Coast of Mexico! Panama!*

The localities from which I have examined specimens number over thirty and embrace several hundred specimens. I find in the Guerin Collection two specimens from Mauritius which closely resemble Cuban forms.

This is, without much doubt, the species intended by Herbst; Edwards quotes the *Cancer palustris* of Sloane as this species, but aside from the fact that his History of Jamaica was published in 1725, and his name is therefore ante-Linnean (and is also polynomial). Sloane gives not the slightest description, but says that it agrees perfectly with the figure of Maregrave which is the *G. maracoani* of authors. I think that any one studying as I have large series of specimens, will agree with me in uniting these various forms under one specific name, as the characters which separate them are variable and not of specific importance. Probably *G. minax* should also be included here, as suggested by Professor Smith.

23. Gelasimus minax LeConte. Pl. x, f. 21.

Gelasimus minax LeConte, Proc. Phila. Acad., vii, p. 403 (1855); Smith, Trans. Conn. Acad., ii, p. 128, Pl. II, f. 4, Pl. IV, f. 1 (1870); Rep. U. S. Fish Commission for 1871-72, p. 545 (1875); Kingsley, Proc. Phila. Acad., 1879. p. 400.

Carapax strongly arcuate longitudinally, the branchial regions granulate anteriorly. Meros of larger chelipeds, with the upper and lower margins tuberculate as is the upper portion of carpus; inner margin of carpus with prominent tubercles, its inner surface with an oblique tubercular ridge. Palm cristate above, externally with large depressed tubercles above, smaller below, inner surface also tuberculate and with a ridge of tubercles running obliquely up from the lower margin at the base of the thumb to the depression into which the carpus folds, and a second curved one near the base of the fingers. Fingers long, slender, regularly tapering, finger longer than the thumb and distally strongly arcuate.

Beesley's Point, Dennis Creek, N. J.! S. Ashmead (Phila. Acad., LeConte's types); *Bluffton, S. C.!* Dr. Mellichamp (Peab. Acad.); *Northampton Co., Va.!* H. E. Webster (Union College); *New Haven, Conn.*, and *St. Augustine, Fla.* (Smith).

24. Gelasimus annulipes M.-Edw. Pl. x, f. 22.

Gelasimus annulipes M.-Edw., Hist. Nat. Crust., II, p. 55, Pl. 18, f. 10-13 (1837); White, Cat. B. M. Crust., p. 36 (1847); Edw., Ann. Sci. Nat. III, xviii, p. 149, Pl. IV, f. 45 (1852); Dana, U. S. Ex. Ex. Crust., 317 (1852); Heller, Reise der Novara, Crustacea, p. 38 (1867); Hilgendorf in Baron Decken's Reise, p. 85 (1867); Monatsberichte Berliner Akademie, 1878, p. 803; Kossmann, Reise nach rothen Meeren, p. 53 (1873); Spence Bate in J. K. Lord's Naturalist in Vancouver. *Gelasimus macrodactylus* Edwards and Lucas in D'Orbigny's Voyage, 27, Pl. XI, f. 3 (1843); Nicollet in Gay's Hist. Chili Zool., iii, 165 (1840); Edw., Ann. Sci. Nat., III, xviii, 149 (1852). *Gelasimus lacteus* Krauss, Sud. Af. Crust., p. 39 (teste Hilgendorf). *Gelasimus pulchellus* Stimpson, Proc. Phila. Acad., 1858, p. 100. *Gelasimus annulipes* var *albimana* Kossmann, *l. c.*. *Gelasimus rectilatus* Lockington, Proc. California Acad. Sci., p. 148 (1877).

Carapax transversely nearly flat; inferior margin of orbit crenulate. Meros of larger cheliped smooth, angles rounded, carpus the same with a few obsolete granulations on the upper surface. Hand smooth, sub-marginate below, an oblique row of tubercles on the inner surface, running up and back from near the lower margin half way to articulation with the carpus, and two similar curved lines near the articulation of the dactylus. Thumb regularly tapering, a prominent tubercle near the middle, extremity sub-excavate. Dactylus distally strongly curved, extending slightly beyond the thumb.

Australia! E. Wilson; *Singapore!* Dr. McCartee (Phila. Acad.); *Zanzibar!* (C. Cooke) "N. W. Boundary Survey, A. Campbell, Commr., Dr. C. B. Kennerly"! (Peabody Acad.); *Seas of India and Asia* (Edw.); *Ceylon, Nicobars Madras* (Heller); *Mozambique Inhambeni* (Hilgendorf); *Pondicherry* (White); *Valparaiso* (Edw. and Lucas); *Vancouver* (Bate); *Lower California* (Lockington); *Tahiti* (Stm.); *Red Sea* (Kossmann).

25. **Gelasimus lacteus** DeHaan. Pl. x, f. 28.

Ocypode (*Gelasimus*) *lacteus* DeHaan, Fauna Japonica Crust., p. 54, Pl. XV, f. 5 (1835). *Gelasimus lacteus* Edw., Ann. Sci. Nat., III, xviii, 150, Pl. IV, f. 16 (1852); Stm., Proc. Phila. Acad., 1858, 100; Miers, Proc. Zool. Soc., 1879, p. 36.

Carapax longitudinally strongly arcuate, transversely nearly flat; antero-lateral angles prominent; meros of larger cheliped externally granulate, a constriction of the upper margin near the articulation with the carpus, lower crenulate or even denticulate. Carpus externally smooth, inner edge acute denticulate; hand externally finely granulate, above more plainly so; a crenulated ridge near the inner lower margin and one or two near the fingers. Fingers elevated, strongly compressed, the thumb suddenly narrowed near the apex.

Japan! E. Wilson; *Pondicherry!* Dr. T. B. Wilson (Phila. Acad.); *Japan* (DeHaan); *China* (Edw. Stm.).

26. **Gelasimus splendidus** Stm.

Gelasimus splendidus Stm., Proc. Phila. Acad., 1858, p. 99.

Inferior margin of orbit crenulate, externally rounded. Larger hand nearly smooth, internally with an oblique tubercular crest. Crest at the base of the fingers nearly obsolete. Fingers long, slender, slightly denticulate. Thumb with the apex excavate (Stm.).

Hong Kong (Stm.).

I have not seen this species; it, however, appears to be very near *annulipes*.

27. Gelasimus minor Owen.

Gelasimus minor Owen, in Beechey's Voyage of the Blossom; Appendix; Crustacea, p. 76, Pl. XXIV, f. 2 (1831).

Oahu, Sandwich Is. (Owen).

This species is very near the *annulipes* of Edwards, the only difference being the larger teeth of the fingers of the cheliped.

28. Gelasimus triangularis A. M.-Edw.

Gelasimus triangularis A. M.-Edw., Nouv. Arch. du Mus., IX, p. 275, (1873).

Is distinguished from *cultrimanus*, *forcipatus*, *arcuatus*, *tetragonon*, *dussumieri*, *perplexus* et *latreillei* by the carapax greatly larger in front and smaller behind; the lateral angles are spiniform and directed strongly forward, the front between the eyes is large and rounded. Larger cheliped externally smooth, palmar portion long and proximally inflated. Inner surface with a granular ridge, inner margin of fingers dentate, finger a little longer than the thumb. This species is allied to *G. minor* by the form of the hand, but is distinguished by the more triangular carapax (A. M.-E.).

New Caledonia (A. M.-Edw.).

29. Gelasimus gaimardi Edw. Pl. x, f. 23.

Gelasimus gaimardi Edw., Ann. Sci. Nat. III, xviii. 150, Pl. IV, f. 17, (1852); Heller Reise Novara, Crust., p. 38 (1867).

Very near *annulipes*, but having the front more prolonged and more rounded below and the external [internal ?] crest of the hand obtuse and not denticulate, resembling that of *G. latreillei* (Edw.).

Tongatabou (Edw.); *Tahiti* (Heller).

30. Gelasimus panamensis Stm. Pl. x, f. 24.

Gelasimus panamensis Stm., Ann. Lyc., VII, p. 63 (1860); Smith, Trans. Conn. Acad., II, 137, Pl. IV, f. 5 (1870).

Carapax depressed. Anterior and inferior margins of the meros of the larger cheliped crenulated, posterior rounded. Carpus very short, smooth; hand smooth externally and internally, fingers regularly tapering.

Gulf of Fonseca! McNiel (Peab. Acad.).

31. Gelasimus pugillator.

Ocypoda pugillator Bosc., Hist. Nat. Crust., Edit. I, i, p. 197, 1802-3, (*teste Auct.*) Edit. II, i, p. 250 (1828); Latr. Hist. Crust. et Ins. vi, 47 (1803-4). *Ocypoda pugillator* (pars.), Say, Jour. Phila. Acad. I, 71 and 443 (1817-18). *Gelasimus pugillator* Latr., Nouv. Dict. d'-Hist. Nat. Edit. II, p. 519 (1817); Desmarest Consid. 123 (1825), Edw., Ann. Sci. Nat. tom. cit. p. Pl. IV, f. 14 (1852); Stm. Ann. N. Y. Lyc. VII, p. 62 (1859); Smith Trans. Conn. Acad. II, p, 136, Pl. IV, f. 7 (1870); Rep. U. S. Fish Comm. 1871-72, p. 545 (1875). *Gelasimus vocans* (pars.), Gould, Invertebrata of Massachusetts, p. 325 (1841); Dekay, N. Y. Fauna, Crust., 14, Pl. VI, f. 9 (1844).

Carapax polished, swollen, nearly quadrate. Meros of the larger cheliped with the outer surface rugose, upper and lower margins crenulate. Carpus granulate externally, its inner margin acute; hand inflated, the basal portion granulate and margined above and below; inner surface rounded, granulate, but without any trace of a tuberculate ridge except one formed by a continuation of the inner margin of the thumb. Thumb nearly straight, a ridge on the outer surface, a large tubercle near the middle of the inner margin, the extremity obliquely truncate. The finger is longer than the thumb, regularly tapering and distally strongly arcuate. There is a specimen in the collection of the Philadelphia Academy from Surinam which appears to be intermediate, in the characters of the hand, between this and *G. vocator*. The fingers are shorter, the granules on the outside of the palm much more prominent than in typical *pugillator*, and there are traces, though faintly indicated of a tubercular ridge on the inside of the palm.

New Jersey! T. Say, Wm. Wood; *Manatee River!* S. Ashmead; *Mauritius!* Guerin's Collection; *Greenpoint, L. I.!* S. F. Baird; *Boston Harbor!* J. H. Slack (Phila. Acad.); *Nantucket* and *Key West, Fla.!* A. S. Packard; *Bluffton, S. C.!* Dr. Mellichamp; *Savannah, Ga.!* no collector's name given (Peab. Acad.); *Beaufort, N. C.!* H. E. Webster (Union College); *New Haven, Conn., Egmont Key* and *St. Augustine, Fla.* (Smith); *South Carolina* and *Cayenne* (Edw.).

32. **Gelasimus chlorophthalmus** Edw. Pl. x, f. 26, 27.

Gelasimus chlorophthalmus Edw., Hist. Nat. Crust. II, 54 (1837); Ann. Sci. Nat. *tom. cit.* 150, Pl. IV, f. 19 (1852); McLeay in Smith's Zool. S. Africa, p. 64 (1838); White, Cat. B. M. Crust., p. 36 (1847); Guerin, Iconog. Crust., Pl. IV, f. 3; Hilgendorf in Decken's Reise Crust. p. 85 (1867); Monatsberichte Berlin Akad., 1878, p. 803; *Gelasimus marionis* Edw., Hist. Nat. Crust., II, 53 (1837); *Gelasimus perplexus* Edw., Ann. Sci. Nat. *tom. cit.*, 150, Pl. IV., f. 18 (1852); Heller, Novara Crust. p. 38, Pl. V, f. 4 (1867); A. M.-Edw. Nouv. Arch. Mus. IX, 274 (1873); teste Hilgendorf.

Carapax arcuate. Larger hand small, joints all smooth, fingers short, frequently shorter than the palm; the ridges on the inside of the palm either smooth or obsoletely granulate; fingers denticulate, regularly arcuate.

Island of Bourou! Guerin's Collection (Phila. Academy); *Mauritius* (Edw., White); *Zanzibar, Mozambique* and *Mascarenes* (Hilgendorf); *Java* (Edw.), *Ceylon* and *Madras* (Heller); *New Caledonia* (A. M. Edw.).

I also understand that Maillard found this species at Reunion, but I have not seen the work.

Hilgendorf from an actual comparison of specimens says that the *perplexus* and *chlorophthalmus* of Edwards are the same. The *G. stenodactylus* of Lockington (Proc. California Acad., vii, p. 148, 1877), from West Coast of Lower California, would appear from the description and a rough figure of the hand sent me by the author to be near this species; it certainly is not *stenodactylus* of Edwards and Lucas.

33. **Gelasimus subcylindricus** Stimpson. Pl. x, f. 29.

Gelasimus subcylindricus Stimpson, Ann. N. Y. Lyc., vii, p. 63 (1859); Smith, Trans. Conn. Acad., ii, p. 137, Pl. IV, f. 6 (1870),

Carapax obscurely granulate. Margins of meros of larger cheliped granulous. Hand internally without tubercular ridge except two or three parallel curved rows near the base of the fingers, externally granulate. Fingers closely resembling those of *G. vocator*, the common east coast form (Smith).

Matamoras on the *Rio Grande* (Smith, Stm.).

34. **Gelasimus latreillei** Edw. Pl. x, f. 31.

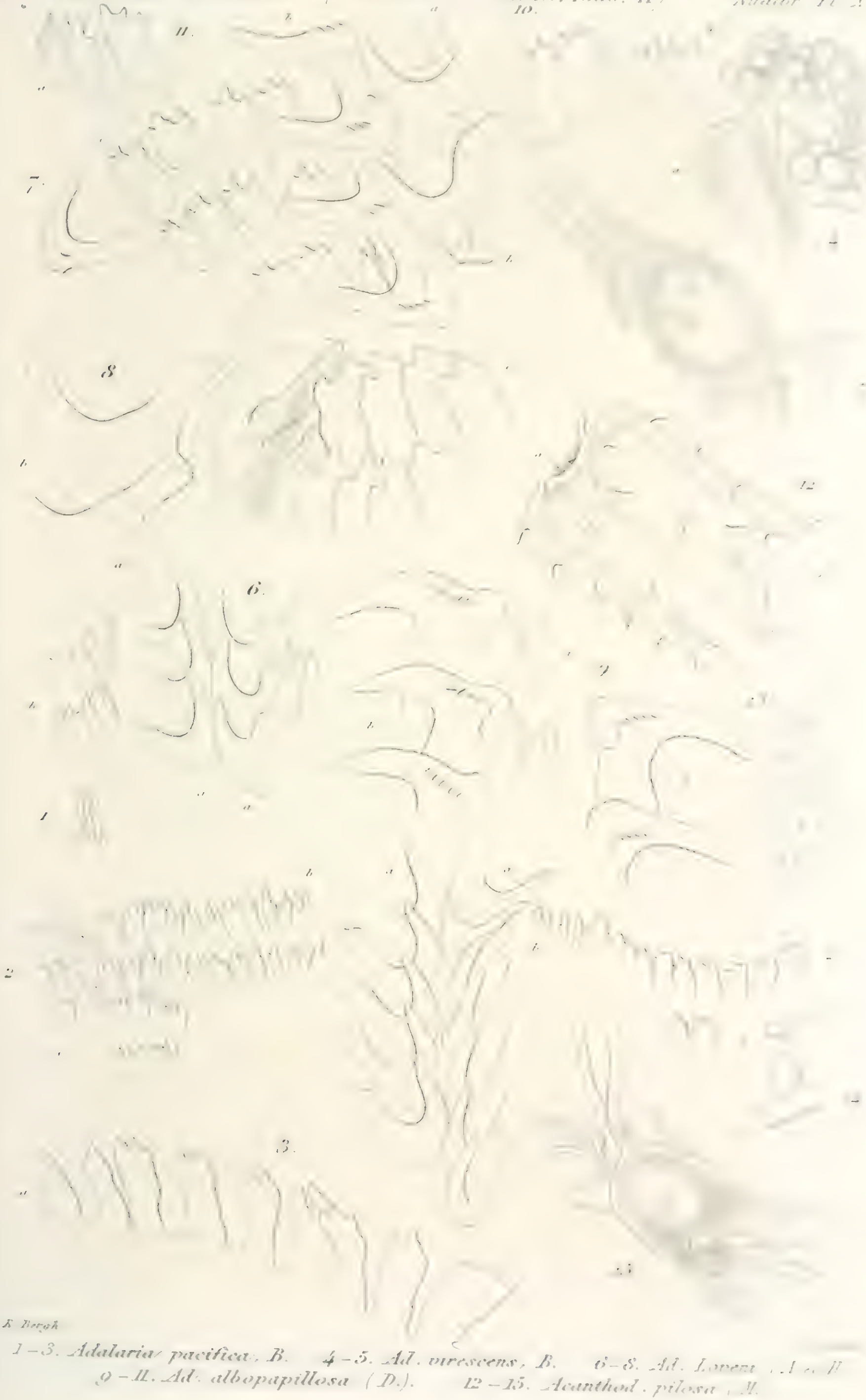
Gelasimus latreillei Edw., Ann. Sci. Nat., III, xviii, p. 150, Pl. IV, f. 20 (1852); A. M. Edw, Nouv. Arch. Mus., ix (1873).

Carapax smooth, lateral angles far behind the front. Greater cheliped smooth; meros with the upper and posterior margins rounded, the upper ending in a prominent tubercle, the lower crenulate and prominent. Inner upper margin of carpus minutely crenulate, the others rounded. Hand cristate above, externally microscopically granulate, internally with a smooth ridge near the lower margin, no tubercles present; fingers slender, slightly compressed, regularly arcuate, with fine tuberculations on the occludent margins, the extremity of the thumb subexcavate.

Philippines! Dr. T. B. Wilson (Phila. Academy); *Isle of Borabora* (Edw.); *New Caledonia* (A. M. Edw.).

1–11 *Jorunna Johnstoni* (A. et H.). 12–15 *Adalaria proxima* (A. et H.).
16. *Ad. albopapillosa* (D.). 17. *Ad. pacifica*, B. 18. *Lamellid. muricata* (M.)

R. Bergh



R. Bergh

1–3. Adalaria pacifica, B. 4–5. Ad. virescens, B. 6–8. Ad. Loveni, A. & H.
9–11. Ad. albopapillosa (D.). 12–15. Acanthod. pilosa, M.

1–2. Acanthod. pilosa (M.).
3–9. Lamellid. bilamellata (L.).
10–12. L. muricata (M.).
13–14. L. varians, B.
15. Ad. pacifica, B.

1–16. Acanthodoris pilosa (M.) var.

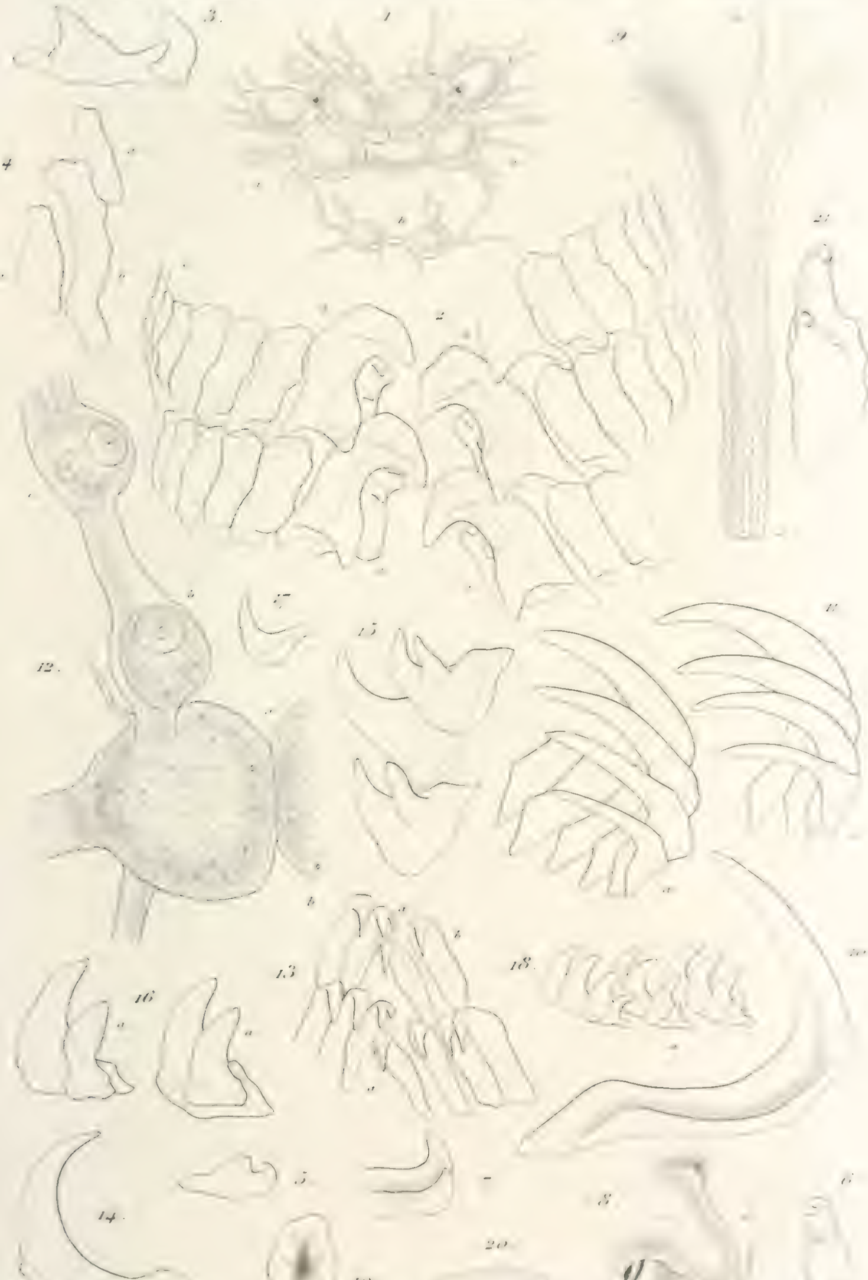
R. Bergh

1. *Lamellid. varians, B.* 2–5. *Acanthod. pilosa M.* 6–7. *Ac. coerulescens, B.*
8–14. *Chromod. Dalli, B.* 15–20. *Triopa clavigera M.*

1–4. Chr. Dalli, B. 5–15. Chr. Calensis, B. 16. Ac. coerulescens. B.
17–20. Triopa modesta, B. 21–22. Tr. clavigera M.

1–10. Triopa modesta, B.   11–13. Tr. clavigera ...
14. Pol. pallida, B.

R. B.



1–9. Polyc. pallida, B. 10–11. Archid. Montereyensis (C.).
12–18. Aphelod. Antill, B. 19–21. Polyc. Holbölli (M.).

35. Gelasimus tangieri Eydoux. Pl. x, f. 30.

Gelasimus tangieri Eydoux, Magazin de Zoologie, 1835, clvii, Pl. XVII: Edw., Ann. Sci. Nat., 1852, p. 151, Pl. IV, f. 21; Heller, Crustaceen des südlichen Europas, p. 101 (1863).

Carapax transversely nearly flat, the sides of the branchial regions strongly arcuate; above everywhere granulate; lower margin of orbit bimarginate. Meros of larger cheliped externally roughened, the upper margin produced into an arcuate crest which is fringed with hairs, the lower margin with two rows of tubercles. Carpus elongate, externally with prominent tubercles, an oblique ridge on the inner surface with a slender obtuse spine at about the middle. Palm margined above, and armed with spiniform tubercles, externally with depressed tubercles, inferior margin denticulate to the tip of the thumb; internally a row of tubercles near the base of the fingers, a second runs obliquely upward from the lower margin, meeting a third running backward from the articulation of the finger, elsewhere internally smooth. Fingers elevated, strongly compressed. Dactylus with the upper margin and outer basal surface tuberculate; the rest of the outer surface finely granulate. Occludent margins of both fingers with three rows of tubercles, the margin of the finger regularly arcuate, that of the thumb with a prominence near the middle. Meral joints of the ambulatory feet denticulate above and below.

Tangier! Guerin's Collection (Eydoux's Types); *West Africa!* (Duchaillu); [?] *Bahia!* E. Wilson (Phila. Acad.); *Cadiz* and *Coasts of Morocco* (Edwards).

Edwards' figure is very poor.

36. Gelasimus perlatus Herklots. Pl. x, f. 25.

Gelasimus perlatus Herklots, Additamenta ad Faunam, p. 16 (1851); Edw., Ann. Sci. Nat., III, xviii, p. 151 (1852); Hilgendorf, Monatsberichte Berlin. Akad., 1878, p. 806.

Carapax arcuate in both directions, above with patches of granules more prominent on the anterolateral portions. Larger cheliped much smaller than is usual in the genus. Meros granulate, the posterior margin rounded, the anterior produced in an arcuate crest; carpus and hand externally granulate. Hand cristate above, internally without tubercular ridges, fingers compressed.

Guinea! E. Wilson (Phila. Academy); *Boutry, West Coast of Africa* (Herklots); *Loando, Chinchoxo, Liberia* (Hilgendorf).

This species is closely allied to *tangieri*, but differs in the proportionately smaller cheliped without tubercular ridges on the inner surface and in the more sparse tuberculation of the carapax.

* * Male Abdomen five-jointed.

37. **Gelasimus stenodactylus** Edw. et Lucas. Pl. x, f. 33-35.

Gelasimus stenodactylus Edw. and Lucas, in D'Orbigny's Voyage Crust. p. 26, Pl. XI, f. 2 (1843); Nicollet in Gay's Hist. of Chili, Zoologie iii, p. 165 (1849); Edw. Ann. Sci. Nat. III, xviii, 149 (1852). *Gelasimus gibbosus* Smith, Trans. Conn. Acad., II, p. 141, Pl. II, f. 11, Pl. IV, f. 8 (1870), Lockington, l. c. *Gelasimus leptodactylus et poeyi* Guerin MS.

Carapax smooth, transversely flat, the regions strongly gibbous. Meros and carpus of larger cheliped elongate, meros smooth, its angles rounded, carpus externally unconspicuously granulate, its inner margin acute denticulate. Hand externally smooth or granulate, a tubercular ridge on the inside of the palm, running obliquely from the lower margin to the groove in which the carpus folds. Fingers much longer than the palm, internally denticulate.

Mexico! Cuba! Brazil! Guerin's Collection (Phila. Acad.); *Gulf of Fonseca!* McNiel (Peab. Acad.); *Gulf of California!* W. N. Lockington (Brown University); *Valparaiso* (Edw. and Luc.).

Of the following species I can say but little. I have not seen specimens which would answer to the descriptions and figures, while the descriptions are so meagre that I cannot decide regarding their affinities.

38. **Gelasimus variegatus** Heller, Verhandlung der Zool. Bot. Gesellschaft, Wien, 1862, p. 521.

"*G. annulari* affinis sed brachium chelipedum ad marginem superiorem carinatum et dentatum, index dactylo paulo brevior acuminatus. *Madras.*"

This is described as one of the specimens collected by the Novara in her voyage around the world, but in Dr. Heller's final memoir on the Crustacea of that expedition, this species is not mentioned.

39. **Gelasimus variatus** Hess, Archiv. für Naturgeschichte, XXXI, 146, Pl. VI, f. 7 (1865). Pl x, f. 32.

Cephalothorax smooth, greatly swollen. Front between the eyes small. Greater cheliped of male somewhat longer than the breadth of the carapax. There is a large triangular depression at the base of the index finger; the index finger is somewhat bent, the thumb is straight; both are tuberculate on the inner margin.

Sydney, Australia.

40. Gelasimus porcellanus White, Cat. B. M. Crust., p. 36 (sine descr.), Adams and White, Voyage of the Samarang, Crustacea, p. 50 (1848), Edw., Ann. Sci. Nat., III, xviii, p. 151 (1852).

"Eye pedicels very long, frontal portion of carapax not narrowed at the base; hind part of carapax much longer than the sides. Fore-legs with the lower claws thickened at the end, the inner margins of both claws with four larger tubercles amongst the smaller crenules. Hab., *Borneo.*" (Adams and White.)

41. Gelasimus inversus Hoffmann, Rech. Faun., Madagascar, p. 29, Pl. IV, f. 23–26.

Madagascar.

I have never seen this work, the quotation being taken from the Zoological Record.

EXPLANATION OF PLATES.

1. *G. maracoani.*
2. *G. heterocheles.*
3. *G. bellator.*
4. *G. styliferus* (after Milne-Edw.)
5. *G. heterophthalmus.*
6. *G. heteropleurus.*
7. *G. cultrimanus.*
8. *G. marionis* (after Desmarest).
9. *G. forcipatus.*
10. *G. arcuatus.*
11. *G. tetragonon.*
12. *G. forceps* (after Milne-Edwards).
13. *G. longidigitum.*
14. *G. smithii.*
15. *G. urvillei* (after Milne-Edw.).
16. *G. dussumieri* (after Milne-Edw.).
17. *G. rubripes* (after Hombron et Jacquinot).
18. *G. signatus* (after Hess).
19. *G. brevipes* (after Milne-Edw.).
20. *G. vocator.*
21. *G. minax* (drawn from type).
22. *G. annulipes.*
23. *G. gaimardi.*
24. *G. panamensis.*
25. *G. perlatus.*
26. *G. chlorophthalmus.*
27. *G. perplexus* (after Edwards).
28. *G. lacteus.*
29. *G. subcylindricus* (after Smith).
30. *G. tangieri* (from type).
31. *G. latreillei.*
32. *G. variatus* (after Hess).
33. *G. stenodactylus* (from Brazil).
34. *G. stenodactylus* (after Edwards et Lucas).
35. *G. stenodactylus* (from Mexico).

April 6.

The President, Dr. Ruschenberger, in the chair.

Forty-two persons present.

The death of Wm. Theodore Rœpper, a correspondent, was announced.

April 13.

The President, Dr. Ruschenberger, in the chair.

Twenty-eight persons present.

A paper entitled "Description of a New Species of Catostomus (C. cypho), from the Colorado River," by Wm. N. Lockington, was presented for publication.

The death of M. Laporte, Count de Castelnau, a correspondent, was announced.

Remarks on Pond Life.—Prof. Leidy remarked, that at the invitation of Mr. Joseph W. Griscom, he had recently visited some little ponds in the vicinity of Woodbury, New Jersey, which were remarkable for the profusion of minute invertebrate life. The ponds occupy hollows in the woods, and consist mostly of accumulated rain water, though several are likewise supplied by springs. Several are completely dried up during the summer. Mr. Griscom says they continue rich in animal life even during the winter.

Of animals, entomostracans are exceedingly numerous and varied. Among some of the most beautiful and conspicuous were noticed abundance of *Branchipus*, of which two species from the same locality have been recently described by Mr. Ryder, under the names of *Chirocephalus holmanii* and *Streptocephalus sealii*. There are also wonderful multitudes of many species of copepods, ostracods and cladoceres, several of which are conspicuous for their large size and bright red color.

In one of the ponds a bright green *Hydra* was frequent, and in another a pinkish one was abundant. These appear to be the *H. gracilis* and *H. carnea* of Agassiz, but it is a question whether they are not the same as the *H. viridis* and *H. fusca* of Europe. Some of the Hydras were of a bright red color, and Mr. Griscom intimated that this was due to the pinkish variety feeding on red entomostracans. This was confirmed by some of the pink ones which were brought home and kept in a jar with abundance of red Cyclops, becoming, after a few days, as a result of feeding on the latter, of the same orange-red hue. Subsequently, when food became scarce, the red Hydras lost their bright color.

In one of the ponds, the stems of rushes and dead branches of trees were invested with a bright grass-green stratum, consisting of a bright green *Vorticella*, probably the *V. fasciculata* of Müller. The green color is dependent on chlorophyl granules, as an element of the structure, and not on food. The body of the animal ranged from 0·108 mm. long by 0·06 mm. broad, to 0·12 mm. long by 0·09 mm. broad. A few measured were 0·15 mm. long by 0·102 mm. broad at the peristome. In a large active bunch, most of them measured 0·09 mm. long and broad. The pedicels were from five to eight times the length of the body.

In another pond, the water was rendered turbid from the profusion of *Volvox globator*. In a bay of this pond filled with dead leaves, a portion of water taken into a jar appeared opalescent from the quantity of minute white flakes it contained. These, on examination, proved to be *Spirostomum ambiguum*. In the same pond, the Spatterdock, *Nuphar advena*, was just about unfolding its leaves, and many of these were thickly invested with a clear jelly, dotted with bright green spots. These proved to be *Stentor polymorphus*. On the under side of a few open leaves on the surface of the water, were many spots of bright green and dull reddish. The former consisted of groups of the green *Vorticella* before mentioned, the other consisted of attached groups of a lilac- or amethystine-colored *Stentor*, probably *S. igneus*. Similar groups of this *Stentor* were observed on a floating log, which had been in the water since last year, as it exhibited attached many statoblasts of a *Plumatella*. Ehrenberg describes *S. igneus* as bright yellow or vermilion; Stein as blood red, or often lilac-colored, or vermilion to brownish red. Ehrenberg found it attached to *Hottonia*. Stein says he never saw it fixed, but always swimming.

The Woodbury variety which might be named *S. amethystinus*, was abundant and invariably found in conspicuous groups, visible to the unaided eye, and when detached, though the animals swam about actively, they were not only disposed to become fixed, but they actually gathered together in groups. They all contained an abundance of chlorophyl, apparently derived from food, but the exterior structure was invariably of a distinct amethystine hue, dependent on fine molecules. The color was more pronounced in the longitudinal bands approaching the peristome. The nucleus was spherical.

In the attached state, when the animal was fully extended and presented a trumpet shape, it was 0·6 mm. long by 0·18 mm. wide at the peristome. This was a common size, but some measured were 0·84 mm. long. In the conical form, when swimming, individuals ranged from 0·27 to 0·42 mm. long. In the most contracted condition of oval shape, they measured 0·18 mm. long by 0·15 mm. broad. The nucleus, 0·03 mm. in diameter.

Ehrenberg and Stein give for *S. igneus* one-sixth of a line length, so that the variety indicated would appear to be much longer.

APRIL 20.

MR. THOMAS MEEHAN, Vice-President, in the chair.

Twenty-nine persons present.

APRIL 27.

The President, Dr. RUSCHENBERGER, in the chair.

Thirty-four persons present.

Lionel S. Beale, of London, was elected a correspondent.

MAY 4.

MR. THOMAS MEEHAN, Vice-President, in the chair.

Twenty-eight persons present.

MAY 11.

The President, Dr. RUSCHENBERGER, in the chair.

Twenty-two persons present.

The following papers were ordered to be printed in the Journal of the Academy.

"The Terrestrial Mollusca inhabiting the Cooks or Harvey Islands," by Andrew Garrett.

"The Placenta and Generative Apparatus of the Elephant," by Henry C. Chapman, M. D.

May 18.

The President, Dr. Ruschenberger, in the chair.

Twenty-six persons present.

A paper entitled "On the Structure of the Orang Outang," by Henry C. Chapman, M. D., was presented for publication.

The death of Wm. Logan Fox, a member, was announced.

A fine portrait in oil, by Uhle, of Isaac Lea, LL. D., was presented to the Academy, and the following resolution was unanimously adopted:

Resolved, That the thanks of the Academy be presented to Dr. Isaac Lea, for his gift of an admirable portrait of himself, which has been long desired by the society, and especially by the senior members, who are cognizant of his valuable contributions to science, as well as towards the prosperity of the Academy.

May 25.

The President, Dr. Ruschenberger, in the chair.

Twenty-two persons present.

The "Proceedings of the Mineralogical and Geological Section of the Academy of Natural Sciences of Philadelphia, for the years 1877, 1878 and 1879," was presented for publication.

Henry S. Gratz, R. S. Peabody, Mrs. R. S. Peabody and William Barbeck, were elected members.

Adolf E. Nordenskiold of Stockholm, Carl Ochsenius of Marburg, Oscar Hertwig and Richard Hertwig of Jena, were elected correspondents.

The following were ordered to be printed:—

ON THE STRUCTURE OF THE ORANG OUTANG.

BY HENRY C. CHAPMAN, M. D.

Various parts of the Orang, *Simia satyrus*, L., have been dissected, described, and figured by Tiedemann,[1] Owen,[2] Sandifort,[3] Cuvier,[4] Schroeder van der Kolk and Vrolik,[5] Rolleston,[6] Selby,[7] Huxley,[8] Bischoff,[9] Barnard,[10] Langer,[11] Gratiolet,[12] Spitzka,[13] and others. It was hardly to be expected, the subject having been investigated by such eminent observers, that I could hope to find anything particularly new to science. It occurred to me, however, that it might not be altogether useless to bring to the notice of the Academy a general resumé of the results of my dissection of the Orang that died at the Philadelphia Zoological Garden in February last, more especially as the memoirs referred to below are scattered through the journals, and are often limited to descriptions of certain parts of the animal only, such as the brain, muscular system, etc.

My Orang was a young male, supposed to be about three years old. The following measurements were taken: From vertex to rump, 16 inches; upper extremity, $20\frac{1}{2}$ inches; arm, 7 inches; forearm, 8 inches; hand, $5\frac{1}{2}$ inches; lower extremity, $17\frac{1}{2}$ inches; thigh, 5 inches; leg, 6 inches; foot, $6\frac{1}{2}$ inches. What struck me at once was the length of the upper extremity, it being 3 inches longer

[1] Tiedemann, Zeit. Phys. Darmstadt, 1827.

[2] Owen, Proc. Zool. Soc., i, 1830, 1831.

[3] Sandifort, Ontleerhundige Beschryving, Leiden, 1840.

[4] Cuvier and Laurillard, Planches, 1849.

[5] Schroeder van der Kolk and Vrolik, Verhandelingen Kon. Nied. Inst., 1849; Verslagen Kon. Acad., 1862.

[6] Rolleston, Nat. Hist. Rev., 1861.

[7] Selby, Nat. Hist. Rev., 1861.

[8] Huxley, Med. Times, 1864.

[9] Bischoff, Munich Abhand. 1870.

[10] Barnard, Proc. American Assoc., 1876.

[11] Langer, Sitzungsberichte, Wien, 1879.

[12] Gratiolet, Plis Cerebraux des Primates, no date.

[13] Spitzka, Journal of Mental and Nervous Diseases, 1879.

NOTE.—I regret that when dissecting the Gorilla I was unacquainted with Mr. Macalister's valuable paper in the Proceedings of Royal Irish Academy for 1873.

than the lower one, the Orang agreeing nearly in this respect with the Gorilla[1] which I dissected, the difference in the extremities in that animal being $3\frac{1}{2}$ inches, whereas in the Chimpanzee[2] I found only a difference of $1\frac{3}{4}$ inches. The foot in the Orang, however, was $\frac{1}{2}$ inch larger than the hand, whereas in the Gorilla the hand was $\frac{1}{2}$ inch larger than the foot; in the Chimpanzee the difference in this respect was $\frac{3}{8}$ inch in favor of the foot. The foot in the Orang, however, resembled superficially a hand much more than it does in the Gorilla. Indeed the distinctness of hand and foot superficially is more marked in the Gorilla than in the other anthropoids. I found the thoracic, abdominal and pelvic visceræ perfectly healthy. The animal seemed to have died from congestion of the brain; there was also some cerebritis. As the osteology of the Orang has been thoroughly described by Prof. Owen[3] and others it will not be worth while for me to dwell on that part of its organization. I will pass therefore to the muscular system, and more particularly to that of the extremities, as being the most interesting as compared with man.

Muscular Systems.—In Prof. Bischoff's[4] paper on the Gorilla an excellent figure is given of the muscles of the face of the Orang, from a preparation by Rudinger. These muscles were described by Prof. Owen,[5] but not figured. The same facial muscles are found in man and the Orang with the exception that there is but one zygomaticus possibly corresponding to the zygomaticus minor of man, though on account of its size it may represent both the zygomaticus major and minor. The facial muscles in the Orang are not as well differentiated as in man, rather hanging together. I noticed that the digastricus had only the posterior head. There was nothing peculiar, however, about the sterno cleido mastoid, omohyoid, or the scaleni. The omocervicalis or elevator claviculæ passed from the transverse process of the atlas to the acromial end of the clavicle, as I found it in the Chimpanzee and in the Gorilla. The pectoralis major arose in three portions: the first, from sternum and first intercostal space; the second, from sternal part of third, fourth, fifth, and sixth ribs, and the third from costal

[1] Proc. of Acad. of Nat. Sciences, Philadelphia, 1878.

[2] Proc. of Acad. of Nat. Sciences, Philadelphia, 1879.

[3] Trans. of Zool. Society, 1835.

[4] Beitrage, Munich Abhand., 1879.

[5] Proc. of Zool. Society, i, 1830, p. 28.

portion of fourth, fifth, sixth and seventh ribs. This distinction in origin is partly visible even in man. There was nothing noticeable about the pectoralis minor or subclavius, supraspinati or teres. The latissimus dorsi, as in all monkeys, gave off the slip the latissimo condyloides, which, however, in the Orang scarcely reached the condyle, and was pierced by the ulnar nerve. The biceps, triceps, and brachialis anticus were well developed, and the external cutaneous nerve passed through the coraco-brachialis as in man. The anterior aspect of the forearm was quite human. The pronator radii teres arose by two heads, between which passed the median nerve. The flexor carpi radialis and ulnaris and the palmaris longus were well developed. The flexor sublimis did not differ from that of man. The flexor profundus was rather separated into two portions, one for the under and the other for the remaining fingers. There was no trace of a flexor longus pollicis either as a distinct muscle or as a slip from the flexor profundus. The abductor, flexor brevis, adductor and opponens pollicis, abductor flexor brevis, and opponens minimi digiti, and the lumbricales were all present. As regards the back of the forearm, the supinator longus arose higher than in man. The supinator brevis, and extensor radialis longior and brevior, extensor ossi metacarpi pollicis and exterior secundi internodii pollicis did not differ from those in man. The absence of an extensor primi internodii pollicis was noticeable, as was also the fact of the extensor indicis giving a slip to the middle finger and the extensor minimi digiti one to the ring finger, making eight tendons supplying the back of the fingers with the four from the extensor communis digitorum. The interossei were the same as in man. Briefly, the upper extremity of the Orang in its muscles differed essentially from that of man in the absence of the flexus longus, and primi internodii pollicis and in the presence of the additional tendons to the ring and middle fingers. The Orang agreed with the Gorilla in not having a flexor longus pollicis, but disagreed with it in having the pronator radii teres arising by two heads, in the presence of a palmaris longus, in the additional tendons for ring and middle fingers, and in not having the extensor primi internodii pollicis. As compared with the Chimpanzee, the Orang agreed in reference to the pronator radii teres and palmaris longus, but in the extensor ossi metacarpi pollicis being single, and in the absence of the flexor longus pollicis as a slip from the profundus, and in the presence of the additional extensor tendons it differed.

As might be expected from the elongated form of the pelvis and the absence of the round ligament of the hip-joint in the Orang, the glutei muscles differ somewhat from those of man. The glutæus magnus (Pl. 12, *e*) in the Orang—not as large or as fleshy as its glutæus medius—is inserted together with the tensor vaginæ femoris, which is scantily developed, if at all, into the fascia lata of the thigh, the glutæus medius being inserted into the great trochanter. Parallel with the lower edge of the glutæus medius (Pl. 12, *c*), is seen a small muscle rising from the edge of the great sciatic notch, and inserted into the great trochanter (Pl. 12, *b*). This muscle seems to correspond to part of the pyriformis in man, the sacral portion of the muscle not being developed in the Orang. The glutæus minimus is represented by a muscle arising from the external edge of the ileum, and passing almost vertically downwards until inserted into the great trochanter, close to the pyriformis (Pl. 12, *a*). At first sight this muscle seems much displaced if it is the glutæus minimus, but if one can imagine the ileum (Pl. 12, *d*) in the Orang to be widened outwardly to the same extent as seen in man, there would be little or nothing anomalous about the muscle. From the position of the glutæus minimus in the Orang, it would seem that this muscle would supplement, to a certain extent, the want of the ligamentum teres, which, it will be remembered, is absent in this ape.

In the Chimpanzee there is so little that is peculiar about the glutæus minimus that I had no difficulty in identifying it, and the same can be said of the Gorilla. In the account of the Chimpanzee by Traill[1] however, the glutæus minimus is described as a distinct new muscle, the scansorius; the muscle I have described as pyriformis, Traill regarded as the glutæus minimus, the pyriformis, according to Traill, being absent. Since then, this so-called scansorius muscle has been referred to by Bischoff, Owen, Huxley and others, as a distinct muscle. With all deference to such eminent anatomists, I cannot see any essential difference between the scansorius of Traill, and the glutæus minimus in man.[2]

[1] Wernerian Transactions, p. 18, 1821.

[2] On looking up the literature upon the anatomy of the Orang, I find that in 1876 Prof. Barnard, *op. cit.*, considered the scansorius as being homologous with the glutæus minimus, and mentioned in his paper that

The obturators, gemelli and quadratus femoris, were well developed. There was nothing peculiar about the muscles of the thigh either on the anterior or posterior surface; the rectus arose, however, only from the inferior spine of the ileum. In the leg anteriorly, I noticed the tibialis anticus divided into two tendons; otherwise, the muscles were as in man. The peroneus longus and brevis were well developed, but there was no peroneus tertius. The soleus, as usual in monkeys, had only the plantar head, and there was no trace of a plantaris, although, according to Sandifort, it is present. The flexor longus digitorum supplied the perforating tendons for the second and fifth, the flexor longus hallucis those for the third and fourth digits. There was no slip from the longus hallucis for the big toe, that muscle, therefore, except from its origin, scarcely deserves that name. The flexor brevis digitorum supplied the perforated tendons for the second and third toes. Those for the fourth and fifth came off from the flexor longus digitorum. The tendon for the fifth toe was not perforated. There was a connecting slip between the third and fourth tendons. The external head only of the flexor accessorius was present. In addition to the abductor, flexor brevis and adductor of the hallux, there was a well-marked opponens hallucis. The lumbricales for the second and fifth digits came from the flexor longus digitorum, those for the third and fourth digits from the flexor longus hallucis. The abductor and flexor brevis minimi digiti were well developed, but there was no transversus pedis. The interossei were like those of the hand. Briefly, as compared with man, the leg and foot of the Orang differ in the absence of the peroneus tertius, plantaris, flexor longus hallucis and transversus pedis, in the fibular origin of the soleus, and external origin of accessorius only, in the distribution of the perforating and perforated tendons for the toes, in the interossei, and in the presence of an opponens for the big toe. In this latter respect the Orang differs not only from man, but from all the other monkeys and anthropoids, the foot having a very hand-like appearance, as compared with that of the Gorilla and Chimpanzee. The foot of the Orang differs further in the absence of a special

Prof. Humphrey held essentially the same opinion. I was not aware, until I had finished my dissection, of the views previously published by these anatomists, and am glad to have been able, independently, to come to the same conclusion.

flexor for the big toe. This is supplemented to a certain extent by the opponens, and in a partly developed accessorius. The perforated tendon for the fifth toe in the Gorilla came from the flexor longus hallucis, whereas in the Chimpanzee and Orang it is supplied by the tendon of the longus digitorum. If Prof. Huxley's canon be accepted that the distinction between a hand and a foot consists in the latter possessing tarsal bones, the peroneus longus and brevis, the short extensor and short flexor muscles, then the posterior extremity of the Orang terminates in a foot. It appears to me, however, that the difference between the hand and foot in man, the Gorilla, Chimpanzee, and the lower monkeys, is greater than that observed between the corresponding members of the Orang.

Alimentary Canal, etc.—It is usually stated that the uvula is absent in the Orang, and, on looking into the mouth, at first sight this appears to be the case, as it does not hang down as in man between the pillars of the fauces—nevertheless it exists. I found it pointing directly backwards in a straight line from the posterior palatine spine. It contained the azygos uvulæ muscle. Prof. Bischoff[1] mentions also finding the uvula in the Orang. The circumvallate papillæ of the tongue are disposed in the form of a Λ, as in man; I found this to be the case in the female Chimpanzee,[2] of which I gave an account, and also in a male which I had the opportunity recently of dissecting. The salivary glands with their ducts were well developed, the submaxillary being very large both relatively and absolutely, as compared with man. The stomach in the Orang (Pl. 13, fig. 1) is not so human in its form as that of either the Gorilla or the Chimpanzee, the cardiac portion, two-thirds of the stomach, being more elongated and constricted from the pyloric part, which was tubular. The greater curvature measured 6 inches, the less 4. The small intestine was 8 feet 4 inches in length, the large 4 feet. The constant presence of valvulæ conniventes in the small intestine of the Orang appears even at the present day questionable by some anatomists. In speaking of these folds occurring in the Gorilla, Bischoff[3] refers to Owen not finding them in the Orang, while they are said to exist by Sandifort, Mayer and Barkow. As to his own opinion on the subject, he expresses himself as follows: "Die beiden jetzt auf's Neue

[1] Beitrage sur Gorilla, p. 37. [2] Op. cit., p. 57. [3] Op. cit., pp. 40, 41.

von mir untersuchten Dünndärme des Orangs aus Dresden und aus der hiesigen Zoolog. Sammlung, sowie der eines Zweiten Chimpanzee aus Dresden, zeigen keine Spur der genannten Falten. Ich halte nach alle diesem ihre Gegenwart beim Orang und Chimpanzee für zweifelhaft; beim Gorilla, wenn gleich in schwacher Entwicklung, für gewiss; individuelle Verscheidenheiten sind doch in einem solchen Punckte nicht wahrscheinlich." I found indications of valvulæ conniventes in the Orang, but of the most rudimentary character as compared with man. In places they run parallel with the long axis of the intestine (Pl. 14, fig. 2), then transversely as in man (Pl. 14, fig. 3), then again as at first, and afterwards again transversely. They are found in parts of the jejunum and ileum. The valvulæ conniventes I found very well developed in the male Chimpanzee (Pl. 14, fig. 4), but not at all in the female. I noticed in the Orang the villi and solitary glands; the Peyer's glands were very well developed. I counted fifteen, some of which measured 4 inches in length. The cæcum and ileocolic valve did not differ from the same parts in man. The vermiform appendix attained a length of 6½ inches absolutely, and was relatively much larger than that of man, reminding one of the condition of this structure in the human embryo. As regards the large intestine, the only noticeable peculiarities were the large size of the solitary glands, and the fact that the mucous membrane of the ascending colon was thrown into well-marked longitudinal folds, with transverse connecting ones, exhibiting quite a reticulated appearance (Pl. 14, fig. 1). This is not the case in the Chimpanzee. The peritoneum was disposed as in man. The transverse colon was connected with the stomach, as was also the case in the Chimpanzee, and Prof. Bischoff[1] noticed that this obtains also in the Gorilla. As is well known, the transverse colon in the monkeys can be raised entirely without drawing up with it the stomach, with the exception sometimes of the Macacques, in which I have noticed a slight peritoneal connection between pyloric part of stomach and colon, indicating a beginning of a gastrocolic omentum? I did not notice anything peculiar about the spleen or pancreas. The quadrate lobe of liver was absent; the spigelian lobe, however, was very well developed; the hepatic duct opened at a little distance from the pancreatic. I found in the small intestine, five fine specimens of

[1] Op. cit., p. 39.

the *Ascaris lumbricoides*, and one in the large, and in the cæcum a *Trichocephalus dispar*. I believe this is the first time these entozoa have been found in the same anthropoid. According to Diesing[1] the *Trichocephalus* is found in the Orang, and Cobbold[2] states that Murie sent him an *Ascaris* from the Chimpanzee.

Respiratory System.—In the Orang, as in the Gorilla and Chimpanzee, particularly in the males, the ventricles of the larynx are prolonged into the so-called laryngeal pouches. In young specimens of the anthropoids, these pouches, though not so well developed as in the adults, can usually, however, be perfectly identified. In dissecting my Orang, after removing the skin in the cervical region, I noticed what appeared to me to be the laryngeal pouches, and by passing a tube into one of the ventricles of the larynx, the pouch of that side could be readily inflated. On tracing, however, the anterior wall of the pouch downward, I noticed that it was attached to the front of the sternum and clavicle, and on opening the pouch and following its posterior wall, I found it attached to the back of the sternum and first rib. Thus the interior of the pouch corresponded with the space between the two layers of the cervical fascia in man, usually filled with fat and absorbent glands, but in the Orang it is empty and communicating with the interior of the larynx. The pouch was not lined with mucous membrane, resembling the remaining fascia, which was indeed continuous with it. Supposing that my dissection really represented the true relation of these parts, then, morphologically speaking, the laryngeal pouch in the anthropoids would be homologous with and replace the two layers of the cervical fascia in man, so familiar to the surgeon. There was nothing especially noticeable about the vocal cords, epiglottis or trachea. The lungs (Pl. 13, fig. 2), however, were not divided into lobes as in the Gorilla and Chimpanzee.

Vascular System.—I did not notice about the heart anything especially different from the human. In reference to the origin of the vessels, however, the innominate gave off the left carotid and continuing an eighth of an inch then divided into the right carotid and right subclavian, the left subclavian coming off separately from the aorta (Pl. 13, fig. 2). In the Gorilla and male Chimpanzee I found the disposition of these vessels the same as in man, which is the case in the Orang, according to Sandifort. In the female Chimpanzee there were two innominates, a long and a

[1] Helm., vol. ii, p. 534. [2] Entozoa, p. 291.

short one, the latter dividing into left carotid and subclavian. The arteries and veins of the extremities did not differ from those of the Gorilla and Chimpanzee. I found in the Orang, as in them, the "long saphenous artery" accompanying the nerve and vein of same name. The mesenteric vessels exhibited loops along the borders of intestine.

Genito-urinary Apparatus.—The general appearance of these structures resembled strikingly those of man (Pl. 15). The kidney measured $1\frac{1}{4}$ inches in length, and exhibits only one papilla. The ureters were 5 inches long. The bladder was 2 inches in length and 1 in diameter. The testicles measured $\frac{6}{8}$ of an inch in length, and were situated near the inguinal canal. The cavity of the tunica vaginalis testes was shut off from the general peritoneal cavity. The vas deferens was 4 inches in length, the seminal vesicle 1 inch; the seminal duct was very short. The caput gallinaginis was well developed, as was also the prostate. The penis measured 2 inches in length, the glans was of cylindrical shape. There was no bone in the penis. The Cowper's glands were relatively large.

Nervous System.—The brain of the Orang has been figured by Tiedemann, Sandifort, Schroeder van der Kolk and Vrolik, Gratiolet, Rolleston, etc. On account, however, of the few illustrations extant, and of the importance of the subject, I avail myself of the opportunity of presenting several views of my Orang's brain (Pl's 16 and 17), which was removed from the skull only a few hours after death. The membranes were in a high state of congestion, and a little of the surface of the left hemisphere had been disorganized by disease, otherwise the brain was in good condition. It weighed exactly 10 ounces. The brain of the Orang in its general contour resembled that of man more than those of either of the Chimpanzees which I examined. In these the brain was more elongated. The general character of the folds and fissures in the brain of the Orang, Chimpanzee, and man are the same, there are certain minor differences, however, in their disposition in all three. The fissure of Silvius in the Orang runs up and down the posterior branch pursuing only a slightly backward direction, the anterior branch is small. The fissure of Rolando, or central fissure, quite apparent, is, however, situated slightly more forward in the Orang than in man. It differentiates the frontal from the parietal lobe. The parieto occipital fissure is well marked, bordered externally by the first occipital fold it descends internally on the mesial side of the hemisphere, separating the parietal from the occipital lobes. In the Orang, the parieto-occipital fissure does not reach the calcarine, being separated from it by the "deuxieme plis de passage interne" of Gratiolet, or "untere innere Scheitelbogen-Windung" of Bischoff. I have noticed this separation as an anomaly more than once in man.

According to Bischoff, this disposition obtains in the Gorilla, and seems to be usual also in the Chimpanzee. In the female Chimpanzee, however, on the left side I found the parieto-occipital fissure passing into the calcarine, as in man. The frontal lobe is easily distinguished from the parietal by the fissure of Rolando, and from the temporal by the fissure of Sylvius. In the Orang it is higher, wider, and more arched than in the Chimpanzee. The anterior central convolution in front of the central fissure runs into the post-central convolution above and below, as in man. It is difficult, however, to identify the three frontal convolutions seen in man and the Chimpanzee, the frontal lobe of the Orang dividing rather into two convolutions, the middle one being badly defined. This is due somewhat to the length of the pre-central fissure, which is as long as the fissure of Rolando, extending farther upward than in man. There was nothing particularly noticeable about the base of the frontal lobe; on the mesial surface it ran into the parietal. The part above the calloso-marginal fissure in the Orang is not as distinctly divided into convolutions as in man, though these are not constantly present even in all human brains. The parietal lobe is separated from the frontal by the central fissure, from the occipital and temporal incompletely, by the parieto-occipital and Sylvian fissures. The posterior-central convolution is well defined. The parietal fissure in the Orang is more striking than that of man, resembling the Gorilla's; it is twice as long as the corresponding fissure in the Chimpanzee, extending from the transverse occipital fissure, as is sometimes the case in man, almost into the fissure of Rolando. It is unbridged and without a break, and divides the parietal lobe completely into upper and lower parietal lobules. The upper parietal lobule is bounded externally by the parietal fissure; posteriorly it is separated from the occipital lobe, internally by the parieto-occipital fissure; externally it is continuous with the occipital lobe, as the first occipital gyrus, anteriorly it is separated from the posterior central convolution more completely than in man, by a fissure which runs parallel with the central fissure. There is in the Orang, also, a fissure running parallel with the parietal, which subdivides the upper parietal lobule into inner and outer portions. The precuneus, or the space on the mesial side of the parietal lobe between the parieto-occipital fissures and the ascending branches of the calloso-marginal, is well defined. The lower parietal lobule in the Orang divides naturally into the supra-marginal and angular gyri. The supra-marginal fold curves around the upper end of the posterior branch of the fissure of Sylvius and runs into the superior temporal gyrus. The angular gyrus, which is very evident, arches around the first temporal fissure, and becoming continuous with the second occipital fold, passes then into the upper temporal gyrus. The occipital lobe, separated from the parietal, internally, by the parieto-occipital fissure, is continuous with upper parietal lobule through the first occipital gyrus, and by the second occipital gyrus with the angular. There are no sharp lines of demarkation between the occipital and temporal lobes. In the occipital lobe of my Orang the transverse occipital fissure was present, and received the parietal fissure. The calcarine fissure was well marked, but was separated in the Orang from the parieto-occipital fissure by the "deuxieme plis de passage interne" of Gratiolet, the "untere innere Scheitelbogen-Windung" of Bischoff. The cuneus of the Orang is therefore somewhat different from that of man. In man I have seen these two fissures separated as an anomaly. The calcarine passed into the hippocampal fissure, so that in the Orang, as in monkeys generally, the gyrus fornicatus was separated from the hippocampal gyrus, whereas in man these convolutions are continuous. This disposition has been noticed in the Hylobates, in Ateles, and in one Chimpanzee, where the calcarine did not reach the hippocampal. The first occipital gyrus is very well developed, and, as the late Professor Gratiolet observed, is one of the most striking convolutions in the brain of the Orang. It rises so to the surface that the internal perpendicular fissure or external part of the parieto-occipital fissure is almost entirely bridged over, the operculum so characteristic of the monkey almost disappearing. It is continuous with the upper parietal lobule arching around the parieto-occipital fissure. This convolution comes to the surface in the

Hylobates and Ateles almost to the same extent as in the Orang, but it is more developed in the latter than in the Chimpanzee. It is called also the "premier plis de passage externe," by Gratiolet, the "obere innere Scheitelbogen-Windung," by Bischoff, the "first annectant gyrus," by Huxley, and "first bridging convolution," by Turner. The second occipital convolution connects the occipital lobe with the angular gyrus. In my Orang it was partly concealed by the first occipital. It was not as superficial as in man. The third occipital gyrus is continuous with that part of the temporal lobe below the first temporal fissure. I noticed, also, in my Orang the "quatrieme plis de passage" of Gratiolet. On the mesial side of the occipital lobe in my Orang, was well seen the "deuxieme plis de passage interne" of Gratiolet, the "untere innere Scheitelbogen-Windung" of Bischoff, which separates the calcarine from the parieto-occipital fissure; and in both the Orang and Chimpanzee, more especially on the left side, I had no difficulty in recognizing the "premier plis de passage interne" of Gratiolet, its convexity turning inwards, while that of the first occipital gyrus, or the "premier plis de passage externe," turns outward. These two convolutions, the first occipital gyrus and the "premier plis de passage interne," in my Orang were continuous. They are regarded as one by Bischoff, forming his "obere innere Scheitelbogen-Windung," but as two by Gratiolet, constituting his "premier plis de passage externe et interne."

The temporal lobe in the Orang is much less convoluted than in man, or even in the Chimpanzee. The first temporal fissure and first temporal convolution are well marked, but the second and third are badly defined. The fusiform and lingual lobes are separated by the inferior occipito-temporal fissures, the collateral fissures of Huxley. The island of Reil was perfectly covered in both the Chimpanzee and the Orang by the operculum, but was not convoluted in my Orang. The surface in places was slightly roughened. I noticed, however, three or four convolutions in the Chimpanzee. On making a section of the left hemisphere of the Orang I noticed that the corpus callosum was relatively smaller than in man, but that the ventricle exhibited an anterior, middle and posterior cornu, the corpus striatum, tænia semicircularis, thalamus opticus and fornix were well developed, the hippocampus major with corpus fimbriatum were perfectly evident, and the hippocampus minor larger relatively than in man. I did not see a trace of the emmenentia collateralis; this is often, however, absent in man.

The cerebellum in my Orang was relatively larger than that of man, but smaller than that of either the Chimpanzees I have dissected, and was just covered and no more by the posterior lobes of the cerebrum. This relation is still retained in my Orang, though the brain has been lying in alcohol for three months since it was taken out of the chloride of zinc in which it was placed until the pia mater could be removed. During this period it has been subject to the conditions, such as the want of the support of the membranes, the effect of pressure, etc., urged by Gratiolet, Huxley, Rolleston, Marshall, etc., as sufficient to explain why after death the cerebellum was uncovered by the cerebrum in the Orang and Chimpanzee, as held by Owen, Schroeder van der Kolk and Vrolik, and Bischoff. Every anatomist knows that the brain after removal from the skull, especially without the membrane, if left to itself, very soon loses its shape. It is absolutely necessary therefore to examine the brain in situ, and after removal from skull to place it in some hardening fluid in which it will float. Even with these precautions, through the change of the surroundings, shrinkage, etc., the brain is always somewhat altered. It happens, however, that I have had lying in alcohol for some years a number of human and monkey brains. Among the latter, examples of the genera *Cebus*, *Ateles*, *Macacus*, *Cynocephalus*, *Cercopithecus*, etc., taken out of the skull sufficiently carefully, but preserved in the rudest manner without any regard to the above precautions. Now, while all of these brains have somewhat lost their natural contour, they are not so changed that in a single one, human or monkey, do I find the cerebellum uncovered by the cerebrum, and in every instance the posterior lobes overlap the cerebellum to a greater extent than I find is the case in my Orang. If the cerebrum and cerebellum in the Orang and Chimpanzee invariably bear the same proportion to each other as they do in man and the monkeys, why should not the brain of an Orang or Chimpanzee, after lying in alcohol for some years, exhibit the cerebellum covered by the cerebrum as in them? Why should it be necessary to replace the brain of the Chimpanzee or the Orang in the skull, to make plaster casts, etc., if there is no difference between their brains and those of man and the monkeys, for there is no necessity of having recourse to such measures to prove that the cerebellum is covered in the latter?

In the account I gave of the female Chimpanzee,[1] I stated that I found the cerebellum uncovered. I had the opportunity a short time since, of verifying that statement in the male, noticing in situ that the cerebellum was uncovered by the posterior lobes. This was found to be the case by Mr. Arthur Browne, the Superintendent of the Phila. Zool. Garden, in a third Chimpanzee which died there. With all deference to Prof. Marshall's[2] photograph of a plaster cast of the brain of a Chimpanzee, and however it may truthfully represent the relations of the cerebellum in his specimen, I must say that it would be simply monstrous if accepted as an illustration of either of mine, and with profound respect for Prof. Huxley's[3] opinion regarding the interior of the skull being a guide for the determination of the proportion between posterior lobe and cerebellum, I find it anything but a safe one as regards the anthropoid apes. For the space between posterior lobes of brain and dura mater and bone, both posteriorly and laterally, I find very variable in situ, due to the state of the blood vessels and amount of fluid in arachnoid and subarachnoid cavities. In speaking of the Gorilla, Prof. Bischoff[4] observes, p. 100, "Das es bei ersterem am wenigsten von oben Hinterlappen der grossen Hemisphäre bedeckt wird und bei der Betrachtung des Schädel gewiss von oben mit seinem hinterem Rande sichtbar wird." And in reference to the Chimpanzee,[5] p. 95, "Die Hinterhauptslappen des grossen Gehirns bei diesem Affen wie bei dem Menschen das kleine Gehirn überzogen und von oben fast ganz bedecken." And Vrolik[6] states, p. 7, of the Orang: "Ce lobe postérieur ne se prolonge pas autant que chez l'homme; il ne recourve pas si bien le cervelet du moins il ne cache pas complétement surtout vers les cotés." The fact of the cerebellum being covered by the posterior lobes in my Orang and that figured by Gratiolet, and but slightly uncovered in that of Vrolik's, is no more strange than that Bischoff[7] should find it covered in one Hylobates, and Prof. Huxley[8] having stated it to be uncovered in another.

I did not observe anything particularly noticeable about the

[1] Proceed. of Acad., 1879.
[2] Natural History Review, 1861.
[3] Man's place in Nature, p. 97.
[4] Das Gehirn des Gorillas, 1877.
[5] Gehirn des Chimpanzee, 1871.
[6] Amsterdam Verslagen, Deel 13, 1862.
[7] Beitrage zur Hylobates, 1870.
[8] Vertebrate Anatomy, p. 411.

pons or medulla, except that in the latter the olivary bodies are not as distinct as in man. As regards the peripheral nervous system it was essentially the same as the human. As the brain of the Orang which I have just endeavored to describe is the property of the Academy, the animal having been bought and presented by Mr. Wm. S. Vaux, and as it was desirable to preserve it in its present condition, I could not make use of it to examine the structure minutely. I would refer those interested in the histology of the anthropoid brain, to Dr. Spitzka's paper.[1]

What can be inferred from the general organization of the Orang as to its relation to the other primates? The Orang like man has twelve ribs, whereas the Gorilla and Chimpanzee have thirteen; on the other hand the carpal and tarsal bones are nine in number in the Orang, while the Chimpanzee and Gorilla agree with man in having eight. The upper extremity of the Orang resembles that of the Gorilla in the absence of the flexor longus pollicis. The Chimpanzee and man are alike in this respect, at least the slip from the flexor longus digitorum in the former is functionally a flexor longus. In the absence of a flexor longus hallucis, and in the presence of an opponens hallucis, the Orang differs from man, the anthropoids and all the monkeys. The great blood-vessels arise from the arch of aorta in the Gorilla and man in the same way; the same disposition is usually seen in the Chimpanzee, rarely in the Orang. The lungs in the Orang are not divided into lobes as in the Gorilla, Chimpanzee and man. The stomach in the Gorilla and Chimpanzee is human in its form; in the Orang, however, it is quite different. The peritoneum in the Gorilla, Chimpanzee and Orang is like that of man; in the lower monkeys it is different. The brain of the Orang in its globular form, in the cerebellum being usually covered by the cerebrum, and in the development of the first occipital gyrus, resembles man more than that of the Gorilla and Chimpanzee. On the other hand, the frontal and temporal lobes in the Orang are not as much convoluted as in the Chimpanzee, and still less than in man, and the island of Reil is not convoluted at all, at least in my Orang.

It will be seen from the above illustrations, of which many others might be given, that the Gorilla and man, in some respects, agree with and differ from the Chimpanzee and Orang; while

[1] Op. cit.

from other points of view the Orang approaches man more closely than either the Gorilla or Chimpanzee, and that as regards certain muscles, man and the lower monkeys agree in having them, while they are absent in the anthropoids. From these facts we may reasonably infer that the ancestral form of man was intermediate in character as compared with the living anthropoids or lower monkeys, agreeing with them in some respects, and differing from them in others. The Orang is closely allied to the Gibbons, the Chimpanzee to the Macacques, and the gap between these and the *Semnopithecus* is bridged over by the *Mesopithecus* of Gaudry. Until, however, the paleontologist will have procured more material like that from Pikermi, and interpreted it as ably, it will seem to me premature to offer any detailed genealogical tree of the Primates.

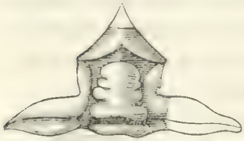
DESCRIPTION OF A NEW CRUSTACEAN FROM THE UPPER SILURIAN OF GEORGIA, WITH REMARKS UPON CALYMENE CLINTONI.

BY ANTHONY W. VOGDES, U. S. A.

Calymene rostrata Vogdes.

This species differs in one aspect from the usual forms classed under the genus *Calymene*, in having a projecting process arising directly from the cephalic shield in front of the glabella, and in this respect resembles *Homalonotus rhinotropis* of Angelin, a species which has been referred by Salter, in his monograph of British Trilobites, to *H. Knightii*. Salter says "the front margin is of most singular structure and may be described as tricuspid. The narrow edge is so deeply indented, and at the same time folded, that the front portion overhangs the rostral shield, forms one projecting angle flanked by two smaller projections opposite the axial furrows, exactly like the salient and re-entering angles of a fortification." Our species has only the central triangular projection, the margins of which are deflected, and the marginal border unites and forms a triangular projection, directly in front and on the median line.

Fig. 1.



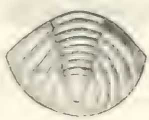
Calymene rostrata Vogdes. The glabella and fixed cheeks showing the projecting process.

The following characteristics are drawn from three specimens, consisting of the glabella and fixed cheeks, and many pygidia found associated with them at the same locality.

The glabella is convex and widens out posteriorly, being contracted in front; the sides are marked with three lobes, the basal one large, the middle lobe nearly spherical, the third is somewhat obscurely defined. The fixed cheeks are separated from the glabella by deep dorsal furrows, but opposite the eyes the furrows are restricted by a buttress thrown across it, nearly touching the middle side lobes; the cheeks are gibbous but not elevated above the glabella, they are narrow along the sides of the glabella and widen out laterally from the eyes. The facial sutures cut the posterior angles of the head, but anteriorly from the eyes these lines run almost straight with a slight tendency outward, and pass over the margin. The neck furrow is continued nearly to the posterior angles of the head. The frontal limb is triangular in outline, and prolonged into a prominent projection, the bourrelet of the limb is defined by a triangular ridge which forms the base of the projection. The projection is formed by the thickening of the crust and by the union of the outer marginal borders along the median line, it is pointed and has its sides deflected. The space between the front of the glabella and the base of the projection is somewhat depressed.

The pygidium is obtusely triangular, with the front greatly arched in uncrushed specimens, but this character seems to be confined to the medium-sized specimens: the larger forms are not so much arched, and correspond in this respect to typical pygidia of *C. blumenbachii.* The axis occupies along the anterior border about one-third of the width of the tail, and gradually tapers posteriorly into an obtuse point: it is marked with about eight or nine articulations, the anterior one being slightly arched forwards, but the others are extended almost straight across it. The dorsal furrows are well defined. The lateral lobes are marked with five pairs of ribs, four of which are grooved and double half-way up; they are contracted along the dorsal furrows, but widen out laterally. The ribs curve downwards and backwards, and are separated from each other by well-defined grooves, the last pair unite and form a ridge extending around the posterior termination of the axis.

Fig. 2.



Calymene rostrata Vogdes. The pygidium usually found associated with the head.

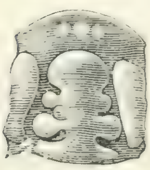
Geological Position.—Clinton Group, Taylor's Ridge, near Catoosa Station; and also at Dug Gap, Georgia.

Among the trilobite specimens which I have collected in Georgia, there are three movable cheeks and one pygidium showing a strong resemblance to the same parts of *Calymene Clintoni* as figured by Prof. Hall in Pal. N. Y., vol. ii, pl. 66 a, fig. 5. These fragments were found associated with two glabellæ, having characteristics not shown by the illustrations of the species just referred to; therefore, for the purpose of comparison, I carried the specimens to the American Museum, and through the courtesy of Prof. Whitfield was enabled to study the trilobites found in the Clinton Group of New York. The Georgia forms are almost identical with those of New York, but show some variations from the typical *C. Clintoni;* I shall, therefore, describe these fragments.

Calymene Clintoni Vanuxem.

Glabella slightly convex, the base broad, so as to form a nearly equilateral triangle. The sides are marked with three lobes, the posterior one being twice as large as the middle lobe, but the anterior one is ill-defined. The dorsal furrows are deep. The occipital ring triangular in front, and narrowing out laterally. The frontal limb is broad, and equal to half the length of the glabella, and arched in front. It is worthy of remark that this character is not common to the minute glabella found in the same beds. The fixed cheeks have a buttress thrown across them extending along the sides of the glabella, but this does not elevate them above it. The movable cheeks are triangular in outline, and posteriorly extended into spines, and correspond to those figured by Prof. Hall, Pal. N. Y., vol. ii, pl. 66 a, fig. 5, c. They are convex laterally along their inner half, and grooved near the outer margin, which is defined by a raised border. The pygidium is triangular in outline, and resembles the figure of this part given by Prof. Hall, Pal. N. Y., vol. ii, pl. 66 a, fig. 5 a, d, except in size. The axis is marked with about eight articulations. The lateral lobes are not marked with ribs, as usual in *Calymene*, and in this respect the pygidium bears some resemblance to that of *C. arago* and *C. salteri*, two European forms found in the Lower Silurian, and described by Rousault in 1849.

Fig. 3.



Calymene Clintoni Vanuxem. The glabella and fixed cheeks showing the wide frontal limb.

Fig. 4.

Calymene Clintoni Vanuxem. The movable cheek.

Geological Position.—Clinton Group, Catoosa Station; also in the Hematitic bed at Dug Gap, Georgia.

CARCINOLOGICAL NOTES, No. 3.—REVISION OF THE GENUS OCYPODA.

BY J. S. KINGSLEY.

The following paper is based on the Collections of the Academy. I have observed the rule adopted in previous papers of following the locality from which I have seen specimens, by an exclamation point. In all other cases the name of the person who has reported a species from any place follows that of the locality. The same conservative spirit which pervades my paper on the "Fiddler Crabs" (*Gelasimi*) will be found in this. Many of the characters given by authors prove to be of no specific value, but I have not ventured to unite forms unless I had specimens which corresponded to each nominal species.

OCYPODA Fabricius.

Cancer l. c., Fabr. *Ocypoda* Fabr., Suppl. Ent. Syst., 347 (1798); Edw., Hist. Nat. Crust., ii, p. 41 (1837); Dana, U. S. Ex. Ex. Crust., p. 324 (1852).

Carapax transverse, rhomboidal or nearly square. Eyes stout, the cornea occupying the larger portion. Meros of external maxillipeds shorter than ischium. Chelipeds unequal.

In many species there is a stridulating organ composed of a row of tubercles on the inner surface of the palm, which, by being drawn across a ridge on the ischium of the cheliped, produces a noise.

§ 1. *Ocular pedicels prolonged beyond the cornea as a spine or style.*

1. O. ceratophthalma Fabr.

Cancer ceratophthalmus Pallas, Spicelegia, p. 83, Pl. V, f. 17 (1772). *Ocypoda ceratophthalma* Fabr., l. c., 347 (1788); Latreille, Hist. Crust. et Ins., vi, 47 (1803-4); Encyc. Meth., x, Pl. 274, f. 1; Lamarck, Hist. Animaux sans Vert., v, 252 (1818); Desmarest, Consid. sur le Crustaces, 121, Pl. XII, f. 1 (1825); Edw., Hist. Nat. Crust., ii, p. 48 (1837); III. Edit. Regne Animal, Pl. XVII, f. 1; Ann. Sci. Nat., III, xviii, p. 141 (1852); Krauss, S. African Crust., p. 41 (1843); Stimpson, Proc. Phila. Acad., 1858, p. 100; Hess, Archiv. für Naturgeschichte, XXXI, 143 (1865); Martens, Verhandl. Zool. Bot. Gesellsch. Wien, 1866, p. 381; Heller, Reise Novara, Crust., p. 42 (1867); Hilgendorf in v. Decken's Reise, Crust., p. 82, 1867; A. M.-Edw., Nouv. Arch. du Mus., ix, p. 270 (1873). *Cancer cursor* Herbst., Pl. I, f. 8–9 (1790). *Ocypoda brevicornis* Edw., Hist. Crust., ii, 48 (1837); Ann. Sci. Nat., III, xviii, 142 (1852); Dana, U. S. Ex. Ex. Crust., p. 326, Pl. XX, f. 3 (1852). *Ocypoda brevicornis var longicornuta* Dana, l. c., 327, Pl. XX, f. 4 (1852). *Ocypoda ægyptica* Gerstaecker, Archiv. fur Naturgeschichte, xxii, 134 (1856); Heller, Sitzungsberichte Wien Akad., xliii, p. 361 (1861); Hoffmann, Rech. Fauna Madagascar Crust., p. 14 (1874 teste Zool. Record); Miers, Ann. and Mag. Nat. Hist., V, ii, 409 (1878).

Carapax nearly square, granulate, front strongly deflexed, orbits sinuate, oblique, the lateral angles being far behind the front. These angles are nearly right angles. Orbits with an indistinct fissure below. Eyes terminated with a style which in most cases is long and cylindrical, extending far beyond the orbits. In the young, however, it is small and in some cases even wanting; that form, when small and conical, characterizes the nominal species *brevicornis;* maxillipeds granulate. Meros of larger cheliped, with the margins armed with spiniform tubercles, more prominent on the anterior margins. Carpus granulate, with internally one or two teeth. Hand externally acute, tuberculate, serrate below, the inner surface with scattered tubercles. Stridulating ridge at some distance from the base of the fingers, straight and composed of rounded tubercles. Ambulatory feet with acute granules, which exhibit a tendency to arrange themselves in rugæ.

Natal! (E. Wilson); *Mauritius*! (Guerin's Collection); *Anjir, Ternate, Amboina, Adenare, Zanzibar, Benkula* (Hilgendorf); *Sandwich Is., Tahiti, Bonin, Loo Choo, Hong Kong Ouisma* (Stm.); *Egypt, Mauritius, Bombay, Australia* (Edw.); *Ceylon* and *Nicobars* (Heller); *Madagascar* (Hoffmann); *Tongatabu* (Dana).

A specimen collected by the Wilkes Expedition ("East Indies") has the carapax intermediate between this species and *cursor*. The ocular styles are wanting. Milne-Edwards' figure in the Regne Animal is different from any specimens that I have seen. I agree with Kossmann in considering *ægyptica* as but a variety of *ceratophthalma*.

2. **O. platytarsis** Edw.

Ocypoda platytarsis Edw., Ann. Sci. Nat., III, xviii, p. 141 (1852); Heller, Reise Novara Crust., p. 42 (1867).

Carapax wider than is usual in this genus and covered with large granules. Superior margin of orbit sinuate, the external angles rounded; sides parallel about one-fourth of their length. Orbits with an indistinct fissure below. Eyes spined as in *ceratoph-*

thalma (*teste* Edw., the single specimen I have seen has the eyes broken). External maxillipeds granulate; meros of larger cheliped with the upper margin produced and dentate, the lower spined, the posterior with transverse granular rugæ, carpus granulate; hand with large granules, serrate below, stridulating ridges carved and composed of crowded granules. Ambulatory feet with rugæ and subspiniform tubercles, dactyli broad.

Pondicherry! Guerin's Collection (labelled by Guerin "Ocypoda platytarsis, Edw., Cat. Mus., Paris") and probably one of the original specimens). *Tahiti* and *Nicobars* (Heller).

3. **O. urvillei** Guerin.

Ocypoda urvillei Guerin, Voyage Coquille, Crust. p. 9, Pl. I, f. 1 (1836), Edw. Hist. Crust., II, p. 49 (1837), Ann. Sci. Nat. III, xviii, p. 141 (1852), Owen in Beechey's Voyage Crust., p. 80 (1839), Dana, U. S. Ex. Exp. Crust., 328, Pl. XX, f. 5 (1852).

Carapax wider than long, superior margin of orbit sinuate, angles acute. Eyes moderate, ocular spines short, extending only to angles of orbit. Meros of larger cheliped rounded above, its two other margins denticulate. Carpus with a strong internal spine. Hand externally granulate, serrate above and below; the stridulating ridge nearly straight, a little remote from the fingers and extending from the lower margin of the hand two-thirds of the way to the upper. (Guerin.)

Tahiti (Guerin); *Isle Bouron* (Edw.); *Sandwich Is.* (Dana).

4. **O. macrocera** Edw.

Ocypoda macrocera Edw. Hist. Nat. Crust., II, 49 (1837), Ann. Sci. Nat. IV, xviii, p. 142 (1852), Heller, Novara Crust., p. 142 (1867).

Orbits wide, oblique, angle obtuse, eyes with a spine as in *O. ceratophthalma*. Larger hand very short, broad and a little spinose above; its palmar portion broader than long. The fingers of the smaller hand lamellate and very broad at their extremities. Ambulatory feet roughened above. (Edw.)

E. Indies, Pondicherry, [?] *Brazil* (Edw.); *Tahiti, Nicobars* (Heller).

5. **O. gaudichaudi** Edwards et Lucas.

Ocypoda gaudichaudi Edw. et Lucas in D'Orbigny's Voyage, Crust., p. 26, Pl. XI, f. 4 (1843), Edw. Ann. Sci. Nat. III, xviii, 142 (1852), Nicollet in Gay's Chili, Zool. III, p. 163 (1849), Stimpson, Ann. N.Y. Lyc. Nat. Hist., VII, p. 61 (1859); Smith, Rep. Peab. Acad. Sci., III, p. 91 (1871); Streets, Proc. Phila. Acad., 1872, p. 240.

Carapax longitudinally strongly arcuate, distal portion of front nearly vertical. Superior border of orbit sinuate internally, its external three-fourths nearly straight and directed slightly backwards. Lateral angles nearly right angles, the sides behind them being concave for about a fifth of the length of the carapax; orbits with a deep median fissure below. Eyes with a short conical style reaching to, or slightly beyond, the angle of the orbit. External maxillipeds nearly smooth, or with a few inconspicuous granules. Meros of larger cheliped with the upper and lower margins spino-tuberculate, the posterior with transverse rugæ. Carpus granulate; hand subspinose above, finely serrate below, internally granulate and with a well-marked transverse stridulating ridge, fingers lamellate, the extremities truncate.

Chili! Guerin; *Panama*! Capt. Field and McNiel (Phila. Acad.); *Gulf of Fonseca*! McNiel (Peab. Acad.); *Callao* (Edw. et Lucas); *Valparaiso* (Dana).

6. O. fabricii Edw.

Ocypoda fabricii Edw., Hist. Nat. Crust., II, p. 47 (1837), Ann. Sci. Nat. XVIII, p. 142 (1852), Hilgendorf in Decken's Reise Crust., 82, Pl. III, f. 1 (1867).

Carapax convex, finely granulate, front strongly deflexed, orbits strongly sinuate; lateral angles acute and some distance posterior to the base of the rostrum; sides parallel for about a third of the length of the carapax. Orbits without emargination below; eyes with a short conical style, not reaching beyond the orbital angle. Anterior margin of meros of larger cheliped crenulate, distally spinose, posterior margin rounded, rugose. Carpus granulate, as is the outside of the hand; inner surface of the hand polished, with minute scattered granules; stridulating ridge straight, composed of small, closely set granules; lower margin of hand finely serrate; fingers of moderate length. Joints of ambulatory feet with transverse rugæ.

Australia! E. Wilson; *Natal*! E. Wilson; *Oceanica* (Edw.); *Zanzibar* (Hilgendorf).

7. O. cursor.

Cancer cursor Linn., Syst. Nat. Edit., xii, p. 1039 (1766). *Ocypoda ippeus* Olivier, Voyage, p. 234, Pl. XXX, f. 1 (1807); Savigny, Egypt, Pl. I, f. 1; Lamarck, An. sans Vert., v, p. 252 (1817); Desm., Consid. Crust., p. 121 (1825); Edw., Hist. Crust., ii, p. 47 (1837); Moseley, Notes by a Naturalist on the Challenger, pp. 48–49, woodcut, 1879. *Ocypoda cursor* DeHaan, Fauna Japonica, Crust., p. 29; Edw., Ann. Sci. Nat., III, xviii, p. 142 (1852); Stm., Proc. Phila. Acad., 1858, p. 100; Heller, Crust. S. Europa, p. 99 (1863).

Carapax arcuate, front strongly depressed. Upper margin of orbits but slightly sinuate and nearly transverse. Lateral angles acute, the sides converging posteriorly, making the carapax widest at the angles. Orbits below with a slight median fissure. Eyes terminated by a short conical style armed with pencil of hairs. Meral joint of cheliped with the spines and rugæ much less prominent than in *O. ceratophthalma*. Carpus internally with a denticulated tooth. Hands small, externally with depressed granules, the lower margin finely serrate, the upper rounded and without spiniform tubercles. Internally the hand is nearly smooth except below where there are granules similar to those of the outside. The stridulating ridge is very near the fingers and is crossed by numerous fine striæ. The propodal joints of the ambulatory feet spined below, the dactyli of the second pair hairy.

Senegal! (Guerin); *Syria, Egypt* (Edw.); *Cape Verdes* (Auct.); *Greece* (Guerin).

This is probably the species described by Hasselquist (Iter Palestinum, p. 433, 1757) under the name *Cancer anomalus*, but he gives many characters which will apply to no known decapod and so to avoid confusion I refrain from applying his name to this species. McLeay, in Smith's Zoology of South Africa, mentions "*Ceratophthalma cursor* DeHaan," an expression not to be found in the pages of that Dutch Carcinologist.

8. O. ryderi Nov.

Carapax coarsely granulate, the upper margins of the orbits sinuate, transverse, lateral angles acute, sides arcuate, the carapax being widest at the anterior third, as in *O. arenaria*, the lateral margins anteriorly finely serrate.

Eyes not reaching the extremities of the orbits, terminated by a minute spine. Chelipeds like those of *O. arenaria*; ambulatory feet roughened by subspiniform granules.

Natal! (E. Wilson).

This species is closely allied to the *Ocypoda arenaria* of the coasts of America, but is readily separated by the ocular spines and the granulations on the ambulatory feet. It is dedicated to my friend, John A. Ryder, of the Academy of Natural Sciences of Philadelphia.

§ II. *Eyes without an ocular spine.*

9. O. arenaria Say.

Cancer arenarius Catesby, History of the Carolinas, ii, Pl. 35 (1731 and 1771 *). *Cancer quadratus* Fabr., Ent. Syst., ii, p. 439 (1793). *Ocypoda quadrata* Fab., Suppl., p. 347 (1798); Bosc. Edit., I, "i, p. 194;" (teste Auct.) Edit., II, i, p. 247 (1828); Latr., Hist. Crust. et Ins., vi, p. 49 (1803–4). *Ocypoda arenaria* Say, Jour. Acad. Nat. Sci., Phila., i, p. 69 (1817); Edw., Hist. Nat. Crust., ii, p. 44, Pl. XIX, f. 13-14 (1837); DeKay, N. Y. Fauna, Crust., p. 13 (1841); Gibbes, Proc. Am. Assoc., iii, p. 180 (1851); Gerstäcker, Arch. für Naturg., xxii, p. 36 (1856); Guerin in La Sagra's Hist. Cuba, Crust., p. 7 (1857); Martens, Arch. für Naturges., xxxviii, p. 103 (1872); Smith, U. S. Fish Comm. Report for 1871–72, p. 545 (1875); Kingsley, Proc. Phila. Acad., 1878, p. 322. *Ocypoda albicans* Latr., Encyc. Méth., x, Pl. 285, f. 1 (after Catesby vix *O. albicans* Bosc.). *Ocypoda rhombea* Edw., Hist. Nat. Crust., ii, p. 46 (1837); Ann. Sci. Nat., III, xviii, p. 143 (1852); Gibbes, l. c., p. 180 (1851); Dana, U.S. Ex. Exp. Crust., p. 322, Pl. XIX, f. 8 (1852); Heller, Reise Novara, Crust., p. 42 (1867); Smith, Trans. Conn. Acad., ii, p. 135 (1870); Streets, Proc. Phila. Acad., 1872, p. 240. *Monolepis inermis* Say, l. c., p. 157 (Megalops).

Carapax convex, granulate above, front but little deflexed; lateral angles of carapax acute, extending as far forward as the middle of the front. Lateral margin crenulate, arcuate, the carapax being widest at the anterior third. Orbits below with spiniform tubercles and occasionally a distinct emargination. Eyes with the extremities rounded and not reaching to the extremity of the orbit. Chelipeds with spines and tubercles; the meros with the upper and lower margins spined, the posterior rounded and crossed by tubercular rugæ. Carpus with the tubercles obsolete above but pronounced near the margins, the inner margin armed with one or more strong spiniform teeth. Hands tuberculate, the upper margin spined, the lower serrate. A tubercular stridulating ridge on the inside near the fingers. Fingers strongly inflexed. Ambulatory feet compressed, hairy, their sides smooth, the upper portion margined and crossed by transverse rugæ.

* There were at least two editions of Catesby published, bearing dates respectively as above and as the second is post-Linnean, the names employed by him must hold. I think that another edition exists in the library of the Essex Institute at Salem, Mass., the date of which is between those quoted above, but I have nothing at hand by which to decide the matter.

Young specimens (less than 10 mm. broad) have the lateral angle further back than in the adult, while the spines of the chelipeds are wanting or but faintly indicated.

The *O. albicans* of Bosc, Lamarck and Desmarest has the eyes terminated by a style, a feature I have never observed in any specimen of *O. arenaria.* The locality given is South Carolina. The *O. rhombea* of Fabricius is *not* this species, as his expression "*Carpus utrinque unidentatis, manibus sublaevis*" will not apply to this form, but agrees better with *O. cordimana.* Fabricius gives no locality for his specimens. The Brazilian forms (*rhombea* Auct.) show no differences from northern specimens. I have seen specimens from over thirty localities embraced in the limits of Great Egg Harbor, N. J. (Say's types), to Rio Janeiro, Brazil, and also specimens from the west coast of Mexico (Dr. W. H. Jones).

10. O. convexus Quoy and Gaimard.

Ocypoda convexus Quoy et Gaimard, Voy. Uranie, Zool., iii, p. 525, Pl. LXXVII, f. 2 (1828); Edw., Hist. Crust., ii, p. 49 (1837).

Carapax granulate, sides arcuate, front deflexed, orbits sinuate. lateral angles behind the base of the rostrum, acute. Meros internally entire, distally tuberculate; carpus tuberculate, its inner surface with a bifid tubercle. Hands cordate, externally granulate, serrate above and below.

This brief description is taken from the figure of MM. Quoy and Gaimard. I have never seen the species. It is said to have come from Australia.

11. O. cordimana Desm.

? Ocypoda rhombea Fabr., Suppl. Ent. Syst., p. 348 (1798). *Ocypoda cordimana* Desm., Consid. sur les Crustaces, p. 121 (1825); Edw., Hist. Nat. Crust., ii, p. 45 (1837); Ann. Sci. Nat. III, xviii, p. 143 (1852); Jacquinot et Lucas, Voy. Astrolabe et Zelee, p. 64; Heller, Reise Novara Crust., p. 42 (1867); A. M. Edw., Nouv. Arch. Mus., ix, p. 271 (1872). *Ocypoda rhombea ?* Desmarest, l. c., p. 122; Randall, Jour. Phila. Acad., viii, p. 123. *Ocypoda pallidula* Jacquinot et Lucas, l. c., Pl. VI. f. 4. *Ocypoda laevis* Dana, U. S. Expl. Exped., Crust., p. 325, Pl. XX, f. 2 (1852). *? Ocypoda convexa* Stm., Proc. Phila. Acad., 1858, p. 100.

Carapax arcuate, evenly granulate. Front strongly deflexed. Orbits sinuate above; lateral angles acute, but not extending as far forward as the base of the front. Sides in the adult slightly arcuate, but in the young they are parallel or even concave, converging behind. Eyes, without styliform process, and extending nearly or quite to the orbital angle. Meros of chelipeds with its anterior margin crenulate in the young, in the adult with spiniform tubercles. Carpus externally granulate. Hand short, broad, cordate, granulate internally and externally, its lower margin serrate, the stridulating ridge nearly obsolete. Fingers short, compressed, the thumb slightly hooked at the extremity. Meral joints of the ambulatory feet with transverse rugæ. Carpal and propodal joints similarly roughened and covered with a short pubescence.

New Zealand ! *Mauritius* ! (Guerin) ; *Australia* ! (E. Wilson); *Sandwich Is.* ! (J. K. Townsend) ; *Tahiti* ! (A. Garrett) ; *Mozambique* and *Zanzibar* (Hilgendorf) ; *Red Sea, Manilla, Nicobars* (Heller) ; *Hong Kong, Loo Choo* (Stm.) ; *Japan* (Edw.).

The following are not true members of the genus :

O. angulatus Latr.	= *Gonoplax angulatus.*
O. aurantia Bosc. ex Herbst	= *Thelphusa aurantia.*
O. carnifex Latr. ex Herbst	= *Cardiosoma carnifex.*
O. heterochelos Bosc.	= *Gelasimus heterochelos.*
O. hispana Bosc. ex Herbst	= *Sesarma sp.*
O. hydrodromus Latr. ex Herbst	= *Thelphusa hydrodromus.*
O. longimana Latr.	= *Gonoplax rhomboidalis.*
O. maracoani Latr.	= *Gelasimus maracoani.*
O. macrocheles Bosc.	= ? *Macrophthalmus* sp.
O. pugillator Bosc.	= *Gelasimus pugillator.*
O. quadrata Bosc.	= *Sesama sp.*
O. rufopunctata Latr. ex Herbst	= *Trapezia rufopunctata.*
O. senex Latr. ex Fabr.	= *Thelphusa sp.*
O. tetragonon Bosc. ex Herbst	= *Gelasimus tetragonon.*
O. tridens Latr. ex Fabr.	= ? *Pachygrapsus sp.*
O. vocans Latr.	= *Gelasimus sp.*

I have not been able to identify

O. granulata Bosc. (Edit. ii) p. 247.

O. macleayana Hess, Archiv. für Naturgesch., XXXI, p 143, Pl. VI, f. 8 (1865). *Australia.*

O. unispinosa Rafinesque, Precis de découvertes Semiologiques, p. 21, No. 35 (1814).

CARCINOLOGICAL NOTES. No. IV.—SYNOPSIS OF THE GRAPSIDÆ.

BY J. S. KINGSLEY.

The following paper is a continuation of my studies of the Catometopa contained in the Museum of the Academy of Natural Sciences of Philadelphia. In it I have endeavored to embrace every known species of the family with sufficient references to their geographical distribution. To aid in the identifications of species I have compiled analytical tables for most of the genera, but descriptions are given of only those species of which I have examined specimens. I have reduced considerably the number of nominal species, but believe that I am fully warranted in relegating to synonymy many so-called species founded on size, color, geographical distribution, or variations of minor importance. All localities from which I have examined specimens are marked with an exclamation point (!). The classification employed is mainly that of Dana, in the U. S. Exploring Expedition Crustacea (1852); those of Milne-Edwards (Annales des Sciences Naturelles, III Series, Zoologie, tome xx, pp. 163–200, 1853), and Kossmann (Zoologische Ergebnisse, Reise in die Küstengebiete des rothen Meeres, 1877), being comparatively worthless. Owing to the limited amount of space at my disposal, the synonymy and bibliography have been condensed as far as possible.

Family GRAPSIDÆ Dana. (*Grapsoidiens* M. Edw.).

Carapax subquadrate, depressed. Front generally broad. Eyes short. Antennulæ transversely plicate. Epistome short, sometimes linear. Meros of the external maxillipeds bearing the palpus at the summit or at its external angle. Second joint of the abdomen of the male nearly as wide as the adjacent portion of the sternum.

The *Grapsidæ* are all inhabitants of the temperate or tropical waters, and generally live near the shores. A few, however (e.g. *Nautilograpsus* and *Varuna*), live on the high seas. The family may conveniently be divided into two[1] sub-families, by characters derived from the antennæ. In the *Grapsinæ* the antennæ are

[1] The characters given by Dana for the Sesarminæ I do not consider of sufficient importance to warrant its retention as a sub family, and would rather consider it as a group of the Grapsinæ.

covered by the front; in the *Plagusinæ* they are received into notches in the front and are visible from above.

Analytical Key to the Genera of the Grapsidæ.

Antennæ covered by the front. GRAPSINÆ.
External maxillipeds without a piliferous ridge. GRAPSINI.
External maxillipeds widely gaping.
Antennæ excluded from the orbit.
Meros of the external maxillipeds as long as the ischium. *Goniopsis.*
Meros of the external maxillipeds shorter than the ischium. *Metopograpsus.*
Antennæ entering the orbit.
Front less than half the width of the carapax.
No tooth behind the orbital angle. *Epigrapsus.*
One tooth behind the orbital angle.
Fingers of cheliped excavate. *Grapsus.*
Fingers acuminate.
Sides straight. *Orthograpsus.*
Sides arcuate in front. *Geograpsus.*
Two teeth behind the orbital angle. *Leptograpsus.*
More than two teeth behind the angle of the orbit.
Male abdomen five-jointed, antennulæ transverse, front straight. *Grapsodes.*
Male abdomen seven-jointed, antennulæ oblique, front excavate. *Cyrtograpsus.*
Front more than half the width of the carapax.
Carapax transverse. *Pachygrapsus.*
Carapax longer than broad. *Nautilograpsus.*
External maxillipeds without a rhomboidal gape.
Palpus articulating with the inner angle of the meros of the external maxillipeds.
One tooth behind the orbital angle. *Brachygrapsus.*
Several teeth behind the orbital angle. *Euchirograpsus.*
Palpus articulating with middle of the anterior margin of the meros of the external maxillipeds.
Exognath of external maxillipeds very broad. *Ptychognathus.*
Exognath much narrower than the ischium.
Sides of carapax entire. *Acmæopleura.*
Sides of carapax dentate.
External distal angle of the meros of the external maxillipeds expanded.
Joints of ambulatory feet rounded, dactyli styliform. *Pseudograpsus.*
Ambulatory feet compressed, dactyli flattened, natatorial. *Varuna.*
Meros of external maxillipeds not expanded.

Meros of external maxillipeds broader than long.
Meros as long as ischium. *Glyptograpsus.*
Meros shorter than ischium. *Utica.*
Meros as long or longer than broad.
Front nearly half as wide as carapax. *Heterograpsus.*
Front not over one-third as wide as carapax. *Eriocheir.*
Palpus articulating with the outer angle of the meros of the external maxilliped.
One tooth behind the orbital angle. *Perigrapsus.*
More than one tooth behind the orbital angle. *Platygrapsus.*
External maxillipeds with an oblique piliferous ridge. SESARMINI.
Meros of external maxilliped elongate, its apex rounded.
Antennæ excluded from the orbit. *Metasesarma.*
Antennæ not excluded from the orbit.
Carapax subquadrate, sides arcuate.
Joints of ambulatory feet entire. *Sarmatium.*
Joints of ambulatory feet dentate. *Rhaconotus.*
Carapax quadrate, sides straight. *Sesarma.*
Carapax elongate, narrowed behind. *Aratus.*
Meros of external maxilliped short, its distal border truncate or even excavate, and bearing the palpus.
Antennæ excluded from the orbit. *Clistocœloma.*
Antennæ entering the orbit.
Sides of carapax straight. *Helice.*
Sides arcuate.
Sides entire. *Cyclograpsus.*
Sides emarginate or toothed. *Chasmagnathus.*
Antennæ lodged in notches in the front, and visible from above. PLAGUSINÆ.
Meros of external maxillipeds large, as broad as ischium. *Plagusia.*
Meros small and much narrower than ischium. *Leiolophus.*

Sub-family Grapsinæ (*Grapsinæ* et *Sesarminæ* Dana).

Antennulæ more or less transverse, and covered by the front.

Tribe GRAPSINI (Sub-family *Grapsinæ* Dana).

§ External maxillipeds without an oblique piliferous ridge on the ischial and meral joints.

Genus GONIOPSIS De Haan, 1835 (*Goniograpsus* (pars) Dana, 1851).

Carapax flat; front vertical, over half as wide as carapax; sides straight, one-toothed. Suborbital lobe broad, reaching the front and excluding the antenna from the orbit. External maxillipeds slender; meral and ischial joints of equal length.

1. **G. cruentatus** De Hann *ex* Latreille.

Cancer ruricola De Geer. Memoirs pour servir a l'Hist. Insectes, vii, 417, Pl. XXV, 1778 (non Linné).

Grapsus cruentatus Latreille. Histoire Naturelle des Crust. et Ins., vi, p. 70 (1803-4).

Goniopsis cruentatus De Haan. Fauna Japonica Crust., p. 33 (1835).

Grapsus longipes Randall. Jour. Phila. Acad., viii, p. 125 (1839).

Goniopsis ruricola White. List Brit. Mus. Crust., p. 40 (1847).

Grapsus pelli Herklots. Additamenta ad Faunam Carcinologicam Africæ Occidentalis, 8, Pl. I, f. 6-7 (1851).

Goniograpsus cruentatus Dana. U. S. Expl. Exped. Crust., p. 342, Pl. XXI, f. 7 (1852).

Front granulate, supra-frontal lobes four, margins crenulate, orbits entire above, distally emarginate. Carapax with oblique transverse ridges. Anterior margin of meros of chelipeds expanded, dentate, the upper and lower margins with spiniform tubercles, as is also the upper margin of carpus. Hands with spiniform tubercles above and below, the middle of the outer surface smooth, the inner surface with scattered prominent granules. Thumb and finger sub-excavate, the latter spinose above. Ambulatory feet compressed and armed with stiff black bristles. Posterior angle of meros of last pair rounded, in the other feet dentate.

Florida! (H. E. Webster, in Union College Museum); *Bahamas! Cuba!* (H. F. Baker); *Surinam!* (Dr. Hering, Randall's type of *G. longipes*); *Gaboon, W. Africa* (Du Chaillu); *West Coast of Nicaragua!* (J. A. McNiel, in Museum of Peabody Academy); *Tropical Seas of America* (Auct.).

Genus **METOPOGRAPSUS** M.-Edw., 1853.

Front more than half the width of carapax, deflexed. Sides straight. Internal suborbital lobe very broad, reaching the front and excluding the antenna from the orbit. Meros of external maxilliped short, much broader than long.

Key to Species.

Antero-lateral margin entire.	
Frontal margin sinuate.	*messor.*
Frontal margin straight.	*latifrons.*
Antero-lateral margin toothed.	*oceanicus.*

M. messor Edwards *ex* Forskal.

Cancer messor Forskal. Descr. An. in Itin. Observ., p. 88 (1775).

Grapsus gaimardii Andouin, Expl. Pl. Savigny (teste Edw.).

Grapsus messor Edw. Hist. Nat. Crust., ii, p. 88 (1837).

Grapsus thukuhar Owen. In Beechey's Voyage, Zoology, p. 80, Pl. XXIV, f. 3 (1839).

Grapsus parallelus Randall. Jour. Acad. Nat. Sci., Phila. viii, p. 127 (1839).

Metopograpsus messor, thukuhar, eydouxi et *intermedius* Edw. Ann. Sci. Nat., III, xx, p. 165 (1853).

Carapax slightly narrowed behind, plications and rugæ more or less distinct. Frontal lobes rather prominent, frontal margin sinuate, smooth or crenulate at the angles. Meros of chelipeds with the posterior surface rugose, the anterior margin expanded and distally truncate, a few spinose teeth near the base and several on the truncate margin. Carpus externally rugose, internally with a prominent bifid or quadrifid tubercle. Hands with oblique folds above and below, and a longitudinal ridge on the lower outer surface. Fingers sub-excavate. Last joint of male abdomen but slightly narrower than penult joint.

Sandwich Is. ! (Nuttall, Pease, Jones, Wilkes' Expedition); *Tahiti !* (A. J. Garrett); *Australia !* (E. Wilson); *Mauritius !* (Guerin); *Aden ; ! Natal !* (Dr. T. B. Wilson); *Indian and Pacific Oceans* (Auct.)

M. latifrons Edwards *ex* White.

Grapsus latifrons White, in Jukes' Voyage of the Fly, ii, p. 337, Pl. II, f. 2 (1847).

Metopograpsus latifrons et *maculatus* Edw., Ann. Sci. Nat. III, xx, pp. 166 and 165, Pl. VII, f. 1 (1853).

Metopograpsus pictus A. M.-Edw., Ann. Soc. Ent. France, vii, p. 283 (1867); Nouv. Arch. du Mus., ix, p. 289. Pl. XIII, f. 2 (1873).

Carapax narrowed behind, plications indistinct; frontal lobes granulate on the edge. Front broad, nearly straight, margin denticulate. Chelipeds similar to those of *M. messor*. Base of last joint of male abdomen much narrower than the extremity of penult joint.

Batavia ! (Dr. Wilson); *Singapore* (White); *Java* (Edw); *New Caledonia* (A. M.-Edw.).

M. oceanicus Jacq. et Lucas.

Metopograpsus (*Grapsus*) *oceanicus* Jacquinot et Lucas, Voyage Astrolabe et Zéelee, Crust., p. 73, Pl. VI, f. 9 (Text 1853, Plates 1842–53).

Metopograpsus quadridentatus Stimpson, Proc. Acad. Nat. Sci. Philadelphia, 1858, p. 102.

Pulo Han (J. et L.); *near Hong Kong* (Stm.); *Nicobar Is.* (Heller).

Genus **EPIGRAPSUS** Heller, 1862[1] (*Nectograpsus* Heller, 1865).

Sides arcuate, entire orbits externally open; external maxillipeds gaping, meros shorter than the ischium, rather broad abdomen of the male five-, of the female seven-jointed.

E. politus Heller.

Epigrapsus politus Heller, Verh. Z. B. Ges. Wien, 1862, p. 522.
Nectograpsus politus Heller, Reise der Novara, Crustaceen, p. 57, Pl. V, f. 3 (1865).

Nicobars; Tahiti (Heller).

Genus **GRAPSUS** Lamarck (restrict).

Sides arcuate, with one tooth behind the orbital angle; front narrow, deflexed; antennæ entering the orbit. External maxillipeds slender, gaping; meros oblong. Fingers of chelipeds excavate.

G. maculatus Edwards *ex* Catesby.

Pagurus maculatus Catesby, Nat. Hist. of the Carolinas, ii, Plate XXXVI, f. 1 (1743 et 1771).[2]

[1] Dr. Heller, in his preliminary account of the Crustacea collected by the Novara Expedition (Verhandl. Zool. Bot. Gesellschaft, Wien, 1862, pp. 519–528), characterizes several genera and species of which no mention is made in the final report. These are *Menœthius brevirostris* which is probably *Acanthonyx consobrinus* A. Edw., of the final report; *Xantho tetraodon* is *Eudora tetraodon*, *Carpilodes granulatus* appears to be *C. tristis* Dana. *Lupa hirsuta* was probably referred to *Neptunus sanguinolentus*. *Thelphusa wüllerstorfi* appears to be *T. leschenaudii*, *Parathelphusa dentipes* to be *P. tridentata*, *Helœcius areolatus* to be *H. cordiformis*, *Metaplax hirtipes* is apparently referred to a new genus, *Grapsus depressus* is probably *Geograpsus crinipes*, *Grapsus declivifrons* is apparently rechristened *Pachygrapsus intermedius*, *Heterograpsus barbigerus* has its specific name altered to *barbimanus*, *Epigrapsus* nov. gen. reappears as *Nectograpsus* nov. gen. with no reason assigned for the change. *Metasesarma granulatus* is redescribed as new under the name *rugulosa*. *Plagusetes elatus* is probably, as pointed out by Mr. Miers (Ann. and Mag. Nat. Hist., ix, p. 147, 1878), *Acanthocyclus gayi* of the final report. *Gelasimus variegatus* appears to have been finally referred to *G. annulipes*. *Palinurus paulensis* was afterward apparently referred to *P. lalandii* and *Pelias notatus* is referred to *Anchistia*. All this shuffling of names is made without the slightest hint to aid one in correlating the two papers, and is a proceeding which cannot be too strongly condemned.

[2] There were at least two editions of Catesby bearing dates as above, and as the second appeared thirteen years after the tenth edition of the *Systema Naturæ* of Linné, and five after the twelfth edition, the names employed by Catesby will hold.

Cancer grapsus Linn., Syst. Nat., Edit., x, p. 630 (1758).

Grapsus pictus Latreille, Hist. Crust. et Ins., vi, p. 69, Pl. XLVII, f. 2 (1803–4.)

Goniopsis pictus De Haan, Fauna Japonica Crust., p. 33 (1835).

Grapsus strigosus Brullé, in Webb et Berthelot Hist. Canaries, ii, Pl. II ; Crustacea, p. 15, 1836–44 (teste Edw.)[1]

Grapsus maculatus, webbi, ornatus et *pharaonis* Edw., Ann. Sci. Nat. pp. 167–8, Pl. VI, f. 1 (1853).

Grapsus altifrons Stimpson, Annals N. Y. Lyceum Nat. Hist., vii, p. 230 (1860).

Carapax depressed, transversely plicate, folds anteriorly broken up into squamiform tubercles. Frontal crest four-lobed, median lobes the larger, their margins subtuberculate. Frontal margins crenulate, regularly arcuate. Lateral margin arcuate. Inferior border of orbit with a deep fissure. Anterior border of ischium and meros of cheliped spinose, the lower margin of the meros spinotuberculate, the posterior surface plicate. Carpus with distant tubercles, its interior margin with a laminate spine. Hand above tuberculate, externally with longitudinal ridges, below with oblique folds. On the inner surface the tubercles and folds are less prominent. Fingers short, tips excavate. Ambulatory feet compressed, propodal and dactylic joint spinose.

Florida Keys! (Webster, Ashmead) ; *West Indies!* (Lawrence, Wood, Wilson, Göes, Lea) ; *San Lorenzo!* (Wilkes' Expedition) ; *Pernambuco!* (Dr. Wilson) ; *Tahiti!* (A. Garrett) ; *W. Coast Mexico!* (Dr. Jones) ; *Central America!* (McNiel) ; *New Zealand!* (Dr. Wilson) ; *Mauritius!* (Guerin) ; *Natal!* (Dr. Wilson) ; *Georgia, California, Peru, St. Helena and Cape Verde Is.* (Miers) ; *Paumotu and Hawaian Is.* (Dana) ; *Honduras!* (no collector's name).

The genus *Grapsus*, as well as several others, is divided into sections by Milne-Edwards, characterized either by having the posterior distal angle of the meros of the last pair of ambulatory feet regularly rounded, or dentate ; but in specimens of *G. maculatus*, I have occasionally found this angle on one side entire, and the other dentate.

G. maculatus var. tenuicristatus Martens *ex* Herbst.

Cancer tenuicristatus Herbst. Krabben und Krebse, Pl. III, f. 33-34, 1790 (teste Martens).

Grapsus rudis Edw., Hist. Nat. Crust., ii. p. 87 (1837).

Grapsus hirtus Randall, Jour. Phila. Acad., viii, p. 124 (1839).

[1] Brullé gives not the slightest description which will distinguish his specimens from either *maculatus* or *strigosus*.

Is distinguished from the typical forms of *G. maculatus* only by the hairy carapax and meral joints of the ambulatory limbs, and the narrower carpal spine. All other characters which have been given prove inconstant. Dr. Martens, by an examination of Herbst's type, has shown the identity of Herbst's *tenuicristatus*, and Edwards' *rudis*.

Hawaian Is.! (J. K. Townsend, Randall's type) ; *Oahu!* (Dr. W. H. Jones) ; *Ceylon* (Heller) ; *Bonin* (Stm.).

G. strigosus Latreille *ex* Herbst.

Cancer strigosus Herbst, Pl. XLVII, f. 7 (1799).

Grapsus strigosus Latr., Hist. Crust. et Ins., vi, p. 70 (1803-4).

Grapsus albolineatus Lamarck, Hist. Animaux sans Vertebres, v, p. 249 (1817).

Goniopsis strigosus De Haan, Fauna Japonica Crust., p. 33 (1835).

Grapsus granulosus, peronii et *pelagicus* Edw., Ann. Sci. Nat., III, xx, p. 169 (1853).

Grapsus longipes et *subquadratus* Stimpson, Proc. Acad. Nat. Sci. Philadelphia, 1858, pp. 102 et 103.

Carapax but little convex, posteriorly with oblique transverse lines, anteriorly with squamiform tubercles. Frontal lobes moderate, frontal margin crenulate. Orbits with a deep fissure below. Epistome short. Meros spined anteriorly, its other margins rounded, the posterior surface with transverse rugæ. Carpus granulate and bearing internally a slender spine. Hands much as in *G. maculatus*. Posterior distal angle of meros of last pair of ambulatory feet denticulate.

Natal! Australia! (Dr. T. B. Wilson) ; *Sandwich Is.!* (in Peabody Acad.). Its distribution is embraced within the above limits and *Hong Kong* (Stimpson).

G. gracilipes Milne-Edwards.

Grapsus gracilipes Edw., Ann. Sci. Nat., III, xx, p. 168 (1853).
China (Edwards).

Subgenus **Orthograpsus**, nov.

Carapax transverse, broadest behind. Sides straight, with one tooth behind the orbital angle. Antennæ entering the orbit. Fingers of chelipeds acute.

O. hillii nov.

Carapax depressed, plications faint. Supra-frontal lobes moderate ; front straight, narrow, deflexed. Sides of carapax straight, post-orbital tooth small. Meros of external maxilliped a little longer than broad. Chelipeds much as in *Metopograpsus messor*, the hand granulate above, fingers acuminate. Posterior distal angle of meral joints of ambulatory feet rounded, entire or finely serrate, there being a variation in the sides of the same specimen.

West Indies! (Dr. Wilson); *Key West, Fla.!* (Dr. A. S. Packard, Jr., Peab. Acad.).

O. longitarsis Kingsley *ex* Dana.

Grapsus longitarsis Dana, Proc. Acad. Nat. Sci., Phila., 1851, p. 249. U. S. Expl. Exped. Crust., p. 339, Pl. XXI, f. 4 (1852).

Paumotu Archipelago (Dana).

Genus **GEOGRAPSUS** Stimpson, 1858 (*Discoplax*, Am. Ed., 1867).

Carapax depressed, sides curved in front, straight behind, one tooth behind the angle of the orbit. Front narrow, strongly deflexed. Internal suborbital lobe large. Antennæ entering the orbit. Dactyli of chelipeds acuminate.

Synopsis of Species.

Meros of chelipeds with a laminiform expansion of the anterior margin.
- Front nearly straight.
  - Folds of carapax transverse. *lividus.*
  - Folds of carapax oblique. *grayi.*
- Front arcuate. *crinipes.*

Meros not expanded, carapax tuberculate anteriorly. *longipes.*

G. lividus Stimpson *ex* Milne-Edwards.

Grapsus lividus Edwards, Hist. Nat. Crust., ii, p. 85 (1837).

Grapsus brevipes Edw., Ann. Sci. Nat., III, xx, p. 170 (1853).

Geograpsus lividus Stimpson, Proc. Acad. Nat. Sci. Philadelphia, 1858, p. 101.

Geograpsus occidentalis Stimpson, Annals N. Y. Lyc., vii, p. 230 (1860).

Carapax much broader than long, depressed. Plications nearly transverse. Frontal lobes prominent, front deflexed, its margin nearly straight. Sides of carapax slightly arcuate. Orbit with a deep fissure below. Meros of chelipeds above and below with transverse rugæ, its anterior margin expanded, proximally denticulate, distally the teeth are larger. Carpus granulate and with a short spine on the inner margin. Hand and dactylus tuberculate above, externally and below with short, oblique rugæ; fingers acuminate. Distal angle of meral joints of the last pair of ambulatory feet rounded.

Isle Bartholomew, W. I.! (A. Goës); *Chili!* (Guerin); *West Indies* (Auct.); *Cape St. Lucas* (Stm.).

G. crinipes Stimpson *ex* Dana.

Grapsus crinipes Dana, Proc. Acad. Nat. Sci. Philadelphia, 1851, p. 249. U. S. Expl. Exped. Crust., p. 341, Pl. XXI, f. 6 (1852).

Geograpsus crinipes Stimpson, Proc. Acad. Nat. Sci. Philadelphia, 1858, p. 101.

Grapsus depressus Heller, Verh. Z. B. Gess. Wien, 1862, p. 521.

Carapax depressed, the sides nearly parallel, folds of the carapax oblique, frontal lobes but little prominent, front arcuate. Ischial joint of cheliped spined in front; meros with the anterior margins expanded, finely serrate proximally, more coarsely so at the apex; carpus and hand roughened above, a few inconspicuous lines on the lower outer surface of the palm. Distal angle of meros of the last pair of ambulatory feet rounded.

Sandwich Is.! (Dr. W. H. Jones); *Tahiti* (Heller).

G. grayi A. Milne-Edwards *ex* H. Milne-Edwards.

Grapsus grayi Edw., Ann. Sci. Nat., III, xx, p. 170, 1853.

Geograpsus rubidus Stimpson, Proc. Acad. Nat. Sci. Philadelphia, 1858, p. 103.

Geograpsus grayi A. M.-Edw., Nouv. Arch. du Mus., ix, p. 288 (1873).

Carapax somewhat inflated, its folds oblique; frontal lobes prominent, front nearly straight. Orbit with a slight fissure below; chelipeds much as in *G. crinipes*. Distal angle of meros of last pair of feet rounded, entire or dentate.

This is probably the adult of the preceding species.

Tahiti! (A. Garrett); *Australia*, *Mauritius*, *Zanzibar* (Hilgendorf); *Madagascar*, *India*, *Bonin*, *New Caledonia* (A. M.-Edw.).

G. longipes Kingsley *ex* A. Milne-Edwards.

Discoplax longipes A. M.-Edw., Ann. Soc. Ent. France, vii, p. 284 (1867). Nouv. Arch. du Mus., ix, p. 294, Pl. XV (1873).

New Caledonia (A. M.-Edw.).

Genus **LEPTOGRAPSUS** M.-Edwards (pars), 1853, Stimpson.

Carapax with the sides arcuate, two-toothed. Front less than half the width of the carapax, not deflexed. Internal sub-orbital lobe small, antennæ entering the orbit. Meros of external maxillipeds as broad as long, but shorter than the ischium.

Leptograpsus variegatus Milne-Edwards *ex* Fabricius.

Cancer variegatus Fabr., Ent. Syst., ii, p. 450 (1793).

Grapsus marginatus Latr., Hist. Crust. et Ins., vi, p. 71 (1803-4).

Grapsus personatus Lamarck, Hist. An. sans Vert., v, 249 (1817).

Grapsus pictus Quoy et Gaimard, Voyage Uranie et Physiciene, p. 523, Pl. LXXVI, f. 2 (1824).

Grapsus strigillatus White, in Gray's Zoological Miscellany, p. 78 (1842).

Grapsus variegatus Edwards et Lucas, in d'Orbigny's Voyage, p. 27 (1849).

Grapsus planifrons Dana, Proc. Acad. Nat. Sci. Philadelphia, 1851, p. 249. U. S. Expl. Exped. Crust., p. 638, Pl. XXII, f. 3 (1852).

Leptograpsus variegatus Edw., Ann. Sci. Nat., III, xx, p. 171 (1853).

Leptograpsus bertheloti, verreauxi, ansoni et *gayi* Edw., l. c., p. 172 (1853).

Carapax nearly flat, transversely plicate. Protogastric region concave, with squamose tubercles, protogastric lobes but little prominent. Front slightly depressed, its margin crenulate and nearly straight. Orbits with a narrow, deep, external fissure. Meros of chelipeds with the anterior border expanded, dentate; the other angles rounded, the posterior surface rugose. Carpus tuberculate and with a short spine on the internal surface. Hand tuberculate above, externally smooth. In the young there is an elevated line along the outside of the palm. Ambulatory feet with stiff setæ.

Pernambuco! (Dr. Wilson); *Chili!* (Wilkes' Expedition); *Australia!* (E. Wilson); *New So. Wales!* (Capt. Putnam, Peabody Academy); *Isle Guam* (Quoy and Gaimard); *Canaries* (Edw.); *Norfolk I.* (Miers); *Shanghai* (Heller).

Genus **GRAPSODES** Heller, 1865.

Carapax depressed, sides arcuate and dentate in front, behind straight. Front less than half the width of the carapax, strongly deflexed. Orbits externally open. Internal sub-orbital lobe small, antennæ entering the orbit. Meros of external maxilliped longer than broad. Male abdomen five-jointed.

G. notatus Heller.

Grapsodes notatus Heller, Novara Crust., p. 58, Pl. V, f. 2 (1865).

Nicobars (Heller).

Genus **CYRTOGRAPSUS** Dana, 1851.[1]

Carapax broader than long, front narrow, excavate, sides arcuate, with three teeth behind the orbital angle. External maxillipeds widely gaping, without a piliferous ridge. Epistome very

[1] For some reason, Prof. Smith in his paper on Brazilian Crustacea (Transactions of the Connecticut Academy of Arts and Sciences, Vol. ii, pp. 1–42, 1869), and in his notes on Ocypodoidea (l. c., p. 154), refers several times to this genus, and always as *Cryptograpsus*.

short. Antennæ entering the orbit. Male abdomen seven-jointed, the second joint very short.

C. angulatus Dana.

Cyrtograpsus angulatus Dana, Proc. Acad. Nat. Sci. Phila., 1851, p. 250. U. S. Expl. Exped., p. 352, Pl. 22, f. 6 (1852).
Cryptograpsus angulatus Smith, Trans. Conn. Acad., ii, p. 37, 1869.

Carapax uneven, granulate. Sides three-toothed, second tooth small. Orbits with a slight fissure above. Feet all granulate. Hands inflated, fingers acuminate.

Rio Negro, Patagonia! (U. S. Expl. Exped.).

C. cirripes Kingsley *ex* Smith.

Cryptograpsus cirripes Smith, Trans. Conn. Acad. ii, p. 11, Pl. I, f. 3 (1869).

Carapax depressed, areolate; front narrow, slightly excavate. Sides of carapax strongly arcuate, with four teeth behind the angle of the orbit, the second and last teeth much smaller than the others; all of the borders of the carapax are crenulate. Chelipeds stout, granular. Propodal joints of first, second, and fourth, and dactylus and carpus of fourth pair of ambulatory feet haired.

Rio Janeiro! (Captain Harrington, Peabody Academy of Science, Salem, Mass., types).

Genus **PACHYGRAPSUS** Randall (1839); Stimpson (1858).

Carapax somewhat narrowed behind, and with transverse striæ. Front more than half the width of the carapax, sides entire, or with one or two teeth; inner sub-orbital lobe small, allowing the antennæ to enter the orbit. External maxillipeds widely gaping, meros as broad as long. Type, *P. crassipes*.

Synopsis of Species.

Sides entire.
  Front straight or nearly so.
    Numerous transverse folds on carapax; lower margin of hand spined. *corrugatus.*
    Carapax but little plicate, hands smooth below. *æthiopicus.*
  Front strongly sinuate.
    Hands smooth. *minutus.*
    Hands externally with longitudinal ridges. *plicatus.*
Sides with one tooth behind the orbital angle.
  Posterior distal angle of meros of fifth pair of feet rounded.
    Front with a prominent tooth at angle. *crassipes.*
    Front slightly sinuate without prominent teeth. *maurus.*
  Posterior distal angle of meros of fifth feet dentate.

Fingers of cheliped smooth. *transversus.*
Fingers dentate or spined above. *gracilis.*
Sides two-toothed.
Transverse lines of carapax naked. *marmoratus.*
Transverse lines of carapax haired. *pubescens.*
Unknown to me. *latipes.*

P. crassipes Randall.

Pachygrapsus crassipes Randall, Jour. Acad. Nat. Sci. Philadelphia, viii, p. 127 (1839).

Grapsus eydouxi Edw., Ann. Sci. Nat., III, xx, p. 170 (1853).

Leptograpsus gonagrus Edw., l. c., p. 173 (1853).

Carapax somewhat arcuate, sides with a single tooth behind the orbital angle; frontal lobes prominent; front deflexed, its margin nearly straight, the angles with a prominent tooth. Meros of chelipeds with the anterior margin produced, distally truncate and dentate. Hands inflated, margined above and with a longitudinal ridge on the lower outer surface; fingers excavate. Distal angle of meros of posterior ambulatory feet rounded; dactyli of the ambulatory feet spinulose.

(?) *Sandwich Is.!* (T. Nuttall, Randall's type); *California* from *San Francisco!* to *San Diego!* (Many collectors); *? New Providence, W. I.!* (H. C. Wood, Jr.); *Yokohama* (Tozzetti).

P. maurus Lucas.

Pachygrapsus maurus Lucas, Expl. Algiers, Crust., p. 20, Pl. II, f. 5 1849).

Goniograpsus simplex Dana, Proc. Acad. Nat. Sci. Phila., 1851, p. 249; U. S. Expl. Exped. Crust. p. 344, Pl. XXXI, f. 8 (1852).

Pachygrapsus simplex Stimpson, Proc. Acad. Nat. Sci. Phila., 1858, p. 102.

Algiers (Lucas); *Madeira* (Dana); *Rio Janeiro* (Dana, Heller).

P. transversus Gibbes.

Pachygrapsus transversus Gibbes, Proc. Am. Assoc. Adv. Science, iii, p. 182 (1850).

Goniograpsus innotatus Dana, Proc. Acad. Nat. Sci. Phila., 1851, p. 249; U. S. Expl. Exped. Crust., p. 345, Pl. XXI, f. 9 (1852).

Leptograpsus rugulosus Edw., Ann. Sci. Nat. III, xx, p. 172 (1853).

Pachygrapsus lævimanus Stimpson, Proc. Phila. Acad., 1858, p. 102.

Metopograpsus dubius et *miniatus*, Saussure, Mem. Soc. Phys, et d'Hist. Nat. Geneve, xiv, pp. 444-445, Pl. II, f. 16, 17 (1858).

Grapsus declivifrons Heller, Verhandl. Z. B. Gesellschaft, Wien, 1862, p. 521.

Pachygrapsus intermedius Heller, Novara Crust, p. 44 (1865).

Pachygrapsus socius Stm., Ann. N. Y. Lyc. x, p. 114 (1871).

Pachygrapsus advena Catta Ann. Sci. Nat. VI, iii, No. 1. p. 7, Pl. I (1876).

Carapax depressed, shining, with transverse plicæ, oblique on the branchial region. Sides generally slightly arcuate, with one tooth behind the orbital angle. Frontal lobes prominent, front sinuate. Meros of chelipeds with transverse rugæ, the inner margin dentate; carpus rugose, with an internal rounded tubercle. Hand minutely granulate, a longitudinal ridge on the lower outer surface, margins rounded; dactylus with the upper margin smooth. Postero-distal angle of the meros of last pair of ambulatory feet dentate.

Florida! (A. S. Packard; Peab. Acad.; Brown Univ.; H. E. Webster, Union College); *West Indies!* (S. G. Morton, H. C. Wood, Jr.); *Brazil!* (Dr. T. B. Wilson); *California!* (J. L. Leconte); *New Zealand!* (E. Wilson); *Tahiti* (A. Garrett); *W. Coast Nicaragua!* (J. A. McNiel, Peab. Acad.); *Australia* (Stm.); *Rio Janeiro* (Heller); *Madeira* (Stm.).

P. gracilis Stimpson *ex* Saussure.

Metopograpsus gracilis Saussure, l. c., p. 443, Pl. II, f. 15 (1858)

Grapsus guadulpensis Desbonne et Schramm, Crustaces de la Guadaloupe, p. 48 (1867).

Pachygrapsus gracilis Stimpson, Ann. N. Y. Lyc., x, p. 113 (1871).

Grapsus (Leptograpsus) rugulosus Martens, Archiv für Naturgeschichte, xxxviii, p. 102 (1872).

Carapax much as in *P. transversus*, but with no folds on the cardiac region; lateral margins nearly straight, one-toothed. Frontal lobes nearly obsolete; front nearly horizontal, regularly arcuate and minutely crenulate. Chelipeds and ambulatory feet nearly as in *P. transversus*, the hand and dactylus, however, being spined or toothed above.

Florida! (A. S. Packard, Jr., Peab. Acad.); *West Indies* (Auct.).

P. corrugatus Kingsley *ex* Martens.

Grapsus (Leptograpsus) corrugatus Martens, l. c., p. 107, Pl. IV, f. 8 (1872).

Cuba (Martens).

P. æthiopicus Hilgendorf.

Grapsus (Pachygrapsus) æthiopicus Hilgendorf, in von der Decken's Reisen in Ost-Afrika, Crust., p. 88, Pl. IV, f. 2 (1869).

Ugurunga, East Africa (Hilgendorf).

P. plicatus Stimpson *ex* Milne-Edwards.

Grapsus plicatus Edwards, Hist. Nat. Crust., ii, p. 89 (1837).

Grapsus krausii Edwards, Ann. Sci, Nat. III, xx, p. 170 (1853).

Pachygrapsus plicatus Stimpson, Proc. Acad. Nat. Sci. Phila., p. 102 (1858).

Pachygrapsus striatus A. M.-Edw., Journal Museum Godeffroy, iv. p. 82 (1873).

Carapax broader than long, everywhere crossed by plications which are bordered by short hairs; frontal lobes prominent, front sinuate. Sides of carapax entire. Meros and carpus of chelipeds externally plicate, inner margin of meros expanded, proximally denticulate distally with spiniform teeth. Carpus with a prominent internal spine. Hand and dactylus granulate above, externally the hand bears several longitudinal rugæ. Fingers short, gaping, extremities excavate.

Oahu! (Dr. W. H. Jones); *Tahiti!* (A. Garrett, Peab. Acad.); *New Caledonia; Samoan Is.* (A. M.-Edw.); *Natal* (Krauss); *Loo Choo* (Stimpson).

P. marmoratus Stimpson *ex* Fabricius.

Cancer marmoratus Fabricius, Ent. Syst., ii, p. 450 (1793).
Grapsus varius Latreille, Hist. Crust. et Ins. vi, p. 69 (1803–4).
Grapsus marmoratus Desmorest, Considerations, p. 131 (1825).
Leptograpsus marmoratus Edw., Ann. Sci. Nat. III, xx, p. 171 (1853).
Pachygrapsus marmoratus Stimpson, Proc. Acad. Nat. Sci. Phila., 1858, p. 102.

Carapax depressed, naked, transversely plicate; frontal lobes prominent, front depressed, slightly arcuate, or sometimes a little sinuate. Sides with two teeth behind the angle of the orbit. Meros of chelipeds expanded in front, expansion distally truncate and dentate. Carpus and hand tuberculate above, the former with a prominent internal tooth. Fingers slightly excavate. Posterior distal angle of meros of last pair of feet rounded, entire.

France! (Guerin); *Bosphorus!* (Smithsonian); *Mediterranean* (Auct.); *Madeira* (Stm.).

P. pubescens Heller.

Pachygrapsus pubescens Heller, Novara Crust, p. 45, Pl. IV, f. 4 (1865).
Chili (Heller).

P. minutus A. M.-Edwards.

Pachygrapsus minutus A. M.-Edw., Nouv. Arch du Mus., ix, p. 292, Pl. XIV, f. 2 (1873).
New Caledonia (A. M.-Edw.).

P. simplex Kingsley *ex* Herklots.

Grapsus simplex Herklots, Additamenta, etc., p. 9, Pl. I, f. 8 (1851).
Boutry, West Coast of Africa (Herklots).

Genus NAUTILOGRAPSUS Edwards (*Planes* Bell[1]).

Carapax narrow, regularly arcuate, sides slightly convex, and bearing a rudimentary tooth behind the orbital angle. Front

[1] The genus *Planes* is a MS. one of Leach. Bowdich, in his "Excursion to Madeira and Porto Santo," p. 15, f. 2 (1825), figures and mentions a spe-

more than half the width of the carapax. External maxillipeds broad, meros broader than long. Posterior feet compressed.

N. minutus Edwards *ex* Linné.

Cancer minutus Linné Syst. Nat. Edit. xii, p. 1048 (1766).
Grapsus minutus Latreille, Hist. Crust. et Ins., vi, p. 68 (1803–4).
Grapsus cinereus Say, Journ. Acad. Nat. Sci. Phila. i, p. 99 (1817).
Grapsus pelagicus Say, l. c., p. 442 (1818),
Planes clypeatus Bowdich, l. c., p. 15, Pl. f. 2 (1825).
Grapsus testudineum et *pelagicus* Roux, Crust. Med., Pl. VI, f. 6–7 (1828–30).
Ocypoda (*Grapsus*) *pusillus* De Haan, op. cit., p. 59, Pl. XVI, f. 2 (1835).
Nautilograpsus minutus Edw., Hist. Nat. Crust. ii, p. 90 (1837).
Grapsus divis Costa, Fauna Napoli, Crustaces, Pl. IV, f. 1 (1838–1851).
Planes minutus White, Cat. Brit. Mus. Crust. p. 42 (1847)
Nautilograpsus Major et Smithii, McLeay in Smith Zool., South Africa, Annulosa, pp. 66–67 (1849).
Planes linneana Bell, British Stalk-eyed Crustacea, p. 135 (1851).
Planes cyaneus Dana, Proc. Phil. Acad., 1851, p. 250.
Nautilograpsus angustatus Stimpson. Proc. Acad. Nat. Sci. Phila., 1858, p. 103.

Carapax smooth, arcuate in both directions; front nearly straight, post-orbital tooth small, sometimes obsolete. Sides arcuate. Meros of chelipeds with its inner distal border dentate; Carpus with a tubercle on the inner surface; hand smooth, fingers deflexed. Ambulatory feet compressed, ciliate.

Gulf Stream! (Many Collectors); *West Indies!* (Dr. Griffith); *Surinam!* (Dr. Hering); *Falkland Is.!* (Dr. Wilson); *Peru!* (Dr. Ruschenberger); *West Coast of Mexico! Alaska!* (Dr. W. H. Jones); *China!* (Capt. Putnam); *New Zealand! Natal!* (Dr. Wilson); *Rio Gambia!* (J. Cassin); *Mediterranean* (Dr. Wilson); *France!* (Guerin); "*toutes des mers!*" (Guerin). Guerin's ideas of the distribution leave nothing more to be said.

Genus **EUCHIROGRAPSUS** M.-Edwards, 1853.

Carapax depressed, subquadrate, sides slightly arcuate, with three teeth behind the orbital angle; orbits entire. Antennæ long,

cies in these words: "A small crab, f. 3, *a* and *b*, which I conceive to be a new species of *Planes* was found in great numbers amongst the anatiferæ." In a foot-note the species is described as follows: "It was of a delicate, but bright, rose-color; from the symmetrical form of its test (notched so regularly as to increase the projection and distinctness of its chaperon), it may be called *P. clypeatus*." This can hardly be considered as a sufficient description to establish the genus, and hence I prefer to retain the commonly accepted name.

entering the orbit; Meros of the external maxillipeds about half the length of the ischium, its outer distal angle rounded, its inner excavate and bearing the palpas.

E. liguricus Edwards.

Euchirograpsus liguricus Edwards, Archives du Museum, vii, p. 153, Pl. X, f, 2 (1853).

Nice (Edwards).

Genus **BRACHYGRAPSUS** nov.

Carapax broader than long, arcuate, without transverse lineation, sides nearly straight, with one tooth behind the angle of the orbit. Meros of the external maxillipeds shorter than broad, its external distal angle prominent, the internal one bearing the palpus.[1]

B. lævis nov.

Front straight, external angles of orbit not prominent, tooth of lateral margin spiniform. Meros of cheliped triquetral, bearing an obtuse tooth on the upper border. Carpus with an acute internal spine. Hands inflated, smooth; fingers acute. Ambulatory feet elongate, slender, but slightly compressed, the dactyli longer than the propodal joints.

New Zealand! (E. Wilson).

Genus **PTYCHOGNATHUS** Stimpson, 1858 (*Gnathograpsus* A. M.-Edwards).

Carapax flat, lateral border emarginate. External maxillipeds very broad, nearly meeting, the exognath fully as broad as the ischium. The carpus bears the palpus at the middle of the anterior margin, and has the external distal angle strongly produced.

Synopsis of Species.

Exognath of external maxilliped extending to or exceeding the external distal angle of the meros. *riedelii.*

Exognath extending only to the middle of the meros.

Oblique portion of branchial ridge bounded by a granulated ridge. *pilipes.*

Oblique portion without a prominent boundary. *pusillus.*

Insufficiently characterized. *glaber.*

P. glaber Stimpson.

Ptychognathus glaber Stimpson, Proc. Acad. Nat. Sci. Philadelphia, 1858, p. 104.

Bonin I. (Stm.)

[1] I am not certain as to the exact position of this genus, as it appears to combine the characters of both the *Cyclometopa* and *Catometopa*. In the form of carapax and structure of the external maxillipeds it closely resembles *Trapezia*. In the male genital appendages it is allied to the *Grapsidæ*, where for the present I prefer to allow it to remain.

Dr. Stimpson's short diagnosis presents no characters which are not held in common by both *P. riedelii* and *pilipes*, excepting the non-pilose hand, which in other species of the genus is only of sexual importance.

P. riedelii Kingsley *ex* A. Milne-Edwards.

Gnathograpsus riedelli A. M.-Edw., Nouv. Arch. du Museum, iv, p. 182, Pl. XXVII, f. 1–5 (1868).

Celebes (A. M.-Edw.).

P. pusillus Heller.

Ptychognathus pusillus Heller, Riese der Novara Crustaceen, p. 60, 1867.
Gnathograpsus barbatus A. M.-Edw., Nouv. Arch. du Museum, ix, p. 316, Pl. XVII, f. 4, 1872.

Carapax depressed, nearly smooth, with a few shallow impressions anteriorly. Front slightly sinuate. Antero-lateral margin with two indistinct teeth behind the orbital angle. Chelipeds finely granulate, but without spines or tubercles. Hands of the male with a lanose spot on the outside at the base of the fingers; in the female this is wanting. The exognath of the external maxillipeds reaches only to the middle of the meros. Ambulatory feet slender, compressed.

Mauritius! (Guerin[1]); *Nicobars* (Heller); *New Caledonia* (A. M.-Edw.)

P. pilipes Kingsley *ex* A. Milne-Edwards.

Gnathograpsus pilipes A. M.-Edw., Nouv. Arch. du Museum, iv, 184, Pl. XXVII, f. 6–10 (1868).

This species is scarcely more than a variety of *P. pusillus*, but I prefer for the present to leave them separate.

Philippines and *Celebes* (A. M.-Edw.).

Genus **ACMÆOPLEURA** Stimpson, 1858.

Carapax depressed, the antero-lateral margins entire. External maxillipeds nearly meeting the meros, bearing the palpus on the middle of the anterior margin; the exognath narrow.

A. parvula Stimpson.

Acmæopleura parvula Stimpson, Proc. Acad. Nat. Sci. Philadelphia, 1858, p. 105.

Japan (Stimpson).

Genus **PSEUDOGRAPSUS** M. Edwards (1837), *restr.*

Carapax depressed, transverse; sides arcuate, with two teeth behind the orbital angle. Front less than half the width of the

[1] These were labeled by Guerin "*Sesarma penicillata* sp. ined."

carapax. Meros of external maxillipeds broader than long, shorter than the ischium and with its external distal angle strongly produced.

Synopsis of Species.

Hands inflated without elevated lines.
- Fingers with many long hairs, carapax inflated. *setosus.*
- Hairs on the hand between the bases of the fingers short, carapax flat. *albus.*

Hands with an elevated line on the lower outer surface, fingers without hairs. *crassus.*

P. setosus.

Cancer barbatus Rumph., Pl. X, No. 2 (1705).
Cancer setosus Fabricius, Suppl. Ent. Syst., p. 339 (1798).
Grapsus penicilliger Latr., Reg. An. (I Edit.), iii, p. 16, Pl. XII, f. 1 (1817).
Eriocheir? penicilliger De Haan, Fauna Japonica, Crust., p. 31 (1835).
Pseudograpsus penicilliger Edw., Hist. Crust., ii, p. 82 (1837).
Pseudograpsus barbatus Edw., Ann. Sci. Nat., III, xx, p. 191 (1853).
Eastern Seas (Auct).

P. albus Stimpson.

Pseudograpsus albus Stimpson, Proc. Acad. Nat. Sci., Phila., 1858, p. 104.
Japan (Stimpson); *New Caledonia* (A. M.-Edwards).

P. crassus A. Milne-Edwards.

Pseudograpsus crassus A. M.-Edw., Nouv. Arch. du Mus., iv, p. 176, Pl. XXVI, f. 6–10 (1868).
Celebes (A. M.-Edw).

Genus **VARUNA** Edwards, 1830 (*Trichopus* De Haan, 1835).

Carapax depressed, sides arcuate, two-toothed. Antennulæ oblique. Antennæ entering the orbit; external maxillipeds slightly gaping. Meros much shorter than the ischium, its external distal angle expanded. Palpus articulating with the middle of the anterior margin. Exognath half as wide as ischium. Ambulatory feet compressed, natatorial.

V. litterata Milne-Edwards ex Fabricius.

Cancer litterata Fabr., Suppl. Ent. Syst., p. 342 (1798).
Trichopus litterata De Haan, Fauna Japonica, Crust., p. 32 (1835).
Varuna litterata Edw., Dict. Class. d'Hist. Nat., xvi, p. 511 (1830). Hist. Nat. Crust., ii, p. 95 (1837).

Carapax smooth, cardiac region partly circumscribed. Front straight, orbits fissured above, lateral teeth separated by slight fissures. Posterior margin of meros of chelipeds acute, the inferior granulate, the anterior with spiniform tubercles. Carpus with a prominent internal spine and one or two smaller ones. Hands inflated, rough, an elevated line on the lower outer margin. Ambulatory feet strongly compressed, margins ciliate. In a specimen from New Zealand the carpal spines are wanting.

> *Philippines!* (E. & T. B. Wilson); *Indian Ocean!* (Guerin); *New Zealand!* (E. Wilson); *China!* (Capt. Putnam, Peab. Acad.); *Penang!* (J. P. Ward, Peab. Acad.); *Japan* (Miers); *Mauritius* (A. M.-Edw.).

Genus **UTICA** White, 1847.

Carapax depressed, sides more or less arcuate, two-toothed. Antennulæ oblique. Antennæ entering the orbit. Meros of external shorter than the ischium, its external angle not expanded. Posterior feet compressed.

Synopsis of Species.

Inner margins of fingers strongly haired.		*barbimanus.*
Hands naked.		
	Angles of front acute.	*gracilipes.*
	Angles of front rounded.	*glabra.*

U. gracilipes White.

> *Utica gracilipes* White, Proc. Zool. Soc., 1847, p. 86. Adams and White, Voyage Samarang, Crust., p. 53, Pl. XIII, f. 6 (1850).
> *Philippines* (White.)

U. glabra A. Milne-Edwards.

> *Utica glabra* A. M.-Edw., Nouv. Arch. du Mus., ix, p. 296, Pl. XIV, f. 3 (1878).
> *New Caledonia* (A. M.-Edw.).

U. barbimanus A. Milne-Edwards.

> *Utica barbimanus* A. M.-Edw., l. c., p. 297, Pl. XIV, f. 4 (1873).
> *New Caledonia* (A. M.-Edw.)

Genus **GLYPTOGRAPSUS** Smith, 1870.

Carapax transverse, distinctly areolate, sides arcuate, three-toothed. Antennæ entering the orbit. External maxillipeds nearly meeting. Ischium and meros nearly equal in length, very broad, the meros being broader than long, its external distal angle not expanded. Ambulatory feet elongate, the dactyli quadrangular and spinose.

G. impressus Smith.

> *Glyptograpsus impressus* Smith, Trans. Conn. Acad., ii, p. 154 (1870).
> *Acajutla, West Coast of Central America* (Smith).

Genus HETEROGRAPSUS Lucas, 1849.

(*Pseudograpsus*, pars, Edw., Dana; *Hemigrapsus* Dana.

Carapax arcuate, front inclined, antero-lateral margins dentate. External maxillipeds nearly closing. The meros as long or longer than broad, and bearing the palpus on the middle of its anterior border, the exognath narrow.

As the distinctions between the species are mainly comparative and the descriptions of authors are very brief, no synopsis can be given. The species may however be divided into two sections, according to the number of teeth on the antero-lateral margin.

A. *Antero-lateral margin with two teeth behind the orbital angle.*

H. lucasii Edwards.

Heterograpsus sexdentatus Lucas, Exploration Algiers, i, p. 19, Pl. II, f. 4 (1849), (nec Edwards).

Heterograpsus lucasii Edwards, Ann. Sci. Nat., III, xx, p. 192 (1853).

Carapax regularly arcuate, epigastric lobes but slightly indicated. Front four-lobed. Antero-lateral margin with two prominent, narrow, acute teeth. Chelipeds without spines or tubercles, the hands of the male are smooth and rounded, in the female they have a double crest above and two elevated lines on the outer surface.[1] Ambulatory feet slender, naked; dactyli long and slender.

Algiers! (Dr. T. B. Wilson); *Candia* (Edwards).

H. sexdentatus Edwards.

Cyclograpsus sexdentatus Edwards, Hist. Nat. Crust., ii, p. 79 (1837).

Hemigrapsus sexdentatus Dana, U. S. Expl. Exped., Crustacea, p. 348, Pl. XXII, f. 2 (2850).

Heterograpsus sexdentatus Edwards, Ann. Sci. Nat., III, xx, p. 192, Pl. vii, f. 7 (1853).

Carapax arcuate, surface uneven, laterally granulate. Epigastric lobes prominent. Front straight. Antero-lateral margin with two teeth behind the orbital angle, the teeth broad, the emarginations narrow. Chelipeds without spines or tubercles. Hands small, fingers excavate. Ambulatory feet moderate, naked; dactyli short and stout.

Australia! (E. Wilson); *New Zealand!* (Dr. T. B. Wilson); *Bay of Islands* (Dana).

[1] Milne-Edwards (l. c., p. 192,) divides this section of the genus into two groups, one with the hands rounded and without longitudinal crests, the other with crests a division which evidently cannot be maintained.

H. sanguineus Edwards ex De Haan.

Grapsus sanguineus De Haan, Fauna Japonica, Crustacea, p. 58, Pl. XVI, f. 3 (1835).

Grapsus marmoratus White, Cat. Brit. Museum, Crust., p. 41, 1847 (*sine descr.*).

Pseudograpsus nudus Dana, Proc. Acad. Nat. Sci. Phila., 1851, p. 249. Expl. Exped., Crust., p. 335, Pl. XX, f. 7 (1852).

Heterograpsus sanguineus, marmoratus et maculatus Edw., Ann. Sci. Nat., III, xx, p. 193 (1853).

Heterograpsus nudus Stimpson, Proc. Acad. Nat. Sci. Phila., 1858, p. 104.

Carapax posteriorly nearly flat, in front arcuate, with scattered punctæ and a curved line of larger depressions running inward from the last tooth of the lateral margin. Front obsoletely two-lobed; antero-lateral margin with two teeth closely similar to those of *H. sexdentatus.* Chelipeds smooth, with small red spots, which persist in alcoholic or dried specimens. Hands with an external crest, becoming obsolescent with age; fingers excavate. Ambulatory feet short, stout, naked, punctate; the dactyli very stout.

California! (many localities and collectors); *Vancouver Is.!* (Dr. A. S. Packard, Jr., in Peabody Acad. Science); *San Lorenzo, Gulf of California!* (Wilkes' Expedition); *Australia!* (E. Wilson); *Japan* (De Haan); *Punipet and Auckland* (Heller); *Hong Kong* (Stimpson); *Sitka* (White); *Polynesia* (Edwards).

H. crassimanus Kingsley ex Dana.

Hemigrapsus crassimanus Dana, Proc. Phila. Acad., 1851, p. 250. U. S. Ex. Exped., Crust., p. 349, Pl. XXII, f. 4 (1852).

Hawaian Is. (Dana).

H. crenulatus Edwards ex Guerin.

Grapsus crenulatus Guerin, Voy. Coquille, ii, pt. i, p. 15 (1838).[1]

Cyclograpsus crenulatus Edw., Hist. Nat. Crust., ii, p. 80 (1837).

Hemigrapsus crenulatus Dana, U. S. Ex. Ex., Crust., p. 349, Pl. XXII, f. 3 (1852).

Heterograpsus crenulatus Edwards, Ann. Sci. Nat. III, xx, p. 193 (1853).

Heterograpsus barbigerus Heller, Verh. Z. B. Gesellschaft Wien, 1862, p. 522.

Heterograpsus barbimanus Heller, Novara Crustacea, p. 53, Pl. IV, f. 5 (1867).

Australia (Guerin); *New Zealand* (Edwards); *Bay of Islands* (Dana); *Punipet and Auckland* (Heller).

[1] The title bears the date 1830, the introduction to the Crustacea and Arachnida, "15 Novembre 1838," and the plates 1826. Guerin in his description, refers to Milne-Edwards' classic work as then in manuscript.

H. elongatus A. M.-Edw.

Heterograpsus elongatus Alph. Milne-Edwards, Nouv. Arch. du Museum, ix, p. 317, Pl. XVII, f. 5 (1873).

New Caledonia (A. M.-Edw.).

H. oregonensis Stimpson ex Dana.

Pseudograpsus oregonensis Dana, Proc. Acad. Nat. Sci. Philadelphia, 1851, p. 248. Expl. Exped. Crust., p. 334, Pl. XX, f. 6 (1852).

Heterograpsus oregonensis Stimpson, Proc. Acad. Nat. Sci. Philadelphia, 1858, p. 104.

Carapax depressed, anteriorly irregularly roughened; protogastric lobes defined. Front four-lobed, the inner lobes the more prominent. Antero-lateral margin with two prominent teeth. Chelipeds without spines or tubercles. Hands with an elevated line on the lower outer surface, the inner surface of the hand of the male with a pilose spot. Ambulatory feet moderate, ciliate.

Pacific Coast of North America from Puget Sound! (Geo. Davidson); *to Santa Cruz!* (Miss Hecox).

There are two specimens belonging to this species in the Museum of the Academy, bearing the label "New Providence, W. I., Dr. H. C. Wood, Jr."

H. penicillatus Stimpson ex De Haan.

Eriocheir penicillatus De Haan, op. cit., p. 60, Pl. XI, f. 6 (1835).

Heterograpsus penicillatus Stimpson, Proc. Acad. Nat. Sci. Philadelphia, 1858, p. 104.

Japan (De Haan).

H. erythræus Kingsley ex Kossmann.

Pseudograpsus erythræus Kossmann, Reise in den Küstengebiete des rothen Meeres, p. 61, Pl. 1, f. 5 (1877).

Red Sea (Kossmann).

H. pallipes Milne-Edwards.

Pseudograpsus pallipes Edw., Hist. Crust., ii, p. 82 (1837).

Heterograpsus pallipes Edw., Ann. Sci. Nat., III, xx, p. 194 (1853).

Australia (Edw.).

B. *Antero-lateral margin with three teeth behind the orbital angle.*

H. octodentatus Edwards.

Cyclograpsus octodentatus Edwards, Hist. Nat. Crust., ii, p. 80 (1837).

Heterograpsus octodentatus Edwards, Ann. Sci. Nat., III, xx, p. 194 (1853).

Locality unknown.

H. affinis Kingsley ex Dana.

Hemigrapsus affinis Dana, Proc. Acad. Nat. Sci. Philadelphia, 1851, p. 250. U. S. Exp. Exped., Crustacea, p. 350, Pl. XXII, f. 5 (1852).

Patagonia (Dana).

H. spinosus Edw.

Heterograpsus spinosus Edw., Ann. Sci. Nat., III, xx. p. 194 (1853).
Vanikoro (Edw.) ; *Australia* (A. M.-Edw.

Genus **ERIOCHEIR** De Haan (1835).

Carapax quadrate, antero-lateral margin two-toothed. Front much less than half the width of the carapax. Antennulæ oblique. Antennæ not excluded from the orbit. External maxillipeds nearly closing. Meros as long as broad, the external distal angle not expanded and the carpus articulating with the middle of its anterior border.

Synopsis of Species.

Sides convex.
  Mesial frontal lobes rounded. *japonicus.*
  Frontal lobes acute. *sinensis.*
Sides straight. *rectus.*

E. japonicus De Haan.

Eriocheir japonicus De Haan, op. cit., p. 59, Pl. XVII (1835).

Carapax nearly flat, surface uneven. Front four-lobed, mesial lobes rounded, outer lobes acute; protogastric lobes prominent, granulate. Antero-lateral border two-toothed, with indications of a third. Meros of chelipeds with the margins granulate, the posterior terminating in an acute tooth. Carpus with a prominent internal spine; distal margin of the carpus and external surface of the hand with thickly set long hair; the inner surface of the palm with a short horizontal line of granules. Fingers sub-excavate. Ambulatory feet hairy above.

Japan! (no donor's name).

E. sinensis.

Eriocheir[us] sinensis Edw., Ann. Sci. Nat., III, xx, p. 177 (1853). Arch. du Mus., vii, p. 146, Pl. IX, f. 1 (1854).

China (Edw.).

E. rectus.

Eriocheir rectus Stimpson, Proc. Acad. Nat. Sci. Phila., 1858 p. 103.

Macao (Stimpson).

Genus **PERIGRAPSUS** Heller, 1862.

Carapax convex, sides arcuate, with one tooth behind the angle of the orbit. Front narrower than half the width of the carapax. Meros of the external maxilliped a little longer than broad and bearing the palpus on the external angle. Dactyli of ambulatory feet spined.

P. excelsus Heller.

Perigrapsus excelsus Heller, Verh. Zool. Bot. Ges. Wien, 1862, p. 522. Novara Crust., p. 50, Pl. V, f. 1 (1865).

Tahiti (Heller).

Genus **PLATYGRAPSUS** Stimpson, 1858 (*Platynotus* De Haan, 1835, preocc.).

Carapax flat. Front horizontal. Sides nearly straight, with two teeth behind the angle of the orbit. Meros of the external maxilliped longer than the ischium and bearing the palpus on the external angle.

P. depressus Stimpson ex De Haan.

Platynotus depressus De Haan, Fauna Japonica, Crust., p. 63, Pl. VIII, f. 2 (1835).

Platygrapsus depressus et convexiusculus Stimpson, Proc. Acad. Nat. Sci. Phila., 1858, p. 104.

Carapax depressed, smooth; front horizontal, four-lobed, mesial lobes the larger; sides with two teeth behind the angle of the orbit, the posterior tooth indistinct. Chelipeds smooth and unarmed; meros with the anterior margin acute; carpus without spines or tubercles; hand with an elevated line on the lower outer surface; fingers slender, gaping. Ambulatory feet elongate.

Japan! (no donor's name); *Hong Kong* (Heller); *Loo Choo* (Stimpson).

Tribe SESARMINI (Sub-family *Sesarminæ* Dana).

Meros and ischium of the external maxillipeds crossed obliquely by a piliferous ridge.

Genus **METASESARMA** Edw (1853).

Carapax quadrate, sides but slightly arcuate, entire; front broad, deflexed. Sub-orbital lobe large, meeting the front and excluding the antennæ from the orbit. Meros of external maxilliped greatly elongate, its apex rounded.

Synopsis of Species.

Hands smooth, externally and above.	*rousseauxi.*
Hand roughened above.	*granularis.*
Hand roughened above and externally.	*trapezium.*

M. rousseauxi Edw.

Metasesarma rousseauxi Edw., Ann. Sci. Nat., III, xx, p. 88 (1853). Arch. du Mus., vii, p. 158, Pl. X, f. 1 (1854).

Zanzibar (Edw.).

M. granularis[1] Heller.

Metasesarma granularis Heller, Verh. Z. B. Ges. Wien, 1862, p. 522.
Metasesarma rugulosa Heller, Novara Crust., p. 65 (1865).

Tahiti (Heller).

M. trapezium Stimpson ex Dana.

Sesarma trapezium Dana, U. S. Expl. Exped. p. 354, Pl. XXII, f. 8 (1852).
Metasesarma trapezium Stimpson, Proc. Acad. Nat. Sci. Phila., 1861, p. 373.

Sandwich Is. (Dana).

Genus **SARMATIUM** Dana, 1851 (*Metagrapsus* Edw., 1853).

Carapax convex, sides arcuate, entire or toothed. Front inclined, less than half the width of the carapax. External maxillipeds nearly as in *Sesarma*. Ambulatory feet with the margins entire.

Synopsis of Species.

Sides of carapax with two teeth behind the orbital angle.
  Hands externally smooth and rounded.
    Carapax smooth, hand transversely plicate above. *crassum.*
    Carapax areolate, hand smooth above. *curvatum.*
  Hands externally roughened.
    Hands externally bearing a pectinate crest. *pectinatum.*
    Hands without a prominent external crest.
      Hands with an internal granulate ridge. *punctatum.*
      Hands entire within. *indicum.*
Sides of carapax entire. *integrum.*

S. crassum Dana.

Sarmatium crassum Dana, Proc. Acad. Nat. Sci. Phila., 1851, p. . U. S. Expl. Exped., Crust., p. 358, Pl. XXIII, f. 1 (1852).

Samoan Is. (Dana).

S. curvatum Kingsley ex Milne-Edwards.

Sesarma curvata Edw., Hist. Crust., ii, p. 75 (1837).
Metagrapsus curvatus M.-Edw., Ann. Sci. Nat. III, xx, p. 189 (1853). Arch. du Mus., vii, p. 160, Pl. X, f. 3, 1854.

Senegal (Edw.).

S. pectinatum Kingsley ex Milne-Edwards.

Metagrapsus pectinatus Edw., Ann. Sci. Nat. III, xx, p. 189 (1853).

Martinique (Edw.).

S. punctatum Kingsley ex A. Milne-Edwards.

Metagrapsus punctatus A. M.-Edw., Nouv. Arch. du Mus., ix, p. 308, Pl. XVII, f. 2 (1873).

New Caledonia (A. M.-Edw.).

[1] I have here as in other places employed the earlier name; what reason Dr. Heller had for the change I cannot imagine.

S. indicum Kingsley ex A. Milne-Edwards.

Metagrapsus indicus A. M.-Edw., Nouv. Arch. du Mus., iv, p. 174, XXVI, f. 1-5 (1868).

Celebes (A. M.-Edw.).

S. integrum Kingsley ex A. Milne-Edwards.

Metagrapsus integer A. M.-Edw., Nouv. Arch. du Mus., ix, p. 309, Pl. XVII, f. 3 (1873).

New Caledonia (A. M.-Edw.).

Genus **RHACONOTUS** Gerstæcker, 1856.

Carapax sub-quadrate, sides arcuate, toothed. Front narrow, about one-third the width of the carapax. Meros of external maxillipeds nearly as broad as long and about half the length of the ischium. Ambulatory feet compressed, the margins of the joints serrate.

R. crenulatus Gerstæcker.

Rhaconotus crenulatus Gerstæcker, Archiv für Naturgeschichte, xxi, p. 142 (1856).

Locality unknown.

Genus **SESARMA** Say, 1818. (*Pachysoma* De Haan, 1835. *Holometopus* Edw., 1853.)

Carapax thick, quadrate, lateral margins straight, entire or toothed. External maxillipeds with an oblique piliferous ridge crossing the ischium and meros; the meros elongate, its apex rounded. Antennæ entering the orbit.

I have not attempted to revise the species of this genus on account of a lack of sufficient material. I merely give a list of the described species, indicating in a few cases the synonymy, but leaving the task of comparing a large number of poor descriptions to some future carcinologist.

S. affinis Edw. (= ? **quadrata**).

Grapsus (*Pachysoma*) *affinis* De Haan, op. cit., p. 61, Pl. XVIII, f. 5 (1835).

Sesarma affinis Edwards, Ann. Sci. Nat., III, xx, p. 183 (1853).

Japan (De Haan); *China* (Edw.); *Natal* (Krauss).

S. africana Edwards.

Sesarma africana Edw., Hist. Nat. Crust., ii, p. 73 (1837).

Senegal (Edw.).

S. americana Saussure.

Sesarma americana Saussure, Mem. Soc. Phys. et Hist. Nat., xiv, p. 441 (1858).

St. Thomas, W. I. (Saussure).

S. angolensis Capello.

Sesarma angolensis Capello, Descr. tres sp. Nov. Crust. du Africa Occident, p. 4, f. 2 (1864).

Angola, West Africa (Capello).

S. angusta Smith.

Sesarma angusta Smith, Trans. Conn. Acad., ii, p. 159 (1870).
Panama (Smith).

S. angustifrons A. Milne-Edwards.

Sesarma angustifrons A. M.-Edw., Nouv. Arch. du Mus. Bulletin, v, p. 26 (1869).
Sandwich Is. (A. M.-Edw.).

S. angustipes Dana.

Sesarma angustipes Dana, U. S. Expl. Exped., Crust., p. 853, Pl. XXII, f. 7 (1852).
Florida! West Indies! Brazil!

S. aspera Heller.

Sesarma aspera Heller, Novara, Crust., p. 63, Pl. VI, f. 2 (1865).
Nicobars, Ceylon, Madras (Heller).

S. atrorubens Hess.

Sesarma atrorubens Hess, Archiv für Naturgeschichte, xxxi, p. 149, Pl. VI, f. 12 (1865).
Sydney, Australia (Hess).

S. aubryi A. Milne-Edwards.

Sesarma aubryi A. M.-Edw., Nouv. Arch., Bulletin, v, p. 25 (1869). Nouv. Arch., ix, p. 307, Pl. XVI, f. 3 (1873).
New Caledonia (A. M.-Edw.).

S. bidens Milne-Edwards ex De Haan.

Grapsus (*Pachysoma*) *bidens* De Haan, op. cit., p. 60, Pl. XVI, f. 4, Pl. XI, f. 4 (1835).

Sesarma bidens Edw., Ann. Sci. Nat., III, xx, p. 185 (1853).
Japan (De Haan); *Hong Kong, Nicobars* (Heller); *Friendly Is.* (Dana); *Ceylon, Zanzibar* (Hilgendorf).

S. boucourti A. Milne-Edwards.

Sesarma boucourti A. M.-Edw., Bulletin, l. c., p. 28 (1869).
Siam (A. M.-Edw.).

S. chirogona Tozzetti.

Sesarma chirogona Targioni-Tozzetti, Zoologia del Viaggio della Magenta, p. 136, Pl. IX (1877).
Yokohama (Tozzetti).

S. cinereus Say ex Bosc.

Grapsus cinereus Bosc., Hist. Nat. Crust., i, p. 204, Pl. V, f. 1, 1802-3 (teste Auct.).

Sesarma cinerea Say, Jour. Acad. Nat. Sci., Phila., i, p. 442 (1818).
Virginia! to *Florida!* and the *West Indies!*

S. dentifrons A. Milne-Edwards.

Sesarma dentifrons A. M.-Edw., Bulletin, l. c., p. 31 (1869).
Samoan Is. (A. M.-Edw.).

S. dehaani Milne-Edwards.

Grapsus (*Pachysoma*) *quadratus* De Haan, op. cit. p. 62, Pl. VIII, f. 3 (1835).

Sesarma dehaani Edw., Ann. Sci. Nat., III, xx, p. 184 (1853).
Japan (De Haan).

S. dusumieri Milne-Edwards (= **S. bidens**).

Sesarma dusumieri Edw., Ann. Sci. Nat., III, xx, p. 185 (1853).

Bombay (Edw.).

S. elegans Herklots.

Sesarma elegans Herklots, Addit. ad Faunam Afric. Occident., p. 10, Pl. I, f. 10 (1851).

Boutry, West Africa (Herklots).

S. elongata A. Milne-Edwards.

Sesarma elongatum A. M.-Edw, Bulletin, l. c., p. 30 (1869).

Madagascar (A. M.-Edw.).

S. erythrodactyla Hess.

Sesarma erythrodactyla Hess, Arch. für Naturges., xxxi, p. 151, Pl. VI, f. 10 (1865).

Sydney, Australia (Hess).

S. eydouxi Milne-Edwards.

Sesarma eydouxi Edw., Ann. Sci. Nat., III, xx, p. 184 (1853).

Cochin China (Edw.); *Madras* (Heller).

S. fascicularis Hilgendorf ex Herbst.

Cancer fascicularis Herbst, Krabben und Krebse, Pl. XLVII, f. 5 (1795).

Sesarma mederi Edw., Ann. Sci. Nat., III, xx, p. 185 (1853) teste Hilgendorf.

Batavia (Edw.).

S. frontale A. Milne-Edwards.

Sesarma frontale A. M.-Edw., Bulletin, l. c., p. 27 (1869).

Madagascar (A. M.-Edw.).

S. germani A. Milne-Edwards.

Sesarma germani A. M.-Edw,, Bulletin, l. c., p. 28 (1869).

Poulo Condore.

S. gracilipes A. Milne-Edwards.

Sesarma impressa jun. Homb. et Jacq., Voy. Ast. et Zelee, Crust., Pl. VI, f. 5.

Sesarma gracilipes Edw., Ann. Sci Nat., III, xx, p. 182 (1853).

Vaoa (Edw.); *Nicobars* (Heller).

S. guerini Milne-Edwards.

Sesarma guerini Edw., Ann. Sci. Nat., III, xx, p. 183 (1853).

Locality unknown.

S. guttatum A. Milne-Edwards.

Sesarma guttatum A. M.-Edw., Bulletin, l. c., p. 26 (1869).

Zanzibar (A. M.-Edw.).

S. hæmatocheir Kingsley ex De Haan.

Grapsus (*Pachysoma*) *hæmatocheir* De Haan, op. cit. p. 67, Pl. VII, f. 4 (1837).

Holometopus hæmatocheir[1] Edw., Ann. Sci. Nat., III, xx, p. 188 (1853).

Japan (De Haan).

[1] M. Milne-Edwards has elevated this species to distinct generic rank on what seem to me wholly inadequate characters. A similar proceeding with other *Sesarma* would result in the creation of nearly a dozen genera.

S. impressa Milne-Edwards.

Sesarma impressa Edw., Hist. Nat. Crust, ii, p. 74 (1837).

Locality unknown.

S. indica Milne-Edwards.

Sesarma indica Edw., Hist. Nat. Crust., i i, p. 74 (1837).

Indian Seas (Edw.); *Ceylon* and *Nicobars* (Heller).

S. intermedia Milne-Edwards ex De Haan.

Grapsus (*Pachysoma*) *intermedia* De Haan, op. cit., p. 61, Pl. XVI, f. 5 (1835).

Sesarma intermedia Edw., Ann. Sci. Nat., III, xx, p. 186 (1853).

Sesarma læve A. M.-Edw., Bulletin, l. c., p. 27 (1869).

Japan (De Haan); *Shanghai, Hong Kong* (Heller); *Arrow Is.*)A. M.-Edw.).

S. lafondi Jacquinot et Lucas.

Sesarma lafondi Jacquinot et Lucas, Voyage Astrolabe et Zelee, Crust., p. 70, Pl. VI, f. 4 (1853).

Batavia (J. and L.).

S. leptosoma Hilgendorf.

Sesarma leptosoma Hilgendorf, in Decken's Reise, p. 91, Pl. VI, f. 1 (1869).

Zanzibar (Hilgendorf).

S. lividum A. Milne-Edwards.

Sesarma lividum A. M.-Edw., Bulletin, l. c., p. 25 (1869), N. Arch., ix, p. 303, Pl. XVI, f. 2 (1873).

New Caledonia (A. M.-Edw.).

S. longipes Krauss.

Sesarma longipes Krauss, Süd Afric. Crust., p. 444, Pl. III, f. 2 (1843).

Umlass River, S. Africa (Krauss).

S. Müllerii A. Milne-Edwards.

Sesarma mülleri A. M.-Edw., Bulletin, l. c., p. 29 (1869).

Desterro, Brazil (A. M.-Edw.).

S. obesum Dana.

Sesarma obesum Dana, Proc. Phila. Acad., 1851, p. 250; U. S. Expl. Exped., Crust., p. 356, Pl. XXII, f. 10.

Balabac Straits (Dana).

S. oblonga Martens.

Sesarma oblonga Martens, Monatsber. Akad. Wiss. Berlin, 1868, p. 611.

Philippines (Martens).

S. obtusifrons Dana.

Sesarma obtusifrons Dana, Proc. Phila. Acad. 1851, p. 250; U. S. Expl. Exped., Crust., p. 355, Pl. XXII, f. 9 (1852).

Sandwich Is. (Dana).

S. occidentalis Smith.

Sesarma occidentalis Smith, Trans. Conn. Acad., ii, p. 158 (1870).

West Coast of Central America (Smith).

S. pentagona Hutton (=? **S. tetragona**).

Sesarma pentagona Hutton, Trans. New Zealand Inst., 1875, p. 279.

New Zealand (Hutton).

S. quadrata Milne-Edwards ex Fabricius.

Cancer quadratus Fabr., Suppl. Ent. Syst., p. 341 (1798).
Ocypoda plicata Bosc., op. cit., i, p. 198, 1802-3 (teste A. M.-Edw.).
Grapsus (*Pachysoma*) *pictus et affinis* De Haan, op. cit., pp. 61-66 (1835-37).
Sesarma quadrata Edw., Hist. Nat. Crust., ii, p. 75 (1837).
Sesarma picta Krauss, op. cit., p. 45 (1843).
Japan (De Haan); *New Caledonia* (A. M.-Edw.); *Zanzibar* (Hilgendorf).

S. recta Randall.

Sesarma recta Randall, Jour. Acad. Nat. Sci., Phila., viii, p. 123 (1839).
Surinam! (Randall).

S. reticulata, Say.

Sesarma reticulata Say, Jour. Acad. Nat. Sci., Phila., i, pp. 73, 76 et 442, Pl. IV, f. 6 (1818).
Sesarma cinerea De Kay, N. Y. Fauna, Crust., p. 15 (1842).
Virginia! to Florida!

S. ricordi Milne-Edwards.

Sesarma ricordi Edw., Ann. Sci. Nat., III, xx, p. 183 (1853).
Hayti (Edw.).

S. roberti Milne-Edwards.

Sesarma reticulata McLeay in Smith Zool. S. Africa, p. 65 (18), *vix* Say.
Sesarma roberti Edw., Ann. Sci. Nat., III, xx, p. 182 (1853).
Gori! (Dr. Wilson); *So. Africa* (McLeay).

S. rotundata Hess.

Sesarma rotundata Hess, l. c., p. 149, Pl. VI, f. 9 (1865).
Sydney (Hess).

S. rotundifrons A. Milne-Edwards.

Sesarma rotundifrons A. M.-Ed., Bulletin, l. c. p. 30 (1869).
Samoan Is. (A. M.-Edw.).

S. rupicola Stimpson.

Sesarma rupicola Stimpson, Proc. Phila. Acad., 1858, p. 106.
Japan (Stimpson).

S. schüttei Hess.

Sesarma schüttei Hess, l. c., p. 150, Pl. VI, f. 11 (1865).
Sydney, Australia (Hess).

S. similis Hess (= **S. atrorubens**).

Sesarma similis Hess, l. c., p. 150 (1865).
Sydney (Australia).

S. sinensis Milne-Edwards.

Sesarma sinensis Edw., Ann. Sci. Nat., III, xx, p. 186 (1853).
China (Edw.).

S. smithii Milne-Edwards.

Sesarma smithii Edw., Ann. Sci. Nat., III, xx, p. 187 (1853); Arch. du Mus., vii, p. 149, Pl. IX, f. 2 (1854).
Natal (Edw.); *New Caledonia* (A. M.-Edw.).

S. sulcata Smith.

Sesarma sulcata Smith, Trans. Conn. Acad., ii, p. 156 (1870).
Corinto, Nicaragua! (J. A. McNiel, Peab. Acad.

S. tæniolata Miers *ex* White MS.

Sesarma tæniolata White MS., Miers, Proc. Zool. Soc., London (1877), p. 137.
Philippines! (Dr. Wilson, with White's label).

S. tetragona Milne-Edwards *ex* Fabricius.

Cancer tetragonon Fabricius, Suppl. Ent. Syst., p. 341 (1798).
Grapsus tetragonon Latr., Hist. Crust. et Ins., vi, p. 71 (1803-4).
Sesarma tetragona Edw., Hist. Nat. Crust., ii, p. 73 (1837).
Zanzibar (Hilgendorf) to *New Caledonia* (A. M.-Edw.).

S. trapezoida Milne-Edwards.

Sesarma trapezoida Edw., Hist. Nat. Crust., ii, p. 74 (1837).
Locality unknown.

S. ungulata Milne-Edwards.

Sesarma ungulata Edw., Ann Sci. Nat. III, xx, p. 184 (1853).
Celebes (Edw.).

S. vestita Stimpson.

Sesarma vestita Stimpson, Proc. Acad. Nat. Sci. Phila., 1858, p. 106.
Japan (Stimpson).

S. villosum A. Milne-Edwards.

Sesarma villosum A. M.-Edw., Bulletin, l. c., p. 31 (1869).
Samoan Is. (A. M.-Edw.).

S. violacea Herklots.

Sesarma violacea Herklots, op. cit., p. 10, Pl. I, f. 9 (1851).
West Africa! (Du Chaillu).

Genus **ARATUS** M.-Edw., 1853.

Carapax trapezoidal, elongate, narrow behind, sides straight, entire; front deflexed, very broad. External maxillipeds as in *Sesarma*. Ambulatory feet compressed, the dactyli very short.

A. pisoni Milne-Edwards.

Sesarma pisoni Edw., Hist. Crust., ii, p. 76, Pl. XVI, f. 4–5 (1837).
Aratus pisoni Edw., Ann. Sci. Nat., III, xx, p. 187, 1853.

Carapax transversely arcuate, the branchial regions obliquely plicate. Front vertical, its margin two-lobed. Meros of chelipeds triquetral, the margins denticulate, the anterior one slightly expanded distally. Carpus externally granulate. Hands everywhere granulate, the fingers ornamented with pencils of stiff black hairs.

Florida! (H. E. Webster, Union College); *West Indies!* (many collectors and localities); *West Coast of Nicaragua!* (J. A. McNiel, Peab. Acad.); *Rio Janeiro* (Heller); *Praya, Brazil* (Martens).

Genus **CLISTOCŒLOMA** A. M.-Edwards, 1873.

Carapax sub-quadrate, sides dentate. Sub-ocular lobe large, united to the front and excluding the antennæ from the orbit. Meros of external maxillipeds short and rounded.

C. balansæ A. Milne-Edwards.

Clistocœloma balansæ A. M.-Edw., Nouv. Arch. du Mus., ix, p. 311, Pl. XVII, f. 1 (1873).

New Caledonia (A. M.-Edw.).

Genus **HELICE** De Haan (1835).

Carapax quadrate, front deflexed, sides straight, with one, two or three teeth behind the orbital angle. Antennæ entering the orbit. Meros of external maxillipeds as long as or longer than the ischium, its external distal angle prominent, its distal border truncate.

Synopsis of Species.

Lateral margin with three teeth behind the angle of the orbit.	
Ambulatory feet with a single distal spine on the meros.	
A transverse ridge on the branchial regions.	*tridens.*
No transverse crest on the branchial regions.	
Hands smooth.	*spinicarpa.*
Hands roughened.	*latreillei.*
Meral joints of ambulatory feet with several spines.	*dentipes.*
Lateral margin two-toothed.	
Hand strongly granulate.	*gaudichaudi.*
Hand nearly smooth.	
Meral joints of ambulatory feet with a spine on the upper distal margin, the hands of the male with a pilose spot at the base of the fingers.	*pilimana.*
Meral joints without spines, hands of male without pilose spots.	*crassa.*
Lateral margin one-toothed.	*gibba.*
Imperfectly characterized.	*leachii.*

H. tridens De Haan.

Helice tridens De Haan, op. cit., p. 57, Pl. XI, f. 2, Pl. XVI, f. 6 (1835).

Carapax longitudinally strongly convex, punctate, front curved downward, its anterior border sinuate when viewed from above. Superior margin of the orbit sinuate, oblique; lateral margin with three teeth behind the orbital angle, the posterior tooth rudimentary. Branchial regions with an oblique ridge running inward from this tooth. Orbits coarsely crenulate below. Inferior borders of the meral joints of the chelipeds with small tubercles. Carpus spined on the inside. Hands externally smooth, sub-cristate and granulate above, internally granulate; fingers excavate. Carpal and propodal joints of the first two pairs of ambulatory feet pilose in front.

Japan!

H. spinicarpa Edwards.

H. spinicarpa Edwards, Ann. Sci. Nat. III, xx, p. 190 (1853).

Locality unknown.

H. dentipes Heller.

Helice dentipes Heller, Novara Crust., p. 62, Pl. V, f. 5.

Ceylon (Heller).

H. latreillei Edwards.

Cyclograpsus latreillei Edwards, Hist. Nat. Crust., ii, p. 80 (1837).
Helice latreillei Edwards, Ann. Sci. Nat. III, xx, p. 190 (1853).

Mauritius (Edwards).

H. gaudichaudi Edwards.

Helice gaudichaudi Edwards, Ann. Sci. Nat. III, xx, p. 190, Pl. VII, f. 6 (1853).

Sumatra (Edwards).

H. pilimana A. Milne-Edwards.

Helice pilimana Alph. Milne-Edwards, Nouv. Arch. du Mus., ix p. 313, Pl. XVIII, f. 1 (1872).

New Caledonia (A. M.-Edw.).

H. crassa Dana.

Helice crassa Dana, Proc. Phila. Acad. (1851), p. 252—U.S. Ex. Exp., Crust., p. 367, Pl. XXIII, f. 8 (1853).
H. lucasii Edw., Ann. Sci. Nat. III, xx, p. 190 (1853).

Carapax closely resembling that of *H. tridens*, but with but two teeth behind the orbital angle. Carpus of cheliped without an internal spine. hands externally microscopically granulate, more coarsely so internally, the upper margin acute. Carpal and propodal joints of the first two pairs of ambulatory feet, pilose.

This is probably but a variety of *H. tridens.* Small females show the elevated line on the hand characterizing *H. lucasii.*

New Zealand! (Dr. Wilson); *Aukland* (Heller); *Australia* (Dana).

H. leachii Hess.

Helice leachii Hess, Archiv für Naturgeschichte, xxxi, p. 153 (1865).

Sydney, Australia (Hess).

Genus **CYCLOGRAPSUS** Edw. (1837)(restrict). (*Gnathochasmus* McLeay.)

Carapax depressed, sides arcuate, entire front about half the width of the carapax. Antenna not excluded from the orbit. Meros of the external maxillipeds short, about as long as the ischium; its external angle well marked, the palpus articulating with the anterior margin.

C. punctatus Milne-Edwards.

Cyclograpsus punctatus Edw., Hist. Nat. Crust., ii, p. 78 (1837).

Gnathochasmus barbatus McLeay, in Smith, Zool. S. Africa, p. 65 (1838).

Sesarma barbata Krauss, Sud Af. Crust., p. 45, Pl. III, f. 3 (1843).

Cyclograpsus audouinii, lavauxii, whitei, granulosus et reynaudi Edw., Ann. Sci. Nat. III, xx, p. 197 (1853).

Cyclograpsus lævis Hess, Archiv für Naturgeschichte, xxxi, p. 152 (1865).

Carapax smooth or slightly granulate; sides arcuate in front, straight behind. Front broad, nearly straight. Orbits externally broadly emarginate, the emargination continuing backward as a groove for some distance. Hands externally smooth, internally with a prominent longitudinal ridge. Male abdomen triangular, regularly tapering from the third to the sixth joints, the seventh much narrower than the sixth.

New Zealand! (Guerin); *Australia!* (E. Wilson and Wilkes' Expedition); *Cape of Good Hope, Madras, Java* (Heller); *New Guinea* (Edw.).

C. granulatus Dana.

Cyclograpsus granulatus Dana, Proc. Acad. Nat. Sci. Phila., 1851, p. 251; U. S. Ex. Exp. Crust., p. 361, Pl. XXIII, f. 4 (1852).

Sandwich Is. (Dana).

C. cinereus Dana.

Cyclograpsus cinereus Dana, Proc. Acad. (1851), p. 251; U. S. Ex. Exp. Crust., p. 360, Pl. XXIII, f. 3 (1852).

Cyclograpsus eydouxi Edw., Ann. Sci. Nat., III, xx, p. 198 (1853).

Valparaiso and *Sandwich Is.* (Dana).

C. longipes Stimpson.

Cyclograpsus longipes Stimpson, Proc. Acad. Nat. Sci. Phila. (1858), p. 105.

Bonin Is. (Stimpson).

C. integer Milne-Edwards.

Cyclograpsus integer Edw., Hist. Nat. Crust., ii, p. 79 (1837).

Florida! (A. S. Packard, Jr., Peab. Acad.); *Brazil* (Edw.).

Genus **CHASMAGNATHUS** DeHaan, 1835. (*Paragrapsus* Edw.).

Carapax convex, sides arcuate, dentate, front curved downward. Antennæ not excluded from the orbit. Meros of external maxillipeds longer than broad, widest distally, its anterior border slightly excavate, the palpus medially articulated.

Synopsis of Species.

Lateral margin with three teeth behind the orbital angle, the posterior tooth inconspicuous.	*convexus.*
Lateral margin with two teeth.	
Front rounded.	*urvillei.*
Front nearly straight.	*gaimardii.*
Front excavate.	
Carapax and chelipeds granulate.	*granulatus.*
Carapax and chelipeds smooth.	
Epigastric lobes prominent.	*lævis.*
Epigastric lobes inconspicuous.	*subquadratus.*
Lateral margin with one post orbital tooth.	*quadridentatus.*

C. convexus DeHaan.

Chasmagnathus convexus DeHaan, Fauna Japonica, p. 56, Pl. VII, f. 5 (1835).

Japan (DeHaan); *Eastern Seas* (Adams and White).

C. subquadratus Dana.

Chasmagnathus subquadratus Dana, Proc. Acad. Nat. Sci. Phila., 1851, p. 251; U. S. Ex. Exp., Crust., p. 363, Pl. XXIII, f. 5 (1852).

New Zealand? Australia? (Dana).

C. lævis Dana (= ? **C. subquadratus.**)

Chasmagnathus lævis Dana, Proc. Acad., p. 252; Ex. Exp., p. 365, Pl. XXIII, f. 7 (1852).

Paragrapsus verreauxi Edw., Ann. Sci. Nat., III xx, p. 195 (1853).

Paragrapsus lævis Heller, Novara Crust, p. 55 (1865).

Carapax slightly convex, punctate; regions not defined. Epigastric lobes prominent. Front deeply excavate in the middle, when viewed from above. Antero-lateral teeth separated by narrow fissures. Chelipeds everywhere smooth. Anterior surface of carpus and propodus of first pair of ambulatory feet tomentose.

Australia! (Guerin; *New Zealand* (Miers).

C. urvillei Kingsley *ex* Milne-Edwards.

Paragrapsus urvillei Edw., Ann. Sci. Nat., III, xx, p. 196 (1853).

Vanikoro I. (Edw.).

C. granulatus Dana.

Chasmagnathus granulatus Dana, Proc. Acad., 1851, p. 251; U. S. Ex. Exp., Crust., p. 364, Pl. XXIII, f. 6 (1852).

Helice granulata Heller, Novara Crust., p. 61 (1865).

Carapax convex, distinctly areolate, granulate; the granules on the branchial regions being larger; epigastric lobes obsolete. Front curved downward and, viewed from above, deeply excavate.

Sides of carapax acute, the fissures between the teeth being very slight; all of the border of the carapax finely crenulate. Chelipeds externally granulate. Carpus produced internally; the inner surface of the hand with a patch of granules on the inner surface. Carpal joints of the ambulatory feet longitudinally sulcate.

Rio Janeiro! (Wilkes' Expedition); *Rio Grande, Brazil!* (Capt. Harrington Peabody Academy).

C. gaimardi Milne Edwards.

Cyclograpsus gaimardi Edw., Hist. Nat. Crust., ii, p. 79 (1837).

Paragrapsus gaimardi Edw., Ann. Sci. Nat. III, xx, p. 196 (1853).

Australia (Edwards).

C. quadridentatus Kingsley *ex* Milne-Edwards.

Paragrapsus quadridentatus Edw., Ann. Sci. Nat., III, xx, p 195 (1853).

Australia (Edw.).

Sub family **Plagusinæ** Dana.[1]

Carapax flattened, antennulæ longitudinally plicate, lodged in sinuses of the front, and visible from above.

Genus **PLAGUSIA** Latr., 1806 (restrict).

Meros of external maxilliped well developed, as broad as the ischium.

P. speciosa Dana.

Carapax arcuate, covered everywhere with squamiform tubercles, the inter paces being clothed with a short pubescence, these tubercles being similar in their arrangement to those of *P. depressa* Say, but much more depressed than in that species. The margins of the inter-antennular portion of the front is simple. Inferior margin of the orbit acute, minutely denticulate. Sides of carapax with two equal acute spiniform teeth behind the angle of the orbit. Feet closely resembling those of *P. depressa*, the ornamentation being similar, but not so prominent. The hands, however, are externally marked by six longitudinal impressed lines, the lowest of them being on the inferior margin. The fingers are widely gaping, the extremities deeply excavate. The dentiform process

[1] This sub family having recently been revised by Mr. Miers (Annals and Magazine of Natural History, V, ix, pp. 147–154, February, 1878), and as I agree with his determinations and ideas of specific limits, I omit the synopsis of species from this paper, merely giving a few notes on the more uncommon forms.

on the coxa of the third pair of ambulatory feet is minutely denticulate. The only additional character in the female is that the squamæ of the carapax are more depressed.

Mr. Miers (l. c., p. 151) remarks: "Only a carapax of this species is known." The carapax referred to, Dana's type, was destroyed in the Chicago fire. The Academy possesses two specimens, male and female, sent by Mr. Andrew Garrett, from Tahiti.

Genus **LEILOPHUS** [1] Miers, 1876. (*Acanthopus* DeHaan.)

Meros of external maxillipeds very small, and much narrower than the ischium.

L. pilimanus Miers *ex* A. M.-Edw.

Specimens of this rare species are in the museum of the Academy, from the Sandwich Is. (J. K. Townsend) and Tahiti (A. Garrett). So far as I am aware, the only other specimen, in any collection, is the type in Jardin des Plantes at Paris. The British Museum has no specimens.

I am unable, either from the poorness of the descriptions, or possible inaccuracy of the figures, to assign the following species to their proper generic positions.

Cyclograpsus ? tasmanicus Jacquinot et Lucas, Voyage Astrolabe et Zélee, Crustaces, p. 76, Pl. VI, f. 6 (1842-53).
Tasmania (J. et L.).

Cyclograpsus minutus J. et L., l. c., p. 75, Pl. VI, f. 8 (1842-53).
Chili (J. et L.).

Grapsus inornatus Hess, Archiv für Naturgeschichte, xxxi, p. 148, Pl. VI, f. 11 (1865).
Sydney, Australia (Hess).

Grapsus huzardi Desmarest, Consid. sur les Crust., p. 131 (1825).
Senegal (Desmarest).

Cancer tridens Fabricius, Suppl. Ent. Syst., p. 340 (1798).
E. Indies (Fabricius).

Cancer hispanus Herbst, Pl. XXXVII, f. 1 (1796).

Goniograpsus pulcher Lockington, Proc. Cal. Acad., vii, p. 152 (1876).
Lower California (Lockington).

M. Henri Milne-Edwards (Archives du Museum, vii, p. 158, 1854) mentions a genus *Holograpsus*, possibly intending *Holometopus*.

[1] In the dismemberment of the genus *Plagusia* of Latreille, the name *Plagusia* should have been retained for this section.

JUNE 1.

The President, Dr. RUSCHENBERGER, in the chair.

Twenty-nine persons present.

A paper entitled "Description of a Partula supposed to be new, from the Island of Moorea," by W. D. Hartman, M. D., was presented for publication.

The Treasurer having announced the reception of a gift of twenty thousand dollars from Jos. Jeanes, acting for the heirs of the late Joshua T. Jeanes, who, in an unsigned codicil to his will, had indicated his intention of bequeathing that amount to the Academy, the following preamble and resolutions were unanimously adopted:

WHEREAS, The late Mr. Joshua T. Jeanes in a codicil to his will bequeathed to the Academy twenty thousand dollars, an act which may be regarded as significant of his appreciation and approval of the objects of the Society, but left this codicil without his signature, and therefore legally inoperative; and,

WHEREAS, His executors have placed in possession of the Treasurer of the Academy the sum named, thus manifesting their respect for the intention of their late brother in a most generous and affectionate manner; be it

Resolved, That the Academy of Natural Sciences of Philadelphia highly appreciates and gratefully acknowledges the generosity of the executors of the late Joshua T. Jeanes in bestowing on the Academy twenty thousand dollars in compliance with his wish, simply indicated.

Resolved, That the money thus bountifully given to the Society be invested securely in the name of the Academy of Natural Sciences of Philadelphia, to constitute a distinct and permanent fund which shall be named the JOSHUA T. JEANES FUND and the income thereof shall be applied towards defraying the ordinary expenses of the Society.

Serpentine Belts of Radnor Township, Delaware Co.—At the last meeting of the Mineralogical and Geological Section of the Academy of Natural Sciences, THEODORE D. RAND read a paper on the Serpentine Belts of Radnor Township, Delaware County, and the adjacent rocks. He adduced facts which he thought incompatible with Mr. Charles E. Hall's view, that the middle belt consists of altered Hudson River shales, and stated that the belt was not continuous but was a succession of outcrops nearly east and west from each other, the strike of which was, wherever observable, more N. E. and S. W. than the line joining them, thus agreeing in structure with what Prof. Rogers states of the trap dykes north of the serpentine in Chester County. He also called attention to the existence of two trap dykes or two branches of that extending through the Gulf Valley, and to curious markings in quartz rock in the vicinity, suggestive of fossils in a formation regarded as azoic.

JUNE 8.

The President, Dr. RUSCHENBERGER, in the chair.

Twenty-two persons present.

A paper entitled "On the Development of Lemna minor," by Wm. Barbeck, was presented for publication.

JUNE 15.

The President, Dr. RUSCHENBERGER, in the chair.

Eighteen persons present.

A paper entitled "A Bibliographical Catalogue of the Genus Partula, with observations on the Species," by W. D. Hartman, M. D., was presented for publication.

JUNE 22.

The President, Dr. RUSCHENBERGER, in the chair.

Eighteen persons present.

The deaths of Wm. G. E. Agnew and Morris L. Hallowell, members, were announced.

JUNE 29.

The President, Dr. RUSCHENBERGER, in the chair.

Eleven persons present.

The deaths of B. F. Lautenbach, M. D., and Wm. Kent Gilbert, M. D., members, were announced.

On some Homologies in Bunodont Dentition.—Dr. HARRISON ALLEN, in speaking of the teeth of the Carnivora, Insectivora and Chiroptera, dwelt upon the forms of the canines and premolars as being valuable guides in interpreting the plan of the molars. He traced the shapes of the last-named teeth from the sub-conical form of the canine, with its associated cusplets or cingules characterizing the canines, up to the complicated figures of the molars. Among the seals, *Leptonyx* exhibits to the best advantage the figure resulting from the pronounced development of the antero-posterior cusplets, and is of still greater interest inasmuch as the molars retain in all essential features the same parts. In genera where the form of the molars is not so retained, the manner after which the departure takes place in the upper jaw is as follows:

1. The buccal cingulum becomes developed.

2. The buccal surface of the main cusp is directed obliquely backward and inward, and at the same time becomes concave.

3. In genera having the W-shaped pattern, the first V answers to the concave, obliquely placed buccal surface of the main cusp. The second V is a vegetative repetition of the first, and is formed from the posterior cusplet of the canine.

The W thus formed is a conspicuous feature in the molars of most Insectivora and Chiroptera. It can be traced through its several stages of development from the Carnivora. The genera of the Procyonidæ exhibit the transition advantageously. The W of the upper jaw, while forming a portion of the free under-surface of the crown, is not functionally active as part of the grinder, but *is an extremely obliquely placed portion of the shearing buccal surface, and is not articular.*

The V V seen from the palatal side of tooth form the summits of two downward-projecting, prismoidal, shearing columns. Examined in relief from before backwards these columns are seen to be of different relative lengths. In *Vespertilio* and *Antrozous*, for example, where the appearance of the under free surfaces of the crowns are almost identical, conspicuous differences in the lengths of the columns are detected when the teeth are examined with the columns in antero-posterior relief.

The elevations placed to the palatal side of the base of the columns are developments from the palatal fold of the cingulum of the caniniform tooth. If one cingule be alone developed it lies to the median side of the first V. Should a second be present, it lies in an analogous position to the second V, and is much less pronounced than the first.

The differences in the forms of the lower molars are traceable to similar modifications of the simple cone and associated cusplets. The second V is incomplete, the anterior limb not joining the first to form a true W. There is no disposition to form a lingual outgrowth. In its stead a tendency to backward projection from the base of the second V exists. This projection is conveniently called the "heel" of the tooth, and is always articular.

The forms of the canines and premolars are not as simple and uniform as they at first sight appear. They often present remarkable differences in their details. This is especially true of these teeth in the Chiroptera. The buccal, approximal and median surfaces should be carefully studied in the different genera. Full descriptions of these differences would be out of place in a communication of this kind. One notable feature of many as seen in the canines is especially well developed in the bats, viz., the junction of the buccal and palatal surfaces resulting in forming a thin compressed posterior edge. This may receive the name of the "sabre" edge. It is repeated and exaggerated in the last premolar and forms at least in Chiroptera (other than the Pteropidæ) the "sectorial" surface of the tooth. It constitutes a sharp obliquely-placed ridge which is parallel with the last stroke of the first V, and is doubtless serially homologous therewith.

The following were ordered to be printed:

DESCRIPTION OF A PARTULA SUPPOSED TO BE NEW, FROM THE ISLAND OF MOOREA.

BY W. D. HARTMAN, M. D.

Partula Mooreana, Hartman.

Shell sinistral, ovate, elongate, thin, translucent, pale yellowish horn-color, apex darker; whorls 5, flatly convex, body-whorl, with or without from one to three narrow, pale, brown revolving bands; surface smooth, with fine, oblique striations, which are decussated by crowded waved spiral striæ; a narrow white line beneath the suture; aperture hearly half the length of the shell, lip white, moderately reflected, pillar tooth oval, prominent, situated nearest the superior angle, umbilicus open, moderately compressed.

Length 18 mill., diameter 9 mill.

Hab.—Vaianai Valley, Island of Moorea (Andrew Garrett, Esq.).

In one hundred and forty-six species and varieties of *Partula* represented in my collection, this shell possesses constant and well-marked specific characters. Mr. Garrett informs me that fifteen hundred specimens were all sinistral and dentate. The surface of the shell resembles *P. spadicea* and varieties from Moorea in possessing the thickly crowded waved spiral striæ.

This species is arboreal, and is not uncommon on bushes, in Vaianai Valley, the metropolis of *P. vexillum* Pse. = *P. stenostoma* Ph.

ON THE DEVELOPMENT OF LEMNA MINOR.

BY WM. BARBECK.

In the early part of last April, I found, in a little pond near Camden, N. J., among patches of *Riccia fluitans*, a number of minute brownish bodies, which under the lens had very much the appearance of germinating spores, showing at the top a greenish, prothallium-like outgrowth. They were of an oval form, and less than a millimetre in size.

I secured several of these little bodies, and, upon further examination under the microscope, I found that they contained a well-developed embryo, which was enclosed by a comparatively large cotyledon. Thus they were evidently the seeds of some monocotyledonous plant.

I was not able to return to the pond until a week later. Within this week the germination had been completed in a number of specimens, and numerous little plants were developed, most of them still in connection with the seed. These obovate, indistinctly three-nerved individuals, with a single root hanging from the under surface, were apparently *Lemna minor*. Thousands of fresh seeds had meanwhile appeared at the surface of the water, most of them germinating, and thus I could get the specimens in all stages of their development. I have tried to show this gradual development (up to the completion of the second frond) by a series of illustrations, Plate XVIII.

Figures I and II represent longitudinal sections through a seed in which the germination is about to commence. (Fig. I is from the centre, Fig. II from a part nearer to the surface).

The seeds are seen surrounded by a comparatively strong coat, the testa (t), which is considerably thickened towards the top, where it covers the lid, or operculum (o), by means of which the mycropyle is closed. In (c) we have the large cotyledon, surrounded by a scanty layer of endospermium ($sp.$); in (v) and (v) the two lobes into which the cotyledon will afterwards split, begin to be differentiated. The axis of the embryo (e) forms an obtuse angle with the medial line of the cotyledon. In (p) we have the plumula, in (r) the radula of the embryo; (f) indicates a fissure inside of which the gemma of the second frond is being formed.

In Fig. III the testa has been removed from the cotyledon (c). The two lobes are distinctly separate, (w) bearing the operculum under which the upper part of the plumula is concealed. The radula (r) is further developed; in (g) we have the bud of the second frond. The section in Fig. IV shows the plumula (p) fully developed into the first frond, which in (r) sends down its radula. The angle formed by this frond and the axis of the cotyledon is about 120°. Corresponding to the first figures (c) and (w), are the lobes of the cotyledon. (We have to bear in mind that all the figures represent thin sections through the different parts.) In reality the lobes of the cotyledon are two parallel obovate sheets enclosing the basal part of the much larger, likewise obovate frond. In this figure the gemma has been so far developed as to show in (f) the fissure in which the bud of the third frond is being differentiated. Its elongated inferior part (p') is the secondary plumula. In using a high power, the microscope will show in the region indicated by (x) several rows of very wide cells. Here the separation of the frond from the cotyledon will take place.

In Fig. V this separation is complete. In (p') we have the yet more elongated plumula, in (r') the radula of the second frond, and (f') shows again the fissure for the formation of the third individual.

The section represented in Fig. VI goes through the radula (r), showing a central vascular bundle (i) surrounded by a tissue of very loose, almost hyaline cells (k). In the further development of the rootlet this outer tissue will follow the growth of the vascular bundle to a certain extent; then its basal part will be separated from the frond. But, remaining in connection with the more and more extending vascular bundle, this wide-celled tissue will form at the top of the full-grown root the well-known hood or calyptra, characterizing the roots in all *Lemnaceæ*.

The last two figures (VII and VIII) need no further explanation. They show the formation and completion of the second frond (p'), from which the third individual will be developed in the same way as has been illustrated in the first figures. In (p'') we have the plumula, in (r'') the radula of the third fronds; (f'') in Fig. VIII shows the fissure for the formation of the fourth individual.

In this way we see the propagation continued through the summer, plant after plant being formed from a cleft of the preceding individual through a process of prolification.

My investigations have been made only on the *Lemna minor*, but there is no reason to doubt that in the development of the whole family of *Lemnacea* (analogous to our species) we have an interesting instance of parthenogenesis, there being seeds (produced in autumn by a sexual process) from which, during the course of summer, generation after generation is propagated without any further fertilization.

DESCRIPTION OF A NEW SPECIES OF HEMITRIPTERUS FROM ALASKA

BY W. N. LOCKINGTON.

Hemitripterus cavifrons, nov. sp.

D. iv-xiv, 1-12. A. 14. P. 20. V. $\frac{1}{3}$. C. 3-12-3. L. lat. 44.

Head very large and depressed; abdomen protuberant, so that the depth equals the width; snout to tip of ascending process of pre-maxillary rising at an angle of about 45°; thence to occiput, along the median line of the fish, deeply concave; from occiput to caudal peduncle regularly arched, the curve reaching its highest point at about the tenth dorsal spine. Outline of anal base corresponding to that part of the dorsal directly above it.

Depth, $3\frac{1}{2}$; greatest width, $3\frac{1}{2}$; length of head, $3\frac{1}{2}$; length of pectoral rather more than 4 times in the total length, caudal included.

Axial length of snout, $3\frac{3}{5}$; longitudinal diameter of orbit, $6\frac{3}{7}$; interocular width, $2\frac{1}{17}$ times in length of head; least depth of caudal peduncle rather less than 5 times in greatest depth.

Anterior nostril on a level with the centre of the pupil, and prolonged into a conspicuous tube; posterior nostril somewhat tubular.

Orbits elevated considerably above the general surface of the forehead, so that the concavity of the inter-ocular area is equal to about $\frac{3}{4}$ of the transverse diameter of the eye; eyes lateral, somewhat elliptical.

Mouth very large, very slightly oblique; its width from tip to tip of the opposite maxillaries, $1\frac{1}{6}$ in the length of the head, and exceeding that of the upper jaw by more than one-third.

Pre-maxillaries not forming the whole of the margin of the upper jaw, the maxillaries entering into it posteriorly.

Posterior extremity of maxillary considerably behind the orbit, its upper margin not concealed by the pre-orbital in the closed mouth.

Lower jaw slightly projecting beyond the upper.

Several rows of sharp, recurved, cardiform teeth, forming a broad band, in both jaws, also on the vomer, palatines and pharyngeal bones. The teeth on the vomer and palatines slightly longer than those on the jaws.

No gill-rakers; pharyngeal bones large.

Supra-ocular and post-ocular ridges prominent, the former curved inwards posteriorly, parallel to the post-ocular; between the two, at the posterior upper angle of the eye, are two small spines or short ridges.

Occipital ridges with three tubercles, the anterior near the post-ocular ridge, the two posterior near together and elongated transversely; a low ridge between the first and second.

Temporal ridge with three tubercles, the first immediately exterior to the first of the occipital series, the second a longitudinal ridge; the third rounded, close to the second.

A long low crest across the operculum; just above and anterior to this a shorter ridge connecting it with the temporal series; a tubercle on the supra-scapula; no spines upon the head, except two upon the posterior border of the pre-operculum.

All the tubercles of the head and the spines of the pre-operculum, covered by skin.

Maxillary with a fimbriated skinny flap near its posterior extremity: lower margin of mandible set along its whole length with skinny flaps, of which three pairs are especially long and fimbriated on both edges, while the posterior flap is very broad.

Lips well developed; lower lip pendulous at sides, and to a rather less extent in front, and bearing a fimbriated flap on each side.

Two pairs of similar flaps on the snout, and two over each eye.

Gill-membranes continuous below the throat.

Branchiostegals, 6.

Origin of first dorsal slightly anterior to the lower pectoral axil: first two spines longest, about $2\frac{4}{7}$ in the length of the head, fourth much shorter than the third, and a little shorter than the fifth: sixth, seventh and eighth much longer than fourth, the remaining spines diminishing to the eighteenth, which is the shortest.

A tag at the end of each spine, the membrane between the two parts of the first dorsal notched considerably.

A spine at the commencement of the second dorsal, the base of which is contained more than $2\frac{1}{2}$ times in that of the first, the rays increasing in length to the fifth, which is about $\frac{1}{5}$ longer than the longest spine of the first dorsal; upper margin of second dorsal, convex.

Anal longer than soft dorsal, arising opposite the last spine of the first dorsal, and terminating somewhat posterior to the second. Ninth to twelfth rays slightly the longest.

Pectorals very broad and rounded, their base oblique, the tip of the longest (sixth) ray reaching to about the sixteenth dorsal ray; rays simple, the longest a little less than one-fourth the total length of the fish.

Ventrals small, narrow, the longest (middle) ray rather more than half the length of the longest pectoral ray, but not reaching to the vent.

Caudal truncate on hinder margin, rather narrow, rays simple.

Vent midway between insertion of ventrals and origin of anal.

Lateral line with a series of skinny fimbriated flaps, similar to those upon the head.

Body and head scaleless, but the former covered all over with osseous papillæ; largest above the lateral line, smallest upon the protuberant portion of the abdomen.

Color, in alcohol, blotches of dark purplish-brown on a lighter ground; the blotches on the fins conspicuous, and running into transverse bars on the pectorals. Abdomen, light dirty-brown.

A single specimen of this interesting species was obtained by Mr. W. J. Fisher, at St. Paul's, Kodiak. It is in the museum of the California Academy of Sciences.

Hemitripterus cavifrons is the western representative of *H. acadianus* of the Atlantic, and differs from that species in the following characteristics, among others:—

The great depression of the inter-ocular area, whence the specific name; the greater number of dorsal spines; the shorter pectorals; the lesser depth of the posterior anal rays; the absence of hook-like papillæ along the lateral line, and the presence in their place of fleshy slips; and the smaller size of the bony papillæ along the dorsal region.

DIMENSIONS.

Total length,	15.75
Greatest depth,	4.50
Least depth of caudal peduncle,	.92
Length of head,	4.50
Width "	4.50
" of mouth, from tip to tip of maxillaries,	3.75
Length of upper jaw along its curve,	2.75

Axial length of snout, ...	1.25
Longitudinal diameter of eye, ...	.70
Interocular width, ...	1.70
Width of pectoral base, ...	2.75
Length of longest (sixth) pectoral ray, . .	3.88
Tip of snout to origin of dorsal, axial, . . .	2.75
" " " " " along top of head,	3.25
Length of base of spinous dorsal, . . .	6.50
Height of first spine, ...	1.75
" second spine, ...	1.70
" fourth spine, ...	.90
" fifth spine, ...	.98
" sixth spine, ...	1.00
" eighth spine, ...	1.20
" eighteenth spine, ...	.88
" spine of second dorsal, . . .	1.00
" longest (fifth) ray of second dorsal, .	2.00
Length of base of second dorsal, . . .	2.50
Tip of lower jaw to ventrals, along abdomen, .	3.75
" " " origin of anal, along abdomen,	8.80
" " " vent, ...	6.32
Length of ventrals, ...	2.00
" base of anal, ...	3.44
" longest anal rays (9-12) . . .	2.10

DESCRIPTION OF A NEW SPECIES OF CATOSTOMUS (CATOSTOMUS CYPHO) FROM THE COLORADO RIVER.

BY WM. N. LOCKINGTON.

Catostomus cypho, sp. nov.

D. 3, 14. A. 2, 7. C. 7-1-16-1-7. P. 18. V. 10. L. lat. 79.

Head conical; snout long, much depressed; dorsal outline rising in a straight line to the occipital region, where commences a prominent and considerably elevated hump, which attains its greatest height at a distance from the occiput about equal to the length of the snout, and thence descends to the origin of the dorsal.

Along the base of the dorsal fin the dorsal outline descends rapidly to about the end of the second third of the total length of the fish; caudal peduncle extremely elongated, and widening considerably toward the caudal base.

Abdominal outline almost straight to the origin of the anal, thence diminishing to the caudal peduncle.

Greatest depth, at anterior pectoral axil, contained not quite $4\frac{1}{4}$ times; head a little more than 4 times in the total length; snout a little more than $2\frac{5}{8}$, eye between 8 and 9 times in the length of the head; length of top of head not quite $2\frac{1}{4}$ times in the distance (in a straight line) from the tip of the snout to the dorsal; inter-ocular width equal to the length of the snout; pectoral about $1\frac{1}{3}$ in length of head; caudal peduncle about $3\frac{2}{5}$ in the greatest depth.

Mouth rather wide, inferior. Lower lip small, in two distinct ovoid lobes, covered with low, flat-topped papillæ; the front of the dentary bones covered by a well-developed, round-edged, horny plate. Lower lip quite distinct from the upper; the skin of the cheeks forming an obliquely ascending crease, which does not, however, cover the angle of the mouth.

Anterior nostril horizontally sub-elliptical; posterior large, vertical, crescentic, entirely covered by its anterior flap.

Two distinct rows of pores on the top of the head; connected on the occiput with a series running behind and below the eye almost to the tip of the snout.

Pharyngeals arcuate, with numerous teeth, regularly diminishing posteriorly.

Opercular region well developed; the distance from the posterior margin of the eye to that of the operculum being, to the length of the snout, about as eleven to nine. Posterior margin of operculum and sub-operculum forming a continuous bold convex curve.

Pectorals triangular-lanceolate, fourth and fifth rays longest; their tips extending to beyond the middle of the pubic bones, rays once or twice bifurcate, the first two excepted.

Ventrals reaching beyond the vent, the third rays longest, the last about two-thirds as long; all the rays twice bifurcate except the first.

Dorsal well developed, fourth and fifth rays longest, and contained about $1\frac{1}{3}$ times in the greatest depth; first three rays simple, the others twice bifurcate.

Anal considerably shorter than the dorsal, but equal in depth to the height of the latter; the first two rays simple, the others (except the last) twice or thrice bifurcate; first ray about half as long as the second.

Origin of the dorsal about one-sixth nearer to the tip of the snout than to the centre of the base of the caudal (measuring along the axis of the body), the base of its eighth ray above the anterior axil of the ventrals.

The tips of the anal rays reach beyond the first caudal accessories.

Caudal with numerous accessory rays, the longest about half as long as the outer simple principal ray; the other principal rays three times bifurcate; posterior margin of fin triangularly emarginate.

Scales cycloid, of variable size; each scale with 8-16 conspicuous radiating striæ on its exposed portion; the striæ and their interspaces crossed by numerous, much less distinct concentric striæ. Engaged portion of each scale with numerous diverging striæ, less distinct than those of the free portion. Scales along and near the lateral line larger than those above and below, and increasing considerably in size posteriorly, as do also those above and below, so that the largest scales of the body are upon the peduncle of the tail. The scales diminish much more rapidly in size downwards than upwards, so that those of the abdominal region and behind the pectoral base are by far the smallest. Scales somewhat pentagonal, the length exceeding the height; those upon the caudal peduncle almost twice as long as high.

Fins scaleless, as is also a small patch on the anterior part of the dorsal hump.

Lateral line deflected near its origin, then running along the median line of the body to the origin of the caudal. Pores simple.

Color of the preserved specimen silvery-gray above, light straw-color or creamy on the abdominal region and under side of the head; fins light uniform slaty-gray. The color is produced by numerous dark dots upon the scales and membrane between them, but fewer upon the scales, the outlines of which are therefore quite distinct.

The hump is supported anteriorly by a very large trapezoidal inter-neural, formed of a thick central pillar with anterior and posterior alæ, the latter twice as large as the former. The upper margin of the bone is highest at the point of the central pillar, from which it slopes anteriorly and posteriorly. The base of the central pillar is broadly expanded transversely, offering a double articulating surface on its under side. The next inter-neural is a thin flat sub-rectangular plate, while the next three are expanded above, attenuated below; the fifth bent, and smaller than the fourth, the lower portion of which is also bent forward. Inter-neurals of dorsal fin with a central ray and an anterior and posterior expansion dying out at their lower fourth; symmetrical, except that supporting the first two rays. This is evidently formed by two inter-neural bones, united by a thin bony plate, which forms a broad expansion in front of the first, and a narrow one behind the second.

Upon the first vertebra there is a broad articulating surface, apparently for the reception of the first inter-neural, as a thin longitudinal perpendicular partition exactly fits into a notch between the two articulating surfaces of that bone. The transverse processes of this vertebra are broadly expanded inferiorly, and their lower edges suturally united to a pair of very large bony plates of complex form, connecting the air-bladder with the back of the skull.

From the anterior margin of each neurapophysis of the next nine vertebræ springs an upward-directed process, which, in the first of these vertebræ, is almost as long as the neural spine, but which diminishes in size on each successive vertebra.

The neural spines of the first two of these vertebræ are bifid.

The single specimen from which the above description is taken was brought from the Colorado River, at the junction of the Gila, and was sent to the museum of the California Academy of Sciences by John E. Curry, Esq., Civil Engineer.

It is said that the species is not uncommon in the locality from which this specimen was procured, and it is much to be regretted that we have only this example, especially since it is greatly damaged by the extraction of the large inter-neural some two years ago. The air-bladder is destroyed, so that it is impossible to tell whether it agrees with the other species of *Catostomus*, in having that organ divided into two portions. The extremities of the fins are also much broken, and the shape of the body distorted.

DIMENSIONS.

	INCHES.
Total length,	$11\frac{1}{4}$
Length to base of caudal,	$8\frac{13}{16}$
Greatest depth, about	$2\frac{5}{8}$
Length of head,	$2\frac{3}{4}$
" top of head,	$2\frac{1}{\text{[illegible]}}$
" snout, from eye,	$1\frac{1}{16}$
Longitudinal diameter of eye,	$\frac{5}{16}$
Inter-ocular width,	$1\frac{1}{16}$
Depth of head, at front of eye,	$1\frac{3}{32}$
Snout, from front of nostrils,	$\frac{27}{32}$
Tip of snout to origin of dorsal, in a straight line,	$4\frac{3}{4}$
Length of base of dorsal,	$2\frac{3}{8}$
Height of longest dorsal ray,	$1\frac{15}{16}$
Tip of snout to anterior portion of pectoral base,	$2\frac{13}{16}$
Length of pectoral fin,	$2\frac{1}{32}$
Tip of snout to anterior portion of ventrals,	$5\frac{3}{16}$
Length of ventrals,	$1\frac{5}{8}$
" anal base,	$\frac{7}{8}$
" longest anal ray,	$1\frac{15}{16}$
Tip of snout to origin of anal,	$6\frac{3}{4}$
Width of caudal peduncle,	$\frac{25}{32}$
Length of first inter-neural,	$\frac{15}{16}$
Height of " "	$\frac{29}{32}$

PROCEEDINGS

OF THE

MINERALOGICAL AND GEOLOGICAL SECTION OF THE ACADEMY OF NATURAL SCIENCES OF PHILADELPHIA.

1877–1879.

MAY 28, 1877.

A New Polariscope.—Mr. H. C. LEWIS remarked that a cheap and accurate polariscope for the measurement of the optic-axial divergence in minerals had long been a desideratum among mineralogists. He wished to direct attention to an instrument for this purpose, lately made for him by Queen & Co., of this city, which had proved very satisfactory. The light was polarized by reflection from a plate of black glass, converged upon the rotating stage by two sets of adjustable lenses, and analyzed by a Nicol's prism. A graduated circle of steel, having through its axis a sliding forceps, is fastened at right angles to the stage. A pointer records the amount of rotation of the forceps. The mineral to be examined is either held in the forceps or is attached by a drop of oil to a piece of thin glass which is held in the same way. Cross-hairs are fixed below the eye piece, and the measurement of the divergence of the optic axes is performed in the usual way. The instrument was found to work admirably and could be recommended. The adjustments were made quickly and the axial divergence could be determined to within 30′. It is simple, absorbs but little light, and gives good results even with very small fragments of minerals.

A Garnet with Inverted Crystallization.—Mr. LEWIS exhibited a garnet which he had found in Germantown, and stated that it showed a very perfect example of inverted crystallization. Its form was a perfect trapezohedron except that one octant was depressed, its apex lying within the crystal, one-half way towards the centre. The re-entrant angles corresponded in position with the trihedral edges on the opposite octant of the crystal. The garnet was an isolated one found in a matrix of gneiss. Attention was called to the fact that such inverted crystallization was apparently more common in the isometric than in other systems of crystallization and comment was made upon the cause of such phenomena.

JUNE 25, 1877.

Change of Serpentine into Quartz.—Mr. THEODORE D. RAND described and presented specimens showing the change of serpentine into quartz, very strikingly shown near a quarry of serpentine rock on the farm of John Stacker, about a third of a mile N. W. of Radnor Station, P. R. R., Delaware Co., Pa.

The outcrop of the serpentine is accompanied by a rock, locally called "Ironstone," which however is a cellular quartz, generally stained by oxide of iron. It occurs as loose masses in the soil, generally of small size, but sometimes of over a hundred pounds weight; the cavities are frequently lined with drusy quartz. This rock is of common occurrence in connection with serpentine belts, but that it has arisen from a decomposition of the serpentine, has, he believed, not been observed elsewhere. On the south side of Stacker's quarry a few feet below the original surface of the ground, is a bed of soft serpentine much cracked; a foot or two above, these cracks are found lined with chalcedonic quartz, of paper-like thinness; above, the quartz thickens, the serpentine becomes more and more decomposed, until near the surface the quartz only remains, with the cavities empty, or filled with what appears to be oxide of iron with alumina. It is an instance of pseudomorphism on a large scale, the progress of which can be traced, step by step, from almost unaltered serpentine to almost pure quartz.

Well-water.—In this connection the analysis of the water of a well 50 feet deep in the serpentine, about 400 hundred feet from the quarry, but under the same quartz outcrop, may not be uninteresting.

In a gallon of 70,000 grains,—mean of three analyses:—

	Grains, per Gall.	Parts in 1,000,000.
Silica,	2.753	39.3
Magnesia,	1.262	18.
Lime,	.262	3.7
Peroxide of Iron and Alumina,	.577	8.2
Sulphuric Acid,	.687	9.9
Chlorine,	.124	1.7
	5.665	80.8

A New Locality for Siderite.—Mr. H. C. Lewis announced Dunbar, Fayette Co., Penna., as a new locality for Siderite. It there occurs in finely crystallized specimens in the interior of nodules of amorphous Siderite. These nodules or concretions are of various and often curious shapes. Doubly terminated limpid quartz crystals and minute but very perfect crystals of Pyrite are associated with those of Siderite, forming handsome specimens.

Magnetite Markings in Muscovite.—Mr. Lewis made some remarks on the markings in the Muscovite of Brandywine Hundred, Delaware. He proved that these markings were Magnetite, by exhibiting their attractability by the magnet, and said that in order to exhibit this properly, the section must be exceedingly thin. He stated that an optical examination had proved that the direction of the main lines of the markings corresponded with or was at right angles to that of the crystallographic axes of the Muscovite. He exhibited a plate of the mica shown distinctly to be a twin by the two different groupings of Magnetite markings. Examination in the polariscope confirmed this structure. Thus, frequently, the crystalline structure of the mica and the direction of its axes may be ascertained by an inspection of these markings alone. It appeared, therefore, that the form and direction of the markings was determined, not by independent crystallization of the Magnetite forming them, but in part at least by the Muscovite from which it had probably been derived. These markings are, in some respects, pseudomorphs after Muscovite. He thought that the statement in Dana's Mineralogy (p. 150), referring to these markings, that "the branching at angles of 60° indicates composition parallel to a dodecahedral face," was misleading, implying that this form was produced by an inherent property of the Magnetite, and not, as he thought now appears, by the crystalline structure of the Muscovite.

SEPTEMBER 24, 1877.

A New Locality for Asbolite.—Mr. LEWIS stated that he had found Asbolite at Flourtown, Montgomery Co., a new locality for this mineral. It is found in iron ore mines as an incrustation upon Psilomelane. It is of a bluish-black color, is as soft as graphite, and gives a shining streak when scratched by the nail. The blowpipe indicates a considerable percentage of cobalt.

A New Locality for Fluorite.—Mr. W. W. JEFFERIS stated that a few days since he was shown a massive specimen of Fluorspar of a deep purple color, which was found in the limestone near the village of Howellville, in Tredyffrin Township, Chester County, Pa. This is the third locality of fluor in this county.

Epidote in Molybdenite.—Mr. LEWIS mentioned that while examining some Molybdenite from Frankford, Phila., he had found plates of a transparent hard mineral, of a light greenish-yellow color, somewhat resembling Wulfenite, occurring in thin layers and minute scales between the foliæ of the Molybdenite, and sometimes coating it as a thin film. It was not until after a careful examination that it was proved to be Epidote in an unusual form and situation.

OCTOBER 22, 1877.

A New Locality for Millerite.—Mr. THEO. D. RAND announced the discovery of Millerite in Dolomite, from the Soapstone quarry on the Schuylkill, in Philadelphia, near the Montgomery County line. It occurred in capillary crystals in cavities of the Dolomite.

THE OPTICAL CHARACTERS OF SOME MICAS.

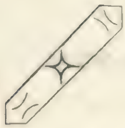
BY HENRY CARVILL LEWIS.

For the determination of the true characters of the micas—a class of minerals rapidly gaining in importance—a knowledge of their optical characters is almost as necessary as is that of their chemical composition. The optical is certainly the most ready method of determination. The investigation here recorded is but a partial one, and it is hoped that in the future it may be extended so as to include most of the American micaceous minerals. The measurements have been made for the most part upon minerals which have never been optically examined, and are chiefly American. A few foreign species have been introduced for comparison. The micas examined are largely those in the collection of the Academy. Others were either in the writer's collection or have been kindly given him by friends. The source from which each specimen has been obtained is noted in the tables given below.

The polariscope used was made by Queen & Co., of this city, and was described before this Section at its meeting last May. It reads to within 30′. The figures given below represent the mean apparent optic-axial angular divergence for white light. As the angle is somewhat different in different specimens and sometimes even in different portions of the same plate, the figures must be regarded as only approximate. In each case they represent a mean of a number of separate measurements, and collectively are the result of over 1600 such measurements.

Phlogopite.

1. Sussex Co., N. Y. Hexagonal crystals, yellow, transparent. (Acad. Nat. Sci.) 6°.
2. Burgess, Ont., Can. Clear brown. (A. N. S.) 6°45′.
3. N. Shore of Rideau Lake, Burgess, Can. Angle varies in same piece. Clear brown. (J. Willcox.) 6°–12°
4. Hammond, St. Lawrence Co., N. Y. Clear yellow. Hyperbolas closer in the centre than they are near the edges of the crystals. Crystals are sometimes uniaxial in the centre and biaxial at each end, while the plane of the optic axes at



one end is at right angles to that at the other end, viz.:
One crystal had angle at centre, 7°30′, angle at edge, 11°15′. (A. N. S.) 10°40′.

5. Jefferson Co., N.Y. Brownish-yellow. (A. N. S.) 11°21′-12°50′.
6. Vrooman's Lake, Jefferson Co., N. Y. Wine-yellow. (A. N. S.) 12°45′.
7. Oxboro', Jefferson Co., N. Y. Light yellow. (A. N. S.) 13°12′.
8. Ottey Lake, Burgess, C. W. Brown hexagonal crystals. (W. W. Jefferis). 13°20′.
   A crystal from the same locality (J. Willcox) gave for the outer part of crystal, 13°41′; centre of crystal, 11°23′.
9. Calumet Is., Canada. Greenish-yellow, transparent. (A. N. S.) 13°20′-14°18′.
10. New Hampshire. Reddish-brown, similar to Darby Biotite; nearly uniaxial in thin plates. 13°10′–17°.
11. Sparta, N. J. Dark brown; by reflected light nearly black. 14°20′.
12. Vrooman's Lake, Jefferson Co., N. Y. Clear pale yellow. Some crystals show identical phenomena with those from Hammond, St. Lawrence Co. 14°24′.
13. St. Denis. "Plumose mica:" brown: thick, nebulous hyperbolas. 14°30′.
14. Warwick, N. Y. Dark green; cleaving into rhombs; often mistaken for Biotite. 14°52′.
15. Pope's Mills, St. Lawrence Co., N. Y. Deep reddish-brown. (W. W. Jefferis.) 15°.
16. Vesuvius. Black by reflected light, dark reddish-brown in thin plates. With icespar: very opaque. (A. N. S.) 15°[illegible].
17. Clark's Hill, St. Lawrence Co., N. Y. Brown. (W. W. Jefferis.) 15°10′.
18. Kennett Square, Del. Co., Pa. Brown; in limestone. 15°20′.
19. Edwards, N. Y. Pearly white. (W. W. Jefferis). 15°30′.
20. Rossie, St. Lawrence Co., N. Y. Yellowish-brown. (A. N. S.) 15°52′.

21. S. Burgess, Can. Large brown crystal, purple on edges. (A. N. S.)	16° 38′.
22. Clark's Hill, near Rossie, N. Y. Brownish-yellow. (A. N. S.)	16°45′.
23. Clark's Mills, N. Y. Light brown, transparent: (probably identical with Nos. 17, 20, 22). (A. N. S.)	17°.
24. Canada. Asteriated Phlogopite.	19°.
25. S. Burgess. Clear yellow-brown. (A. N. S.)	19°.
26. Burgess, C. W. Yellowish-brown crystals, with secondary cleavage along diagonal. (W. W. Jefferis).	20°.
27. Rossie, N. Y. Black by reflected, reddish-brown by transmitted light. (A. N. S.)	21°13′.
28. Vesuvius. Black, crumbling, very opaque, mixed with black hornblende. (A. N. S.)	21°20′±.
29. Burgess, C. W. Asteriated, not transparent, silvery-brown. (A. N. S.)	21°35′±.
30. Rossie, N. Y. Black by reflected, dark brown by transmitted light. Contains apatite. (A. N. S.)	22°.
31. Chester Co., Pa. Feebly asteriated; locality wrong?; probably from Rossie, N. Y. (A. N. S.)	23°15′.
32. Alamutchie, N. J. Clear reddish-brown. (Frankl. Inst.)	30°5′.
33. Van Arsdale's Quarry, Bucks Co., Pa. Red-brown; with graphite, etc.	34°.

Biotite.

1. Easton, Pa. White, silver mica.	2°±.
2. Antwerp, N. Y. Greenish-white.	0°.
3. Culsagee, N. C. White.	0°.
4. Vesuvius. White.	0°.
5. Darby, Del. Co., Pa. Deep red.	0°.
6. Delaware Co., Pa. Crystal in muscovite; black by reflected, brownish-red by transmitted light.	5°±.
7. Scotland. Brown.	0°.
8. Rossie, N. Y. Brown.	0°.

Probably several of these Biotites have an angle of 1°–2°.

Lepidomelane.

Arendal, Norway.	Black; uniaxial.	0°.
Frankford, Phila.	Black; uniaxial.	0°.

Muscovite.

1.	Brunswick, Me. Bright green scales. (A. N. S.)	56°25′.
2.	Pennsbury, Pa. (A. N. S.)	56°50′.
3.	Vesuvius. With adularia. (A. N. S.)	59°20′.
4.	Dutton's Mills, Del. Co., Pa. (J. M. Cardeza.)	60°.
5.	St. Lawrence Co., N. Y. Greenish-white, plumose radiated crystals, showing Airy's spirals. (A. N. S.)	60°40′.
6.	Darby, Phila., Pa. Small scales in gneiss.	61°10′.
7.	Siberia. (A. N. S.)	63°.
8.	Germantown, Phila. Smoky brown, clear crystals.	63°4′.
9.	Plainfield, Conn. Margarodite. Contains 5 p. c. of water.	63°15′.
10.	Poorhouse, Del. Co., Pa.	63°47′.
11.	Germantown, Pa.	64°23′.
12.	Germantown, Pa. Containing enclosed crystals of a black, uniaxial mica.	64°30′.
13.	Frankford, Pa. In hornblende rock: in calcite. with fluorite and epidote. (T. D. Rand).	64°50′.
14.	Falls of Schuylkill, Phila. In hornblende rock.	65°.
15.	Cumberland, England. "Nacrite." (A. N. S.)	65°.
16.	Goyaz, Brazil. (A. N. S.)	65°50′.
17.	Brandywine Hundred, Del. Containing magnetite markings.	65°–67°30′.
	After heating until it whitens, it has an angle of 49°.	
18.	Litchfield, Me. (A. N. S.)	65°–68°34′.
19.	Portland, Conn.	66°.
20.	Southern Colorado. Identical with mica of Pennsbury, Pa., and Brandywine Hundred. Del., having magnetite markings.	66°7′.
21.	Grafton, N. H.	66°12′.
22.	Chandler's Hollow, Del. (J. M. Cardeza.)	66°40′.
23.	Black Hills, Wyoming. (A. N. S.)	66°48′.
24.	Zinnwald, Bohemia. (A. N. S.)	66°51′.
25.	Buncombe Co., N. C. (A. N. S.)	67°30′.

26.	Germantown, Pa. Large silvery plates.	67°30′.
27.	Dixon's Quarry, Del. Pale green.	67°45′.
28.	Connecticut. Green scales. (A. N. S.)	67°45′.
29.	Georgetown, Col.	68°.
30.	Upland, Del. Co., Pa. Pale green. (J. M. Cardeza.)	69°19′.
31.	Germantown, Pa. Pale green.	69°38′.
32.	Chester Co., Pa. (A. N. S.)	69°45′.
33.	Westchester Co., N. Y.	70°14′.
34.	Fabyans, White Mountains, N. H.	71°30′.
35.	Glacier of the Aar, Switz. (A. N. S.)	74°10′.
36.	Trumbull, Conn. Margarodite.	75°.
37.	Paris, Me. Rose-color. (A. N. S.)	76°15′.

Where not otherwise indicated, the above muscovites are of a clear yellowish-brown tint.

Lepidolite.

1.	Altenberg, Saxony. With Pycnite; sometimes distorted. (A. N. S.)	31°.
2.	Zinnwald, Bohemia. Often very irregular. On different parts of the same piece the angle varies from 34°30′ to 51°30′. (A. N. S.)	49°30′
3.	Paris, Me. Much distorted; several axes. (A. N. S.)	60° ±.
4.	Middletown, Conn.	66°.

Talc.

1.	Lafayette, above Manayunk, Pa. Exfoliating: fan-shaped crystals: images much distorted.	12°40′.
2.	Lafayette, Pa. Clear.	15°.
3.	Lafayette, Pa. Foliated talc; distorted images.	15°.
4.	Harford Co., Md. White.	15°.
5.	Shetland Is. Clear pale green, sometimes nearly uniaxial.	17°.

Pyrophyllite.

Westana, Sweden. 106°51′.

Serpentine.

Chrysotile from Chester Co., Pa., shows strong double refraction when the fibres make an angle of 45° with the plane of polarization of the instrument. Bissectrix apparently parallel to the fibres. Probably orthorhombic. Common serpentine and Williamsite show no double refraction.

Damourite.

1. Culsagee, N. C. In scales: analyzed by Koenig. (F. A. Genth.)	66°17′±.
2. Unionville, Pa. "Emerylite:" irregular hyperbolas. (A. N.S.)	69°35′±.
3. Unionville, Pa. On corundum.	72°.
4. Unionville, Pa. "Corundellite." (J. M. Cardeza.)	72°.
5. Horsjoberg, Sweden. (T. D. Rand.)	72°25′.
6. Chester Co., Pa. "Margarite:" irregular, showing sometimes four hyperbolas. (A. N. S.)	72°30′.
7. Haywood, N. C. "Altered from corundum." (F. A. Genth)	74°.
8. Unionville, Pa. Analyzed by Sharpless. (F. A. Genth.)	74°10′.
9. Unionville, Pa. Analyzed by Koenig. (F. A. Genth.)	74°15′.
10. Newtown, Conn. With Cyanite.	74°24′.
11. Newlin, Chester Co. "Margarite." (A. N. S.)	75°50′.

It is evident that the minerals labelled Emerylite, Corundellite, Margarite, etc., are all Damourite.

Euphyllite.

1. Chester Co., Pa. (A. N. S.)	37°–40°.
2. Unionville, Pa. "Original." (F. A. Genth.)	36°30′.

A thicker piece in which the hyperbolas were very dim, had an angle of 45°±.

This result is interesting, as the optical angle given by Silliman is 71°.

Cookeite.

Paris, Me. In small scales.	42°40′.

Vermiculite.

1. E. Nottingham, Chester Co., Pa. *Hallite.* In green crystals: uniaxial. 0°.

2. Cecil Co., Md., Magnesia Quarry. *Hallite.* Contains enclosed arrow-shaped crystals like Hallite: uniaxial. 0°.

3. Chester Co., Pa., Brown's Quarry. Uniaxial. (T. D. Rand.) 0°.

4. Macon Co., N. C. *Maconite.* In brown scales; uniaxial or with a divergence of 1° ±. (F. A. Genth.) 1° ±.

5. Mineral Hill, Del. Co., Pa. Pale green. (A. N. S.) 19°.

6. Lenni, Del. Co., Pa. Brown and green; sometimes a very small optic angle occurs. 19°–20°.

7. Culsagee, N. C. *Culsageeite.* Yellowish-brown: variable angle. Sometimes the angle varies as different portions of the same piece are moved into the field. One piece gave 9°, and another was nearly uniaxial. The angle given is the most constant one. 20° ±.

8. West Chester, Pa. *Jefferisite.* Variable angle: a specimen gave at one part 16°30′, and at another 25°, the latter being the most distinct; a very thin piece gave 11°30′, and a thicker piece 27°20′. Apparently the optic-angle increases with the thickness of the plate. Some good specimens gave 22°, 25°, and 28°; mean angle probably, 26° ±.

9. Lafayette Soapstone Quarry, Montgomery Co., Pa. Brown scales in chlorite slate: constant angle 32°–36°30′; mean, 34° ±.

10. Germantown, Phila. Brown plates in hornblende rock. Optic-angle constant within 31°20′–39°30′; the most constant angle is 37° ±.

It is very probable that, as suggested by Prof. Cooke, the variation in the optic-angle of the Vermiculites is caused by twinning

Ripidolite.

1. Patterson's Quarry, Newlin Township, Chester Co., Pa. Irregular green plates; with corundum; inclination of bissectrix to normal to cleavage plane, 5°30′: optic-axial divergence variable on the same plate on account of twinning, varying from 50° to 59°30′. (T. D. Rand.) Generally as given.	59°30′.
2. West Chester, Pa. Green plates; inclination of bissectrix 10°: axial divergence,	78°30′.
3. Brinton's Quarry, Chester Co., Pa. Fine clear green plates; inclination of bissectrix, 12°30′. $\rho > \nu$. Axial divergence,	82°.
4. Dudleyville, Ala. Pale rose-color; on chromite. Inclination of bissectrix, 16°. $\rho > \nu$. (F. A. Genth).	94°15′.

In all of these, double refraction is feeble compared with that of Muscovite. It is observed that the inclination of the bissectrix to the normal to the cleavage plane increases with the divergence of the optic axes.

Prochlorite.

Brewster, N. Y., Tilly Foster Mine. Uniaxial.	0°.

Margarite.

1. Cullakanee, N. C. White, "altered from corundum." Irregular figures. (F. A. Genth.)	110° ±.
2. Chester, Mass. Rose-color, with corundum; irregular, in some places showing four hyperbolas; one piece gave 89°30′.	112°45′.
3. Dudleyville, Ala. White, clear; inclination of bissectrix, 1° ±. (F. A. Genth).	122°15′.
4. Cullakanee, N. C. White, "altered from Zoisite." Inclination of bissectrix to normal to cleavage plane, 2° ±. (F. A. Genth.)	124°.

The large optic-axial divergence of Margarite readily distinguishes it from Damourite and other micas which resemble it. If further observations agree in showing that the bissectrix is inclined to the normal to the cleavage plane, it will show that Margarite is *Monoclinic* and not Orthorhombic as has been supposed.

OCTOBER 22, 1877.

A New Locality for Analcite.—Dr. A. E. FOOTE called attention to the fact that Analcite had been found at Falls of Schuylkill,—a new locality for that mineral.

NOVEMBER 26, 1877.

On the Measurement of Plane Angles.—Mr. LEWIS described a simple and quick way of measuring plane angles in minerals. It was a method which he had found very useful in the measurement of all edge angles, of cleavage and striation angles, the angles of markings and dendrites in mica, and of other flat angles to which a goniometer could not conveniently be applied.

A paper protractor was constructed, the radii of which, distant each from each 1°, were continued from the circumference to the centre. Horizontal lines, about twenty in number, are drawn across these, parallel to the radius 0° and at right angles to the radius 90°. These lines being parallel, the angles formed by the intersection of any radius with each of them are equal. In order to measure the angle of a crystal, it is laid on the protractor, one of its edges is made parallel to a horizontal line, and then the crystal is slid along that line until the other edge, forming with the first the angle to be measured, becomes parallel to one of the intersecting radii. The desired angle is now read off on the circumference of the protractor. Angles approaching 90° are read on one of the upper horizontal lines, while those of less amplitude are read correspondingly farther down. A magnifying lens is conveniently used to determine the exact coincidence of the edges of the crystal with the lines of the protractor. Very large crystals as well as crystals as small as a millimetre in diameter can be measured in this way.

It was found that this method of measurement was very convenient, and, if the protractor had been carefully made, was exact to within 30′; while it applied to those cases in which neither the reflective nor the hand goniometer could be used.

DECEMBER 17, 1877.

On an Exfoliating Talc.—Mr. HENRY CARVILL LEWIS described a variety of talc, occurring at the soapstone quarry above Manayunk, which is in some respects new. It occurs in fan-like crystals in Dolomite, and is much more similar to Pyrophyllite than to common talc. It moreover differs from common talc by exfoliating when held in the flame of a candle or Bunsen burner, and was, therefore, at first mistaken for Pyrophyllite. In the closed tube it exfoliates and gives off water. In optical characters it is identical with common talc, having been found to have an axial divergence of about 12°40′, frequently distorted. It is marked with striations or cleavage planes crossing at angles of 60° and 120°. In this respect it is like Jefferisite or Culsageeite, while in common talc such markings are rarely visible, and never distinct. It has the chemical composition of talc, except that the percentage of water is larger than usual, being 7.02 per centum. None of this water is hygroscopic, as its weight remains constant in a desiccator over sulphuric acid.

The water of two other talcs from the same locality was determined. A massive talc which does not exfoliate in the Bunsen burner flame or in the platinum crucible, but does so at the point of the blowpipe flame, contains 4.23 per centum of water.

A foliated talc which is caused to exfoliate only very slightly even in the blowpipe flame, contained 2.84 per centum of water, and this was driven off only at an extremely high and long continued heat.

In these three talcs, therefore, we have the interesting results:

1. That there is a direct ratio between the amount of combined water and the amount of exfoliation.

2. That there is a direct ratio between the tenacity with which the water is held and the temperature at which exfoliation occurs.

It is thought that perhaps these results may have a bearing in an explanation of the properties of the various Vermiculites.

January 28, 1878.

Tin in North Carolina.—Mr. Lewis exhibited a small piece of tin ore said to have been found in Surry Co., N. C., and which had been handed to him for examination. It was a soft, light earthy mass of a brown color, crumbling when pressed, which, when held in a candle flame, became covered with small globules of pure tin. The earthy base was a silicate of alumina, iron, and lime, and was partially soluble in acid. The tin was reduced by very gentle heat, far less than that required to reduce Cassiterite. It was suggested that the tin existed in it either native or as an ochre or hydrous oxide. No sulphides were present. It was questioned whether the specimen exhibited was a genuine native product.

A New Locality for Gypsum.—Mr. Theo. D. Rand announced his discovery of gypsum, as an efflorescence upon gneiss, at a quarry near Darby, Pa.

ON SIDEROPHYLLITE—A NEW MINERAL.

BY HENRY CARVILL LEWIS.

Among other interesting minerals which are found in the neighborhood of Pike's Peak, Colorado, is a hard black mica, occurring sometimes in large and fine crystals, which the writer has been unable to identify with any known species.

It is monoclinic, and has an eminent micaceous basal cleavage. It has the following characters:

Hardness, 3.2. Specific gravity, 3.1. Lustre, bright micaceous. Color, black by reflected light, and fine chrome-green by transmitted light. Opaque except in very thin pieces. Streak, pale green. Laminæ very brittle. Biaxial; optic-axial divergence $10^\circ \pm$.

In its composition it appears to be an iron-alumina mica. The analysis here given is a mean of two made by the writer. In one the mineral was fused with sodic carbonate before solution, and in the other it was dissolved in hydrochloric acid. The analyses were performed in the usual way. Iron was estimated by solution in sulphuric acid in a closed flask, and subsequent titration. The percentage of alkalies was kindly determined by Mr. F. A. Genth, Jr. The percentage of water is that given off on moderate ignition. On strong ignition the mineral loses over 3 per centum of its weight, some of the alkalies being driven off.

		O ratio.		
SiO_2	36.68	2.44	2.44	2.00
Al_2O_3	20.41	1.19	1.25	1.02
Fe_2O_3	1.55	.06		
FeO	25.50	.71		
MnO	2.10	.06		
MgO	1.14	.06		
CaO	.81	.03	1.22	1.00
Na_2O	1.09	.03		
Li_2O	.37	.02		
K_2O	9.20	.20		
H_2O	1.01	.11		
	99.86			

This gives $R : \dddot{R} : Si = 1 : 1 : 2$, and for the ratio of bases to Silica 1 : 1. It is therefore a Unisilicate in which the water is basic.

It has the formula

$$\overset{\cdot\cdot}{\underline{Si}} \parallel O_4 \parallel (\tfrac{1}{2}(K_2, \underline{Fe}) + \tfrac{1}{2}\beta\, \underline{Al})_2.$$

and the symbol

$$R_3, \underline{R}, Si_3, O_{12}.$$

Before the blowpipe it fuses with intumescence at about 2.5 to a black glass. It sometimes gives a red lithia color to the flame. It is soluble in hydrochloric and sulphuric acids, with separation of silica. In its pyrognostic properties it is thus similar to Annite, although Annite is less fusible. Its oxygen ratio is that of Biotite, but the absence of magnesia, and its physical and optical properties, distinguish it from that mineral. It occurs in good crystals back of Pike's Peak, Colorado. Amazon-stone and Astrophyllite occur in the vicinity. The material upon which this investigation has been made was obtained from Dr. A. E. Foote, of this city.

The name of *Siderophyllite* (*σίδηρος φύλλον*) has been given in allusion to the large percentage of iron which it contains.

FEBRUARY 28, 1878.

On Sterlingite and Damourite.—Mr. H. C. LEWIS stated that an optical examination of a number of American damourites had shown that they all had a large optic-axial divergence. This angle was generally 72°–74°. It is an angle somewhat larger than that of muscovite, and is remarkably constant in different specimens. On the other hand, the original damourite of Delesse has, according to Descloiseaux, an optic-axial divergence of only 10°–12°. No such angle has been found in any of the American damourites. As it has been shown that damourite ("hydro-mica") is an important element in our rocks, and is of wide distribution and frequent occurrence, it is essential that its characters should be well known.

The damourite of Sterling, Mass., conforming precisely, both as to composition and structure, with the type of American damourite, and which Prof. Cooke has shown to have an optic-axial divergence of 70°±, has been named by him, *Sterlingite*. This distinctive name was given solely on account of its larger optic angle. But it appears that this large angle is characteristic of all American damourites, and probably of many European ones.[1] It therefore follows either that all of our damourites should be called Sterlingite, or that the name should be dropped; there would otherwise be confusion. Notwithstanding the exceptional optical character of the mineral examined by Descloiseaux, it is thought that identity of chemical composition and of physical properties is sufficient reason for retaining the original name of Damourite.

MARCH 25, 1878.

Vanadium in Philadelphia Rocks.—Mr. LEWIS said that he had discovered the presence of Vanadium in hornblendic gneiss near Wayne Station, Germantown. The presence of sphene in that rock suggested the search for vanadium, recent researches having shown that this element frequently accompanies titanium. The following method was employed for its detection. The pulverized rock was slowly heated in a crucible with sodic carbonate and sulphur. After partial fusion the mass was digested in warm water and the filtrate acidified. The precipitate was washed, ignited, and fused with sodic carbonate and sodic nitrate. It was now digested in water, filtered, the filtrate concentrated, and solid ammonic chloride added. A precipitate fell, which was found by blowpipe and other tests to contain pure vanadium. An exfoliating hydrous mica occurred at this locality, resulting

[1] *V.* "The optical characters of some Micas:" by H. C. Lewis, Proc. Min. and Geol. Section, October 22, 1877.

perhaps from the alteration of hornblende, and which was believed to be a new species, in which there was .38 per centum of oxide of vanadium.

A New Locality for Epsomite.—MR. LEWIS reported having found Epsomite in Sideling Hill Tunnel, E. Broad Top R. R., Huntington Co., Pa. It there occurs in small, colorless, acicular crystals in an olive-colored shale in the lower part of the Vespertine formation (No. X).

NOVEMBER 25, 1878.

THE SURFACE GEOLOGY OF PHILADELPHIA AND VICINITY.

BY HENRY CARVILL LEWIS.

At intervals during the past year the writer has been devoting some attention to the gravels and clays of our city, and although the work as yet is only preliminary, and is still in progress, it is thought that a sketch of what has been done may serve to show what an interesting field is open for more thorough investigation. A large number of localities have been examined and many sections have been made, but it is proposed at present merely to summarize the facts observed.

The Upland Terrace.—1. A traveller going from the city upon the Germantown Railroad will notice in the cuttings for new streets between Tenth and Broad Streets, and in the railroad cut at New York Junction, numerous exposures of red or yellow gravel, often overlaid by clay. The brickyards in the vicinity of Nicetown expose large beds of brick-clay containing occasional well-rounded boulders and pebbles. The land so far has been comparatively level, and no rocks have been seen. Just before reaching Wayne Station, rocks rise upon both sides of the road, the clay and gravel disappear, and a rolling wooded country is entered. A thin covering of light micaceous soil containing no pebbles or boulders covers the gneissic rocks from here to Chestnut Hill. There is a great contrast between the two regions.

2. On the Pennsylvania Railroad it will be noticed that, soon after leaving the depot, gravel covers the rocks along the Schuylkill, and as the railroad turns back from the river, a plateau of clay follows. The Centennial grounds lie upon this clay, and boulders are frequent. Upon reaching Fifty-seventh Street, opposite Belmont and George's Hill, the hill is entered by a cut, the rocks come to the surface, and the drift is no more seen.

3. Again, on the North Pennsylvania Railroad gravels first appear, then, on higher ground, clay, and soon after passing Green Lane Station, the rocky uplands, free from drift.

4. So, too, on the West Chester Railroad, gravels and clays cover the ground up to the base of the hill on which Swarthmore College stands.

5. On the other hand, the New York division of the Pennsylvania Railroad and the Philadelphia, Wilmington and Baltimore

Railroad, which run parallel with the Delaware River, do not rise out of the region of drift.

Now, connecting by a line the four points mentioned, it will be found to represent a long straight hill 200 feet or more in height, having a northeast and southwest trend, parallel to the river, and lying at a mean distance from it of about four miles. We have traced it from Bucks County, through Philadelphia and Delaware Counties, into the State of Delaware, and find that it uniformly defines the western boundary of the drift. This hill is easily recognized where uncrossed by creeks, being remarkably straight and of uniform height. It forms the limit of tidewater, and is recognized where it crosses streams by the occurrence of rapids or falls. Being the first hill of importance west of the Delaware, it often commands a fine view and is a favorite site for residences. The geographical position of this ancient terrace may be more exactly defined in the vicinity of Philadelphia, as the hill which crosses Second Street Pike near Foxchase, and crossing Tacony Creek farther south, runs nearly parallel with it as far as Crescentville; which crosses Green Lane and New Second Street road near the place of Mr. J. L. Fisher; crosses the North Pennsylvania Railroad above Olney road, and the York road below the Jewish Hospital; which crosses Germantown Avenue at the railroad bridge (being here called Negley's Hill), and running along the railroad to beyond Wayne Station, passes back of the Germantown Cricket Ground, past Old Oaks Cemetery to Falls of Schuylkill. Thence, passing Chamouni, Belmont, and George's Hill, it crosses the Pennsylvania Railroad near Hestonville, and Haverford Road at Haddington; passes back of the Burd Orphan Asylum into Delaware County, and runs north of Kelleyville, Clifton and Morton to Swarthmore College, and thence past Village Green into Delaware.

This hill, which is approximately parallel not only to the river, but also to the shore of the Atlantic Ocean and to the line of strike of the Cretaceous formations of New Jersey, forms, as we have seen, the main dividing line between the ancient and the modern formations.

We shall call it for convenience the *Upland Terrace*. The strike of the gneiss forming it corresponds closely with the trend of the terrace itself. A boulder-bearing clay rests upon its southeastern slope at a uniform elevation of 150–170 feet above mean ocean-level. While it is true that, as will appear hereafter, there are patches of an ancient gravel on high points back of it, the Upland Terrace nevertheless remains as the most important geological feature in southeastern Pennsylvania.

Between the Upland Terrace and the Delaware, clays and gravels cover the rocks in a continuous sheet except where eroded away in the neighborhood of streams. The amount of their erosion is in some respects a measure of the age of the surface formations. It has been noticed that these formations in the vicinity of Philadelphia have undergone very different amounts of erosion, the amount of such erosion increasing as we recede from the Delaware; and this fact is regarded as offering evidence that the deposits are of different ages; those lying farthest from the river and highest in elevation being the most ancient, and those which are close to the river, which have undergone but little erosion, being the most modern of our surface formations. Examples of erosion of the Philadelphia gravel may be well seen on the Philadelphia and West Chester Railroad which crosses a number of creeks and runs nearly parallel to the terrace for several miles. As each creek is approached the drift[1] disappears and rocks come to the surface. So on the Schuylkill, no gravel is seen on the river drive in the East Park, but upon going back from the river and rising 100 feet above it, as far as the East Park Reservoir, gravel appears abundantly. Yet on the same river, nearer the Delaware, a newer gravel, made of different materials, not only forms its banks but underlies it.

Recent Alluvium.—The most recent of all the surface deposits is the stiff bluish clay which covers the low ground in the southern part of the city. The Richmond meadows and the flats of Moyamensing, Greenwich and Tinicum are covered by this deposit. It is bounded by a low terrace which may be called "*The Floodplain Terrace.*" This terrace, up to which the river often comes in times of flood, crosses South Broad Street diagonally below Moyamensing Avenue, and crossing the Delaware extension of the Pennsylvania Railroad near Penrose Ferry Road, winds around Point Breeze Park back towards the Gas Works, and passing below Suffolk Park crosses into Delaware County. This terrace is about ten feet above mean tide. It is the lowest and newest of all the terraces and is formed of the next older formation, the "River gravel." The mud or clay lying between this terrace and

[1] The term "drift" here includes all superficial formations of whatever age.

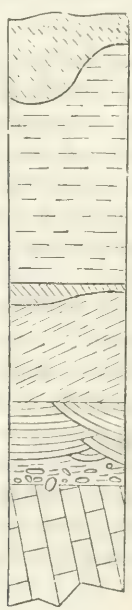
the river is too stiff to be useful for brickmaking. Blackened fragments of twigs, roots and leaves are frequent in it, and it is said that trunks of the white cedar abound in it in some places. There is here an indication that these beds are sinking and that, as on the Atlantic coast, the water is encroaching. Frequently a good peat covers the clay.

The River Gravel.—Forming the Floodplain Terrace and lying back of it, is a light sand and gravel free from clay, which may be designated the "River Gravel," since it formed the ancient river bed. It is composed of a light micaceous sand made from the wear of gneissic rocks, overlying a clean, loose gravel, whose pebbles are composed of the rocks which form the river bottom farther north. The pebbles are generally flattened and are composed of gneiss, Triassic red shale, Triassic argillite, etc. It is of a gray color, white quartz pebbles being comparatively scarce. It underlies the river to a great depth and forms islands in it. Frequently large boulders lie upon the river gravel. Bridesburg and the Lazaretto are built upon it. The sand is used for building purposes. It is bounded by the "*River Gravel Terrace*," a terrace rising some twenty feet above mean tide, and which is capped by the red gravel and brick-clay about to be described, while rocks are frequently exposed at its base. The Chester Branch of the Reading Railroad lies below this terrace, and the present line of the Philadelphia, Wilmington and Baltimore Railroad is above it.

The Red Gravel and Brick-Clays.—The built-up portion of the city stands upon an extensive deposit of brick-clay and gravel, sections of which are exposed in every cutting. The brick-clay invariably overlies the gravel, and will therefore be first described. By far the finest exposures of brick-clay are those on either side of Long Lane, in the "Neck." The clay here is very compact, free from sand and gravel, and is often 15 feet or more in depth. Loam lies above it, and is mixed with it for brick-making. Well-rounded boulders of Potsdam, Medina, Trias, etc., are frequent. The whole lies upon some 20 feet of stratified gravel. It is a much finer and deeper clay than that of the northern part of the city, as at Nicetown. It is interesting to note that while the clay which is farthest from the Upland Terrace and lowest in elevation is purest and deepest, on the other hand that near the terrace and more than 100 feet above the river is both shallow and sandy. It suggests that the former was deposited in deep water and the latter near the shore. At the base of the terrace the clay is but two or three feet deep. The boulders of the Nicetown clay are similar to those of the Neck clay, except in the fact that in the latter there are numerous rounded and sharp fragments of triassic red shale, while in the former boulders of that material are very scarce. The boulders of both clays are invariably derived from a northern source. No shells or organic remains have as yet been noticed in this formation.

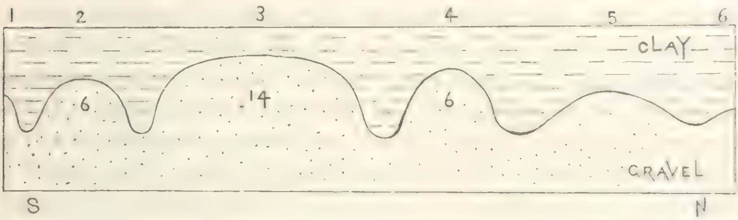
Beneath the clay, and often unconformable with it, is the Philadelphia red gravel. It is a clayey gravel which packs well and is much used on roads, and whose red color is caused by the ferruginous clay in which the pebbles are imbedded. The pebbles are composed of all kinds of rock and are not flattened as are those in the river gravel. The predominant material is white quartz, but pebbles of all other materials, as conglomerate, sandstone, fossiliferous hornstone, flint, red shale, etc., are numerous. Stratification is observed in almost every section exposed. Good sections of gravel are seen near the University of Pennsylvania. It has here an elevation of about 50 feet, and comes to the surface of the ground with but a very slight covering of clay. The gravel is here over 15 feet deep, and as it is in some respects a typical exposure, a section is herewith presented.

Ft. FIG. 1.



It will be noticed, in the *first* place, that the clay lies in the form of crests and hollows upon the gravel. This is almost invariably the case. Beautiful examples of wave motion may be seen at Twenty-eighth Street and Columbia Avenue, at Tenth and Tioga, at Fifteenth and Clearfield Streets, and in Fairmount Park. In each of these we have apparently the action of a rushing flood of water upon the gravel. Often the clay lies in a kind of pot-hole in the gravel, and a concentric structure of clay and pebbles can be seen. The following section, at Twenty-eighth Street and Columbia Avenue, shows six well-marked waves of gravel and clay, the clay always filling the hollows between the crests of gravel.

FIG. 2.



The approximate dimensions of the waves are given in the diagram. Along the line of contact between clay and gravel there are alternate streaks of fine and coarse gravel.

A very beautiful example of water action is exposed at Fifteenth and Clearfield Streets, in a cut about 100 feet in length (Fig. 3).

The *second* point to be noticed in the section near the University is the stratification of the gravel, and its division into layers of three different colors,—red, black and yellow. It is instructive to note that this division is by no means a local one, but exists along a line of about equal elevation (60 to 80 feet above ocean level), in widely separated parts of the city. While the colors are of course due simply to different states of oxidation of the iron, the fact that they mark continuous deposits through long distances, indicates a uniformity in the condition of deposition which could be due only to the presence of a large body of water.

In the *third* place, the section (Fig. 1) shows the important fact that the gravel rests, not upon a hard floor of rock, as is usual with the drift in more northern States, but upon a completely decomposed gneiss. This is universally the case in every section examined in the vicinity of Philadelphia. In no case does the gravel rest upon unaltered rock, except possibly in the vicinity of streams where the water has eroded away the soft rock. In such positions, however, the gravel also is usually eroded, except in the case of the "River gravel" proper. It will be observed that a sharp stratified micaceous sand, made up of the materials of the decomposed gneiss, and often showing "flow and plunge" structure, lies below the gravel. In the section given, a well-rounded boulder of a lower Silurian sandstone is seen partially imbedded in the decomposed gneiss. This fact offers two interesting deductions:—

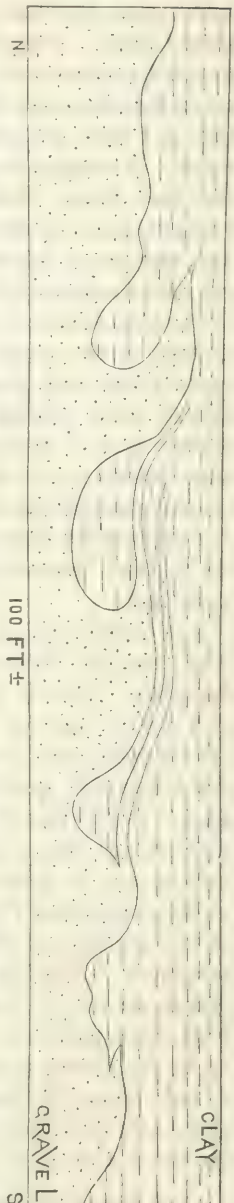
(1.) That the gneiss was decomposed before the deposition of the gravel.

(2.) That water, not ice, was the agent of such deposition.

(1.) As additional evidence in support of the first deduction, it has been observed in several sections that portions of the decomposed gneiss have been taken up and interstratified in horizontal layers, either with the gneissic sand, or with the gravel itself. That the steeply-dipping decomposed gneiss should be thus re-stratified, as though by a flood, and that, on the other hand, no such phenomena are ever observed in undoubted glaciated regions, can only be explained upon the assumption that the gneiss was decomposed before the Glacial epoch. That such decomposition took place in a yet earlier geological age, will be indicated below under a description of the "Bryn Mawr gravel."

(2.) Absence of a glacier in this region is indicated by the wave-like junction of gravel and clay, by the stratification of the gravel, and by the presence of decomposed gneiss. No polished surfaces of rock have

Fig. 3.



ever been observed in this region, although the occasional slickensides upon the gneiss in some quarries has been mistaken for glacial striæ. Frequently the lower yellow gravel is replaced by a yellow sand more or less fine, which is used for building purposes; and in this there are often good examples both of oblique lamination and of "flow and plunge;"—structures attributable to flowing water. Examples may be seen on the North Penna. R. R. and in the East Park. The boulders of both clay and gravel, if not brought down by water alone, have been dropped by floating ice. The absence of life in either deposit indicates that the water was too cold to support it.

The conclusion is therefore forced upon us that, during the melting of the great Northern Glacier, whose southern terminus crossed the river probably near Belvidere, the flooded Delaware, then a great torrent five or ten miles wide and at least 150 feet deeper than it is now, deposited at first gravels and afterwards, when quieter, clays; while floating ice carried down already rounded boulders and dropped them upon its bed.

The uniform elevation of the edge of the clay at the base of the Upland Terrace can hardly be accounted for upon another hypothesis.

The presence of an actual glacier over this region has, however, been brought forward as the only explanation of our surface deposits. Thus, in a recent paper,[1] the author, after inspection of a gravel opening in West Philadelphia, concludes "that this belt of drift deposit is no other than a glacial moraine formed by the Schuylkill glacier receding from the site of the city." He adds, "the surface of the gneiss where laid bare is comparatively smooth, and shows evidence of having been polished, though so soft as not to retain the marks of glaciation." To us the very locality described (Forty-fifth and Spruce) offers strong evidence of the absence of all glacial action. The gravel, containing no scratched pebbles, is horizontally stratified and shows flow and plunge structure; while the underlying decomposed gneiss, so far from being polished, is seen in several places to have been taken up by the swiftly flowing water and mingled with the gravel which it bore along, so that several layers of decomposed gneiss, each about half an inch in thickness, and soon dying out, alternate with the lower portion of the gravel.

[1] "On Glacial Deposits at W. Phila.," Proc. Am. Phil. Soc., Nov, 1875.

It has been supposed that the bending over of the outcrops of steeply-dipping rocks, sometimes observed near Philadelphia, has been caused by the pressure of a glacier. A very beautiful example of such broken and bent-over strata is seen in a quarry at Edge Hill. That such phenomena are to be explained, not by glacial agencies, but by the force of gravity only,—being the gradual sliding-down-hill of the soil known as "creep,"—is shown by the facts, (1) that such bending over is always towards a lower elevation,—down hill; (2) that on the two slopes of the same hill the strata have been seen to be bent over in opposite directions. Thus at various points along the long ridge of altered Primal slates known as Edge Hill, the slates on one slope are bent towards the south, and on the other towards the north. A similar fact has been noticed in the gneiss forming the Upland Terrace. Moreover, such bending of the strata often occurs in regions quite free from drift.

If, as we have conjectured, the Delaware Valley was filled with a large body of water when the drift was deposited, it is reasonable to suppose that the Schuylkill also was of far greater size, and that some boulders would be brought down the valley of that stream. Here again facts sustain the hypothesis. In the gravel taken from the excavation for the East Park Reservoir, associated with Triassic red shale and other boulders, we have found partially worn fragments of chlorite slate containing octagonal crystals of magnetite, evidently derived from the steatite quarry at Lafayette, six miles above on the Schuylkill. At Twenty-eighth Street and Columbia Avenue is a large boulder of trap, identical with that of the trap-dyke which crosses the Schuylkill River at Conshohocken.

It thus appears that during the Glacial epoch the waters of the Schuylkill emptied into those of the Delaware at Falls of Schuylkill, the city proper being entirely submerged.

Before closing our account of the Philadelphia red gravel—the "University gravel," as it might be called for distinction—it will be necessary to say a word as to what occurs on the New Jersey side of the river. If we are correct in ascribing this gravel and brick-clay to a flooded river valley, similar deposits at the same elevation must be found on both sides of the river. Although we have been able to do but very little work upon this point in that State, it has been observed: (1) That there is a sand at Camden near the river, similar to the sand of the "River gravel" of lower

Philadelphia; (2) that at a higher elevation there are deposits of superficial yellow brick-clay quite distinct from the underlying plastic clays; (3) that boulders identical with those on this side of the river occur in the brick-clay; (4) that a stratified red gravel containing Triassic shale, and similar to the University gravel occurs; and, (5) that there are indications of the existence of a Terrace, several miles from the river, bounding the brick-clay and its boulders, and composed of an older, and probably oceanic, gravel and sand.

The Fossiliferous Gravel.—There seems to be evidence that between the Upland Terrace and the River Gravel Terrace there is an intermediate terrace, back of which is a gravel somewhat different from the Philadelphia red gravel. It is characterized by comparative absence of Triassic red shale, and by the presence of numerous pebbles of flint, hornstone, or limestone, which are frequently fossiliferous. These pebbles, as well as those of white quartz, are not fresh-looking, but are eaten and weather-worn by age. In both its position and its appearance it is an older formation than the red gravel. It is of a yellowish color, becoming white when exposed to the weather, and is more sandy than the red gravel. For these reasons it is less esteemed for road-making. The Germantown Railroad cuts through this gravel at New York Junction. We have found here pebbles containing Cyathophylloid corals, Favosites, a Trilobite, etc. The Connecting Railroad at Ridge Avenue Station cuts through the same gravel, and here we have found *Strophomena*, etc. Other fossils have been found below the clay in the East Park and at the Centennial Grounds.

This gravel is found on the high level plateau which lies at the base of the Upland Terrace, and is covered by more recent brick-clay. It lies farther from the river and at a higher elevation than the red gravel, and there is a decided rise in the ground from the latter to the former. This terrace has been observed in many places near and in the city, but has not as yet been traced continuously, and its existence is doubtful. Nearly all the brick-yards in the city, except those in the "Neck," lie upon this gravel and back of this terrace, which lies at a mean distance of about a mile inside of the Upland Terrace. It seems as though the flood, diminishing in breadth, had eroded away the clay within this "Red Gravel Terrace." The red gravel comes to the surface, with very little overlying clay, at elevations below about 100 feet; while at a higher elevation is the brick-yard plateau.

The Pennsylvania Hospital for the Insane stands upon the hill forming this inner gravel Terrace. Its course is somewhat parallel to the main Upland Terrace, and it crosses Walnut Street near Fiftieth Street, and Broad Street near the Reading Coal Road crossing. In Prof. Rogers' Geological Map of Pennsylvania, where a rough attempt is made to represent the boundary of the drift, the line in one place corresponds quite closely with what we have presumed to be the "Red Gravel Terrace;" but it appears that in most places in that map the boundary is meant to be merely a hypothetical one. While the existence of this inner terrace is yet doubtful, and while it is probable that red gravel will be found above it and fossiliferous gravel below it, yet nothing has yet appeared to controvert the assumption that the latter gravel is older than the former. How much older, and whether of oceanic or of fresh-water origin, is not yet determined. Here, again, a study of the New Jersey gravels will be of assistance.

The Branchtown Clay.—Having now described the surface deposits lying between the Delaware River and the Upland Terrace, it remains to point out the existence of some isolated patches of gravel and clay which have been noticed on some of the hills back of and above this terrace.

In the village of Branchtown, on a plateau 250 feet above the river, there is a local deposit of brick-clay lying in an oblong belt running N. E. and S. W., perhaps a mile in length and an eighth of a mile in breadth. That it is not a clay formed in place by decomposition of the gneiss is shown by the presence in it of pebbles and rounded boulders of foreign rocks. The smaller pebbles consist of quartz, and the larger of a friable quartz sandstone, probably Potsdam. Not a single fragment of Triassic red shale, and not a single pebble of flint or fossiliferous rock was found: and in this it is distinguished from any deposit heretofore described. Nor were any of the pebbles formed of the materials of the bed of the Delaware River. Numerous sharp fragments, often six inches square, of white or yellow siliceous sandstone and of brown jaspery quartzite, both probably of lower Silurian age, were found. The peculiar conglomerate described below as "Mt. Holly Conglomerate" does not occur. Decomposed gneiss lies below the clay, which is two to three feet deep. The presence of sharp and rounded boulders of a rock in place farther north suggests an overland flood during glacial times; but the complete absence of all traces of Triassic red shale, a formation of large extent six miles north of here, over which such a flood must have passed, is difficult to explain upon that hypothesis. This belt of clay, which may be called for convenience the "Branchtown clay," extends S. W. to Chelton Avenue and Chew Street, in Germantown, and to the N. E. to Limekiln Pike and City Line Road, and is the site of several brickyards. The clay plateau is bounded on the N. W. by a hill 325 feet high. Doubtless this clay will be found in other places, when more light will be thrown upon its origin and age.

The Bryn Mawr Gravel.—Upon the summits of some of the highest hills in the gneissic region back of Philadelphia, at a mean distance of about nine miles from the river, and at elevations of from 325 to 450 feet above it, there are isolated patches of an ancient gravel, different from any yet described, to which we have given the provisional name of "The Bryn Mawr Gravel." It can always be recognized by the presence of sharp or partially rounded fragments of a hard, heavy iron sandstone or conglomerate. Such fragments are often covered by a brownish-black iron glaze. More than ten years ago, the writer noticed in the soil of the upper part of Germantown, pieces of this conglomerate, unlike any known rock, and it is only of late that its origin has been suspected. It consists of well-rounded pebbles of quartzite or siliceous sandstone cemented by iron into a stone which is often very hard. This conglomerate is found in occasional fragments upon ground over 300 feet high, but is not found in abundance until an elevation of over 400 feet is reached. At these highest points it occurs in a red gravel whose pebbles are identical with those of the conglomerate.

One of such points is near Chestnut Hill, on the City Line Road at its highest elevation, near Willow Grove Road. Here, nearly nine miles from the river and 425 feet above it, is a patch of this gravel and conglomerate. The larger pebbles and boulders, like those of the Branchtown Clay, consist of a friable quartzite sandstone or a jaspery quartzite. Sharp fragments of quartzite are numerous; but there are no traces either of Triassic red shale, of fossiliferous pebbles, or of rounded pebbles of the underlying gneiss. It rests upon a much decomposed gneiss. The conglomerate sometimes contains cavities filled with white sand. The tract of gravel is of an oval form, whose major axis points N. E. and S. W. It crosses the Township Line Road near the Bethesda

Home, near which place have been found a sharp boulder of conglomerate three feet in diameter, several fragments of ferruginous sandstone equally large, a partially rounded boulder of white quartz nearly four feet long, and numerous fragments of quartzite and Primal rocks. The gravel is here in part replaced by clay.

A similar tract of this gravel occurs at Bryn Mawr, extending from that place to near Cooperstown. A good section is exposed in the railroad cut below the station. From this locality, so easy of access from the city, we have named the formation. It is here about 430 feet high, and nine miles from the river. The gravel is ten feet deep, and lies upon a steeply-dipping gneiss so completely decomposed that it is as soft as clay. Underneath the bridge, a soft white kaolin-like material, conformable with the gneiss, shows a decomposed steatite,—being probably the continuation of that which crosses the Schuylkill at Lafayette. Here, as at Chestnut Hill, the gravel lies in an isolated patch upon a hill, distant from any stream or other eroding agency. The gravel holds sharp fragments of primal rocks and also the iron conglomerate. As at Germantown, the fields below, to the south, contain occasional fragments of the conglomerate.

Another good exposure of the Bryn Mawr gravel is on a hill crossed by the road leading from Haverford College to Cooperstown. The conglomerate is here in large, sharp fragments, and the gravel shows slight horizontal stratification. On the crest of the hill, some 450 feet high, there is a weather-worn boulder, four feet in diameter, of a soft, coarse, brown sandstone of Bryn Mawr age, apparently in place.

A fourth, precisely similar exposure of gravel with conglomerate, and at about the same elevation, caps the hill back of Media, near the Rosetree.

Without describing any further exposures, it already appears that in these elevated patches of ancient gravel we have the last remnants of a once continuous formation. The very great erosion which has swept away all but these few traces is a sufficient proof of its age. There are no points at all approaching the elevation of these hills, between them and the Atlantic Ocean; and it is at once suggested that these patches are the remnants of an oceanic deposit, possibly of Tertiary age. It is interesting to find that a precisely similar formation caps some of the hills in New Jersey. On top of the hill at Mount Holly, N. J., is an identical conglomerate and gravel, similar in appearance, and composed of the same materials as the formation in Pennsylvania. The conglomerate has the peculiar ferruginous glaze already noticed. It here overlies Cretaceous marls and sands.

From its abundance at this place, and in order to show its connection with Pennsylvania deposits, we shall call the conglomerate of the Bryn Mawr gravel, "*Mt. Holly Conglomerate.*" Prof. H. D. Rogers[1] suggests that this rock at Mt. Holly may be of Miocene age; but Prof. Cook, not distinguishing it from the modern iron crusts in the red Philadelphia gravel near the river, considers it very recent. In the consideration of its age it is worth noting that the sand of southern New Jersey, apparently of late Pliocene age, frequently contains rounded pebbles of Mt. Holly conglomerate, thus showing that the latter is an older formation.

From the identity of their contained boulders, it is probable that the Branchtown clay and the Bryn Mawr gravel are nearly coeval. Being oceanic, it is presumed that they will be recognized all along the gneissic hills of the southern Atlantic States.

We have given this detailed description of each of the surface formations near Philadelphia in the hope that they may be recognized elsewhere by other geologists. It has been found that a careful examination of the materials comprising each gravel, taken in connection with their elevation above tide, is the only means of discriminating between them. Desultory observations in detached localities are of little value. Should this work be extended in Pennsylvania and New Jersey, and the distinctions between the four gravels described be carried out, it is thought that, notwithstanding the shifting character of the underlying strata in the latter State, much may be done not only towards an exact determination of their age, but towards a settlement of some of the vexed problems of surface geology in Eastern America.

Recapitulation.—The results obtained may be briefly summarized as follows:—

Forming the N W. boundary of the Philadelphia gravel and brick-clay is a hill of gneiss, rising 200 feet or more above the river, which may be called the Upland Terrace. It has a N. E. and S. W. trend, and in this vicinity is at an average distance of five miles from the river.

[1] Report on the Geology of N. J., 1839.

Within the Upland Terrace, resting upon its slope, and extending to the river, is a series of stratified gravels and a boulder-bearing brick-clay. Of these, the oldest is the "Fossiliferous gravel;" a gravel lying near the terrace and under the brick-clay, and containing pebbles which frequently are fossiliferous. Of more recent age, and at a lower level, is the "Philadelphia red gravel," which is made up of the pebbles of the Fossiliferous gravel mixed with fragments of Triassic red shale and other rocks brought down the Delaware Valley. It is distinctly stratified, rests upon decomposed gneiss, and contains rounded boulders dropped by floating ice. Upon both of these gravels rests the Philadelphia brick-clay, often lying unconformably upon them in a series of pot-holes or wave-like forms, and apparently an aqueous deposit.

A yet more recent formation, the "River gravel and sand," lies within the others and close to the river, and is made up of flattened pebbles composed of the rocks over which the river flows. Upon this, in the river flats, lies a modern mud, the "Recent Alluvium."

Back of the Upland Terrace, isolated patches of two surface deposits, more ancient than any yet described, lie upon the hills. These are, the "Branchtown clay," at a height of 250 feet, containing boulders of Potsdam rocks, but no traces of Triassic red shale or of fossiliferous pebbles; and the "Bryn Mawr gravel," which caps hills of a higher elevation, and which, containing boulders and pebbles of identical material with those of the last, is characterized by the presence of a hard iron conglomerate or sandstone. This conglomerate, occurring also in New Jersey, and named the "Mt. Holly Conglomerate," is conjectured to be of Tertiary age.

In these seven formations is written the geologic history of the Delaware Valley.

Much remains to be done before any certain results can be expected. It is hoped that the imperfect examination here recorded may form the basis for a future and more thorough study, which, extending to wider fields, shall make more exact the knowledge of our surface geology.

OCTOBER 28, 1878.

On a Belt of Steatite and Serpentine in Radnor, Del. Co.—Mr. THEO. D. RAND read a paper on a belt of Steatite and Serpentine, in Radnor Township, Delaware Co., Pa.

(Published in Proc. Acad. Nat. Sci.)

NOVEMBER 25, 1878.

Chromite near Radnor, Pa.—Mr. THEO. D. RAND announced the occurrence of Chromite in considerable quantity in the Southerly Serpentine Belt, near Radnor Station, Delaware Co., Pa.

FEBRUARY 24, 1879.

ON RANDITE.

BY THEODORE D. RAND.

At the December meeting of the Mineralogical Section, Mr. Goldsmith made a communication in regard to the uranium-yellow coating found at the south end of the largest quarry at Frankford, northeast of Adams Street, stating that he found in it, carbonic acid, silicic acid, phosphoric acid, uranium, alumina and lime; and that his conclusion was, that it was a mixture of autunnite and calcite. The writer stated at the same meeting that he had made an incomplete examination of the same mineral, which, in great part, confirmed Dr. Goldsmith's observations, but that he failed to find phosphoric acid, and promised the Section the result of experiments then under way.

At the meeting of the Academy held December 31st, 1878, Dr. Koenig communicated the results of a full quantitative analysis, giving the composition, a hydrous carbonate of uranium and lime, to which he gave the name Randite.

The writer's results differ somewhat from those of Mr. Goldsmith and Dr. Koenig. Owing to the very small amount of the coating, and its close adhesion to the rock, proper separation was impossible, and the first experiments were made by treating the rock and coating, first with acetic acid, to remove calcite, then with dilute hydrochloric acid. The coating was unaffected by the acetic acid, as proven by one specimen, in which, after solution of a large amount of calcite, the Randite was left in tufts of acicular crystals. The acetic solution contained chiefly lime, with a little alumina, but no uranium.

The hydrochloric solution yielded a small amount of silica, alumina, sulphuric acid, and phosphoric acid, with a large amount of lime and uranium.

In the treatment with acetic acid, bubbles appeared to rise from the coating—a multitude of tiny bubbles; on the succeeding treatment with hydrochloric acid, the bubbles were much larger, and fewer in number, and appeared to rise from a carbonate in the crevices of the rock.

The proportion between the lime and uranium may be given as follows:

	Koenig.	Rand, 1.	Rand, 2.
Lime,	56	38	26
Uranium,	44	62	74

10.708 gm. of coated rock, after treatment with acetic acid, yielded to 8 p. c. hydrochloric acid, cold, in about five minutes (the coating having disappeared), .122. On evaporating the solution to dryness there was a residue less than .001 gm. The solution was precipitated by ammonia, in the presence of chloride of ammonium; the solution with oxalate of ammonia gave carbonate of lime, .0365. The precipitate treated with acetic acid dissolved wholly, except .001 of a white precipitate, which contained phosphoric acid, and was probably phosphate of alumina. The solution precipitated by phosphate of soda gave phos. uran., .0711 = U_2O_3 .0569.

		Per cent.
Uranic oxide,	.0569	46.71
Lime,	.0204	16.71
Phos. al?	.001	.89
Undetermined,		35.69
		100.

About 100 grams of the rock, free from the coating, were treated with acetic acid in excess. A large amount of lime was dissolved, and a trace of alumina. The residue, treated with hydrochloric acid, yielded a little silica, some alumina, and considerable lime.

I infer from these tests that the mineral has not the composition obtained by Dr. Koenig, and that further investigation is needed, if pure material can be obtained.

March 24, 1879.

Some Microscopic Enclosures in Mica.—Mr. Theo. D. Rand described, and exhibited under the microscope, certain crystals, etc., included in mica, chiefly from Swain's quarry, Chester Co. Pa.

Of these, the magnetite dendritic markings, and similar markings of red and brown colors, apparently due to oxidation of the magnetite, are most common and best known. Besides these the following occur:—

Hexagonal crystals, black and opaque; angles, 60° and 120°. In the form of the crystal in this description, the form of the section exhibited under the microscope is intended. A similar crystal, brown in color, perhaps the same substance, translucent; probably biotite or lepidomelane.

Hexagonal or rhombic crystals of a bright red color, sometimes with the angles modified; angles 60° and 120°. There are some specimens which indicate the change of the black into the red rhombs. One of the red rhombs contained a black crystal, with faces parallel to those of the red, and one, a very symmetrical and simple crystal, from near Newtown Square, Delaware Co., Pa., was black for about one-fourth its length, the remainder red.

Rhombic crystals, polarizing light, giving very brilliant colors. At first this was supposed to be due to films of the mica itself, but the regularity and brilliancy of the rhombs, compared with the mica, and their angles, seem to render this more than doubtful, the angles being between $73\frac{1}{2}^\circ$ and 78°. They are almost universally accompanied by, and in contact with, the red or black rhombs, and generally both.

Quartz crystals, generally flattened, sometimes very minute, sometimes large enough for the crystallization to be seen with the naked eye; generally masses of crystals, showing distinct crystallization on the edges only, occasionally separate doubly terminated prisms. Some of the specimens with polarized light are very beautiful.

A substance usually presenting the form of disks, $\frac{1}{50}$ inch and less in diameter, showing, with polarized light, a radiation from the centre, and a change of brilliant colors as the analyzer is rotated. Apparently the same material occurs in acicular crystals, often twinned at 60° and 120°, in a plumose form, and in a form closely resembling a section of agate across the layers. Some of these disks appear to be strictly a radiation of acicular crystals from a centre, others to be made up of three or more oval masses; sometimes the latter are separate, or joined two, three, four, or six together, showing apparent twinning at 60° and 120°; these oval masses, with polarized light, take each a single tint at a time. This material was found also in mica from near Newtown Square, Delaware Co., Pa., and from the Junction Railroad, above Girard Avenue, Fairmount Park, associated with rhombs apparently of lepidomelane or biotite, and also with quartz.

On the Bryn Mawr Gravel.—Mr. HENRY CARVILL LEWIS remarked, that since the presentation of his paper on the "Surface Geology of Philadelphia and vicinity," he had been able to extend the investigation then begun, considerably beyond the limits of Philadelphia. The "Upland Terrace" has now been traced continuously from near Trenton, through Bucks, Philadelphia, and Delaware counties, to beyond Wilmington in Delaware. As far as could be judged, the clay comes up to a uniform level along this terrace. It has been gratifying to find that the main characteristics of the different deposits, recorded in the paper referred to, are constant throughout the whole of this region.

The principal difficulty in the work has been want of topographical data. While within the limits of the city, the topographical map of the Water Department had been of great service, but beyond these limits elevations had to be estimated from occasional railroad levels. Topography is an aid in all geological investigations, but in the study of surface geology it is a necessity.

It is now desired to call attention to the great development of the Bryn Mawr gravel in Delaware, and to the indications of its assuming an important position in the geology of the Southern States. In Bucks County, north of Philadelphia, the formation has been recognized but scantily, but as we go south of the city it increases largely in extent. Numerous hills in Delaware Co. have been found to be capped by this formation, and in northern Delaware it covers the gneissic hills in patches several miles long and comes close to the river.

The Upland Terrace, after crossing the Delaware State line about two and a-half miles back from the river, gradually approaches it, until near Bellevue Station, P. W. and B. R. R., its base is but half a mile from the river. It forms the upper portion of Wilmington, and then trends S. E. towards Baltimore, north of the railroad and away from the river. In the neighborhood of Wilmington the Bryn Mawr gravel lies directly upon and back of the Upland Terrace, which is here about 300 feet high. It is abundant to the southeast of Tallyville, Del., covering a large tract of country, and it appears on the hills on both sides of the Brandywine in the neighborhood of Dupont's Powder Mills. It is found on the Philadelphia and Wilmington Turnpike, two miles northeast of Wilmington, and one mile from the river. In many places it is five feet deep, and it seems less eroded than in Pennsylvania. It consists of sharp pieces of Mt. Holly conglomerate and iron sandstone with well-rounded pebbles of quartzite and of Potsdam sandstone, being identical with that of Chestnut Hill and Bryn Mawr.

This formation, so abundant in Delaware, is thus proved to be by no means a local one, and it is probable that it will be identified with some of the formations grouped together under the name of "Southern Drift."

The Bryn Mawr gravel has also recently been found in the Montgomery County limestone valley, and there seems to be a close connection between it and the surface or drift iron ores of that valley. Some of these ores appear to be simply a very ferruginous variety of the Mt. Holly conglomerate. They overlie unconformably the steeply-dipping decomposed shales which hold a more ancient and richer ore.

In Bucks County there occurs a gravel different from any yet described, which at first occasioned some confusion. It has proved to be the result of the decomposition of the lower Triassic conglomerate, the pebbles of which, loosened from their cementing material, have been scattered through the soil. These Triassic pebbles are formed of gneiss, not Potsdam. Hills of red shale border this gravel.

A preliminary map of the Surface Geology of Southeastern Pennsylvania was exhibited, and it was suggested that its publication would be of service to many besides geologists.

April 28, 1879.

On some Enclosures in Mica.—Mr. Lewis exhibited some plates of Muscovite which he had found on Shoemaker's Lane, Germantown, which contained microscopic crystals of peculiar shape. They consisted of a dark green mica, probably Lepidomelane, in minute sharp crystals thickly disposed throughout the muscovite. These crystals were frequently arrow-shaped, and generally much elongated. Large numbers of them were shaped like a musket. They were very different from any of the enclosures in the muscovite of Pennsbury, Del. Co., and were interesting objects under the microscope.

On Dendrites.—Mr. Henry Carvill Lewis made some observations upon dendrites and their mode of growth. He stated that dendrites were not caused by filtration of metaliferous water, but that they frequently grow upward by chemical or capillary action. He described an exposure of white lower Triassic sandstone in a quarry in the southern part of Norristown, where dendrites of oxide of manganese were seen upon the surface of the rock, growing from below upwards. The dendrites were apparently in process of growth, and were so soft that they could be scraped with a knife from the rock. The material thus obtained gave a bright metallic streak on the fingers, and was shown by the blowpipe to be hydrous oxide of manganese. It was observed that while the rock above and below these dendrites was spotted with minute rust-specks of manganese, the portion upon which the dendrites grew was pure white and free from such specks. It seemed that the material of the dendrites is abstracted from the rock and by some segregating force built up into tree-like forms. An examination of their structures showed that the dendrites were quite amorphous and that very frequently the upper extremities of their branches were thicker than the stem portion, as though some concretionary or capillary force acted most powerfully at the growing points. No crystalline structure was apparent, the dendrites being bounded throughout by curved lines. It looked as though they might have grown by a succession of concentric metallic shells.

It was remarked that these dendrites were quite different from those in muscovite and other crystals, which, frequently derived from the substance of the crystal, have been so influenced by its structure as to become often pseudomorphic. It was noted that there are several distinct kinds of dendrites. They may be internal, as in moss agate; or external, as in the case now described. They may also be either crystalline or amorphous. The crystalline dendrites are subdivided into those which have been free to crystallize of their own accord, and into those which have been influenced by the crystalline structure of the mineral in which they exist. Examples of each were cited.

On a Jurassic Sand.—Mr. LEWIS directed attention to a fine sand of considerable extent and depth, which he had found underlying the lower Cretaceous plastic clay. If this clay, as is supposed, is the base of the Cretaceous formation, the sand below it may be of Jurassic age. There is a fine exposure of this sand near Elkton, Md. From its coherence it may be regarded as a fine-grained sandstone. It is either white or pale yellow in color, and about 15 feet are here exposed. Underneath the plastic clay south of Trenton, N. J., the same sand is at least 30 feet deep. It is suggested that, in the absence of fossils to fix its age, it may possibly correspond stratigraphically with the "Hastings sand." The overlying clay contains fossils at Baltimore, which Prof. Uhler identifies as Wealden.

Upon the summit of the same hill, near Elkton, where the above-described sand is exposed, "Bryn Mawr gravel" occurs in abundance. It contains "Mt. Holly conglomerate," and has the same features as in Delaware and Pennsylvania. Whether or not it has any connection with the plastic clay is not known. This same plastic clay, of probably Wealden age, occurs at Turkey Hill, in Bucks County, Penna.

MAY 26, 1879.

Potsdam Sandstone near King of Prussia.—Mr. THEODORE D. RAND called attention to primal (Potsdam) sandstone rocks in the bed of a valley on the farm of Samuel Tyson, South Chester Valley Hill, near King of Prussia, Montgomery County, Pa.

A New Locality for Amethyst.—Mr. W. W. JEFFERIS announced that Amethysts, well crystallized, and of a rich purple color, had been found this spring, for the first time, in the northern part of Newlin Township, Chester County. They were brought to the surface by deep plowing, and were supposed to be derived from a vein of this mineral.

SEPTEMBER 22, 1879.

A New Corundum Locality.—Mr. W. W. JEFFERIS remarked that a vein of blue Corundum, similar to that found in North Carolina, was struck, on the south side of the Serpentine Ridge, in Newlin Township, Chester County, a short time since. The vein is well defined, being between walls of Culsageeite, in large plates of a yellowish green color. Over 500 lbs. of massive blue corundum has been taken out within ten feet of the surface.

The Minerals of Surry County, N. C.—Mr. H. C. LEWIS communicated the following list of minerals which he had found near Dobson, Surry Co., N. C., during a recent visit to that locality:—

Native sulphur, galena, pyrrhotite, pyrite, chalcopyrite, hematite, menaccanite, magnetite, limonite, hausmannite, psilomelane, wad, hornblende, actinolite, asbestos, garnet, talc, steatite, ripidolite, chlorite.

The psilomelane occurred in a bed about 18 feet in thickness.

The magnetite was frequently polar. Native sulphur occurred in cavities in quartzite as a coarse loose powder of rounded wax-like grains, and was the result of the decomposition of pyrite.

It was also stated that rutile occurred in Alexander Co., N. C.—a new locality.

Fossil (?) Casts in Sandstone.—Dr. J. M. CARDEZA exhibited specimens of quartz sandstone (Potsdam?) which he had found lying loose upon the soil at Dutton's Mills, Pa., in which were oblong rounded casts of sandstone, about an inch in length, and similar to one another in shape. It was questioned whether they might not be fossils.

On a Peculiar Stratification in Gneiss.—Mr. THEODORE D. RAND stated that while much of the porphyritic gneiss of the belt running southwest from the Falls of Schuylkill at the surface was in rounded boulder-like masses, which had been mistaken for trap, some of it presents at the surface a thin-bedded structure with, apparently, very distinct stratification. Recently the cut of the Pennsylvania Railroad through this belt, between Merion and Elm Stations, about a mile from the boundary of the City of Philadelphia, has been widened, and on the south side may be seen an interesting section. A mass of the gneiss, perhaps 15 feet across, has been cut through, and almost encircling it may be seen the thin-bedded variety, with its apparent stratification tangential to the mass from which, by decomposition, it evidently was derived. The true stratification of this bed of gneiss appears to be more nearly horizontal and less contorted than that of any of the rocks of the vicinity of Philadelphia.

A New Locality for Lignite.—Mr. HENRY CARVILL LEWIS announced the discovery of lignite, or brown coal, in the limestone valley of Montgomery County, a mile and a-half from the boundary of Philadelphia. He had found it, last June, at Marble Hall, close to the marble quarry, within a few feet of diggings for iron ore. In order to ascertain its extent and geological position more definitely, he had caused a shaft to be sunk 40 feet deep on the property of Henry Hitner, Esq. After passing through 38 feet of decomposed hydromica slate, there was found a stratum 4 feet thick of a tough black fire-clay filled with fragments of lignite. These fragments, sometimes a foot or more in length, lay in all directions in the clay. They had the form of twigs and branches, and, though completely turned into lignite, showed distinctly the grain of the wood. The smaller pieces were generally flattened, and often as soft as charcoal, but the larger ones were quite hard and brittle and had the shining fracture of true coal. It burned with a bright yellow flame. Frequently balls of pyrite occurred with the lignite.

The clay which contained it was underlaid by sand, and appeared to dip south. It had an east and west strike, like that of the limestone and of the iron ores. In appearance it was similar to the sub-Cretaceous plastic clays of New Jersey, which also contained lignite resembling that of Marble Hall. White kaolin and white and red potters' clay occur in the vicinity and are probably of similar age. They are all older than the surface deposits and gravel of the valley.

It was stated that while lignite is not uncommon in the Triassic formation, its occurrence in a Silurian limestone valley is of great interest. Whether referred to Tertiary or Jurassic age, it brings a new geological epoch into this region and revolutionizes our ideas of the age of many of the so-called "Primal" iron ores.

On Serpentine in Bucks County.—Mr. LEWIS called attention to the fact that while serpentine was abundant in Delaware Co., it had not been recorded as occurring anywhere in Bucks Co. He had recently noticed an exposure of it in that county, near the village of Flushing, Bensalem Township. A narrow dyke of hard, impure serpentine here crosses the road near the Neshaminy Creek. He thought that the genesis of serpentine and its relation to the gneissic rocks was still uncertain.

OCTOBER 27, 1879.

THE IRON ORES AND LIGNITE OF THE MONTGOMERY CO. VALLEY.

BY HENRY CARVILL LEWIS.

The discovery of lignite in the iron ore region north of Philadelphia introduces some new considerations in the study of its geology, and has a direct bearing upon the age of its iron ores. Lignite was found in this valley many years ago, but was supposed to be Triassic, and therefore unimportant.[1] Before judging of the connection that the occurrence of lignite in the Montgomery Co. limestone valley will have with the geology of the Atlantic coast, it will be important to enumerate other localities of a similar nature where that mineral has been found.

In his Geology of Vermont, Prof. E. Hitchcock described an occurrence of lignite in a similar position at Brandon, Vt., and proposed a theory which excited much attention, but which has been rejected by many geologists. It was shown that a steeply-dipping stratum of lignite lay within beds of plastic clay, kaolin and iron ore, all dipping steeply southeast. The iron ore deposit was sometimes 100 feet deep, and all these beds rested against a limestone which had the same steep dip. Mottled clays were described as similar to those of Martha's Vineyard and the Isle of Wight, and much of the formation was said to resemble a metamorphosed mica schist. The stratum of lignite was opened from near the surface to a depth of 80 feet, and was used as coal. It proved to be generally dicotyledonous, and to contain twigs and fruits which belonged to a tropical climate, and which Professor Lesquereux referred to a Tertiary epoch, probably Miocene. From this discovery, Prof. Hitchcock proposed the theory that all the limonite iron ores of the Atlantic coast in similar geological positions were Tertiary and of oceanic origin. On the other hand, it was argued that an isolated example was not sufficient to establish such a wide conclusion, and the lignite was regarded as locally formed by having been washed into an existing cavern in the limestone floor.

The next occurrence of lignite is a very similar one at Pond Bank, near Chambersburg, Pa., described in an interesting

[1] *V.* Prof. Leidy, Proc. Acad. Nat. Sci., Phila., 1861, 77.

paper by Prof. Lesley.[1] Here again it was found in a limestone valley close to iron ore excavations. It was at a depth of 40 feet, below strata of clay and sand. According to the superintendent of the mine, it was in two strata, the lowest of which was 18 feet in thickness, and was separated from the upper bed, 4 feet thick, by a stratum of sand. Below it, at a depth of 65 feet, red and white plastic clay occurred. The strata were nearly horizontal. It was thought that the lignite was not necessarily connected with the iron ores, but was a local deposit of late date, made in a shallow pond, and that, as at Brandon, a sink-hole had been formed in the underlying limestone. It was regarded as of the latest Tertiary age.

Lignite has also recently been discovered by Prof. Prime, in Brown's iron mine, at Ironton, Lehigh Co., Pa.[2] He states that it occurs in a white plastic clay, but does not give the depth at which it was found. He believes that it was transported by ice and water in the Glacial epoch, and refers the iron ores of the valley to the same origin.

The writer believes that in the light of facts now developed, this theory of the age of the lignite cannot be maintained. After an inspection of the locality, he has found that the surface-drift and boulders of that valley lie unconformably upon the formation containing the lignite. The lignite lies at a depth of 46 feet from the surface, in a tough plastic clay, which is entirely free from boulders. About 30 feet of potters' clay and decomposed hydromica slate lie upon the lignitic stratum, and resting upon the whole is 15 feet of drift. This surface drift, of yellow brick-clay, boulders, gravel and drift iron ore, is thus of quite different character from the strata below it, and is probably deposited by glacial waters. The underlying formations have, apparently, in some places, a dip like that of the adjacent limestone, and are certainly more ancient than the surface drift.

The lignite recently found by the writer in the Montgomery Co. valley, and described at the last meeting of the Section, occurs under conditions very similar to those above indicated. In immediate proximity both to a limestone outcrop and to iron ore diggings, it was found at a depth of 35 feet, in a plastic clay which contains no gravel or boulders, and which is overlaid by

[1] Proc. Amer. Phil. Soc., ix, 463.

[2] Report DD., 2d Geolog. Survey of Pa., p. 76.

clay and decomposed hydromica slate. A surface drift, containing iron ore, gravel, and occasional boulders, lies unconformably upon the whole formation. The section here presented was made in a shaft which the writer was allowed to have sunk within a few feet of Mr. Hitner's marble quarry, Marble Hall, Montgomery County.

FEET.	
10	"Top dirt," yellow, impure.
$13\frac{1}{2}$	Soft white decomposed hydromica slate or impure "kaolin," containing occasional broken seams of sharp quartzite, but no pebbles.
2	Coarse white sand and rounded pebbles; apparently a decomposed sandstone.
$\frac{1}{2}$	Tough mottled red clay.
7	Blue plastic clay.
3	*Lignite* in a very tough, dark clay.
$2\frac{1}{2}$	Coarse yellow sand, with fragments of stony iron ore and with pebbles.

The lignite bed contains occasional streaks of fine gray sand, and is underlaid by a coarser sand. So far as could be judged from the very limited exposure, it dipped south, at an angle of about 30°; becoming thicker as it dipped. The lignite lies in fragments in the clay, and consists of twigs and branches of land plants, apparently all dicotyledonous. The lignite frequently shows a brilliant black lustre when transversely fractured. The small fragments are more like charcoal, and are often in the form of flattened twigs. Some of these appear to be partially rounded by attrition. No shells or marine fossils occur. Pyrite frequently encrusts the lignite or forms nodules, and when exposed to the air decomposes into ferrous sulphate.

At this same locality, lignite has been taken from three other shafts in addition to the one just described. Two of these are close to the Marble Quarry, but the third is about 400 feet east of these, behind the barn of Mr. H. S. Hitner, who says that it was found many feet below the surface. These facts indicate an east and west strike to the lignitic strata, and an extent of 400 feet in length and 40 feet in breadth. Shafts 100 feet north of these struck iron ore, but no lignite. They exhibited the following succession of strata:—(1) "Top dirt;" (2) Decomposed hydro-mica slate; (3) White clay; (4) Yellow sand ; (5) Iron ore.

Recent explorations have shown that Marble Hall is not the only locality where lignite is found, but that it occurs in a number of other places in the same valley. About a mile and three-quarters west of Marble Hall it was formerly found in a field on the Ridge Road, opposite a house once owned by W. Potts. It was at a depth of about 40 feet. Red and white potters' clay, white kaolin and iron ore are found close to the opening. The lignite at this place is hard, and is said to burn well. Another locality is on the farm of W. Wills, south of Plymouth Creek, about one mile from Conshohocken. Considerable quantities of lignite have been here exhumed, the pieces being often a foot in length. This shaft was opened about thirty years ago, and was probably the locality referred to by Dr. Leidy. Lignite has also been found in a number of iron ore pits south of here and east of Conshohocken. It is said always to occur in fire-clay.

The above localities are all included in a strip of country about two and a-half miles long and a quarter of a mile broad, lying in nearly an east and west direction. The lignite appears to form two distinct, na.row lines of outcrop with a definite E. and W. or E. N. E. and W. S. W. strike,—thus conforming with the limestone. While its dip has not been actually established, the decomposed slates and sandstones of apparently similar age have been observed to dip 40° S. 20° W.

From these facts it would appear that the lignite is not a mere local wash or accidental deposit, but that it is part of a stratified and distinct formation, having a trend like that of the limestone, and of considerable extent; and when the strata in the Montgomery County Valley are compared with those in other parts of the country, it will be seen that we have here to deal with a formation which, closely connected with the limonite iron ores of the great limestone valleys, and having remarkably similar characters throughout, may prove an important feature in American geology.

In entering upon a consideration of the *age* of the lignite, it will be desirable briefly to sketch the geology, and especially the surface geology of the valley in which it occurs.

The underlying rock is an altered lower Silurian limestone, the "Auroral" of Rogers, which in the southern part of the valley is crystalline marble and in the northern part is a sandy magnesian limestone. It has an E. and W. strike and a steep south dip, and is supposed to have an inverted synclinal structure. The limestone rises to the surface in a series of parallel ridges, and between these lie the iron ores and the lignitic strata. Bounding the valley are hills of altered shale of probably Potsdam age. Beyond this line of hills to the north, are the Triassic red shales and sandstones, while to the south is the Philadelphia gneissic district. In many places the North Valley Hill has been eroded away and Triassic strata lie directly upon the limestone.

The iron ores of this region probably belong to four different geological ages, and may therefore be divided into four classes.

1. Gneissic Ore. This ore, never found in the valley, occurs in the gneissic rocks of Chester County north of the Chester Valley, and has been formed in place from the altered gneiss. It dips with the gneiss, and is generally accompanied by scales of graphite. Prof. Rogers[1] supposed that this ore belonged to isolated patches of Triassic red sandstone. The writer, however, has not been able to confirm his sections, nor to show the presence of any more recent formation than the gneiss.

2. Primal Ore. The hydromica slates which lie between the Potsdam sandstone and the limestone liberate, when decomposed, a rich limonite ore which is largely mined in portions of the valley. Although in very irregular beds, a steep dip can be recognized. It is perhaps derived from the decomposition of pyrite. This is probably the ore mined at Edge Hill.

3. Tertiary Ore. This ore, associated with which are the deposits of lignite, plastic clay, kaolin, fire-sand, etc., has been hitherto confounded either with the Primal ore or with the Drift ore of the valley. In that part of the valley under discussion there are three distinct lines of outcrop of this ore, having nearly an E. and W. trend. A ridge of limestone separates two of these lines. The ore lies, sometimes at a great depth, below a re-stratified decomposed hydromica slate. This latter formation is almost identical in appearance with the decomposed Primal slate in place

[1] Geol. of Penna., I, 87.

at the edges of the valley, and has therefore been mistaken for it. The discovery of lignite below it proves its re-stratification in a later age. In many places shafts have been sunk over 100 feet without coming to the limestone. The ore, originally derived either from the limestone or from the primal slates, appears to lie below the lignitic strata.

4. Drift Ore. Resting often unconformably upon these last, and capping the elevations throughout the valley, is a drift deposit of gravel and boulders containing a workable iron ore. The composition of this drift is most interesting. Its boulders, almost without exception, are composed of a loose-grained Potsdam sandstone,—a formation not now existing either on the North or South Valley Hill at this place, and found only in a limited exposure at the eastern end of the valley. The *Scolithus linearis* is frequently found in these boulders. Moreover, notwithstanding the large extent of Triassic red shale and sandstone immediately to the north of the valley, and the occurrence of that rock resting often directly upon the limestone, not a trace nor a fragment of Triassic rocks have been found in this drift.

The evidence is here strong that this drift has not been caused by any flood from the north in a modern age. Additional evidence bearing upon the same point is found in the fact that the Triassic region north of here is absolutely free from drift of any kind. A careful study by the writer of much of that region has shown that not a single drifted pebble is there found. The soil is formed from the rocks below it, and such clays as occur are bog clays of local origin and recent age. That the pebbles of the valley drift have not been derived by weathering from the neighboring lower Triassic conglomerate, which holds often large pebbles, is shown by the fact that such pebbles are here formed entirely of gneiss or gneissic quartzite, and never of Potsdam, and therefore are quite different from those in the valley.

The drift ore and gravel does not lie in hollows, as though locally washed, but is found in patches upon the elevated portions of the valley, as though it were the remnant of a once continuous deposit.

The facts above enumerated suggest a possible origin at an age when cliffs of Potsdam sandstone, since eroded away, stood as a high barrier between the limestone valley and the Triassic rocks north of it. Such a barrier would effectually prevent Triassic fragments from mixing with the drift of the valley, and would, during its degradation, offer the material for the pebbles and boulders of that drift. In Triassic times some such barrier may have formed the southern shore of the Triassic waters. It has been interesting to discover that most of the pebbles belonging to the sub-Cretaceous plastic clays of the Delaware are formed of Potsdam sandstone, and that therefore during lower Cretaceous times also, some such mountain of Potsdam must have offered itself to eroding agencies. Again, it is found that Tertiary gravels, both in Pennsylvania and New Jersey, contain an abundance of Potsdam pebbles. The hypothesis that the materials for the sub-Cretaceous plastic clays and the Tertiary gravels were furnished by hills now sunk beneath the Atlantic Ocean [1] is not sustained by what is known of the configuration of the sea-bottom. The theory now offered is supported by numerous facts concerning the power of erosion, which geological considerations in other fields have presented.

In a former paper on "The Surface Geology of Philadelphia and vicinity," the writer showed that, in addition to the clays, four separate gravels of different ages can be distinguished in that region. These are (1) "The River Gravel," the newest of all the gravels; (2) "The Philadelphia Red Gravel," of Champlain age; (3) "The Fossiliferous Gravel," recently proved by the writer to be of upper Tertiary, perhaps Pliocene age, and now called the "Glassboro Gravel;" (4) "The Bryn Mawr Gravel," the oldest of the gravels, also oceanic, and conjectured to be of upper Miocene age. This last gravel, and this only, agrees in its characters with the valley drift now under consideration. In the absence of all Triassic fragments, in the presence of Potsdam boulders, and in the amount of erosion, these two gravels are identical, and it seems probable that the "Drift Iron Ore" of the one is only a very ferruginous variety of the "Mt. Holly Conglomerate" of the other. This being the case, we have here a formation which, notwithstanding its boulders, suggestive of floating ice, appears to be older than an oceanic Pliocene gravel. There is perhaps no good reason why a glacier might not have existed in upper Tertiary times, boulders formed by which may still be found. However this may be, it appears that there are strong grounds for assigning an upper Tertiary age to the drift ore and gravel of the Montgomery County Valley.

Returning, finally, to the lignite and associated strata, shown to

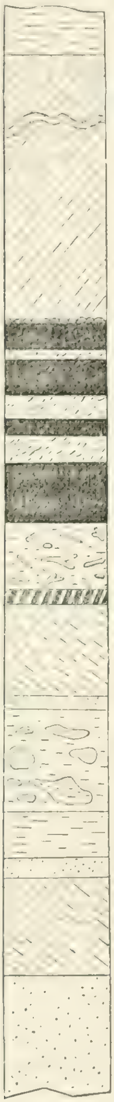
[1] Report on Clay Deposits of N. J., 1878, pp. 20.31.

be older than the formation just described, and shown by its own characters to bear no trace of glacial agencies, we may conjecture, without any reference to the plants of the lignite, a middle or lower Tertiary age. From the steep dip of the beds,—a fact difficult to explain,—and from the great resemblance of the plastic clays to those in New Jersey, on the Delaware, the writer at first supposed them to be of Wealden age. Some facts in connection with a gravel found in Virginia and other Southern States, which, in both appearance and position is very similar to the Bryn Mawr gravel, were at first thought to indicate a Jurassic age. But after a comparison with the other lignite localities, and especially with that at Brandon, where the fossils were shown to be of Tertiary age, this view can hardly be sustained. The absence of shells or marine plants indicates a period of inland waters, and the plants at Brandon belong to a tropical climate.

It is now suggested that the period of the lignite may correspond most closely with that called by European geologists the Oligocene. Since, in the present state of our knowledge, it is obviously unsafe to make the age of these lignite deposits contemporaneous with any exact geological epoch, and as there is a possibility of their belonging to some period not recognized elsewhere, it will probably be wiser for the present to group them together under the name of *The Brandon Period.* As more facts develop and wider comparisons can be made, more certain conclusions will be possible; and it must be understood that the theories here proposed are brought forward only as those which now appear best to explain the facts observed.

Postscript.—Since the presentation of the above paper, the writer has been in correspondence with Prof. N. A. Bibikov, of Augusta, Georgia, who has recently discovered lignite in that vicinity. The locality, called "Read's Brown Coal Mine," is in Richmond County, two and a-half miles from Berzelia, and sixteen miles from Augusta. It is described as lying back of the outcrops of gneiss and limestone, and is apparently in a very similar geological position to the Pennsylvania locality. Iron ore, plastic clay, kaolin, and decomposed sandstone occur with the lignite. As in Pennsylvania, the lignite was found in a plastic clay beneath 25 feet of a decomposed sandstone. Four strata of lignite, separated by layers of shale and clay, were found at a depth of from 30 to 45 feet from the surface. A series of coarse and fine sands and clays underlaid these deposits and were penetrated to a depth of 95 feet.

Three different shafts were sunk, the extremes being 600 feet apart, in all of which lignite was found. The shaft in which the following section was made is about 150 feet from an outcrop of hornstone and quartzite, and 300 feet from a creek which lies 200 feet below it.



4	Mottled clay.
	Decomposed sandstone.
	Crust of iron sandstone and spathic iron.
24	Decomposed sandstone with thin layers of clay.
	Nodules of pyrite.
2	Lignite.
1	Shale and clay.
3	Lignite.
2	Shale and clay.
1	Lignite.
3	Shale and clay.
5	Lignite.
6	Light-colored shale with fossil plants.
1	Dark-colored (bituminous) shale.
8	White clay with streaks of rose-color, etc.
1	Sandy clay.
9	Ferruginous coarse sand with nodules of clay iron-stone, 4 inches to 2½ feet in diameter with ochre, clay, etc., and quartz pebbles sometimes 3 inches in diameter.
4	Light-colored shale.
2	Yellowish sand.
8	Sandy clay.
11 +	White, very fine micaceous sand with clay.

The second stratum of lignite is the best, and contains fragments of lignite sometimes three feet long. A number of fossil plants have been found in this and other layers. Some specimens were imbedded in a layer of brown sandstone. The fossils appear to be fragments of trees, grasses and other land plants, none of which, however, were sufficiently perfect to be determined. No shells were found.

The whole section at Berzelia is remarkably similar to those at Brandon, Chambersburg, Ironton and Marble Hall, and with them indicates the existence of a great inland fresh water Tertiary formation in Eastern America, during the Brandon Period, once fifty miles broad and nearly a thousand miles long.

An Enclosure in Quartz.—Mr. H. C. Lewis exhibited a crystal of quartz from Herkimer County, N. Y., in which, hanging from a bubble which moved in a cavity containing liquid, was a tuft of minute acicular crystals of a pure white color. A microscopical examination had failed to identify them with any known substance. The crystals were similar to those of many organic salts. It was conjectured that they had crystallized out from the liquid. Under a power of 75 they looked like tufts of white wool, and it was suggested that if future investigation failed to refer them to a known mineral species, it might be convenient to give them the name *Erilite* (from ἔριον, wool).

In other cavities in the same crystal there was an amorphous yellowish-brown waxy substance of unknown composition.

Menaccanite and Talc from Maryland.—Mr. Wm. W. Jefferis remarked that in Harford County, Md., near the village of Dublin, there is a vein of green foliated *Talc* in the serpentine, which has been opened about 6 feet in length. It has furnished cleavage foliated specimens over a foot in extent. The same vein contains *Menaccanite* in tabular crystals, well crystallized. Yellow beryl has also been found there, showing all three in the same specimen.

Sunstone in Labradorite.—Mr. Jefferis stated that on examining a specimen of Labradorite in his possession, from the coast of Labrador, he found that in addition to the usual play of colors (blue and green), by turning it in another direction it showed innumerable crystals of göthite, making it a beautiful sunstone, which, he believed, was an unusual thing, and which he had not found mentioned in the books.

On a Probable Pseudomorphism of Gummite and Uranotile after Uraninite.—Dr. A. E. Foote remarked that among a number of specimens of gummite and uranotile, that he had recently received from Mitchell Co., N. C., he noticed some which were of remarkably regular form. The edges were slightly rounded, but they were apparently simple prisms belonging to the triclinic system. On breaking these open he found a solid core of uraninite, surrounded by a layer of gummite, and this, in turn, surrounded by a layer of uranotile. Although crystals of uraninite have never been observed, he ventured to suggest that this is plainly a case of pseudomorphism after uraninite. He hoped hereafter to obtain crystals whose angles can be accurately measured.

He had observed at least twenty specimens having evidently the same crystalline form, and all plainly pseudomorphs after some pre-existing crystal. The majority of those that were broken open showed the alteration of uraninite into gummite, and of gummite into uranotile; though in a few the uraninite had been changed, and the crystal showed simply gummite and uranotile.

NOVEMBER 24, 1879.

ON A NEW FUCOIDAL PLANT FROM THE TRIAS.

BY HENRY CARVILL LEWIS.

The fossil described here as *Palæophycus limaciformis*, *sp. nov.*, is from a very beautiful and well-defined specimen, casts of which stand out in relief upon a slab of Triassic sandstone. It was found by the writer near Milford, New Jersey, in upper Triassic strata. Its general facies is like that of some species of *Palæophycus* and *Astrophycus* of the Carboniferous age, and of *Buthotrephis* of the Clinton group, and it belongs to the same order of plants—that of the fucoid or marine algæ. The general, rather than generic name of *Palæophycus*, which is quite as indefinite as that of *Fucoides*, is well applicable to it.

The frond is cylindrical and jointed. The ramuli, or short branches of the frond are fleshy, tubular, elongated bodies of about an inch in length. They are spindle-shaped, attenuate, and more or less curved at both ends. They are very frequently aggregated in bunches of three or more, radiating from a common point of growth, and are generally detached from the main frond. The form of these bodies is characteristic of the plant, being distinctly *snail-shaped;* hence its specific name, "*limaciformis.*"

Nat. Size.
Palæophycus limaciformis Lewis, sp. nov.

At the locality where it was found there also occur specimens of ripple-marked sandstone, also of rain-prints and mud-cracks. These show the physical conditions under which the plant grew—that of mudflats in shallow water frequently left exposed to sun and rain. The rain-prints have been compared with modern rainprints made in mud, and their great similarity noticed. One specimen of a fucoid found here has apparently been so confused and distorted by the beating of a heavy rain-storm that its structure can scarcely be recognized.

Fucoids of somewhat similar appearance have been described from more ancient geological horizons, but not, so far as can be learned, from the Trias. The occurrence of a plant which has the characters of marine algæ in a formation supposed to have been deposited by fresh water is interesting.

Postscript.—Since the above paper was presented, a photograph of this fossil has been sent to Mr. Leo Lesquereux, the distinguished paleobotanist, who, in a letter to the writer, says: "Your plate represents what I consider a new species of *Palæophycus*, whose analogy is with *P.* (species undetermined) Hall, Paleont. of N. Y., vol. i, Pl. 70 (Hudson River group); also distantly related to *Fucoides auriformis* and especially *F. heterophyllus*, same author, l. c., ii, Pl. 3, figs. 3, 4. You may also find a kind of analogy to what Hall considers and figures as roots or also as stems of some marine plants, same vol., Pl. 8, figs. 4, 5, and pl. 9, fig. 4, and also pl. 10, figs. 5, 7 (all Clinton plants). The type is evidently old, rather Devonian, even upper Silurian. European authors have nothing like this from the Trias, Jurassic, Cretaceous or Eocene."

The Northern Belt of Serpentine in Radnor Township.—Mr. Rand made the following communication.

Some time ago, in a communication to the Academy, (Proc. Ac. N. S., 1878, 402) I described a belt of serpentine in the valley of the Gulf Creek, Radnor Township, Delaware Co., Pa. Recently a trench for water pipe on the property of Judge Hare has enabled me to procure specimens illustrating a section across the bed and on both sides of it, which are presented herewith. The section is on a line nearly N. 75° W. The belt is probably not far from N. 70°–73° E., or about two-thirds that of the section, but this is not certain. While deductions from these few specimens would not be safe, yet the strong resemblance between the decomposed gneiss of the easternmost exposure and the clearly magnesian rocks 40 feet distant, points more to an alteration in place than to a distinct bed.

Garnet mistaken for Corundum.—Dr. J. M. Cardeza called attention to a garnet rock at Chelsea, Delaware Co., Pa., which is quarried and used as corundum.

THE TRENTON GRAVEL AND ITS RELATION TO THE ANTIQUITY OF MAN.

BY HENRY CARVILL LEWIS.

In the course of an investigation of the Surface Geology of Southeastern Pennsylvania, some facts have been developed in connection with one of the gravels, which, bearing directly upon the Antiquity of Man in America, become of great interest. Among the many scientific problems now attracting attention, none perhaps holds a more prominent position than that of the Antiquity of Man. It is a subject which, notwithstanding the numerous facts gathered and the bulk of literature published, must be regarded as still in an undecided condition.

As the Delaware is in many respects a typical river, and as therefore deductions made here will hold good for the valleys of many other rivers of the Atlantic coast, it is thought that a record of the investigation will be of more than mere local interest. The subject will be approached from a purely geological standpoint. The main difficulty in inquiries of this kind has been the absence of exact geological data. Hasty conclusions have been drawn from an inspection of relics found in a gravel, which a more accurate knowledge of the age of that gravel would not have sustained.

The writer has shown in former papers [1] that the gravels of the Delaware Valley belong to several distinct ages; and if therefore at any place the remains of man are shown to occur, it will be all important to know to which of these gravels they should be referred.

The surface formations of Southeastern Pennsylvania may be divided into five clays and four gravels. The following is believed to be the succession in which they occur, beginning at the oldest: (1) Jurasso-Cretaceous plastic clay; (2) Tertiary clays, ("Brandon Period"); (3) Bryn Mawr gravel, (upper Tertiary); (4) Branchtown clay; (5) Glassboro gravel, (Pliocene); (6) Philadelphia red gravel, (Champlain); (7) Philadelphia brick-clay, (Champlain); (8) Trenton gravel, ("Eskimo period"); (9) Recent alluvium. Of clays, the oldest is the Jurasso-Cretaceous plastic clay exposed at Turkey Hill, Bucks Co. A similar plastic clay,

[1] "The Surface Geology of Phila. and vicinity." Proc. Min. and Geol. Section, Acad. Nat. Sc. Phila., Nov. 1878.

which, however, may be of later age, has been passed through by artesian wells in the southern part of Philadelphia. The next oldest clay appears to be the potters' clay of the Montgomery Co. limestone valley, which, containing sometimes lignite, and overlaid by kaolin, decomposed hydromica slate, etc., belongs with its associated limonite ores, to an inland Tertiary formation, the "Brandon Period," possibly of Oligocene age.[1] A third clay, the "Branchtown clay," found at high elevations in a few places in the gneissic region, containing occasional boulders, was made at a period of general submergence and appears to be of a late Tertiary age. The "Philadelphia brick-clay" of more recent formation, of large extent, and with numerous boulders, is confined to the river valley. This clay, deposited at the close of the Glacial period by the waters resulting from the melting of the great Northern Glacier, rests against the rocky "upland terrace" at a height of about 150 feet above the present river. The fifth and newest clay is the recent bog clay or mud in the flood-plain of the river, still in process of formation.

The gravels are distinguished from one another both by their composition and by their relative hypsometrical positions. The "Bryn Mawr gravel"—the oldest gravel of consequence in this region—is readily distinguished from others by the peculiar materials composing it, and is also known by being found at high elevations (400 feet), in often isolated patches, capping the gneissic hills. It is characterized by absence of fossiliferous or Triassic pebbles and by the presence of an iron conglomerate, and is of oceanic origin, and probably upper Tertiary age.[2] A similar gravel occurs on the heights of Georgetown, D. C. The next oldest gravel, also oceanic, and which here occurs at lower elevations than the last, the writer called in a former paper "The Fossiliferous Gravel." It frequently contains pebbles formed of Niagara limestone and other fossiliferous rocks, and has been found abundantly in New Jersey as well as in Pennsylvania. It is well exposed in the railroad cut at Ridley Park, Del. Co. It is the yellow gravel which caps the watershed between the Atlantic and the Delaware at a height of nearly 200 feet, and is now named for distinction "The Glassboro gravel." Its pebbles are frequently

[1] *V.* "The Iron Ores and Lignite of the Montgomery Co. Valley," by the writer. Oct., 1879.

[2] *V.* "On the Bryn Mawr Gravel," by the writer, Mar., 1879.

weather-worn and eaten by age, and have thus a much more ancient appearance than the smooth, fresh-looking pebbles of later gravels. It contains no boulders of consequence and is believed to be of Pliocene age.

Lying at a lower level, within the Glassboro gravel, and formed of a mixture of its pebbles with others brought down the Delaware valley, is a third gravel—the "Philadelphia red gravel." This, like its overlying brick-clay, is confined to the river valley. It is distinctly stratified; it contains numerous fragments of Triassic red shale and of gneiss, and smooth boulders of Silurian rocks; it shows flow and plunge structure and wave action on a large scale; and like the older gravels, it rests upon a decomposed gneiss, which is sometimes interstratified with its lower layers. There are numerous exposures near the University of Pennsylvania. The writer has identified it on the Potomac and other rivers, and it appears to belong to the age of the melting glacier—the Champlain epoch.

The last and newest of all the gravels is one which, at Philadelphia, seemed to be of little importance. It lies close along the river, and rising a few feet above it, extends but a short distance back from the river bank. It covers the flat ground of Camden and the lower part of Philadelphia, and forms islands in the river. It was called *The River gravel and sand*. It is this alluvial gravel, the latest, except the recent mud-flats, of all the surface formations, which is the subject of the present paper, and which, from its great development farther up the river, is now named *The Trenton Gravel*. It is in this gravel, and in this gravel only, that traces of man have been found.

The Trenton Gravel at Philadelphia is composed principally of a sharp micaceous sand, which, when below water-level, becomes a "quicksand." Gravel lies below the sand. Unlike all the other gravels, it contains but few pebbles of white quartz, and is of a dark gray color. Its pebbles are made exclusively of the rocks forming the upper valley of the river. Their shape is also very characteristic. The pebbles of the older gravels are oval or egg-shaped, but these are for the most part flat. This flat shape is characteristic of all true river gravels. At several places along the Delaware, gold has been obtained from this gravel. The absence of clay in any of its layers indicates the action of swiftly-running water. Data obtained from artesian wells have shown that this formation has a depth on Delaware Avenue, Philadelphia, of about 50 feet, and that it extends up to about Third and Market Streets. On Smith's Island and on the bar in the river opposite Cooper's Point, it is 100 feet deep, lying upon rock. It therefore underlies the river, filling up its ancient channel. On Richmond Street some very large boulders are seen lying upon the sand.

On tracing the Trenton gravel up the river, it is found to be confined to its immediate vicinity, and that, from Philadelphia to the Neshaminy Creek, its boundary is generally between the line of the Pennsylvania Railroad and the Delaware. From this point the bounding terrace trends directly towards Morrisville and away from the present river. Thus, at Bristol, the gravel and its overlying sand extends two miles back from the river, and is bounded by a well-marked hill, upon which lie the older gravel and brick-clay of Champlain age. These and the Tertiary gravels extend nearly seven miles inland. At Tullytown the Trenton gravel extends two and a-half miles back, and at the canal shows the following succession of strata: (1) sandy loam, 1 foot; (2) fine gray "moulding-sand," $2\frac{1}{2}$ feet; (3) sharp "bar sand," 1 foot; (4) clean gray river gravel of unknown depth. In other openings near here the gravel is so full of boulders that these are dug in large quantities and sent to Philadelphia for "cobble-stones." Near Wheatsheaf Station, close to the railroad, an opening which has exposed a section of the Trenton gravel nearly half a mile in length, exhibits well the general features of the formation. The pebbles, of characteristic shape and color, are made of gray Triassic argillite, slate, red shale, sandstone, conglomerate, and various other rocks found farther up the valley, while large and often sharp boulders of red shale and other materials frequently occur. The whole formation has a very fresh appearance when compared with older gravels. Near Turkey Hill a large smooth boulder, five feet in diameter, lies upon the sand.

At Morrisville the narrower portion of the valley begins, and from here up, the river flows on a rocky bottom, and the gravel is shallow and is confined to the immediate vicinity of the river. The older gravels of oceanic origin continue across New Jersey and do not appear above Yardleyville. The Philadelphia red gravel is no more seen, but the brick clay with its boulders occasionally appears part way up the steep hills enclosing the valley, and is abundant in the side valleys formed by tributary streams.

Above Yardleyville, therefore, we have to deal with but two surface formations,—the boulder-bearing brick clay, often much eroded, and the Trenton gravel, confined to the bottom of the valley and showing but little erosion. It will be well to bear in mind the distinction between these two formations,—the one of glacial, the other of post-glacial age. The writer has traced them as far up as the Water Gap, past the great terminal moraine into glaciated regions. It is interesting to note that while the modified moraine material close to the river at Belvidere is in some points similar to the Trenton gravel, and is the source of part of that formation, the moraine on the Lehigh River at Stemton and at other inland localities contains pebbles and boulders very similar to those of the Philadelphia brick-clay.

Throughout the whole course of the Trenton gravel it is observed that it lies within a channel previously excavated down to the rock through the boulder-bearing brick clay and its red gravel, which, as shown in a former paper, belong to the Champlain epoch. The Trenton gravel is therefore, later than the Glacial and Champlain epochs; and this is a fact which, when considered in connection with the human relics found in this gravel and the consequent antiquity of man, it will be most important to remember.

Having now sketched the character and position of the Trenton gravel along the Delaware valley, we are prepared to examine the formation as exposed at the locality whose name we have chosen to distinguish it.

Trenton is in a position where naturally the largest amount of a river gravel would be deposited, and where its best exposures would be exhibited. It is at the point where a long, narrow valley with precipitous banks and continuous downward slope, opens out into a wide alluvial plain at a lower level. It is here that the rocky floor of the river suddenly descends to ocean level and even sinks below it, forming the limit of tidewater. Thus any drift material which the flooded river swept down its channel would here, upon meeting tidewater, be in great part deposited. Large boulders which had been rolled down the inclined floor of the upper valley would here stop in their course, and all be heaped up with the coarser gravel by the more slowly flowing water except such few as cakes of floating ice could carry oceanward. On the other hand the finer gravel and sand would be deposited farther down the river.

This is precisely what occurs at Trenton. The material, which at Philadelphia is generally fine, grows coarser as the river is ascended, until at Trenton we find often immense boulders imbedded at all angles in the gravel. Moreover, the river has here cut entirely through the gravel down to the rock, exposing at one place a cliff of gravel 50 feet high. At Philadelphia, on the other hand, as we have seen, the river still flows on the top of the gravel. This fact may also be accounted for. Having heaped up a mass of detritus in the old river channel as an obstruction at the mouth of the gorge, the river, so soon as its volume diminished, would immediately begin wearing away a new channel for itself down to ocean level. This would be readily accomplished through the loose material, and would be stopped only when rock was reached. On the other hand, that gravel which had been deposited at places farther down the river where its bottom was below ocean level, would remain un-eroded or nearly so. When the river had attained the level of the ocean there would be no occasion to cut a deep channel, and it would therefore flow on top of the gravel which it had deposited. It is necessary that this point should be understood, as other geologists have brought forward various theories to explain the high bank of gravel at Trenton. The fact of the river having cut through the gravel at Trenton, while at Philadelphia it flows upon it, is due to the configuration of the rock floor of the river, which at Trenton rises above ocean level, and at Philadelphia lies nearly 100 feet below it.

In addition to the exposure upon the river bank, where the whole depth of the formation is seen, the long railroad cuts made by the Pennsylvania R. R. at Trenton, afford excellent sections of the gravel. It exhibits the distinctive characteristics of a true river deposit, and is very different from the gravels which are found at higher levels. It contains no clay; its pebbles are made of the rocks of the river bed and are flattened, and the stratification of the whole deposit is well seen in the alternations of sand and gravel. It extends several miles back from the present river, covering the low ground along the Assunpink Creek, and indicating the existence here of a former bay or arm of the Delaware. This bay was shaped somewhat like a horseshoe, which had one extremity in Trenton at the hill above the canal, and which washed the base of the hill north of the Assunpink Creek, and, extending about three miles back from Trenton, and sweeping around the "Bear Swamp," had its other extremity near the house of Dr. C. C. Abbott, below Chambersburg. This village was under water. Another bay extended up the valley of Crosswicks Creek. Boulders of Champlain age lie upon the Tertiary gravels which form the ancient bank.

From the extent of the Trenton gravel in this vicinity, statements have been published that it covered the whole southern part of the state, and that at the time of its deposition the Delaware River emptied into the ocean at Trenton. It is evident that the distinction between the very different gravels of this region has not been perceived. Careful examination will show the great dissimilarity between the Trenton gravel and such gravels as occur at Princeton Junction and interior New Jersey, which are in great part of Pliocene age, and will prove that it is confined to the ancient river bed.

The presence of very large boulders on the river bank at Trenton has led some geologists to suppose that the formation was a glacial moraine. The occasional though very rare examples of scratched pebbles and polished boulders, which the flood had evidently carried down from the moraine material north of Belvidere, have been brought forward as supporting this theory. Yet the absence of till and of angular masses of rock, and generally of materials foreign to the Delaware Valley, when regarded in connection with what we have shown to be the general characters of the formation, can not be explained upon this theory. The character of the river banks along the valley render the presence of a glacier at Trenton extremely improbable. These show no marks of glacial action. We have, moreover, already shown that the Trenton gravel is more recent than the deposits of Champlain age, and that, lying in a channel cut within them, it is the most recent of all the gravels. Clearly the Delaware Valley and the channel of the river were excavated in a time previous to the deposition of the Trenton gravel. The channel subsequently having been filled up by this gravel, the diminished river still later has cut a new channel either completely through it, as at Trenton, or partially, as at Philadelphia. It is probable that slight undulations of the level of the coast have aided in producing these changes.

Before describing the human relics found in the Trenton gravel, there are several facts bearing upon its origin and age which it will be well to consider.

It has been noticed that from Trenton to Philadelphia the creeks flowing into the river Delaware have a steep south bank, while the ground north of the creek is flat. The writer finds that the flat ground north of the creek is made of Trenton gravel, while the southern bank is made of older formations which have been formerly cut away by water action coming from the north. Thus, the steep south bank of the Neshaminy is made of "Philadelphia red gravel" of Champlain age, while a flat plain of Trenton gravel lies south of the creek. The same configuration of the banks of creeks on the New Jersey shore has been noticed by Prof. Cook. By assuming that the river at the time of the deposition of this gravel was of larger volume than now, this fact is of ready explanation. The southern bank of the creek, often of Cretaceous or Tertiary strata, in each case formed the shore of the ancient river, and was worn away into a steep bank by the flood from the north. Similar in cause and effect are the present banks of the Delaware, which are steep on the outside of each curve of the river, and flat and covered with recent alluvium on the inside.

Another fact showing river action is the frequent occurrence of exposures of "flow and plunge structure" in this gravel. In these the layers are seen to dip up stream, as would be expected by downward flowing water. It is interesting to find, on the other hand, that the same structure in the Tertiary gravels, both of Pennsylvania and New Jersey, shows layers dipping southeast, as though deposited by incoming oceanic tides.

Another instance of the fluviatile character of the Trenton gravel is found in the peculiar topography which it sometimes exhibits. Frequently, instead of forming a flat plain, it forms higher ground close to the present river channel than it does near its ancient bank. Moreover, not only does the ground thus slope downward on retreating from the river, but the boulders become smaller and less abundant. Both of these facts are in accordance with the laws of river deposits. In a time of flood the rapidly flowing water in the main channel, bearing detritus, is checked by the more quiet waters at the side of the river, and is forced to deposit its gravel and boulders as a kind of bank.

In determining the comparative age of the Trenton gravel, a guide may be found in the amount of its erosion. In this respect a marked contrast exists between this and more ancient gravels. Unlike the land covered by older surface formations, that covered by the Trenton gravel is remarkably level and free from hillocks or ravines. The change in topography may be well seen in the neighborhood of Trenton, and can be noticed almost anywhere along the valley. This fact alone would indicate a more recent age than that of the clays and gravels of the Champlain epoch. This difference is much more marked when comparison is made with the oceanic gravels.

The actual time necessary for the Delaware to cut down to the rock through 50 feet of this gravel at Trenton is by no means great. Numerous facts have been adduced by geological writers and by engineers to show how rapidly a stream of water can wear through loose gravel material. When it is noted that the gravel cliff at Trenton has been made, not by a straight downward cut, but by a side wearing away as at a bank, and when it is remembered that the erosive power of the Delaware was formerly very much greater than it is now, it will be conceded that the presence of the cliff at Trenton will not necessarily infer its high antiquity. From what is known of the action of running water upon gravel, it is thought that the time necessary to produce the erosion now observed might be reckoned by hundreds rather than by thousands of years. While the gravel was of course formed in a previous time, the rapid action of the flood which deposited it, shown in many places by the character of the gravel, indicates that the time necessary for its deposition need not have been long.

Having now shown that the Trenton gravel is a true river deposit of modern age, it will be of interest to inquire how such a flood as we have proved to exist could have originated. No flood within the historical epoch has been known to at all approach in magnitude that which deposited the Trenton gravel. No boulders of the size found in and upon that gravel are ever carried down the river by recent ice-cakes. In fact, at Trenton and below, the boulders of this gravel are often much larger than any in the Champlain gravel of that part of the valley.

We have seen that at the time of the Trenton gravel flood, the lower part of Philadelphia, the whole of Bristol and Tullytown, and almost all of Trenton were submerged. That the climate was then cold is indicated not only by the suggestion that there were then probably very large masses of boulder-bearing ice floating in the river, but also by the fact that, as the writer is informed by Dr. C. C. Abbott, bones of Arctic animals (walrus, reindeer, mastodon), often rounded by attrition, have been found in this gravel. Although the Trenton gravel has none of the features of a moraine, it is true that the cliff at the base of Riverview Cemetery, holding immense boulders, has the appearance of having been deposited by glacial waters. At other places, the boulders resting upon the sand overlying the gravel suggests the grounding of large ice-cakes derived from some mass of ice large enough to be called a glacier.

It is difficult to imagine an origin for such a flood as we have described other than the melting of a glacier. We have shown that the flood was not an inroad from the sea, but that it came down the valley. No rain-storms of modern experience could have supplied such an amount of water. To call the time of this flood a "Pluvial Epoch," will be of little assistance, since no origin for such extraordinary rains is suggested, except under a very different climate, or by evaporation from a melting glacier.

Yet such a glacier cannot be the great glacier of the Glacial epoch. That was the glacier which in its melting deposited the brick-clay and red gravel which we have shown to be much older than the Trenton gravel. It must have been, if a glacier at all, another and more recent one whose melting caused the flood which formed this gravel. This last glacial flood flowed in a channel excavated through the deposits of the first glacial period.

It appears, then, that there is evidence of a *Second Glacial Period*—a period in which was deposited the last of the gravels, and which has but lately passed away. From the limited extent of its deposits it is inferred that the second glacier was much smaller than the first, and that its southern extremity was confined to the valley. A second glacial period is recognized in Europe under the name of the *Reindeer Period*.

It is thought that the hypothesis of a second and more local glacier, long subsequent in age to the first great glacier, will explain all the facts observed. The Trenton gravel cannot be assigned to the first glacial period except by assuming that there have been no river gravels deposited since that time;—an assumption which can hardly be maintained. Some European archæologists have held that the *Palæolithic Era*, the era of the river gravels, is antecedent to the *Reindeer Period*, the period of the cave-men. No such distinction has been observed on the Delaware. Should future researches show that a separate and second glacial epoch cannot be proved in America, the facts here observed will indicate a much more recent date for the disappearance of the great glacier than has been assigned to it. The period of the Trenton gravel flood, whether contemporaneous with a glacier or not, is the period of the last geological deposits here known; the recent mud-flats being alone excepted.

We have now glanced at the characters of the Trenton gravel, and have indicated, so far as the facts at hand allow, its position, origin, and relative age.

It is in this gravel that the writer's friend, Dr. Charles C. Abbott, of Trenton, has made the interesting discovery of stone implements of human workmanship, which, in their shape and characters, are quite unlike those of the Red Indians of the Atlantic coast.[1] He has found them imbedded at various depths in the apparently undisturbed gravel of the cliff at Riverview Cemetery and in other places near Trenton. They are of palæolithic type, and differ from Indian stone implements by being larger, ruder, and made from a different material. They are composed of gray argillite, a rock which is found in place farther up the river, and which is a Triassic shale altered and hardened by the heat from adjacent trap dykes. They occur in positions which render it extremely probable that they belong to the same age as that of the deposition of the gravel, or at least to an age when it was overflowed by the flooded river. There are two points which offer strong evidence in that direction.

The first is the fact that modern Indian implements, "neoliths," are never found associated with these "palæoliths" in the gravel. Although abundant on the surface, it is stated that they never occur at a depth of more than a few inches in undisturbed soil, while the palæoliths are found often ten or more feet from the surface. This fact alone argues a different age for the two classes of implements.

The second fact is that when found below the surface of the ground, these palæoliths always occur in the Trenton gravel and never in older gravels. The writer, in company with Dr. Abbott, has gone over much of the ground where the implements occurred; and it was very interesting to find that it was only within the limits of the Trenton gravel, previously traced out by the writer.

[1] *V.* Tenth and Eleventh Annual Reports of the Peabody Museum of American Archæology.

that Dr. Abbott had found implements below the surface. Beyond the terrace of older gravels the palæoliths sometimes occur with implements of the modern type, but are not imbedded at any depth. In Pennsylvania, moreover, the writer has found similar palæoliths in the region covered by the Trenton gravel and in that region only. Here, then, is the strongest probability, even if the implements were found upon the surface only, that they belonged to and were of coeval deposition with the river gravel.

The implements of argillite found at the lowest depth in undisturbed gravel have been generally decided by archæologists to be of human origin. It is, however, true that there are many sharp fragments of this rock in the Trenton gravel which are of natural origin, and that pebbles and partially rounded fragments of the same rock are frequent. The writer has found several fragments of argillite in the gravel exposed at the cut near Wheatsheaf Station, Bucks Co., Pa., which, whether they were artificial or natural, it was impossible to determine.

All the evidence that has been gathered points to the conclusion that at the time of the Trenton gravel flood, man in a rude state lived upon the banks of the ancient Delaware. He may have been in the habit of spearing fish and seals with spears pointed by his rough stone implements, and these having been dropped into the flood may have sunk into the loose and shifting gravel. The weathering upon the implements is so slight as to afford no evidence of their high antiquity. Many of the palæoliths found in the river gravels of Europe, are of very similar type. As a rule, probably the implements of the Trenton gravel are somewhat more rude. The writer is informed that even more primitive forms are now in constant use among some of our Western Indian tribes.

It is interesting to find, as pointed out by archæologists, that until lately the Eskimos have used stone implements quite as rude and similar in appearance to those found in the Trenton and other river gravels, and it has been suggested that that race, now living in a climate and under conditions perhaps similar to those once existing on the Delaware, may have some kinship with the pre-Indian people of this river. It may be that an Eskimo race, living here at the time of the flooded Delaware, were driven north by the coming of the Red Indians. If future archæological work shows this surmise to be correct, the writer suggests that the period of the Trenton gravel and of this palæolithic people,—a period perhaps following a second glacial age,—might appropriately be called *The Eskimo Period*. This name, derived from a higher order of beings than that which gave the name *Reindeer Period*, is much more suggestive and is probably of fully as wide application as the latter name. A term already in use, the *Palæolithic Era*, is also convenient.

It has been held that the occurrence of palæoliths at Trenton offered evidence of a very high antiquity of man in America, and, the gravel being considered as a glacial moraine, that man's existence was carried back to interglacial and even preglacial times.[1] As we have seen, the geological investigations along the Delaware Valley, described in this paper, throw quite a new light upon this subject. They show that the implement-bearing gravel is of post-glacial age, and is a river deposit of comparatively recent formation; and that neither in the gravels of the Champlain epoch nor in deposits of any previous age have any traces of man been discovered. The evidence appears to indicate the origin of man at a time which, geologically considered at least, is recent.

The actual age of the Trenton gravel, and the consequent date to which the antiquity of man on the Delaware should be assigned, is a question which geological data alone are insufficient to solve. The only clue, and that a most unsatisfactory one, is afforded by calculations based upon the amount of erosion. This, like all geological considerations, is relative rather than absolute. The same reasoning that showed that the modern river channel might have been excavated in hundreds rather than thousands of years, will indicate that no great length of time is necessary to produce all the surface features of the Trenton gravel. While the writer may venture to express the opinion that there is no reason geologically for carrying the age of this gravel and the antiquity of man on the Delaware farther back than a very few thousand years at the most, he is fully aware that any close approximation can safely be arrived at only by extended comparison with other river gravels and by a much more complete series of observations than have yet been possible. Ethnological considerations, which make palæolithic man to antedate the oldest races of the mound-builders, will have a bearing upon this question. Meteorologists may show that

[1] It will be remembered that Sir Charles Lyell, in his Principles of Geology, 11th Ed., vol. 1, p. 286, conjectures the period of the great glacier to have been about 200,000 years ago.

a cold climate and a period of a flood far larger than any of late experience may require a long lapse of time. These considerations are not within the scope of this paper. It has been the aim of the writer to define the antiquity of man in relation to geological rather than to historical events. If, in showing that the Eskimo period is the last of the geological ages, it does not necessarily follow that it is by any means recent, it must be remembered, on the other hand, that its high antiquity is not proven by the facts thus far observed.

The conclusions to which the facts seem to point may briefly be summarized as follows:—

1. That the Trenton gravel, the only gravel in which implements occur, is a true river deposit of post-glacial age, and the most recent of all the gravels of the Delaware valley.

2. That the palæoliths found in it really belong to and are a part of the gravel, and that they indicate the existence of man in a rude state at a time when the flooded river flowed on top of this gravel.

3. That the data obtained do not necessarily prove, geologically considered, an extreme antiquity of man in Eastern America.

Note on Philadelphite—a new mineral.—Mr. Lewis gave a preliminary description of a new vermiculite from near Wayne Station on the Germantown Railroad, which he proposed to call "Philadelphite." It occurs in plates of a brown color and talcose lustre, existing as seams in an altered hornblende rock. When heated, it exfoliates with great force to many times its original size and becomes of a coppery bronze color. It was stated that while exfoliating, it was able to lift over 50,000 times its own weight. It had a hygroscopic power nearly as great as that of chloride of calcium. Its optical characters and its chemical composition were given.

Analysis of Philadelphite.—Mr. Reuben Haines contributed the following analyses of Philadelphite.

Specific gravity (determined in alcohol of 95 p. c.) 2.78–2.96.

	I.	II.
SiO_2	39.06	38.52
Fe_2O_3	20.59	20.01
Al_2O_3	14.75	14.82
Fe_2O	2.04	2.04
CaO	.99	1.08
MgO	11.49	11.32
MnO (traces)	....	....
Li_2O (traces)	....	....
K_2O	6.89	6.61
Na_2O	.90	.64
H_2O	4.27	4.27
F (traces)	....	....
	100.98	99.31

Per cent. of hygroscopic water in I, 3.12 p. c.; in II, 3.43 p. c.

In these analyses the mineral was dried at 100° C., the hygroscopic water not being included in the determinations. Owing to its very hygroscopic nature, it was found very difficult to obtain its weight at 100° C. accurately. It gains rapidly in weight while being weighed upon the balance. Examples of its hygroscopic power were given. The analyses were made by dissolving the mineral in concentrated hydrochloric acid. Iron was estimated volumetrically and the alkalies by Smith's method of fusion.

DECEMBER 22, 1879.

THE SO-CALLED EMERY-ORE FROM CHELSEA, BETHEL TOWNSHIP, DELAWARE COUNTY, PENNSYLVANIA.

BY F. A. GENTH, JR.

At the November meeting of this Section, Dr. Cardeza called the attention of the members to a garnet rock, mined as emery-ore, at Chelsea, Bethel Township, Delaware Co., Pa., and subsequently left it with me for analysis.

The rock is composed almost exclusively of rounded rhombic-dodecahedral grains of red garnet, varying in size from a fraction of a millimetre to over one centimetre; also a little quartz, biotite, muscovite, and magnetite. It is very friable, being easily crushed.

Its fracture is uneven, excepting in some of the larger grains, which are so much intersected by mica, that, when struck by a hammer, they break into angular fragments, apparently showing a crystalline cleavage. Specific gravity = 4.028.

An analysis of the smaller and purer grains, obtained by washing and picking out, gave:

SiO_2	=	41.11
Fe_2O_3	=	2.11
Al_2O_3	=	21.60
FeO	=	25.86
MnO	=	2.22
CaO	=	1.89
MgO	=	5.41
		100.20

which proves it to be an ordinary iron-alumina garnet.

Some New Mineral Localities.—Mr. JOSEPH WILLCOX announced the following new mineral localities:

Burgess, Ontario, Canada, on the north shore of Rideau Lake: Phlogopite, Green Pyroxene, Apatite, Zircon. North Elmsley, near Otty Lake, Canada: Phlogopite, in large and perfect crystals. Bedford, Trontenac Co., Ont., Can.: Apatite (unusually fine), Black Pyroxene, Scapolite. Near Westport, Ontario, Can.: Black Tourmaline. Russel, St. Lawrence Co., N. Y.: Steatite pseudomorphous after Tremolite and Scapolite; Black Tourmaline, with modified terminations. Macon Co., N. C.: Crystals of Biotite in Muscovite.

All the above were found in fine specimens, well crystallized. Specimens were exhibited to the Section.

ON PHILADELPHITE (Sp. Nov.).

BY HENRY CARVILL LEWIS.

The mineral to which the above title has been applied was found by the writer four years ago, in what was then a quarry of hornblendic gneiss, close to the boundary of the Twenty-second Ward, Philadelphia. The locality is on Germantown Avenue, at the bridge crossing of the Germantown and Norristown Railroad, near Wayne Station. The quarry is now walled up, and is used as a coal and lime yard.

Geologically, the locality is just at the base of the terrace of metamorphic rocks which bounds the drift formations underlying the greater part of the city. Quaternary clays, boulders of the Champlain period, and tertiary gravels appear within a hundred feet of the quarry, and the waters of those different epochs have successively eroded the hill rising above it. This hill, here called Negley's or Logan's Hill, about 225 feet in height, is part of the same hill or "Upland Terrace," which, trending nearly northeast and southwest, has been traced continuously from here into Maryland, on the one side, and across New Jersey on the other, and which, though composed of quite different rocks in different places, forms throughout, the boundary of the post-jurassic formations.[1]

The rock at this place is a hard black hornblendic gneiss, subject to decomposition in its upper portions. It is well exposed in the cut on Wayne Street, where numerous minerals occur, and it is the same which is quarried at Frankford and at McKinney's quarry, both noted mineral localities. In its altered state it crumbles easily, and when heated exfoliates. In this condition, after being crushed in a mill between heavy iron rollers, it is sometimes used as a building sand.

The mineral here described as *Philadelphite* belongs to the vermiculite group of hydrous silicates. It occurs both disseminated in scales throughout the gangue-rock, and also in seams, an inch or more in thickness and many feet long. Associated with it in the same quarry are crystals of sphene, epidote and hornblende, and specks of chalcopyrite. It has been found in small quantities also at Wayne Street, at McKinney's quarry, and in Germantown.

[1] C. Proc. Min. and Geolog. Section Acad. Nat. Sci., Phila., Nov., 1878.

Since most of the vermiculites occur in serpentinous or chloritic formations, it is to be noted that no such rocks occur here or in the vicinity. The mineral is probably derived originally from hornblende.

Physical Characters.—Hardness, 1.3; Specific gravity, 2.80 (taken in alcohol and referred to water). Lustre pearly. Color, by reflected light, bronze; by transmitted light, brownish red, and in very thin laminæ, brownish yellow. Opaque, except in thin pieces. Streak brownish yellow. Laminæ unelastic, readily flexible, tough, not brittle. Feel greasy.

Crystallographic Characters.—Monoclinic. Cleavage; basal, eminent; also, occasionally, a cleavage parallel to the diagonals. Striations crossing at about 90°, causing the mineral to break into nearly rectangular fragments, are sometimes observed, and these are parallel to the plane of the optic axes and to the diagonals of the rhomb. No triangular striations as in Jefferisite. Plates often contorted and wrinkled. Twin crystals frequent, observable by polarized light. Optically biaxial. Double refraction strong, negative. Optic-axial angle, 31°20′–39°30′; generally 37°±. Crystals sometimes nearly 2 inches wide and $\frac{1}{2}$ inch high. The hyperbolas are well defined in the polariscope, and the angle of their divergence is more constant than in some of the other vermiculites. Twinning produces variations in the angle.[1]

Pyrognostic Characters.—In the closed tube it gives off water and exfoliates with great force, in a direction perpendicular to its base, to ten times its original volume. Upon exfoliation it becomes of a bright copper color and takes a metallic lustre. It also becomes brittle and more opaque. The exfoliated mineral has a far more distinct and frequent secondary vertical cleavage than it has before exfoliation, and the basal cleavage is also easier. It shows strong double refraction in the polariscope, and has an optical divergence of about the same amount as that of the unignited mineral (30° to 37°). The hyperbolas are extremely ill-defined, and no exact measurements could be taken. It is yellow by transmitted light. It forms a fine object under the microscope by reflected light. The fine copper color gained on exfoliation is characteristic, distinguishing it from the other vermiculites. The color is obtained whether it is heated suddenly in the flame, or slowly in an air-bath to exfoliation. Upon long-continued ignition in a platinum cru-

[1] V. Prof. Cooke's Paper on the Vermiculites, Proc. Amer. Acad., Boston, 1874, 35.

cible, heated without access of air, it becomes a steel-gray color, its iron having been reduced. Before the blowpipe it gives the violet flame of potash and fuses to a black magnetic globule, which does not intumesce when further heated.

With the fluxes it reacts for silica and iron. It is readily dissolved by hot sulphuric acid, the pure white silica being left in the original shape of the mica. It is dissolved in hydrochloric acid upon long digestion.

Chemical Composition.—In the investigation of the chemical composition of Philadelphite the writer has had the valuable advice of his friend, Prof. F. A. Genth, of the University of Pennsylvania. The method used in the estimation of vanadium is entirely due to him. The writer is also indebted to his friend, Mr. Reuben Haines, of Germantown, for two analyses, and for some interesting experiments.

Of the four analyses given below, Numbers I and II are by Mr. Haines; Nos. III and IV by the writer. Nos. I and II were made upon the pulverized mineral, previously dried in an air-bath at 100° C.; the hygroscopic water, amounting to over 3 p. c., not being included in the determinations. "In both the analyses the sample was dissolved in concentrated HCl, and the SiO_2 purified by digestion with HCl. The Fe and Al were precipitated together by NH_4HO and the Fe titrated by permanganate. The ferrous oxide was found by dissolving the weighed mineral in sulphuric acid in a closed flask from which the air was expelled by boiling with sodic carbonate, and titrating as before. The magnesia was weighed as pyrophosphate and the alkalies were separated by Smith's method of fusion, and were determined by platinic chloride, controlling the result by ignition of the platinic salt in hydrogen and weighing as metallic platinum. The combined H_2O is an average of the results of experiments Nos. IV and VI (given below) taken at a red heat on bottom of crucible."

Analyses Nos. III and IV were made upon the ignited mineral, this being considered its most constant state. The atomic water was determined separately, and the analysis of the anhydrous mineral reduced when the percentage of water was added. The ignited mineral being with difficulty soluble in acid, it was decomposed by fusion with sodic carbonate for analysis. After repeated evaporation of the silica with HCl, it was found still to contain titanic acid, which was extracted by evaporation with concentrated H_2SO_4 and precipitated by dilution and boiling. Additional titanic acid was separated upon boiling the filtrate from SiO_2, after reduction with H_2S. In one analysis titanic acid was separated from SiO_2 by volatilizing the latter with HF, dissolving the residue in H_2SO_4, diluting and boiling. Ferrous oxide was determined in the air-dried mineral as in analyses I and II. Iron and alumina were estimated by precipitation by boiling with sodic acetate in a neutral solution, dissolving in HCl, reprecipitating with NH_4HO, igniting and weighing together. In the filtrate MnO was precipitated by bromine and ignited.

The following method was employed for the detection of vanadium. 80 grammes of impure mineral were mixed with 90 grammes of sodic carbonate and 100 grammes of sulphur, and the whole heated slowly in a Hessian crucible covered by charcoal until partially fused. It was then digested in warm water, filtered, and to the filtrate dilute HCl was added, precipitating a copious heavy flocculent brown mass of the sulphides of vanadium, copper, cobalt and nickel. The precipitate was washed, ignited and evaporated with nitric acid, when it gave a red residue. This was fused with a mixture of sodic carbonate and sodic nitrate, and extracted with water in order to separate the oxides of copper, cobalt and nickel. Solid ammonic chloride was now added to the aqueous solution, when vanadate of ammonia was precipitated. Upon ignition it was changed to vanadic oxide, and was found to be pure, giving all the characteristic reactions.

For the estimation of vanadium the following method was employed. $4\frac{1}{2}$ grammes of the pulverized ignited mica were fused with a mixture of 3 parts $NaCO_3$ and 1 part $NaNO_3$, the mass extracted with H_2O, filtered, and the filtrate digested with H_2S. Traces of CuS and FeS were filtered off, and the silica eliminated by evaporation to dryness and addition of dilute H_2SO_4. H_2S was again added, giving a blue solution. After driving off the H_2S by heat, the vanadic acid present was estimated volumetrically by the addition of a measured portion of a standard solution of permanganate of potash.

Magnesia was determined as pyrophosphate, and the alkalies by means of Smith's method. Phosphoric acid was precipitated as phosphomolybdate of ammonia, and weighed as pyrophosphate of magnesia.

On account of the remarkable hygroscopic powers of Philadelphite, great difficulty was experienced in the estimation of the combined water. Nearly one-half of the water in the air-dried mineral is hygroscopic, and may be driven off either by long exposure over sulphuric acid in a desiccator, or by drying in an air-bath at 100° C. The percentage of water given in the analyses represents approximately the amount of water in the mineral after such desiccation.

Spec. grav. (taken in alcohol of 95 p. c.) 2.78–2.96.

	I.	II.	Mean.	Quantivalent ratio.		
SiO_2	39.06	38.52	38.79	2.587	2.587	5.45
Al_2O_3	14.75	14.82	14.78	.861	1.622	3.42
Fe_2O_3	20.59	20.01	20.30	.761		
Fe_2O	2.04	2.04	2.04	.056	.831	1.75
MnO	trace	trace	....	....		
MgO	11.49	11.32	11.40	.570		
CaO	.99	1.08	1.03	.037		
Na_2O	.90	.64	.77	.025		
Li_2O	trace	trace	....	....		
K_2O	6.89	6.61	6.75	.143		
F	trace	trace	....	....		
H_2O	4.27	4.27	4.27	.474	.474	1.—
	100.98	99.31	100.13			

Hygroscopic water in I, 3 12; in II, 3.43.

Spec. grav. (taken in alcohol of 84 p. c. on the air-dried mineral) 2.80.

	III.	IV.	Mean.	Quantivalent ratio.			
SiO_2	35.94	35.52	35.73	2.38	2.43	5.05	5
TiO_2	1.30	.77	1.03	.05			
Al_2O_3	15.23	16.32	15.77	.91	1.65	3.43	3
Fe_2O_3	19.48	19.43	19.46	.73			
V_2O_3	.37	.36	.37	.01			
FeO	2.09	2.28	2.18	.06	.87	1.80	2
MnO	.46	.55	.50	.01			
NiO, CoO	trace	.06	.06	..			
CuO	trace	.08	.08	..			
MgO	11.41	11.72	11.56	.58			
CaO	1.38	1.54	1.46	.05			
Na_2O	1.42	.38	.90	.03			
Li_2O	trace	trace	..	..			
K_2O	6.52	7.11	6.81	.14			
PO_5	trace	.11	.11	..			
Cl	trace	trace	..	..			
H_2SO_4	trace	trace	..	..			
H_2O	4.34	4.34	4.34	.48	.48	1.—	1
	99.94	100.63	100.45				

Hygroscopic water in III and IV, 3.24.

From both these pair of analyses we have the ratio

$R : \overset{vi}{R} : Si : H = 2 : 3 : 5 : 1$ and $\dot{R}\overset{\cdots}{R} : \ddot{Si} : \dot{H} = 1 : 1 : \frac{1}{5}$. The ratio of bases to silica is 1 : 1, and for sesquioxides to protoxides. $\overset{vi}{R} : \overset{ii}{R} = 2 : 1$.

Philadelphite dried at 100°C. appears to be a unisilicate, the water not being basic.

The formula may perhaps be written

$$Si \parallel O_4 \parallel [\tfrac{2}{5}(K_2, Mg) + \tfrac{3}{5}\beta(Al, Fe)]_2 + \tfrac{2}{5} aq$$

The general symbol would be,

$$\overset{ii}{R}_4, \overset{vi}{R}_2, O_{20}. Si_5. 2\ H_2O.$$

The water will be regarded as water of crystallization. Prof. Cooke has shown the close chemical relation between the anhydrous vermiculites and biotite. A like result is brought out by the following analysis of ignited Philadelphite. The analysis is a mean of the two analyses of the mineral which formed analyses Nos. III and IV of the mineral dried at 100° C.

V.	$\frac{2}{2}$			Quant. ratio.	
SiO_2	37.35	2.49	2.54	2.82	3
TiO_2	1.08	.05			
Al_2O_3	16.49	.96	1.73	1.92	2
Fe_2O_3	20.33	.76			
V_2O_3	.38	.01			
FeO	2.28	.06	.90	1.—	1
MnO	.52	.01			
MgO	12.09	.60			
CaO	1.53	.05			
Na_2O	.94	.03			
K_2O	7.13	.15			
	100.12				

Here $\overset{ii}{R} : \overset{vi}{R} : Si = 1 : 2 : 3$, the ratio of a typical biotite. Analgous as the anhydrous mineral is to biotite in its formula, it has been shown that physically and optically the two minerals are quite dissimilar, and it is not proven that they have any necessary connection. It is by no means a hydrous biotite in the sense that margarodite is a hydrous muscovite, in which case the characters, optical and physical, are identical. Such hydrous biotites occur in several places in the vicinity of Philadelphia, in a partially altered micaceous gneiss, in which the muscovite has become margarodite, and the orthoclase become white and crumbling. Such mica exfoliates slightly when heated, is uniaxial, fusible with difficulty, and might be called *Hydrobiotite* for convenience. It frequently occurs enclosed in crystals of margarodite, or in muscovite passing into margarodite.

Hygroscopic Properties.—In the determination of water in its different states in Philadelphite, the principal difficulty was on account of the strong hygroscopic properties possessed by the mineral. After the water has been expelled by heat or desiccation, it is rapidly absorbed again from the air, if exposed. Upon the balance, the dried mineral gains so rapidly that it was found necessary while weighing to enclose it in corked tubes. It appears to absorb water with the avidity of chloride of calcium. Even when enclosed in watch-glasses clasped together and standing in the closed balance-case with dry $CaCl_2$, it gains decidedly in weight. The following experiments by Mr. Haines illustrate its hygroscopic properties :

	Grammes.
(1) Weight of undried mica,	.9935
Heated at 100° C. for $1\frac{1}{2}$ hours,	.9616
Weight after standing in balance-case with $CaCl_2$ for 3 days,	.9915
Reheated for 3 hours at 100° C.,	.9580
Left on balance 20 minutes. Gain in weight,	.0070
Left on balance 2 hours. Total gain in weight,	.0085
(2) Weight of undried mica,	1.1280
Heated at 100° C. for 3 hours,	1.0965
Left in balance-case with $CaCl_2$ for 1 hour,	1.1175
Left in balance-case with $CaCl_2$ for $1\frac{1}{2}$ hours,	1.1230
Left in balance-case with $CaCl_2$ for $2\frac{1}{2}$ hours,	1.1250
Left in balance-case with $CaCl_2$ for 2 days,	1.1260
(3) Undried mica heated at 100° C. for $6\frac{1}{2}$ hours. Loss,	2.49 p. c.
On standing in balance-case with $CaCl_2$ for $2\frac{1}{2}$ days, regained nearly the whole of its original weight (all but 2 milligrammes). Again heated at 100° for 3 hours, loss of weight,	3.09 p. c.

These experiments, showing that nearly the total amount of hygroscopic water is regained even in the presence of such an active desiccator as chloride of calcium, indicate a remarkable hygroscopic force in the dried substance; a property not easy to explain. It will be noticed that this force is exercised much more powerfully immediately after desiccation than it is after a lapse of time. Experiment No. (2) shows that two-thirds of the water is absorbed during the first hour. It has been found that the amount of water in the powdered mineral varies with the hygrometric state of the atmosphere at the time of weighing. It is interesting to note that several of the zeolites, a class of hydrous silicates whose exfoliation by heat is very like that of the vermiculites, also have strong hygroscopic powers, losing and regaining part of their water with ease.[1]

Water of Crystallization.—The water in Philadelphite probably exists in three theoretical conditions, viz.:—Hygroscopic water, water of crystallization and water of constitution. The first is driven off by drying at 100° C. or by exposure to dry air over H_2SO_4; the second by gentle ignition, and is accompanied by exfoliation; the third by strong and prolonged ignition. The latter, which probably does not much exceed 1 per cent., and which the analyses have shown is not needed with the basic radicals to complete the unisilicate formula, will be regarded with the water of crystallization. The most satisfactory determinations of the water of crystallization have been made by subtracting the hygroscopic water from the total water.

The following experiments have been made upon the amount and condition of the water.

(1). The dry mica, which had been out of the quarry for more than a year, was cut into pieces about 5 mm. square, heated in a platinum crucible to a bright red heat for 25 minutes, cooled in a desiccator over H_2SO_4 for half an hour, and then quickly weighed. It lost 7.58 per cent., which will be regarded as the total amount of water.

(2). The finely powdered mica holds more water. Different experiments gave:—7.84 (ignited 10 minutes), 7.89, 7.90, 8.11 (ignited 25 minutes), 7.50 (powdered just previous to ignition). Strong ignition of the powdered mica probably volatilizes some of the alkalies in addition to the water.

[1] Damour (Ann. d. Mines, IV, x, 208) shows by an experiment similar to those given above, that the water lost by heulandite exposed over H_2SO_4 is all regained in $1\frac{1}{2}$ days.

(3) The finely powdered mica was divided into two portions, one of which was spread out on an open watch-glass, the other placed in a crucible. Both were weighed, put in a desiccator over sulphuric acid, and let stand unopened for two months. That in the crucible lost 2.76 per cent. of water. That on the watch-glass had lost 3.87 per cent. On standing 3 or 4 minutes upon the scale-pan it gained .53 per cent. of water from the air. Upon exposure over sulphuric acid in the desiccator 24 hours longer and then being quickly weighed, it was found to have lost 3.99 per cent. It was now placed in an air-bath and kept at a temperature of 100° C. for 4 hours. After cooling 15 minutes in the desiccator, it was found to have gained in weight about $\frac{1}{2}$ per cent., indicating that the desiccation over sulphuric acid was more complete than that in the air-bath at 100° C. That in the crucible lost on ignition 5.97 per cent. of its weight.

(4). The powdered mica was placed in a watch-glass in a desiccator over sulphuric acid.

After 27 days it had lost 2.28 per cent.
" 40 " " " 2.36 "

During weighing, it was enclosed in clasped watch-glasses. It was now put in a crucible and ignited.

The dried mineral lost on 1st ignition, 5.18 per cent.
" " " 2d " 5.36 "
" " " 3d " 5.47 "

(5). The following direct determinations of water of crystallization were made from the mica, dried in a glass tube, corked while weighing, and then ignited in a crucible.

	Desiccation.	Time of Desiccation.	Ignition.	Loss of water in dried mineral.
(a)	100° C. in air-bath.	24 hours.	15 min.	5.38 p. c.
(b)	" "	3 days.	20 min.	5. "
(c)	over H_2SO_4	2 weeks.	3 times.	5.60 "
			Mean.	5.32 "

This determination is thought to be too high, including some hygroscopic water, since the mica in a tube cannot be perfectly desiccated.

A mean of the three determinations of hygroscopic water absorbed over sulphuric acid gives 3.24 per cent., which deducted from the total water, 7.58 per cent., gives for water of crystallization, 4.34 per cent. As will be seen below, a similar amount is deduced from Mr. Haines' experiments.

The following experiments by Mr. Haines have been kindly placed at the disposal of the writer. They may be relied upon as having been performed with great care.

I. The powdered mica is placed in a desiccator over concentrated sulphuric acid.

(a)	Dried 15 days.	Loss, 2.69 per cent.
(b)	" 10 "	" 2.89 "

II. The undried mica is heated in an air-bath at 100° C.

(a)	Heated 3 hours.	Loss, 3.14 per cent.
(b)		" 3.33 "
(c)		" 3.42 "
(d)	" $5\frac{1}{2}$ "	" 3.69 "

	Weights.	Per cent. of loss.
III. Weight before heating.	1.0880	
Heated at 100°, $1\frac{1}{2}$ hours.	1.0613	2.46
" " $4\frac{1}{2}$ "	1.0598	2.59
Over H_2SO_4 and heated 5 hours at 100°.	1.0558	2.96
Heated 2 hours at 100° and cooled over H_2SO_4.	1.0613	2.46

	Weight.	Total loss.	Loss from 100° C.	Increment of loss.	p.c. of total loss.	p.c. of total loss fr. 100°C
IV. Weight before heating.	.9035					
Heated at 100° C. for 1 hr.	.8743	.0292			3.23	
" 100° " 2 "	.8730	.0305			3 37	
" 105° " $2\frac{1}{2}$ "	.8715	.0320	.0015	.0015	3.54	0.15
" 119° " 1 "	.8705	.0330	.0025	.0010	3.65	0.28
" full red heat 5 min.	.8350	.0685	.0380	.0355	7.58	4.34
" over blast lamp 1st time.	.8270	.0765	.0460	.0080	8.46	5.27
" over blast lamp 2d time.	.8280	.0755	.0450		8.35	5.15

	Weight.	Total loss.	Loss from 100° C.	Increment of loss.	p.c. of total loss.	p.c. of loss fr. 100° C
V. Weight of undried mica	.8052					
" at 100° C.	.7827	.0225			2.79	
" at 125° C. cooled for 3 minutes.	.7757	.0295	.0070	.0070	3.66	0.89
" at 150° cooled for 3 minutes.	.7682	.0370	.0145	.0075	4.59	1.85
" at 170°–175° cooled for 4 min.	.7682	.0370	.0145		4.59	1.85
" 190° cooled for 3 minutes.	.7647	.0405	.0180	.0035	5.03	2.30
VI. Weight of undried mica.	.9855					
" at 100°C, heated several hours.	.9615	.0240			2.43	
Below faint red heat.	.9445	.0410	.0170	.0170	4.16	1.77
Heated to pale red at bottom of crucible.	.9320	.0535	.0295	.0125	5.32	3.07
Heated to bright red at bottom of crucible.	.9210	.0645	.0405	.0110	6.54	4.21
Heated to full red on whole crucible.	.9148	.0707	.0467	.0062	7.17	4.85

VII. Total water.

(a) Loss of weight at red heat, 7.30 per cent.
(b) " " on ignition, 7.50 "
(c) " " " 3 times, 7.86 "

From the above experiments of Mr. Haines in connection with Nos. (1), (2) and (3) under "hygroscopic properties," we may deduce the following percentages:

For total water, we have (IV), 7.58 p. c.; (VI), 7.17; (VII, a. b, c), 7.30, 7.50, 7.86.

Mean total water, 7.48 per cent.

For hygroscopic water, driven off at 100°, we have

Analysis I.	Analysis II.	Exp. (1) Heated $1\frac{1}{2}$ hrs.	Exp. (1) Reheated 3 hrs.	Exp. (2) 3 hrs.	Exp. (3) 3 hrs.
3.12	3.43	3.21	3.57	2.79	3.09

Exp. II a	Exp. II b	Exp. II c	Exp. II d	Exp. III.	Exp. IV.	Exp. V.	Exp. VI.
3 hrs.			$5\frac{1}{2}$ hrs.	5 hrs.	2 hrs.		several hrs.
3.14	3.33	3.42	3.69.	2.96	3.37	2.79	2.43

A mean of these 14 determinations gives for hygroscopic water 3.17 per cent.

Subtracting this from the mean total water, 7.48 per cent., we have for water of crystallization 4.31 per cent., an amount closely agreeing with that deduced from the writer's experiments. The desiccation over sulphuric acid in Exp. I is for too short a time to completely extract the hygroscopic water.

The exact state of the water cannot yet be regarded as certainly established. There is no reason why a fixed temperature of 100° C. should divide the hygroscopic water from the water of crystallization. The above experiments show that the loss of water as the temperature is raised above that point is a very gradual one. It is difficult to see in what manner the water driven off at 190° in experiment V, differs from that driven off at 100°. It will be seen hereafter that much of the water can be driven off without exfoliation. Again, there is no sufficient reason why some of the water absorbed by sulphuric acid in the desiccator may not be water of crystallization. It has been long known that sulphate of copper either at 100° C. or in a desiccator over sulphuric acid loses much of its water of crystallization. M. Damour has shown that chabazite loses nearly half of its water in a desiccator. It seems probable that Philadelphite, with other vermiculites, holds its water in a similar manner. From the experiments here detailed it would seem that we may define water of constitution to be the more closely combined, and hygroscopic water the less closely combined water of crystallization; and the distinction between the three states of water then becomes a theoretical rather than a practical one.

Temperature of Exfoliation.—The temperature at which exfoliation occurs is from 150° to 160° C. It has been found that the exfoliation temperature is proportional directly to the original volume of the substance, and inversely to the rapidity of the application of heat. The larger the piece experimented upon, the higher the temperature necessary to make it exfoliate, and the more rapidly the heat can be applied, the sooner will it exfoliate; as the following experiments will show.

(*a*) Very small fragments heated on a watch-glass in an air-bath began to exfoliate at 150° C.

(*b*) A large piece heated similarly did not exfoliate at 210° C.

(*c*) A piece was immersed in melted paraffine. At 100° C.

bubbles went off slowly, but there was no exfoliation. The temperature being raised, it made the first movement at 160°, exfoliated vigorously at 175°, and at 180° rose from its support to the surface of the paraffine.

(*d*) Another piece similarly immersed gave bubbles briskly at 130°, and began to exfoliate at 160°.

(*e*) Pieces thrown into melted paraffine whose temperature had previously been raised to 160° C., immediately exfoliated and rose to the surface.

(*f*) A large piece did not exfoliate even after the temperature had been gradually raised to 225° C.

(*g*) Immersed in melted sulphur, it immediately exfoliated and strongly effervesced.

(*h*) Immersed in concentrated sulphuric acid which had been heated to 160° C., it immediately exfoliated and became pure white, being completely and immediately decomposed. Immersed similarly at a temperature of 150° C. it exfoliated, but did not become immediately white. At a lower temperature no exfoliation occurred. A similar piece being similarly immersed and the temperature raised, began to exfoliate at 130° C., and continued exfoliating as the temperature rose, though being meanwhile decomposed. This sudden change of form and color upon immersion in hot sulphuric acid recalls a somewhat similar change in the efflorescence of protosulphate of iron when immersed in the same acid.

It is seen from these experiments that no absolute determination of the exfoliation temperature is possible. By a very slow heat a large proportion of the water (about 5 per cent.) can be driven off and the mica raised to a high heat without any exfoliation of consequence. The following experiment illustrates this fact.

(*k*) A piece of Philadelphite was cut into two equal portions. One piece, heated suddenly on platinum foil to a red heat, exfoliated to ten times its original volume. The other piece was slowly heated in an air-bath. At 285° C. it had exfoliated but very slightly. It was then taken out and heated on platinum foil to a red heat, when it exfoliated very little more, becoming only one-fourth the length of the first piece.

A similar experiment has been made upon heulandite and stilbite from near Philadelphia. Both of these zeolites, as is well known, exfoliate largely when held in the flame. It has been found that if they are heated very slowly on platinum foil, they can be raised to a white heat without exfoliation, and when afterwards held in the flame, exfoliate but slightly. Apparently the water in Philadelphite is combined precisely as in the zeolites.

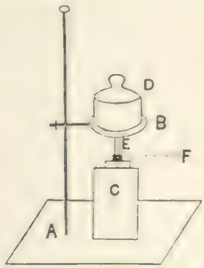
It appears that it is as difficult to make a distinction between water of crystallization and water of constitution as it is to make one between the former and hygroscopic water.

Amount of Exfoliation.—The amount of exfoliation is quite constant at ten times the original volume.

Original thickness. Inches.	Thickness after exfoliation. Inches.		Ratio.
.015	.13	mean	1 : 10
.015	.17		
.02	.2		1 : 10
.03	.25		
.04	.47	mean	1 : 10.4
.06	.68		

These experiments were made by heating the mica on platinum foil over the flame of a Bunsen burner. The heat must be sudden in order to have a large exfoliation (*v.* Exp't. *k*). Exfoliation takes place in one direction only, viz., at right angles to the cleavage. No lateral expansion whatever occurs. When the flame is applied to one side of the mica, that side exfoliates the most, and causes the exfoliating mineral to curve in the opposite direction.

Force of Exfoliation.—It has been found that the force exercised during the exfoliation of Philadelphite is enormous. In one experiment a fragment of it while exfoliating lifted more than 50,000 times its own weight. The force of exfoliation is governed by a law which is the inverse of that controlling the exfoliation temperature. It may be stated thus: The force of exfoliation increases directly with the rapidity of the expulsion of water, and inversely with the volume of the substance. The latter part ot the law follows as a necessary consequence of the first part, since the smaller the fragment, the more rapidly and completely can it be heated. Various experiments were made, and though performed in an extremely rough manner, will give an idea of this force. To find what amount a given weight of the mica could lift when exfoliating, iron pound-weights were placed upon the ring of a retort stand and connected with the fragment of mica placed on a support immediately below them. A pencil of chalk or gas carbon resting loosely in a perpendicular position between the mica and the centre of the weights connected them so that any expansion of the mica would lift the weights from off the ring on which they rested. The blowpipe flame was now directed from one side upon the mica.



a, retort stand.
b, ring.
c, support.
d, weight.
e, pencil of chalk.
f, fragment of mica.

In the following table of experiments, the first column represents the weight of the fragment of mica, and the second column, the iron weight which was lifted by the exfoliating mica.

Philadelphite.			Weight.		
15	grains	lifted	10 lbs.	avoirdupois.	
6	"	"	10 lbs.	"	
$5\frac{1}{2}$	"	"	10 lbs.	"	
$2\frac{1}{2}$	"	"	10 lbs.	"	
2	"	"	5 lbs.	"	
$1\frac{1}{2}$	"	"	2 lbs.	"	
1	"	"	3 lbs.	"	
$\frac{2}{3}$	"	"	2 lbs.	"	
$\frac{1}{2}$	"	"	3 lbs.	"	readily.
$\frac{1}{2}$	"	"	4 lbs.	"	"

In the last experiment the four-pound weight was lifted up and thrown off the ring supporting it; the weight lifted being 56,000 times the weight of the mica.

A remarkable motive power is here developed. That it is owing solely to the escape of the combined water is shown by the fact that if the weights are so arranged that the mica can only slightly expand, and, after heating, are removed, the mica will expand no more, or very slightly more, upon further application of heat, the water having been in great part expelled. If the mica is confined under a weight so heavy that it is impossible for it to exfoliate, and is suddenly heated by the flame, it occasionally explodes with a loud report, throwing off fragments laterally into the air.

It may be stated that the exfoliated mineral when powdered, forms a handsome and permanent bronze powder not liable to tarnish, and useful in the arts.

A Potsdam Sandstone Outcrop on the S. Valley Hill of Chester Valley.—Mr. H. C. Lewis remarked that an occurrence of Potsdam sandstone on the farm of Mr. S. Tyson, near King of Prussia, Montgomery Co., to which Mr. T. D. Rand had directed attention last May, was of considerable interest. A recent examination of the locality with Mr. Rand, had shown that the blocks of sandstone there found were not, as had been supposed, out of place, but belonged to a narrow outcrop of the sandstone on the South Valley Hill. It had a strike, and apparently a dip, nearly identical with that of the limestone in the valley below. In one place the decomposed rock is quarried for white sand. Pits for iron ore have been sunk in a very ferruginous variety of the same rock. The exposure, which can be traced by blocks upon the surface, suddenly comes to an end in a ravine, as though by a fault. A tongue of sandstone blocks extends three hundred yards or more down this ravine, towards the valley, in a line at right angles to the line of strike. On the farther side of the ravine, to the east, no sandstone has been found, its place being filled by the usual damourite slate of the South Valley Hill. The blocks of sandstone therefore make an "L," the shorter arm of which extends down the ravine. There is here an interesting example of the work of erosion in carrying down these blocks to a lower level. Whether or not the existence of a fault can be proved, the occurrence of Potsdam sandstone at a new locality on the South Valley Hill is well worthy of study. This formation forms the North Valley Hill, but is almost totally absent on the South Valley Hill. It is found here only in a few isolated patches. Its place is supplied by a greenish damourite slate. If, as is supposed, the North and South Valley Hills are opposite sides of a synclinal trough which dips beneath the limestone of Chester Valley, it is curious that the rocks of each hill are so very dissimilar. It is important that each one of the rare exposures of sandstone on the South Valley Hill should be made known, and it is thought that a determination of their relations to the adjoining slates will greatly help to elucidate the geology of that region.

July 6.

The President, Dr. Ruschenberger, in the chair.

Eleven persons present.

July 13.

The President, Dr. Ruschenberger, in the chair.

Six persons present.

July 20.

The President, Dr. Ruschenberger, in the chair.

Ten persons present.

July 27.

The President, Dr. Ruschenberger, in the chair.

Eleven persons present.

The death of Constantine Hering, M. D. was announced.

Fresh-water Sponges of Fairmount Park.—Mr. Potts reported that he had found in a small stream within the limits of the late Centennial grounds, Fairmount Park, Philadelphia, three distinct species of Fresh-water Sponges, one of which appears to be undescribed and the others differ in important points from the published descriptions. In anticipation of a more detailed paper describing these and some other forms which had come under his notice, he said—that one of these known as the common green sponge of this neighborhood, resembles the European *Spongilla lacustris* in its general appearance and in the shape of its skeleton and dermal spiculæ; but differs in that the seed-like bodies or spherulæ are entirely smooth, showing no incrustation of curved spined spiculæ as described in the European species.

The second form was first seen as a thin rust-colored incrustation, afterwards discovered to consist of spherulæ forming a continuous layer. Supposing this to be new he had named it provisionally *S. Morgiana;* but later examinations of the living sponge had convinced him that it was identical with the *S. fragilis* of Leidy.

The third was found creeping upon and around *Anacharis* and Willow roots, matting them together and thus forming loose, irregular masses several inches in diameter: color yellowish, light or dark green, according to exposure to the light. Spherulæ, globular, light yellow or brown, rather numerous amongst the roots and spiculæ; covered with long birotulate spiculæ radially arranged; foramen elongated into a tube flaring at its extremity and dividing into 2—5 tapering, slender, curling or twisted tendrils, believed to be as much as half an inch in length. The sarcode decomposes early in the season and most of the skeleton spiculæ are then washed away; but these tendrils hold the mass of spherulæ attached to the roots etc. above mentioned, awaiting the spring germination. For this curious species he suggested the name *S. tentasperma* or tendril seeded.

Dr. M. H. De Bey of Aix-la-Chapelle and Prof. Torquato Taramelli of Pavia were elected correspondents.

AUGUST 3.

The President, Dr. RUSCHENBERGER, in the chair

Sixteen persons present.

The death of James Ridings, a member, was announced.

Notes on Jarosite.—Prof. GEORGE A. KÖNIG communicated his discovery of *Jarosite* at the "Iron Arrow Mine," in Chaffee Co., Colorado.

The mineral occurs there in seams and cavities of silicious thúrgite and hematite, which iron ores crop out on the steep side of a Porphyry hill about 600 feet above the Arkansas River, flowing at a distance of two miles to the south.

The mineral appears in small, but very brilliant crystals, isolated and in groups; also as aggregations of crystals which produce crusts. It is remarkably crystalline, since no compact, or crypto-crystalline masses were observed.

The crystals are rhombohedrons (resembling cubes), modified by the basal plane. The speaker had not observed as yet a crystal of sufficient size to be accurately measured. Hardness slightly above selenite; color, from light amber-yellow to deep brown. Perfectly transparent. Lustre of crystal faces adamantine, resinous on the fracture. Sp. gr. = 3.144.

The material used for analysis consisted of the aggregations before mentioned, which showed an admixture of chalcedony and of brilliant, black grains of thurgite; these could not be separated mechanically, being too small.

The mean of two analyses gave:

Fe_2O_3	= 51.10
K_2O	= 7.13
Na_2O	= 0.84
SO_3	= 28.57
H_2O	= 10.56
SiO_2	= 2.40
	100.80

Calculated from the analysis:

$K_2Fe_6S_4O_{22}$ + $6H_2O$	=	89.58
$Fe_4H_2O_7$ (Thurgite)	=	8.67
Excess of water	=	0.39
Chalcedony (SiO_2)	=	2.40
		100.94

This result may be estimated as a confirmation of Richter's analysis, which gave to Jarosite the formula of "alunite," with which it is isomorphous.

$$\text{Thus Alunite} = K_2Al_6S_4O_{22} + 6A_2O$$
$$\text{Jarosite} = K_2Fe_6S_4O_{22} + 6H_2O$$

The utmost care was given to the estimation of the alkalies, the sulphuric acid and the water, as the question of constitution must be dependent mainly upon them.

AUGUST 10.

The President, Dr. RUSCHENBERGER, in the chair.

Sixteen persons present.

AUGUST 17.

The President, Dr. RUSCHENBERGER, in the chair.

Twelve persons present.

A paper entitled "Rhizopods in the Mosses of the Summit of Roan Mountain N. C.," by Jos. Leidy, M. D. was presented for publication.

AUGUST 31.

The President, Dr. RUSCHENBERGER, in the chair.

Fourteen persons present.

The following was ordered to be printed:

RHIZOPODS IN THE MOSSES OF THE SUMMIT OF ROAN MOUNTAIN, NORTH CAROLINA.

BY JOSEPH LEIDY, M. D.

In a trip to Roan Mountain, Mitchell Co., North Carolina, in the early part of July, the writer was led to make some observations on the microscopic animal life, among the mosses on the summit of the mountain. The top of Roan Mountain, at an altitude of 6367 feet, forms an extensive grassy prairie, suitable for pasture. It is adorned with broad patches of the beautiful *Rhododendron catawbiense*, and bordered with forests, chiefly of Firs—*Abies canadensis* and *A. Fraseri*. The floor of the forests, made up of broken granitic and gneissoid rocks and fallen timbers, is thickly carpeted with a luxuriant growth of mosses, conspicuously decorated at the time by the common Wood-Sorrel, *Oxalis acetosella*. Chief among the mosses, each apparently attempting to outvie the others in the exuberance of its growth, were the three pretty Hypnums—*H. splendens*, *H. crista-castrensis*, and *H. triquetrum*.

Clouds, dews, and frequent rains keep the mossy carpet more or less moist or wet the greater part of the time, and it thus comes to be a favorable habitation for many of the humbler forms of animal life. The shell-covered Rhizopods abound; and the Wheel Animalcule, *Rotifer vulgaris*, and the Water Bear, *Macrobiotus Hufelandii* also find a suitable home in it. When the mosses become more or less dry, the animalcules they shelter become torpid, and then again become active on the restoration of moisture.

In water squeezed from the Hypnums, besides the animals just indicated there were noticed a few young Anguillules, pollen grains of Abies, starch grains, spores of lichens and fungi, ova, vegetal hairs, etc. Few or no living Diatomes or Desmids were present.

The Rhizopods observed were as follows:

Nebela flabellulum.—Common. Nearly circular in outline, usually slightly broader than long, and commonly with a short neck or rim to the mouth; colorless or with a feeble yellowish tint; composed of circular cancelli of variable size and proportions and degree of distinctness. Individual specimens presented the following measurements.[1]

a. *Specimens of equal length and breadth, or of greater breadth than length.*

1.	Length	0.066,	breadth	0.066,	b'th of	mouth	or neck	0.018,	l'th of neck	0.006.
2.	"	0.066,	"	0.069,	"	"	"	0.018,	"	0.006.
3.	"	0.066,	"	0 072,	"	"	"	0.015,	"	0.006.
4, 5.	"	0.066,	"	0.072,	"	"	"	0.018,	"	0·006.
6.	"	0.072,	"	0.078,	"	"	"	0.018,	"	0.003.
7.	"	0.078,	"	0.078,	"	"	"	0.024,	"	0.006.
8, 9.	"	0.078,	"	0.084,	"	"	"	0 018,	"	0.006.
10.	"	0.078,	"	0.084,	"	"	"	0.024,	"	0·004.
11.	"	0.084,	"	0.084,	"	"	"	0.024,	"	obsolete.
12.	"	0.084,	"	0.09,	"	"	"	0.018,	"	0.006.
13.	"	0.084,	"	0.09,	"	"	"	·0.021,	"	0.006.
14-18.	"	0.084,	"	0.09,	"	"	"	0.024,	"	0.006.
19.	"	0.084,	"	0.096,	"	"	"	0.024,	"	0.006.
20.	"	0.096,	"	0.096,	"	"	"	0.03,	"	0.006.

b. *Specimens slightly longer than broad.*

21.	Length	0.072,	breadth	0.066,	b'th of	mouth	or neck	0.018,	l'th of neck	0.006.
22, 23.	"	0.084,	"	0.078,	"	"	"	0.018,	"	0.006.
24.	"	0.09,	"	0.084,	"	"	"	0.018,	"	0.006.
25.	"	0.09,	"	0.078,	"	"	"	0.024,	"	0.006.

In many the sarcode was contracted into a ball, encysted, and the mouth of the shell closed with an opercle. Sarcode colorless, but sometimes mingled with yellow and brown food balls; some oleaginous in appearance. Mostly, a pore was readily distinguishable on each side of the body of the shell, about one-third the distance of the length above the mouth; and the wall of the shell was observed to be sensibly thickened approaching the pore. The shell was usually minutely and more or less distinctly cancellated, the cancelli being circular, sometimes nearly uniform, at others greatly differing in size. Occasionally the cancellated condition was so indistinct that the shell appeared faintly granular and even nearly structureless.

[1] The measurements are given in divisions of the millemetre. As nearly all the Rhizopods indicated are compressed forms, the measurements are given from their most convenient position as usually seen, that is to say, in the greater breadth.

Nebela collaris.—Occasional. Flask-like forms, with the usual variations in the condition of the cancellated structure of the shell; sometimes finely punctate, but mostly with distinct circular cancelli, more or less uniform or greatly varying in proportionate size. In several specimens the cancelli of the shell appeared to be like minute lenses or spheres, and to present an external convexity. Individual specimens measured were as follows:

1.	Length 0.06,	breadth 0.036,	breadth of mouth 0.018.
2.	" 0.066,	" 0.036,	" " 0.015.
3, 4.	" 0.066,	" 0.039,	" " 0.018.
5.	" 0.066,	" 0.042,	" " 0.015.
6.	" 0.066,	" 0.042,	" " 0.018.
7.	" 0.072,	" 0 042,	" " 0.018.
8.	" 0.072,	" 0.048,	" " 0.018.
9.	" 0.096,	" 0 078,	" " 0.024.

Hyalosphenia tincta?—One specimen only. Sarcode encysted as a ball 0.048 diameter, containing much brownish food and bright yellow oil-like globules. Shell structureless, pale yellowish, with a pair of pores piercing the body above the junction of the neck. The specimen looked like a *Nebela flabellulum*, but the $\frac{1}{10}$ inch magnifying power showed no structure to the shell.

Length 0.069, breadth 0.072, breadth of mouth 0,024, length of neck 0.0045.

Difflugia globulosa.—Rare. Small forms with shells of fine sand and dirt. From hemispherical to globular and with circular mouth.

1.	Breadth of shell 0.06,	height 0.042,	breadth of mouth, 0.018.
2.	" " 0.06,	" 0.048,	" " 0.024.

Difflugia constricta.—Rare. Shell of yellowish dirt and sand.

Length 0.072, breadth 0.072.

Difflugia arcula.—Rare. Shell hemispherical, brownish, incorporated with dirt and fine sand; mouth trilobate.

Breadth 0.132, height 0.09, breadth of mouth 0.048.

Heleopera petricola.—Occasional. Purplish brown, with variable proportions of incorporated sand.

1.	Length 0.09,	breadth 0.078,	breadth of mouth 0.042.
2.	" 0.096,	" 0.078,	" " 0.036.

ASSULINA SEMINULUM.—Somewhat frequent. Of varied size and hue; from nearly colorless to dark brown, and mostly lighter at the neck. Mostly empty shells; often living specimens.

1.	Length	0.036,	breadth	0.03;	breadth of	mouth	0.009.
2.	"	0.042,	"	0.036;	"	"	0.012.
3.	"	0.018,	"	0.042;	"	"	0.012.
4.	"	0.054,	"	0·048;	"	"	0.018.
5.	"	0.072,	"	0.072;	"	"	0.024.
6.	"	0.078,	"	0.072;	"	"	0.024.

EUGLYPHA AREOLATA, Ehr.—Small compressed spineless forms, occasional. A living specimen measured as follows:

Length 0.06, breadth 0.018; breadth of mouth 0.015.

EUGLYPHA STRIGOSA.—Occasional. An empty shell measured:

Length 0.06, breadth 0.042; breadth of mouth 0.012.

TRINEMA ENCHELYS.—Common. Small forms of much variety.

1.	Length	0.03,	breadth	0.024.
2, 3.	"	0.036	"	0.03.
4.	"	0.036,	"	0.036.
5.	"	0.042,	"	0.03.

In some positions, on dripping ledges and cliffs, from among the greater profusion of Hypnums, there grew cushion-like masses of bright pea-green Sphagnum, sometimes rose tufted. Water squeezed from the Sphagnum, exhibited many Diatoms, a few Desmids, pollen of Abies, starch grains, spores, etc. It also contained many Rhizopods, an occasional Infusorian, a few Anguillules, but no Rotifers nor Water-bears. Of Rhizopods the following were observed:

NEBELA COLLARIS.—Abundant and of much variety in shape and size and in the arrangement and distinctness of the cancellated structure of the shell. Compressed pyriform, or flask-shaped, with oval or ovoid body and with neck of variable proportionate length and breadth. Cancellated structure very variable; mostly of circles, minute and nearly uniform, or greatly varying in size among themselves or in proportion with the shell. Dead shells most frequent; in living ones observed, the sarcode mostly contracted and inactive, often encysted; least frequently in an active locomotive condition. Small forms common; giant forms few. Individual specimens noted as follows:

1. Length 0.078, breadth 0.06; breadth of mouth 0.018. Compressed oval: living.

2. Length 0.078, breadth 0.06; breadth of mouth 0.018. Oval with short neck. Empty shell; cancelli circular, variable, the largest 0.006, the smallest 0.003.

3. Length 0.078, breadth 0.06; breadth of mouth 0.012. Oval with short neck; living, active; nucleus, 0.12.

4. Length 0.081, breadth 0.054; breadth of mouth 0.018. Empty shell, with sharply defined circles, large and small, together with a few rods.

5 Length 0.084, breadth 0.042; breadth of mouth 0.018; with neck 0.018 long. Empty shell, with minute circles on the neck, but unusually large in proportion to the shell on the body where they ranged from 0.006 to 0.012.

6. Length 0.084, breadth 0.048; breadth of mouth 0.018. Flask-like empty shell, with minute circular cancelli 0.003 or less.

7. Length 0.084, breadth 0 054; breadth of mouth 0.012. Flask-like empty shell minutely and uniformly cancellated.

8. Length 0.084, breadth 0.06; breadth of mouth 0.015. Oval, empty.

9. Length 0.09 , breadth 0.072; breadth of mouth 0.021. Flask-like.

10. Length 0.096, breadth 0.078; breadth of mouth 0.024. Pyriform; neck 0.006 long; cancelli circular, variable in size, a few on the fundus to 0.012. Sarcode an encysted ball, with yellowish oil-like food globules; diameter of ball 0.048.

Some giant forms especially noted were as follows:

11. Length 0.18; breadth 0.09; breadth of mouth 0 042. Living; shell nearly replete with sarcode, colorless but containing a multitude of bright yellowish and brown globules from 0.006 to 0.012.

12. Length 0.21; breadth 0.12; breadth of mouth 0.048. Empty shell of faint yellowish tint; basis of structure faintly and uniformly punctate with only distinct minute circular cancelli approaching the fundus.

13. Same size as preceding. Shell mostly of minute circular cancelli, larger near the fundus and there mingled with a few square ones. Shell closed by an operculum. Sarcode contracted into an oval mass 0.144 by 0.072.

14. Length 0.192; breadth 0.102; breadth of mouth 0.018. Shell with minutely cancellated structure. Sarcode in a ball 0.084 by 0.072.

NEBELA FLABELLULUM.—This form comparatively rare. Shell nearly circular in outline, with a short neck, mostly composed of minute circular cancelli more or less nearly uniform or variable; rarely of elliptical cancelli.

1. Length 0.072; breadth 0.072; neck 0.003 long; breadth of mouth 0.009.
2. " 0.072; " 0.078; " 0.003 " ; " " 0.009.
3. " 0.678; " 0.078; " 0.0015 " ; " " 0.009.
4. " 0.084; " 0.078; " 0.003 " ; " " 0.012.

Shell with minute elliptical cancelli.

Difflugia constricta.—Rare. Only a few specimens seen. Small forms, with shell of minute sand grains and yellowish dirt. Pyriform viewed from the front or back.

1. Length 0.06 ; breadth 0.048
2. " 0.078 ; " 0.048; breadth of mouth 0.024.
3. " 0.108 ; " 0.102; breadth opposite mouth 0.078.

Difflugia pyriformis.—Rare. Shell of dirt and fine sand.

1. Length 0.084; breadth 0.048; breadth of neck and mouth 0.024.

Difflugia arcula.—Rare. Shell yellowish, incorporated with more or less brownish dirt and sand. Form hemispherical; mouth trilobed.

1. Breadth 0.132; height 0.09.

Centropyxis aculeata.—Rare. Shell of pale brown chitinoid membrane incorporated with more or less dirt and sand; with coarser grains of the latter along the course of the usually six spines. Mouth oval, with a more or less sinuous border.

1. Length 0.096; breadth 0.084; breadth of mouth 0.024.
2. " 0.12 ; " 0.096; mouth 0.03 by 0.024.

Heleopera petricola.—Occasional; shell incorporated with more or less dirt and sand, and of a purplish brown tint.

1. Length 0.09 ; breadth 0.078; breadth of mouth 0.042.
2. " 0.108; " 0.09 ; " " 0.036.

Euglypha areolata, Ehr.—Small compressed forms, without spines or other appendages. Abundant. Apparently from six to fifteen teeth to the mouth of the shell. Mostly empty shells. Often living specimens.

1, 2.	Length	0.042,	breadth 0.024;	breadth of mouth		0.012.	10 teeth.
3.	"	0.042,	" 0.024;	"	"	0.009.	6 teeth.
4, 5.	"	0.048,	" 0.024;	"	"	0.012.	10 teeth.
6.	"	0.048,	" 0.03 ;	"	"	0.012.	8 or 10 teeth?
7.	"	0.054,	" 0.024;	"	"	0.012.	6 teeth.
8.	"	0.054,	" 0.03 ;	"	"	0.012.	6 teeth.
9.	"	0.102,	" 0.72 ;	"	"	0.036.	15 teeth?

EUGLYPHA STRIGOSA.—Compressed, hirsute forms. Occasional. Usually with about ten teeth to the mouth of the shell; scales distinct; finely hirsute all over except near the mouth.

1.	Length	0.102,	breadth	0.072;	breadth of mouth	0.024;	hairs	0.008	long.
2.	"	0.108,	"	0.06;	" "	0.021;	"	0.012	"

EUGLYPHA BRACHIATA.—One empty shell observed, with but one divergent spine, and five or six teeth to the mouth.

1. Length 0.102; breadth 0.04; breadth of mouth 0.012; length of spine 0.042

EUGLYPHA CRISTATA.—One empty shell, with acute fundus, but without spines, and four teeth to the mouth.

1. Length 0.54; breadth 0.012; breadth of mouth 0.009.

EUGLYPHA CILIATA.—Compressed forms, with short spines or hairs along the acute lateral borders. Rare. Nucleus 0.018.

1. Length 0.108; breadth 0.06; breadth of mouth 0.021; hairs or spines 0.012 long. Ten teeth to mouth of the shell.
2. Length 0.102; breadth 0.072; breadth of mouth 0.024; spines 0.008 long. Nucleus of sarcode distinctly and uniformly granular (breaking up into spores?), 0.018 diameter. Ten or twelve teeth to mouth of the shell.

PLACOCISTA SPINOSA.—One specimen observed, living, but the ample sarcode contracted and containing a transversely oval nucleus with two nucleoli.

1. Length 0.084, breadth 0.054; breadth of mouth 0.021. Lateral spines short, hair-like, single or in pairs, 0.009 long. Nucleus 0.021 by 0.018: nucleoli 0.003.

ASSULINA SEMINULUM.—Moderately frequent; from nearly colorless to dark brown, mostly lighter at or near the mouth. Living and dead specimens observed.

1.	Length	0.042,	breadth	0.036,	breadth of mouth	0.012.
2.	"	0.048,	"	0.036,	" "	0.012.
3.	"	0.072,	"	0.048,	" "	0.018.
4.	"	0.072,	"	0.072	" "	0.024
5.	"	0.078,	"	0.078,	" "	0.024.
6, 7.	"	0.084,	"	0·072,	" "	0.024.

TRINEMA ENCHELYS.—Frequent and of varied form and size, though none of the largest variety observed. Usually pyriform; often oval; rarely obovoid; of varied proportionate length and breadth, of narrowing opposite the mouth, and degree of obliquity. Mostly dead shells, though frequent living individuals observed Ranging from 0.024 to 0.072 in length. Specimens presented the following measurements.

1.	Length	0.024,	breadth	0.015;	breadth of	mouth	0.006.	Pyriform.
2.	"	0.03,	"	0.018;	"	"		
3.	"	0.036,	"	0.024;	"	"	0.012.	Obovoid.
4, 5.	"	0.042,	"	0.03,	"	"	0.012.	Pyriform.
6.	"	0.045,	"	0.03;	"	"	0.012.	Contained 6 colorless spores from 0.006 to 0.009 in diameter.
7, 9.	"	0.048,	"	0.03;	breadth of	mouth	0.012.	
10.	"	0.051,	"	0.36;	"	"	0.015.	Nucleus 0.012.
11.	"	0.054,	"	0.03;	"	"		
12.	"	0.054,	"	0.036;	"	"		
13.	"	0.057,	"	0.036;	"	"	0.015.	
14.	"	0.06,	"	0.03;	"	"		
15.	"	0.06,	"	0.042;	"	"		
16, 17.	"	0.072,	"	0.03;	"	"	0.015.	
18.	"	0.072,	"	0.03;	Lateral view of a specimen.			

It is worthy of special remark that among the Rhizopods of the sphagnum of Roan Mt., there were observed no individuals of *Hyalosphenia papilio* and *H. elegans*, which are so common in the sphagnous swamps of the eastern plains.

SEPTEMBER 7.

Dr. R. S. KENDERDINE, in the chair.

Fifteen persons present.

On large Sphene from Canada.—Dr. A. E. Foote recorded the occurrence of crystals of sphene of unusual size in the county of Renfrew, Canada, near the upper part of the navigable portion of the Ottawa River. The largest crystal collected weighed 23½ pounds or more than twenty times as much as the largest heretofore found.

SEPTEMBER 14.

The President, Dr. RUSCHENBERGER, in the chair.

Twenty-eight persons present.

The death of Prof. S. S. Haldeman, a member, was announced.

On the Timber Line of High Mountains.—Mr. MEEHAN remarked that on the tops of most high mountains we find a total absence of ligneous plants. The highest alpine vegetation consists for the most part of acaulescent perennials. Lower down we may find some woody species, and often we come to dwarfed forms of trees of species, which, still lower down, form forests of considerable height, and which as timber trees make what is known to mountain travelers as the "Timber Line." Thus in the mountains of Colorado, the forests commence at about 7000 feet above the sea level, and continue up to about 11,000 feet, where they suddenly cease, and form at that elevation what is there known as the "Timber Line." On Gray's Peak he found *Pinus aristata*, *Pinus flexilis*, *Abies concolor*, and *Abies Engelmannii*, with some willows forming the timber line. The Coniferous trees were probably 30 or 40 feet high, and it was interesting to note that this tall timber as suddenly ceased, as if a wood had been cut half away by a woodman's axe. But at once commencing where the tall timber ceased, the same species exist as dwarf stunted shrubs seldom exceeding 3 or 4 feet in height, and often but a foot, though trailing widely over the ground. In this stunted condition the species would often extend some fifteen hundred feet higher up, or half way from the recognized timber line to the top of the mountain. Other observers have noted that the average of 11,000 feet marks the entire timber line of the Rocky mountain range.

So far as he knew this peculiar timber line has been referred wholly to climatic conditions, of which temperature and moisture have been regarded as the chief elements in producing the results. That admirable botanist and energetic collector, Dr. C. C. Parry, in a paper on the Rocky mountain alpine region, published in the "Proceedings of the American Association for the Advancement of Science" for 1869, p. 249, remarks that the most satisfactory explanation is that the so called timber line marks the extreme point of *minimum* temperature below which no exposed phenogamous plant can exist. All that survives above this point does so by submitting to a winter burial of snow, beneath which protecting cover it is enabled to maintain its torpid existence.

The great objection which this purely meteorological view presented to Mr. Meehan's mind was that the dwarfed and gnarled coniferae extending so many hundred feet up the mountain sides, never produced seed, and we are reduced to the alternative of believing either that the seeds have been carried up the mountain sides in enormous quantities and to enormous distances from the fruitive trees below by winds, or else that there were seed bearing progenitors of these scrubby pines, beneath the tall protecting branches of which they had their earliest stages of growth. He was satisfied from subsequent observations in the mountains of North Carolina, and in the White Mountains of New Hampshire, that this last view is the correct one,—that large timber trees at no very remote period extended much further up the mountain sides than they do now, and that they have since disappeared for reasons presently to be stated, leaving only the younger trees to struggle on as best they may.

Roan Mountain in North Carolina is about 6300 feet above the level of the sea. Timber extends to its summit on some parts of it, while in other parts it is destitute of timber for many hundreds of feet down its sides. The species on the summit is *Abies Frazeri*, and *Abies nigra*. Oak and other trees come occasionally to near the top and at about 6000 feet he measured a black oak—*Quercus tinctoria*, that was 5 feet in circumference at 3 feet from the ground, and was perhaps 40 feet high. The places destitute of trees were the steep declivities,—while those on which the trees were growing were of a more level character. Further down the mountain sides the steep inclines would be clothed with forest growth, as well as those of a more gradual ascent. It is of the summit only that the differences in inclination, presented different forest aspects. But in the spaces clear of "Balsam" as the *Abies Frazeri* is popularly known, an occasional one of good size would be seen. In the close Balsam woods, both on the summit and lower down the mountain sides, crops of young plants would be found under the mature trees, but, what was very remarkable, there had evidently been no young trees started till the parents were near maturity. A large area with trees 30 or 40 feet high would have an undergrowth of young ones a foot or so high, while other areas of younger trees, would have innumerable small seedlings growing among the damp moss beneath them, and it was further interesting to note that in most cases the crops of young plants in each area were about the same age in each case, as if the seeds in the several locations had all started to grow together in some one particular year, and probably at no other time. On the naked places, where few or no trees were now found, the surface would be closely covered by a matted growth of a grass almost peculiar to that region, *Danthonia compressa*, but a close examination of the surface showed occasional tracts of deep vegetable mould which had been formed by ages of decaying *Hypnum* or Sphagnum moss, and the evident remains of roots, just as we now find under the Balsam trees, and there is no doubt from these facts that these steep upper declivities were once clothed with trees and mosses, to which the grass previously named succeeded.

With these facts in mind he examined the arboreal features of the White Mountains in New Hampshire. On Mount Washington, which is a little over 6000 feet, the timber runs up to about 4000 feet; while Mount Webster, a mountain forming the southern peak of the same chain, and about 4000 feet high, has little timber above 3000 feet. Clearly, climatic reasons will not account for these peculiarities. On Mount Washington there is much of the same character as distinguishes the forests of the Rocky Mountains. As already noted the timber line becomes marked at about 4000 feet. For at least another thousand feet we meet with scrubby bushes of *Abies Balsamea*, *Abies nigra*, and *Abies alba*, with some *Betula papyracea*. Beyond this, and almost to the summit, an occasional specimen of one or another of the coniferæ may be seen. As noted in regard to the Colorado scrubby growth, none of these had ever produced seed; nor was it at all probable, from a careful survey of the locations, that many of the areas could have been seeded by the winds, however strong, bringing the seeds up these mountain heights. Moreover, there were many cases where there were intermediate areas clear of all scrubby spruce plants, and where seeds could be brought by winds in these modern times much easier than to the heights above. Besides this, it was evident that many of these dwarfed specimens were of immense age. Some that he examined were certainly fifty years old, though the stems at the ground were no thicker than his wrist, and, trailing on the ground, occupied but 16 or 20 square feet of space. There seemed to be but little doubt that at some time in the past Mount Washington had forests of coniferæ at much higher elevations than at present, if not perhaps clean up to the summit; that these scrubby plants now there were seedlings that had sprung up under the elder ones, and that in time the older ones were destroyed, leaving the small ones beneath alone to their fate.

An examination of different parts of Mount Washington shows not only that this is the true explanation of the absence of good timber beyond what is known as the timber line, but that the same law is in progress to day as in centuries past. Illustrations of this are numerous. There is now a railroad running straight up the mountain side from the base to the summit. Near the timber line, a cut had to be made through an area covered by mature Balsam Firs. This cut was about 8 or 10 feet deep. Under the trees moss and dead roots and old fir leaves had made an earthy strata of a foot, or in places, more in depth. The moss was still green from the rains, melting snows, and fogs of this elevated region, and sustaining the various kinds of low vegetation common to these alpine heights. Young firs were springing up in great abundance. But all the larger trees were dead, though here and there might be seen a branch with a few lingering green leaves. This mass of dead, standing timber occupied several acres. The reason for their death was evident. The railroad cut showed that the forest stood on a mass of large but loose gneiss rocks, through which the waters from the two thousand feet of loose rock above rushed as soon as the railroad cut was made, carrying with it all the earthy matter on which the larger trees subsisted, but leaving the tough turfy matter at the surface, on which smaller trees of the same sort may live for many years, though the larger ones cannot longer exist. With the death of the larger trees there is, of course, an increase of light, and then the *Hierochlœ*, with other grasses and sedges, speedily take possession, holding together the loose soil, and even permitting in many cases an increase of the earthy layer, by holding much of the disintegrated rock which may be washed or blown on from above. Carefully examining patches of scrubby spruces above the timber line, it is not uncommon to find dark patches of vegetable mould evidently the remains of large trees that have been growing where now only the masses of small scrubby plants exist. In some places a sharp stick may be pushed down among the scrubby firs and spruces, and the earth found to be but a foot or so deep over the loose rock below, from which the earth has been wholly washed away. Again, there are some places often nearly an acre in extent where the scrubby firs are still standing, dead, from the earth having been washed away from below upwards, not leaving enough for even the moderate demands of these little bushes.

In view of the facts detailed we may conclude that at the elevation of these mountain chains, the lowland vegetation was carried up at the same time. The summits, covered by luxuriant forests would present a cooler surface to the moist clouds, and there would be less condensation than on bare sun-warmed rocks, and deep snows would be less frequent, and not sufficient to interfere much with arboreal growth. But the rain would of necessity carry down the earth and disintegrated rock to lower levels; and the melting snows, such as there were, would make this downward progress of the soil continuous. In some mountains where the rock was easily broken by frost, as in Colorado and the White Mountains, it would be very difficult for the soil to hold its own against these forces of gravitation; but on more solid rock the mass of tree roots protecting the rock, and retaining the earthy matter would longer hold its own. In the former case with the gradual washing away of the earth the larger trees will have to find a lower level; the summit condensing more moisture, and having a cooler atmosphere, would form heavier masses of longer enduring snow, and thus keep down from tall growth the younger trees left as the older and larger ones retired. They would have to be low bushes by the absence of earth for vigorous growth, and remain trailing bushes, through the superincumbent and long continued mass of snow.

We thus see that though a long continued mass of snow has much to do in marking a timber line, that line is precedent to the snowy mass. The primary cause is the gravitation of disintegrated rock—the movement of the hill top towards the sea. From the moment the mountain reaches its highest point it commences its downward march. The entire reduction of the highest to a level with the plain is but a question of time. The frost and rain and melting snow will do it all, and this reduction, bringing down not only the earth, but cold-loving plants to warmer levels, must continually change the aspects of vegetation, as well as perpetually vary the timber line.

In low hills as well as in high mountains the forces of gravitation are also at work. But the sides are seldom so steep as in the loftier hills,—the rains do not gather with such force nor are the melting snows of near the same duration. There are sudden washes, but not the continuous roll of the earth to the bottom. In time they may exhibit the same phenomena of the disappearance of species from their summits as their loftier brethren; but the centuries here will gather much more slowly to produce a similar effect.

In conclusion he would say briefly that the "timber line" of high mountain tops results from the washing down of the earth from the higher elevations.

Mr. Redfield remarked that there could be no doubt that influences other than climatic (such for instance as the washing away of soil, mentioned by Mr. Meehan) do often modify and change the timber-line upon mountains. But he was unable to accept Mr. Meehan's views as to the insignificant part played by climatic causes, and still held them to be the prevailing factor in the problem. Dr. Parry's explanation by the weight and depth of winter snows might not always be the correct one, but snow and ice must be very important agents, and Mr. R. thought that in considering climate, we should have regard not merely to the present period, but to past great secular periods. He then referred to the glacial age, when not only the White Mountains, but all New England was capped with a vast ice-sheet, which under secular changes gradually retreated, leaving only the mountain tops covered. The slow retreat of the glacial covering was followed by the advance of fitting arboreal vegetation, until a point was reached when the present climatic conditions were such as to limit any higher advance of the trees.

SEPTEMBER 21.

The President, Dr. RUSCHENBERGER, in the chair.

Twenty-eight persons present.

Bone Caves of Pennsylvania.—Prof. LEIDY remarked that in the early part of August, in company with Dr. T. C. Porter of Easton, he had visited Hartman's Cave, in the vicinity of Stroudsburg, Pa. They had been invited by Mr. T. Dunkin Paret, of that place, who had recently undertaken the exploration of the cave, and had obtained from it an interesting and important collection of animal remains, which had been submitted to Prof. Leidy's examination.

The cave is situated about five miles from Delaware Water Gap in a ridge which separates Cherry Valley from the valleys of the Pocono and McMichael's Creeks. The ridge is an anticlinal fold of the Helderberg or Upper Silurian limestone, and the cave, occupies the axis of the fold and opens in the face of a cliff formed by a cross section of the ridge. An accumulation of debris forms a slope at the base of the cliff, and above the debris and just below the arching roof of the cave, a low passage way has long been known into which adventurous boys would creep.

Mr. Paret commenced the exploration by having a passage dug through the debris to the entrance of the cave, and then extended the trench within the latter for upwards of a hundred feet, and to a depth sufficient to walk erect. At one place within the cave the digging was carried to the rock floor. It would thus appear that the cave is occupied by a bed of clay about 10 feet in depth. On this is a thin layer of stalagmite and on this again about a foot of black friable earth mingled with animal and vegetal remains.

No remains have been found imbedded in the clay nor on the rocky floor in the pit dug through the latter.

Prof. Leidy supposed that during the glacial period, a stream of water, from melting snow and ice at a higher level, had made a passage way through the fissured limestone of the anticlinal axis and had left in it the abundant clay deposit. When the cave ceased to be a water course the layer of stalagmite was formed and subsequently the more friable earth accumulated from materials, such as dust and leaves, blown in and mingled with the remains of animals, occupants of the cave, and of their food. The recess of the cave above the clay floor appears to have been too small to be inhabited by the larger carnivorous animals or man, and therefore no large entire bones of these have been found in the ossiferous stratum.

The remains thus far discovered are of such interest as to encourage Mr. Paret to continue further exploration Most of these collected to the present time were exhibited by Prof. Leidy, and consist of the following:

Numerous fragments and splinters of limb bones of smaller and large animals, many or most of which exhibit the marks of being gnawed, whether by rodents or small carnivores is somewhat uncertain. A few also show the marks of canine teeth, of medium sized carnivores. Some of the splinters pertain to such large and strong bones as to render it questionable whether they were produced by even our largest carnivores, and probably are the remnants of human feasts, in which the bones were crushed to obtain the marrow. Numerous bones and fragments of others of the smaller and smallest animals. These include especially limb bones, and lower jaws, and less frequently skulls, fragments of others and vertebræ. Many of these are also gnawed, while many are not.

The fragments of larger bones may be supposed to have been conveyed into the cave by small carnivores. A few pieces of bone are somewhat charred; and a small fragment of a lower jaw, containing a molar tooth, of the Bison, also apparently exhibits the marks of fire. This probably is a remnant from a human feast, which may have been carried into the cave by some small gleaner.

All the bones and fragments together amount to about half a bushel. Most of them pertain to animals of a kind still living, though some of these no longer belong to the fauna of our state, and a few of the remains are those of extinct animals. How far the remains of different species are cotemporary is uncertain, though it is most probable that they were introduced through a long succession of years from the time following the glacial period.

The remains of extinct animals consist of an incisor tooth and half a dozen molars of the great rodent *Castoroides ohioensis*, and portions of the upper and lower jaw, with teeth, of a young Peccary, the *Dicotyles nasutus*, previously known only from a single fragment of an upper jaw, discovered in Indiana, (Extinct Mammalia of North America, 385, pl. xxviii, figs. 1, 2. Jour. Acad. Nat. Sc., vii, 1869).

The remains of animals no longer living in Pennsylvania are as follows:

Bones and teeth of the Caribou or Woodland Reindeer. *Rangifer caribou.*

A fragment of the lower jaw containing the last molar tooth, of the Bison, *B. americanus.*

Many lower jaw halves, and other bones and teeth of the Woodrat, *Neotoma floridana*. Most of these are of comparatively large size, and of the character of similar remains referred by Prof. Baird to a supposed extinct species, with the name of *Neotoma* *magister*, (U. S. P. R. R. Exp. & Surveys—Zoology, viii, 1857, 498).

Remains of other mammals are as follow: Lynx, *Felis canadensis;* Wolf, *Canis lupus;* Gray Fox, *Vulpes virginianus;* Skunk, *Mephitis mephitica;* Weasel, *Putorius ermineus;* Raccoon, *Procyon lotor;* Mole, *Scalops aquaticus;* Dusky Bat, *Vespertilio fuscus;* Little Brown Bat, *V. subulatus;* Woodchuck, *Arctomys monax;* Porcupine, *Erethizon dorsatus;* Beaver, *Castor fiber;* Muskrat, *Fiber zibethicus;* Gray Squirrel, *Sciurus carolinensis;* Ground Squirrel, *Tamias striatus;* Gray Rabbit, *Lepus sylvaticus;* Meadow Mouse, *Arvicola riparius;* White-footed Mouse, *Hesperomys leucopus;* Deer, *Cervus virginianus:* Elk, *Cervus canadensis.*

Among the remains, none have been identified as positively pertaining to our domestic animals, unless, perhaps, a pair of specimens are to be referred to this category. The specimens are the complete isolated first and second large molars of a fœtal or new-born Horse!

The collection further contains numerous bird bones, chiefly of the Wild Turkey, *Meleagris galloparo;* some of turtles, the Box Turtle, *Cistudo clausa*, the Snapper, *Chelydra serpentina*, etc.; and others of several species of snakes.

In the same stratum were also found a number of shells of mollusks, chiefly *Helix albolabris*, *H. alternata*, and *H. tridentata*. Also a valve of *Unio complanatus*.

Of vegetal remains there were a few small fragments of charcoal, and many seeds, consisting of those of the Dogwood, *Cornus florida*, Pig-nut, *Carya porcina*, and Walnut, *Juglans nigra*.

The human remains are of an interesting character. One is a large stone celt of hard brown slate, obtained from the bone earth some distance within the cave. There are five bone awls, several of which exhibit marks of gnawing. Some of these were found in the cave, and others in the outside debris. An implement consists of the prong of an antler worked so as to be barbed on one side, and was probably used as a needle for making nets.

A small implement of bone, resembles in its present condition a crochet needle such as is now employed by ladies in making worsted work. It is much gnawed away on one side, and looks as if it may have been like an ordinary needle with a perforation, and this now rendered incomplete from the gnawing.

Another implement is a fish-hook worked out of bone.

Such bone implements are among the rarest of human relics in our portion of the country.

Another remarkable relic is a cone shell bored through the axis as a bead. The shell is a marine species, *Conus tornatus*, found on the western coast of Central America. Its presence among the cave remains, would indicate an extended intercourse among the inhabitants of early times.

The investigation of the interesting collection of remains secured by Mr. Paret, had led Prof. L. to examine a small collection of bones in the Museum of the Academy, which had been presented upwards of thirty years ago, as a sample of many of the same kind discovered in Durham Cave, Bucks Co., Pa. The cave appears to have since been obliterated in the quarrying of limestone. At the time of the presentation of the specimens of bones they were recognized as pertaining to existing species of animals and were therefore regarded as of little interest, though fortunately they have been preserved.

Prof. Leidy remarked that these bones were of the same character as those of Hartman's Cave, and he had distinguished among them the following:

The Black Bear, *Ursus americanus;* Raccoon, Skunk, Gray Fox, Deer, Moose, *Alce americanus;* Woodland Reindeer, Bison, Gray Squirrel, Rabbit, Beaver, Muskrat, Porcupine, Woodchuck, Woodrat, Wild Turkey, Box Tortoise, Snapper, Snake, Sturgeon, and Catfish.

The examination of these collections show that the exploration of small caves may not only prove of ethnographic value, but serve to give us information relative to the early fauna of the country. Thirty years ago Prof. Baird gave an account of the exploration of some bone caves in this State (Proc. Am. Assoc., II, 1849, 352). He refers to a vast accumulation of remains in one of the caves, and remarks that the number of species of mammalia found is twice that of present existing species in Pennsylvania. It is to be regretted that no further account has yet been given of the species to which the remains belong.

Dimorphic Flowers in Houstonia.—Mr. THOS. MEEHAN remarked that flowers dimorphic in their sexual character were well known. Generally there was little difference in the corolla between the short styled or long styled flowers, but in *Houstonia cærulea, L.*, the long styled form was accompampanied by a thick tube, while the tube in the short styled form was not more than half the diameter of the other. In this species of *Houstonia* the anthers were placed on a ledge which was at the base of the tube in the long styled form. In the short styled form the anthers were brought to the mouth of the corolla without any lengthening of filaments, but by the bringing up of this ledge on which the anthers are placed. The position of the anthers at the mouth or at the base of the tube, was in fact decided by the modification of the form of the corolla tube. This had been explained in the first series of "Flowers and Ferns of the United States." In a recent examination of *Houstonia serpyllifolia*, Mx., on the top of Rohn Mountain in North Carolina, Mr. Meehan found precisely the same characters in that species. On the same mountain *Houstonia purpurea, L.*, abounds, and also has a similar sexual dimorphism, but in this case the elevation of the anthers is due to the lengthening of the stamens and the form of the corolla-tube is the same in both sexual forms. The number of plants representing each sexual form is about equal. In a handful of plants gathered at random there were of *Houstonia serpyllifolia* thirteen with long styles and short stamens, and eleven with short styles and the anthers in the mouth of the tube. Of *Houstonia purpurea* there were thirteen with long styles to fourteen with short ones. An interesting fact in connection with these sexual differences is that the dimorphism seemed to be wholly in the shortening of the style or filaments, and did not seem to effect injuriously the anthers or stigma. Both forms seemed to be equally fertile.

In answer to a question by Mr. Redfield, Mr. Meehan said there did not appear to be any intermediate forms. The stigma or the anthers were either exactly at the throat of the flowers, or exactly at the base. In regard to cross fertilization the long styled would be in the best position for receiving pollen from foreign flowers, but the short styled one would more readily receive its own. As cross and self-fertilization had an equal advantage he would infer that the dimorphism had little reference to fertilization as a final cause.

Cleistogamy in Oxalis Acetosella, L.—Mr. MEEHAN observed that under the forests of *Abies Frazeri*, on Roan Mountain, North Carolina, early in August *Oxalis Acetosella* was abundantly in flower.

In a large number of cases examined he could find no traces of any disposition to produce seed vessels, but pushing out beneath the soil or near the surface were numbers of cleistogene flowers, from which, in all probability, seeds would be produced in abundance.

Most plants which produced cleistogene flowers, also produced the usual open corolla bearing flowers at one time or another in the season, and it had been suggested that this bright petalled condition was for the purpose of attracting insects, and thus give the species some chance to escape from the evils which cleistogamy., or close-breeding is supposed to involve. It is worthy of note that no day insects were noted to visit the flower of the *Oxalis* blooming in these dark fir forests, though nocturnal ones might supply the deficiency. Mr. Meehan remarked, however, that no rule could be deduced from single observations, or observations repeated in the same localities, as the behavior of plants and insects varied with circumstances. The *Oxalis* might not be cleistogene, might be visited by insects, and the open flowers might be fertile elsewhere. He referred in illustration to *Amphicarpæa monoica*, Nutt., which near Philadelphia sometimes produced no seeds from the petaliferous flowers, while at other times these flowers were remarkably fertile. Again, all his examinations in the locality named had resulted in finding that the petal-bearing flowers were as perfectly fertilized in the unexpanded corollas as were the cleistogene flowers. But he was prepared to expect different results elsewhere.

SEPTEMBER 28.

The President, Dr. RUSCHENBERGER, in the chair.

Thirty-four persons present.

The following papers were presented for publication in the Journal:

"The Parasites of the Termites," by Jos. Leidy, M. D.

"Remarks on Bathygnathus borealis," by Jos. Leidy, M. D.

OCTOBER 5.

The President, Dr. RUSCHENBERGER, in the chair.

Thirty-two persons present.

The death of James C. Fisher, M. D., a member, was announced.

Sexual Variation in Castanea Americana, Michx.—ISAAC C. MARTINDALE stated he had recently visited Pitman Grove, Gloucester Co., New Jersey, in order to examine some chestnut trees growing there, and remarked that it was well known there are but two species of chestnut trees in this country, the chinquapin, *Castanea pumila*, found occasionally in New Jersey, and abundantly further south, and the common chestnut, *Castanea Americana.* The chinquapin attains the height here of ten to twelve feet, being a shrub rather than a tree. In Maryland, Virginia and North Carolina, it often reaches four times that height, and becomes nearly a foot in diameter. It is from those States that most of the chinquapins found in our markets come. The burs contain but a single nut, and it quite small, but as a cluster of five or six together is not unfrequent, nearly as many chinquapins may be found on a branch, as chestnuts on the common chestnut trees. The leaves of the dwarf chestnut, as it is sometimes called, are woolly underneath, even in their mature condition, while on the other they become green on both sides as they reach full size.

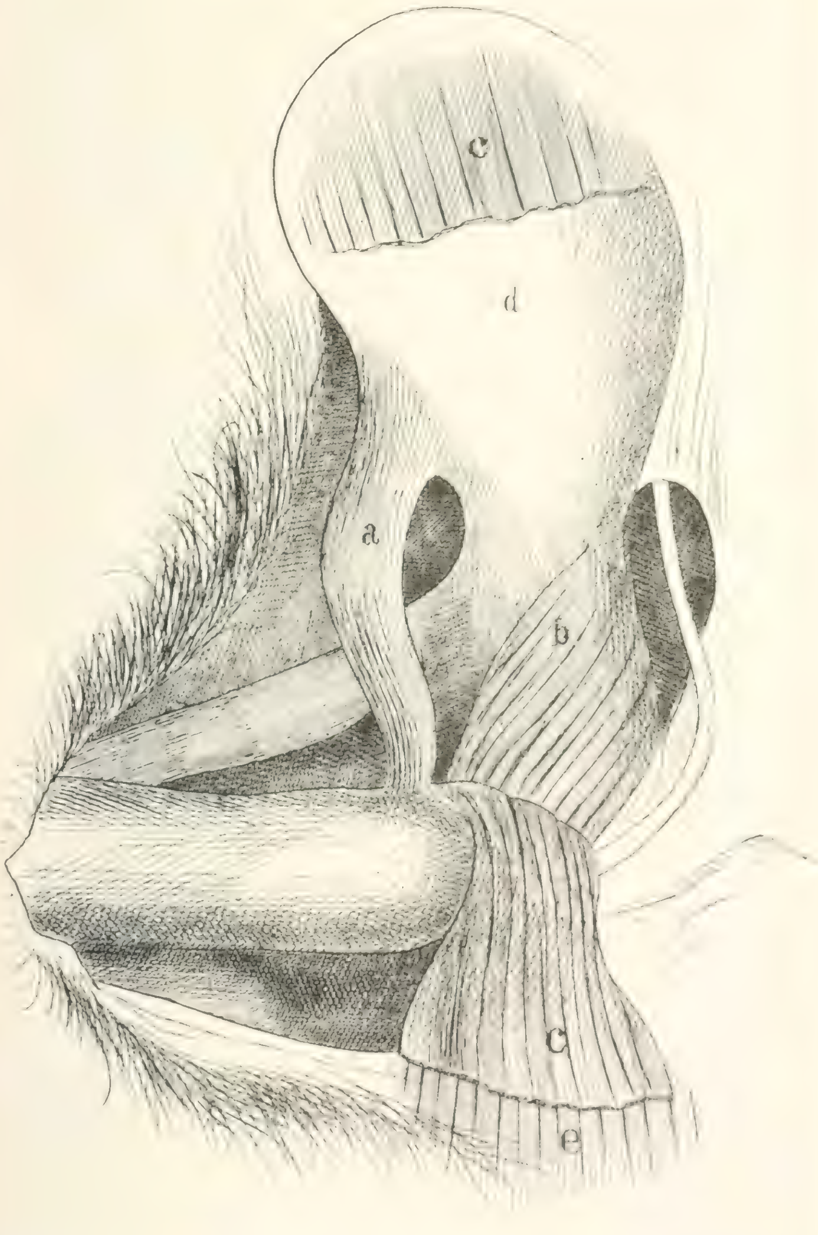
A peculiar feature in the flowering of the chestnut, namely, that the trees bear two sets of flowers, was pointed out by Thomas Meehan, of the *Gardener's Monthly*, a close observer of vegetable growths, more than a year ago. His observations are recorded in the Proceedings of the Academy of Natural Sciences of Philadelphia, for the year 1879. It may not be difficult for any one to recall the manner of the inflorescence, which consists of the flowers growing on a stem, botanically called a spike, from four to six inches in length, there being from thirty to sixty flowers together. These come from buds in the axils of the first leaves of the season, and are composed entirely of staminate (male) flowers. They are very odorous when in full bloom, and often so abundant as to give the trees a white appearance when seen at a distance. As soon as these flowers fade, which is in a few days, a disarticulation takes place close to the branch, and the spike falls to the ground. About ten days later, a second flowering takes place, these spikes coming from the later axillary buds of the season, and instead of being all staminate as in the first instance, at the base of the spike will be found one, sometimes two, rarely more, pistillate (female) flowers. These are fertilized by the staminate flowers that are in blossom at the same time; the staminate part of the spike falls away after flowering, but the pistillate part remains attached to the branch, and developes into a bur, containing from two to five or six nuts. What may be the use of the first set of blossoms, has not yet dawned upon the mind of man; it would seem a great waste of energy to provide for such an abundance without a purpose, but the prodigality of nature is visible in numerous other instances as well.

The variety of forms of the nut was greater in the locality referred to than he had ever seen before. One tree was particularly attractive, the shape of the bur being exactly pyriform instead of globular; its chestnuts, of course, corresponding somewhat in shape, being long and slim.

Near the southern line of the tract was found one tree, and afterwards in another part a second tree, which will require special notice. The former was about twenty feet high and six inches in diameter, while the other was at least seventy-five feet in height, and more than two feet in diameter at the base, a very wide spreading and thrifty looking tree. In these, the later blossoms referred to, instead of being part staminate and part pistillate, have been all pistillate, consequently were succeeded by burs all along the spike, numbering in those counted from fifty to sixty together, and hanging from the branches like bunches of grapes. Every branch of the tree that bore any at all, had them of this character, so that there were doubtless hundreds if not thousands of them. An important point is here manifested. These flowers being all pistillate, and the staminate ones (the first blossoms referred to) having fallen, there was nothing to fertilize them, consequently they could not attain much size nor develop chestnuts within the bur, except that rarely the first or second nearest the base contained three or four very small nuts. These nuts, however, were without germs.

He had been unable to find any record of such an occurrence in this country before, but Dr. Masters records it as having been noted in France. The superintendent of the grove to whom belongs the credit of first detecting these trees, could not say

Simia satyrus L.



CHAPMAN, ANATOMY OF ORANG OUTANG.

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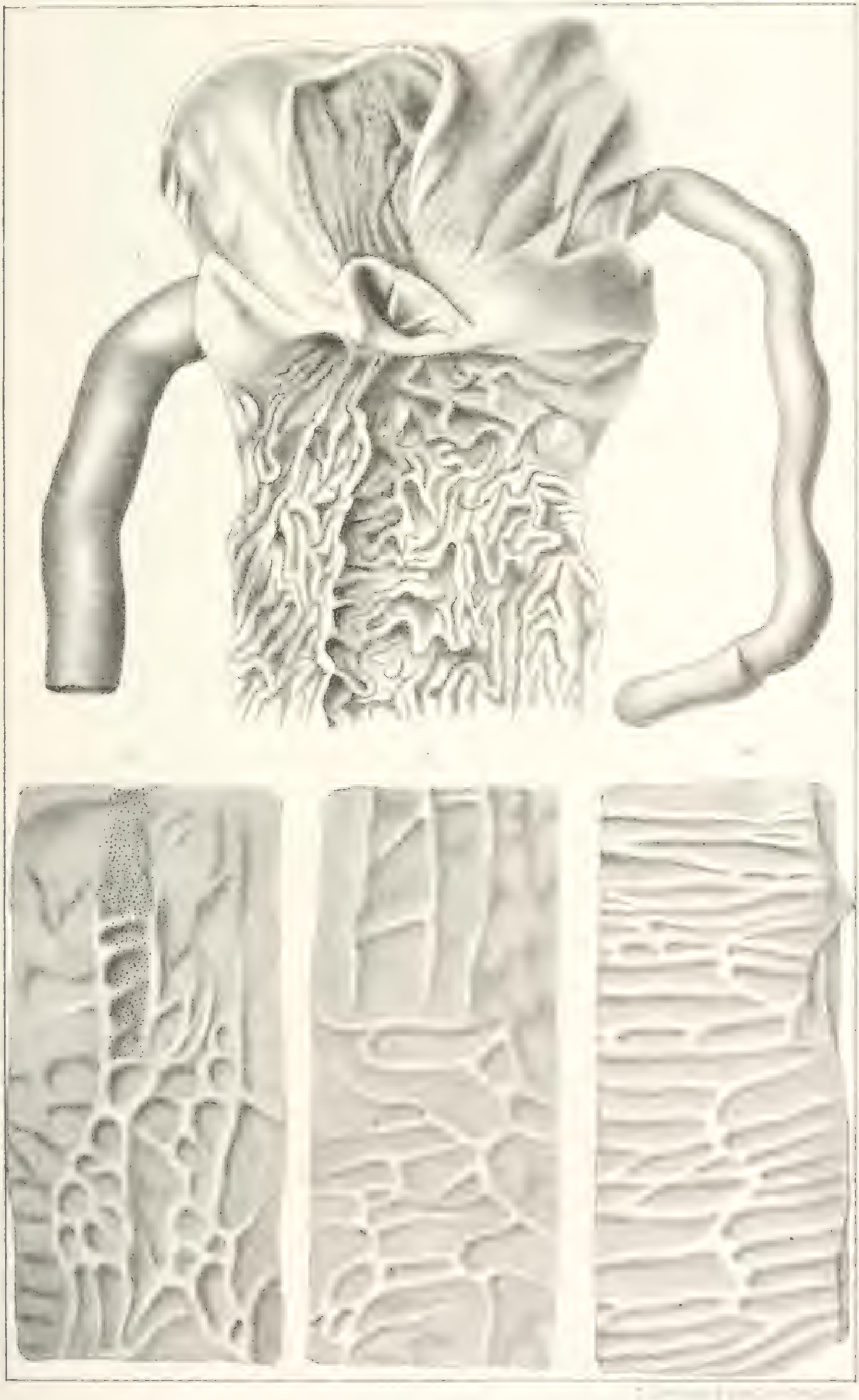

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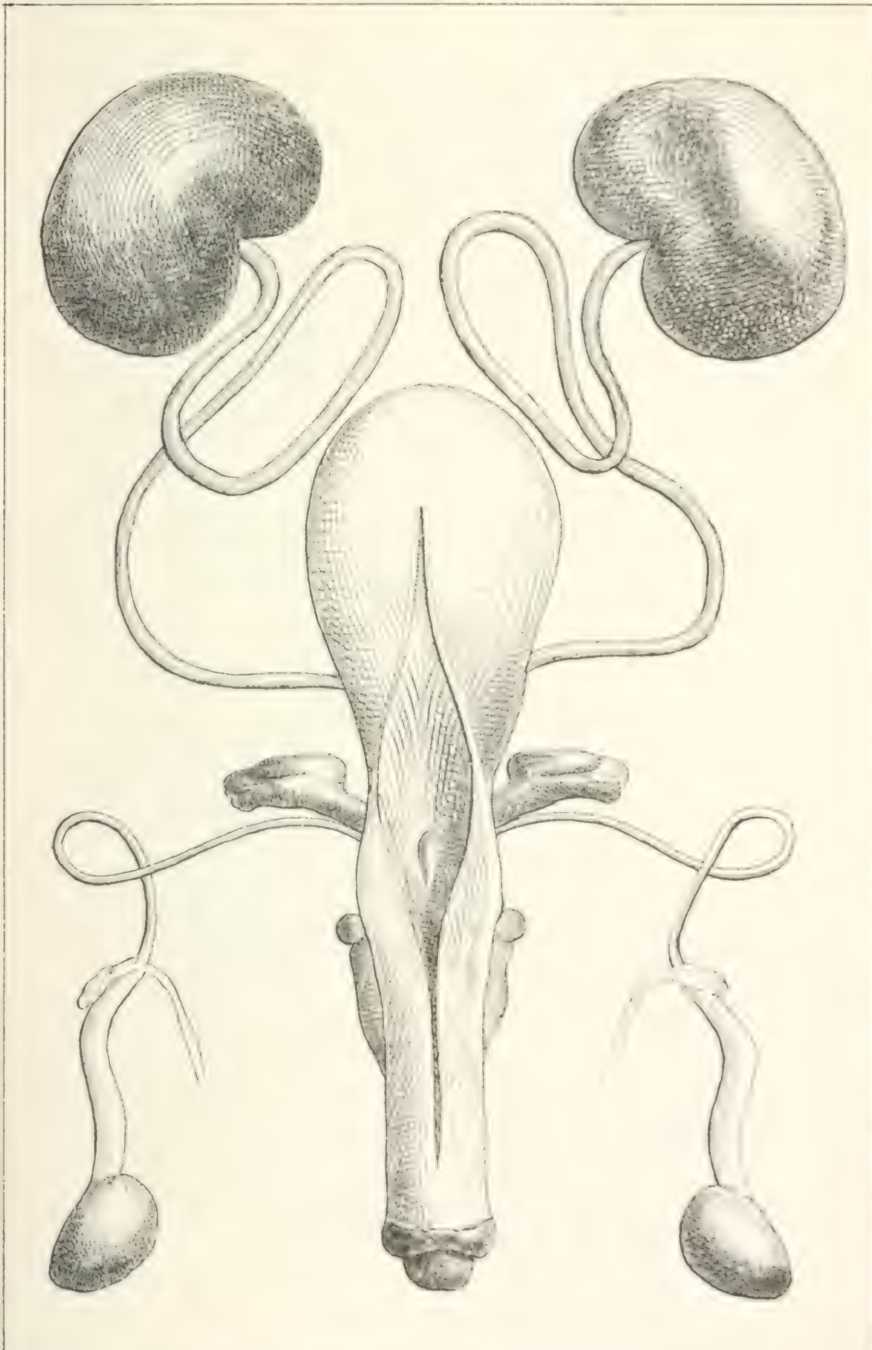

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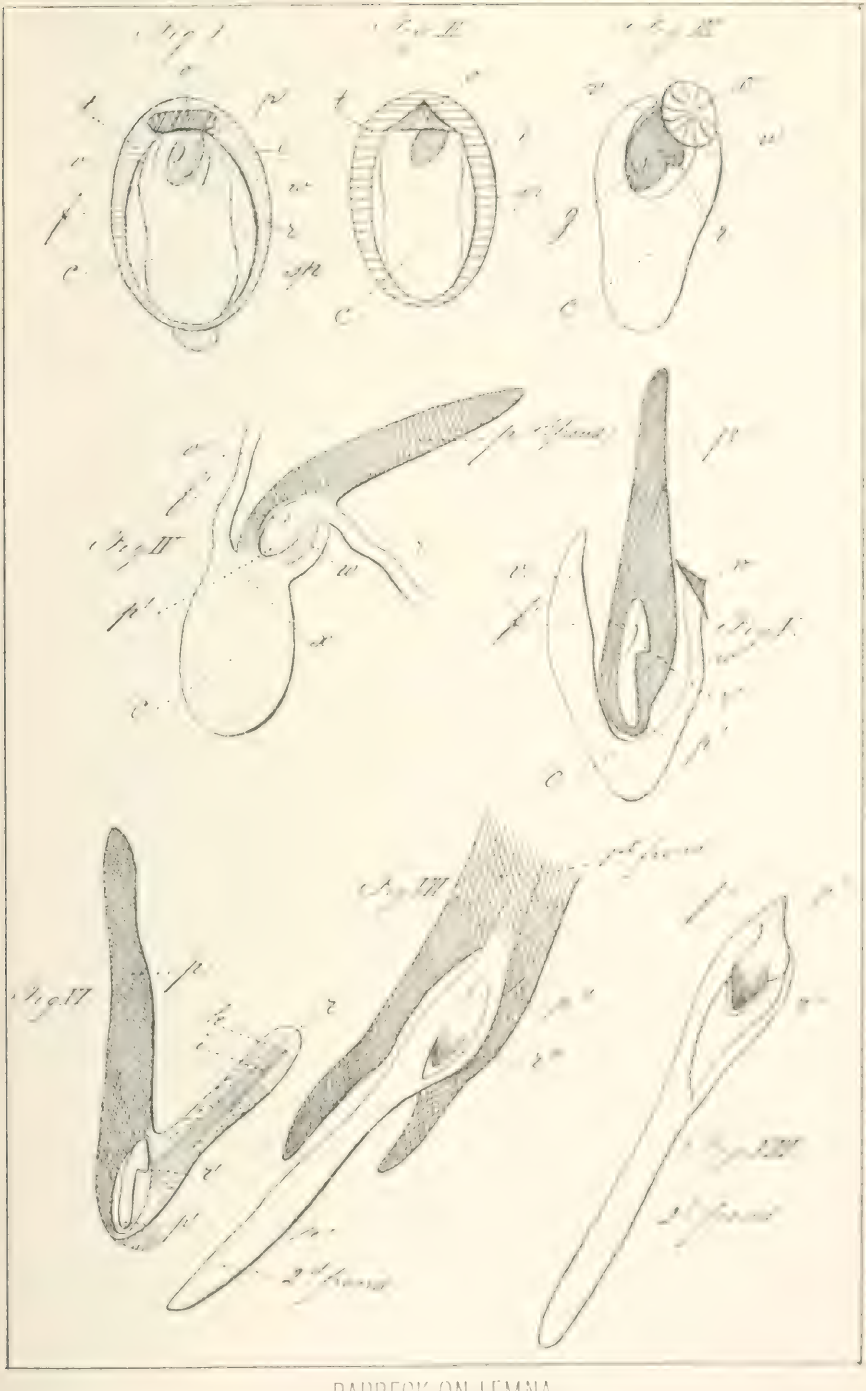
CHAPMAN. ANATOMY OF ORANG OUTANG.



BARBECK ON LEMNA.

whether in past years they had borne burs in this manner or not.

It will be remembered that occasionally in a field of corn the tassel, which is the staminate (male) flower, has a number of grains of corn intermixed. These grains come from pistillate (female) flowers, occurring among the staminate ones; thus it may be observed that our chestnut tree is not the only instance of deviation from the regular laws of development. It has been argued that a want of nutrition will account for this and similar instances, but the healthy appearance and vigorous growth of the trees in question is not such that a lack of nutrition can well apply.

Mr. Thomas Meehan remarked that he believed instances of the changes of flowers normally of one sex to the other, were occasionally met with, though he could not refer to many without further thought or investigation, but it occurred to him just then that it was not unusual for some normally male spikes in *Carex* to have female flowers among them. He had himself seen well developed ovariums among the aments of *Populus alba*, and the case of female flowers among the male catkins of willows, was well known to teratologists. Reference had been made to his papers on sex as influenced by nutrition. His view of sex, as well known, was that in the earlier stages, between the cessation of vegetative growth and reproductive growth, a vegetable cell might be either male or female, and that the power of that cell to assimilate nutrition, involved the question of sex. If a full supply was received, the female form resulted; if limited, the male was produced. In most cases this assimilative power influenced only the branches or cells in the immediate vicinity of the flowers. There might be no difference in the cells of the whole plant in a general way to avail themselves of a full supply of nutrition. He did not know that there was greater vegetative strength in the plant of Maize, which bore some females among the "tassels" or males, than there was in the normal plant. There certainly was no difference in the vegetative strength of plants of separate sexes in many classes of plants. But there were instances which proved that the whole individual plant was influenced by laws of nutrition when the question of sex was involved. The female Hemp, the female Spinage, the female Croton, when the plants were wholly bi-sexual, were cases he could readily call to mind where vegetative vigor favored the whole plant.

The common *Ambrosia artemisiæfolia*, which often grows so thickly over cultivated fields as to appear as a regular farm crop, each plant fighting for nutrition with its neighbor, produces almost wholly male blossoms; the few females are found at the base of the male spikes. But when we go to the maize or the potato fields, where the plants are few and well fed, we may any time find plants which have a great abundance of female flowers,—indeed, sometimes plants which are wholly female.

In the case of these chestnuts he would not say it was a want of nutrition which made these normally male flowers become female. That was not his view of the case. On the contrary, it was that better nutritive advantages prevailed to influence the female sex, and these long spikes of chestnut fruit proved the fact rather than interposed an objection. It was a simple and uncontroverted fact that these young chestnuts were being nourished, were imbibing nutrition, while if they had been normal male flowers, they would have been dead months ago. It was evident to the senses that nutrition was in the end involved, and we only had to consider at what point of early cell life its influence was felt. The old idea would probably be that the question of nutrition followed the "fiat" which made sex, while his views deduced from the numerous facts he had published on the question, were that nutrition, in its various phases, was itself the law-maker. As to the greater power behind this, which decreed that this should be the law, and that the law should produce such even divisions in the proportion of the sexes, it was another question. He only claimed that his discoveries had brought us a step nearer to this greater cause.

NOTE.—I have since learned through an old resident in the vicinity, that the large tree has borne such burs for many years, and that it is known throughout the neighborhood as the "he" tree.—I. C. M.

OCTOBER 12.

The President, Dr. RUSCHENBERGER, in the chair.

Thirty-five persons present.

OCTOBER 19.

Dr. R. S. KENDERDINE in the chair.

Twenty-eight persons present.

The Publication Committee reported in favor of publishing the following papers in the Journal of the Academy:—

"The Parasites of the Termites," by Jos. Leidy, M. D.

"Remarks on Bathygnathus orientalis," by Jos. Leidy, M. D.

October 26.

The President, Dr. Ruschenberger, in the chair.

Nineteen persons present.

The deaths of Dr. Chas. H. Budd and of Joshua Lippincott, members, were announced.

Samuel R. Knight, M. D., and Rev. Wm. F. C. Morsell were elected members.

November 2.

The President, Dr. Ruschenberger, in the chair.

Twenty-four persons present.

Rain Trees. Note on Yucca gloriosa.—Mr. Thomas Meehan referred to a branch of *Yucca gloriosa*, exhibited a few evenings ago, taken from a plant growing in his garden, and which had flowered during September, the usual period for blooming near Philadelphia. Walking through his garden with Mr. Isaac C. Martindale, the latter had called his attention to moisture which covered the whole outer surface of the flowers, and collected in drops at the drooping apices of each leaf of the perianth. The plant was within a few days of going wholly out of bloom, but during these few days the exhibition of moisture continued, and the appearance of the leaves beneath showed that the dropping of liquid had been going on for some time, and perhaps during the whole flowering season. There was no perceptible sweetness in the liquid, but the presence of ants indicated that it might possibly have a slightly saccharine character, though not sensible to the human tongue. It was difficult to decide whether this liquid was an exudation from the leaves of the perianth or was simply an exercise of the power of condensing moisture in the atmosphere which some plants possessed, notably the *Pithecelobium Saman*, Benth., famous as the "Rain-tree" of Peru, which watered its own roots by the moisture condensed from the atmosphere, thus enabling the tree to live in almost rainless regions, if the reports of travelers are to be fully credited. He hoped to make further observations on the Yucca another year.

November 9.

The President, Dr. Ruschenberger, in the chair.

Twenty-four persons present.

The resignation of Mr. Geo. Vaux as a member of Council was read and accepted.

NOVEMBER 16.

The President, Dr. RUSCHENBERGER, in the chair.

Forty-two persons present.

The death of Alexander Wilcocks, M. D., a member, was announced.

The following was unanimously adopted:

Resolved—That the thanks of the Academy of Natural Sciences of Philadelphia be presented to Mrs. Isaac Hays for Waugh's excellent portrait of the late President, Isaac Hays, M. D., whose labors and influence during more than sixty years contributed largely to promote the interests of the society.

Diœcism in Andromeda Catesbæi, Walter.—Mr. THOS. MEEHAN remarked that in 1867 he had reported to the Academy the diœcism of *Epigæa*, and he believed this had stood so far the only case of unisexuality reported in the whole of the large order Ericaceæ. He said he had now to add another in *Andromeda Catesbæi* of Walter, of which he exhibited specimens gathered last year on the Catawba River, in North Carolina. In the course of many days' journeyings he had the opportunity of examining numerous plants in many different districts, and they were all either wholly sterile or wholly fertile in separate plants, as in the specimens exhibited. Occasionally, as often seen in diœcious plants, a few capsules would be found on the sterile plants, but he could not say whether the seeds in them were perfect.

Mr. Redfield inquired whether Mr. Meehan had examined the flowers, and found intermediate stages of development in the sexual organs?

Mr. Meehan replied, that the plants were out of flower when observed; that it was the abundant fertility in some plants, and absolute sterility in others that had attracted his attention. From the remains of the few faded flowers he could find on the plants the stamens appeared perfect on the staminate plant, with no trace of pistil or ovarium, while in the fertile plants no trace of stamens could be found about the remains, though it is probable from analogy in *Epigæa*, these organs in the fresh flowers would be found to exist in a rudimentary state.

On Fresh-water Sponges.—Mr. POTTS, continuing the subject of American forms of fresh-water sponges treated of some weeks ago, said that the number of species noticed during the few months in which they had claimed his attention gave some reason to believe that the Order *Spongida* has many more representatives in our fresh waters than has been generally supposed.

On a former occasion he had described three species of *Spongilla* from a small stream near Philadelphia, one of which, then named *S. tentasperma*, but which he now preferred to call *S. tenosperma*, exhibited features so exceptional as almost to claim for it generic distinction.

He had since found the *S. fragilis* of Leidy plentifully in the Schuylkill river below the dam, (Leidy's original locality), and above the dam a lacustrine form differing from that before alluded to. A very slender green species creeping along stems of sphagnum, etc., had been received from a swamp near Absecom, N. J. As it appeared to be entirely without spined spiculæ of either class, he proposed for it the name *S. aspinosa*.

From the Adirondack lakes a beautiful species, believed to be identical with *S. stagnalis*, Dawson, had been received through the kindness of Prof. H. Allen. Another lacustrine form which yet is not quite *S. lacustris*, was brought from the lake near Catskill Mountain House by Professors Cope and Hunt. Its status has not been fully determined.

From the cellar of an old ruin at Lehigh Gap, Pennsylvania, he had obtained four species, all of which appeared to be new. These were all thin, creeping or encrusting sponges, three of them of the birotulate type, briefly described as follows:

S. argyrosperma—seed body or sphærulæ, large, silver-white, densely covered with radial spiculæ, the shafts of which are long, stout, with numerous long spines, straight or curved; the rotulæ at each end being replaced by 1–4 strong recurved hooks.

S. repens—found creeping over the stems and leaves of *Potamogeton;* sphærulæ also closely covered with spiculæ, shorter and more slender than those of the preceding species; their shafts nearly smooth, the rays of the rotulæ, six, eight or more, uniformly incurved like the ribs of an umbrella.

S. astrosperma—the sphærulæ have the appearance of being much smaller than in either of the former species, which is probably due to the fact that the birotulate spiculæ surrounding the real capsules are very short; the length of the shaft being less than the diameter of the rays. They are rather sparsely scattered over the surface of the nearly transparent sphere, suggesting the name star-seeded.

The remaining form is considered a variety of *S. fragilis*, and called *minuta;* sphærulæ much smaller than in the type species, the dermal and superincumbent spiculæ terminated by sharp points, while in the other they are universally truncate or rounded.

A more particular description with measurements, etc., is intended.

Mr. Ezra T. Cresson was elected a member of Council, to fill the vacancy caused by the resignation of Mr. Geo. Vaux.

NOVEMBER 23.

The President, Dr. RUSCHENBERGER, in the chair.

Thirty members present.

NOVEMBER 30.

The President, Dr. RUSCHENBERGER, in the chair.

Thirty-six persons present.

Note on the Seed-vessels of Wistaria.—Mr. THOMAS MEEHAN remarked that most persons knew that special temperatures were required to insure the germination of various seeds. The common chickweed germinated at a little above freezing point, while one of 70° was required by most palms. Heat and moisture had also a varying influence on the opening of seed-vessels, some requiring more or less than others. He exhibited some seed-vessels of *Wistaria sinensis* and *Wistaria frutescens*, to illustrate the point. A box, four inches deep, with some seed-vessels of Chinese Wistaria was placed on a shelf in a cool room. A fire happened to be made in the room and kept up all night, and the next morning the capsules had burst, and scattered the seeds and open vessels about the room. So great was the force of the expansion that some seeds were projected ten feet from the box. One large seed-vessel had been lifted before opening by one or more beneath, over the four-inch side of the box, and had fallen on the ground at least two feet away from the box in a horizontal line. The few that had been thrown on to the floor by the explosion of their companions did not open, owing to the difference in the temperature of the floor from that of the shelf. Five seed-vessels of each of the two species were then placed together on the shelf, where the temperature of the atmosphere was about 45°. After four days they were examined. The American species had all opened, but without expelling the seeds, which were still attached to the carpel; but those of the Chinese Wistaria were still unopened. The Chinese Wistaria required a much higher temperature to open the capsules than the American, though it might be that hygrometrical conditions would vary the exact degree required.

Mr. Martindale observed that the seed-vessels of the Chinese Wistaria were much more indurated and rigid than the American species, and required more force to open them. He had noted that such hard seed-vessels always exerted a greater projectile power when opening.

C. S. Turnbull, M. D., and J. M. Anders, M. D., were elected members.

DECEMBER 7.

The President, Dr. RUSCHENBERGER, in the chair.

Twenty-three persons present.

DECEMBER 14.

The President, Dr. RUSCHENBERGER, in the chair.

Thirty-two persons present.

A paper entitled "On some Lower Eocene Mollusca from Clarke Co., Alabama, with some points as to the stratigraphical position of the beds containing them," by Angelo Heilprin, was presented for publication.

The Phalanges of Bats.—Dr. ALLEN, in reviewing the manner after which the phalanges in mammalia are enumerated, spoke of the propriety of including the terminal cartilaginous tip to the fingers, present in many bats, in the series of phalanges.

Authors do not hesitate in naming the terminal cartilage to the second finger in *Rhinopoma* a phalanx, nor should they, Dr. Allen held, hesitate in so including the terminal segments in other genera. It is interesting to observe that in *Molossus perotis* the terminal joint in the second finger is bony, and anchylosed to the first phalanx. If this plan of numbering the phalanges in bats be accepted, from one to three joints are present in all the fingers. The position taken by recent writers that the Phyllostomidæ are distinguished from other families by the presence of the third phalanx to the third finger cannot be sustained, since this phalanx can be counted in other families, the terminal joint, however, remaining in them cartilaginous.

DECEMBER 21.

The President, Dr. RUSCHENBERGER, in the chair.

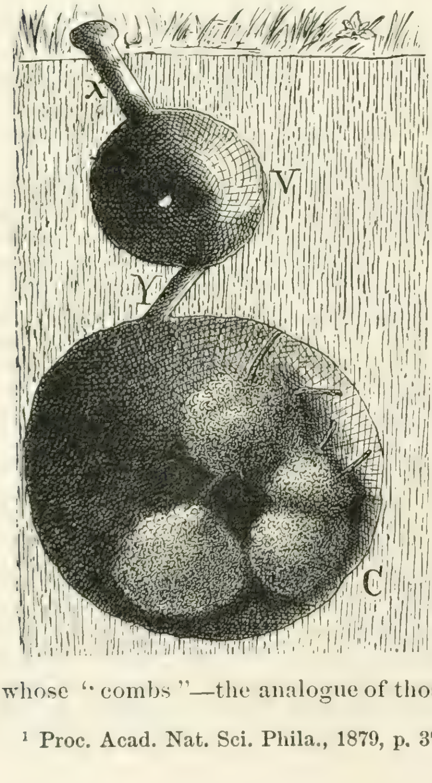
Ten persons present.

Note on a new Northern Cutting Ant, Atta septentrionalis.—Dr. McCOOK remarked that he had the pleasure of announcing an interesting discovery of a species of cutting ant upon the eastern central coast of the State of New Jersey. The discovery was made by Rev. George K. Morris at a new watering place called Island Heights, which is located upon a swelling bluff on the northern bank of Tom's River, near its mouth, three miles from the Atlantic Ocean, in about Lat. 40° N.

Mr. Morris, who has been much interested in noting the habits of ants, observed this species carrying the needle-like leaves of the pine into their nests, and thereupon followed their behavior until he found it to be quite like that of the cutting ant of Texas, *Atta fervens*. Dr. McCook having been informed of the above discovery, made a journey to Island Heights in the early part of September, 1880. Unfortunately a severe eastern storm set in before the train reached Tom's River, and continued during his stay with such rigor as utterly to preclude observation of the out-door behavior of the ants. However, by working in the storm, protected by rubber garments and a temporary shelter, he was able to make a study of the internal architecture of a nest.

The opening from the surface appeared to be a single narrow tubular gallery, *X*, of about two inches in length, which penetrated the ground at an angle of near 45°, and entered a spherical chamber, *V*—a sort of vestibule—about $1\frac{1}{2}$ inches in diameter. Within this a few ants were found, nothing more.

This vestibule communicated by a short gallery, *Y*, with a second chamber or cell, *C*, having generally a spherical shape, but more irregular in outline than the vestibule. It was about 3 in. in diameter. Within this were several small masses of an ashen-gray, fibrous pulp or papery material, closely resembling that found by him in the large cells or caves of the Texas cutting ant.[1] This was evidently the leaf-paper formed by the manducation of the pine leaves. It was exceedingly fragile, even more so than the leaf-paper of the Texas Atta, and could not be kept together in the original mass for examination. It appeared, however, to be without the decided cellular arrangement first observed by him in the leaf-paper of the Texas ant, whose "combs"—the analogue of those of other hymenopters, as



[1] Proc. Acad. Nat. Sci. Phila., 1879, p. 37.

the bee and wasp—were composed of irregular hexagonal cells of various sizes.

None of these leaf-paper masses exceeded an inch in height; they lay upon the floor of the cave, *C*, or were upheld by the filamentous rootlets which penetrated within the hollow, or, more properly speaking, around which the cave had been formed. In this respect also the habit of the northern ant resembles that of the southern. Although, as said, the out-door behavior of the ant could not be observed by Mr. McCook, the insects having all been driven in-doors by the storm, these were observed to some extent by Mr. Morris, the discoverer, during the summer. Mrs. Mary Treat also visited the Heights and noted the same. From verbal reports received from these persons the analogy between the two insects, in respect of gathering and transporting leaves, appears to be quite close. There are many points, however, which remain to be determined accurately, which it is to be hoped will be done next summer.

The following account was communicated to the speaker by Mr. Morris, and is incorporated, by his permission, in this note:—

"In answer to your questions I would say, when first observed, there were two columns, one going each way, and moving very deliberately. If alarmed by any rudeness on my part, they sought safety by remaining perfectly motionless for some time, making it difficult to find them, as they are nearly the color of the dry leaves.

"Those in the column going homeward were carrying little pieces of the pine needle or leaf, cut from seedling plants about 2 inches high and upwards. In some instances the piece of leaf was not as long as the ant itself, but in others it was longer than the bearer. The appearance presented by the column was very singular, for instead of carrying their burdens as other ants do, so far as I have observed, they bore the load on the head, resting in a saddle-like, V-shaped space between ridges on the head, running from the base of the mandible on each side to tne top of the head. One end was held firmly by the mandibles. The effect at a little distance was to give them a 'shoulder arms' appearance.

"Tracing the column back, I readily found their foraging ground a few feet from the formicary. There were the remains of several seedling pines which had been stripped and cut down nearly to the ground. Some ants were at work on the only one left standing, and I enjoyed the pleasure of witnessing their operations. There lay on the ground a few pieces, which were picked up, as I watched, and carried away. On the plant there were two at work cutting. Climbing out on a leaf to a position near the end, the ant applied her mandibles, and moved around as she cut, until the piece was severed, when she repeated the process, in most cases allowing the severed pieces to fall. One cutter held on to her last cutting, backed down with it, and started off home. In no instance have I ever found one of these ants carrying a load of any kind in any other way than as described above. Your account of the Texas ant would answer as well for this.

"The little leaf-cutters at Island Heights have no mounds at the entrance to their formicaries. I found many nests, but none with a mound. The sand pellets in every case where I found ants at work were carried off several inches distant on every side and scattered, as if for secrecy. The ants' movements were exceedingly deliberate, always. Some seemed overloaded and rested often, but never laid down their load.

"All the colonies were comparatively small. I was unable to find any indication that they were connected one with another.

"There is not, so far as my observations go, any elaborate opening and closing of gates, such as you describe, but in wet weather I usually found a leaf over the entrance to their nest.

"The architecture of their caves is a miniature copy of that of your Texas cutting ant.

"I found them cutting only the pine leaf and the leaf of a small shrub called Cow Wheat (*Melampyrum americanum*). Of this plant they took the petals also. They carried the dry curled leaf as well as the green and freshly cut.

"They also carry and incorporate into the nest material the droppings of certain larvæ that feed on oak leaves."

Mr. Morris observed at the same place a second and larger form of leaf-cutting ant, which he thinks to be a distinct species; but as he was not able to point out any of the nests to Mr. McCook and has not yet made thorough examination, this point remains to be solved.

The ant whose economy is described above closely resembles the famous *Atta fervens* of our southern regions, having the same leaf-brown color and the same characteristic spines. It is distinguished by a black longitudinal band along the median dorsal part of the abdomen, and by a similar band along the middle part of the face, marking the furrow formed by two ridges, the prolongation (apparently) of the antennal ridges to the vertex of the caput. A double row of spines extends along the entire thorax and nodes, expanding at the prothorax into about four. Two castes of workers were found, appearing to be the workers major and minor, in length respectively 4 and 3 millimetres, or about one-sixth and one-eighth of an inch. The species appears to be new, and Dr. McCook at least ventured conditionally to name it the Northern Cutting Ant—*Atta septentrionalis*.

The discovery at so northern a point of this species, with habits quite identical with those of tropical congeners, seemed to the speaker to be a remarkably interesting fact in the distribution of our ant fauna. He was at once impressed by the striking contrast between the vast myriads of workers, the extensive excavations, and the formidable and vigorous activities of the Texas colonies, and the small numbers, slight excavations and apparently sluggish movements of their northern allies. And he could not forbear the thought that these New Jersey communities of *Atta septentrionalis* seemed like the feeble remnant of a vigorous race left or thrust by some untoward change upon unfavorable sites, which must work toward their extinction.

DECEMBER 28.

The President, Dr. RUSCHENBERGER, in the chair.

Eighty persons present.

The following papers were presented for publication :—

ON SOME NEW LOWER EOCENE MOLLUSCA FROM CLARKE CO. ALABAMA, WITH SOME POINTS AS TO THE STRATIGRAPHICAL POSITION OF THE BEDS CONTAINING THEM.

BY ANGELO HEILPRIN.

The following species of fossil mollusca, for which I am indebted to Dr. Eugene A. Smith, State Geologist of Alabama, were obtained from sections exposed in that State on Knight's Branch and Cave Branch, tributaries of Bashia Creek (Clarke Co.), and from Wood's Bluff on the Tombigbee River, near the mouth of Bashia Creek, and some twenty-eight miles north of St. Stephen's. They occur in probably the oldest marine tertiary deposits of the State, and occupy a horizon nearly parallel with that which is characterized by the fossils of Upper Marlborough and Piscataway River, Maryland, and Pamunkey River, Virginia. The following enumeration of fossils from the three localities first named, will best illustrate the palæontological relations of the beds containing them toward each other, and to the various Eocene deposits of the Atlantic and Gulf slopes:

Fossils from Knight's Branch.

Astarte tellinoides, Conr. (*Var. A. sulcata*, Lea.)
Cytherea perovata, Conr.
Cytherea Nuttalliopsis, Heilpr. sp nov.
? *Cardita alticosta* (*Blandingi*), Conr.
Corbula rugosa, Lam.
(*C. oniscus*, Conr; *var. C. gibbosa*, Lea.)
Ancillaria (*Ancillopsis*) *subglobosa*, Conr.
Natica ætites, Conr.
Turbinella (*Caricella*) *Bandoni*, Deshayes, sp.
(*Voluta Bandoni*, Desh.)
Lævibuccinum lineatum, Heilpr. sp. nov.
Rostellaria (*Calyptrophorus*) *trinodifera*, Conr.
Solarium cupola, Heilpr. sp. nov.
Fusus interstriatus, Heilpr. sp. nov.
Fusus sub-tenuis, Heilpr. sp. nov.
Fusus (*Strepsidura*) *subscalarinus*, Heilpr. sp. nov.
Tornatella (*Tornatellæa*) *bella*, Conr.
Ostrea.
Cylicosmilia.

Fossils from Cave Branch.

Dentalium micro-stria, Heilpr. sp. nov.
Natica ætites, Conr.
Natica Mississippiensis, Conr.
Pyrula multangulata, Heilpr. sp. nov.
Pyrula tricostata, Desh.
Turritella carinata, Lea.
Solarium cupola, Heilpr. sp. nov.
? *Pleurotoma acuminata*, Sowerby.
Pleurotoma moniliata, Heilpr. sp. nov.
Cassidaria (fragment). Closely allied to *C. carinata*, Lam.
Voluta (*Athleta*) *Tuomeyi*, Conr.
Fusus pagodiformis, Heilpr.
Fusus interstriatus, Heilpr. sp. nov.
Fusus subtenuis, Heilpr. sp. nov.
Fusus (*Strepsidura*) *subscalarinus*, Heilpr. sp. nov.
Leda protexta, Conr.
Cardium (*Protocardia*). Young of *C. Nicolleti*? Conr.
Ostrea (same species as from Knight's Branch).

Fossils from Wood's Bluff.

Dentalium micro-stria, Heilpr. sp. nov.
Natica limula, Conr.
Pyrula multangulata, Heilpr. sp. nov.
Turritella carinata, Lea.
Solarium cupola, Heilpr. sp. nov.
Solarium delphinuloides, Heilpr. sp. nov.
Cancellaria evulsa, Brander, sp.
(*C. tortiplica*? Conr.)
Pleurotoma (*Cochlespira*) *cristata*, Conr.
Pleurotoma, n. sp.
Ancillaria (*Ancillopsis*) *subglobosa*, Conr.
Pseudoliva vetusta, Conr.
Pseudoliva scalina, Heilpr. sp. nov.
Voluta (*Athleta*) *Tuomeyi*, Conr.
Fusus pagodiformis, Heilpr.
? *Fusus* (*Levifusus*) *trabeatus*, Conr.
Fusus interstriatus, Heilpr. sp. nov.
Fusus, n. sp.
? *Cardita alticosta* (*Blandingi*), Conr.
Leda protexta, Conr.

Pecten Poulsoni, Morton.

Ostrea (species different from that of Knight's Branch and Cave Branch.)

From an examination of the above tables it will be seen that a fair proportion of the fossils from Knight's and Cave Branches are held in common by both deposits, and therefore there can be no reasonable doubt that they represent about equivalent horizons. Of the hitherto undescribed forms *Cytherea Nuttalliopsis* and *Lævibuccinum lineatum* appear to have been obtained only at the former, and *Pleurotoma moniliata* at the latter locality, although it is highly probable that further investigation will reveal their mutual presence in both localities. The described American forms are mainly those occurring at various heights on the Claiborne exposure. A comparison of these forms with those obtained by Tuomey (First Biennial Report of the Geology of Alabama, p. 146) from the Bashia Creek sections near Choctaw Corner, shows the two groups to be of a contemporaneous age, for from bed No. 2 of that section Prof. Tuomey obtained (among others) species of "*Ostrea*, *Cytherea*, *Cardita*, *Cardium*, *Rostellaria*, *Actæon*, *Voluta*, *Infundibulum*, and *Solarium*," which appear to have been identical with the species obtained by Dr. Smith from the two localities above mentioned.[1]

[1] The species enumerated by Tuomey are *Ostrea compressirostra*, *Cardita planicosta*, *Rostellaria velata*, *Actæon pomilius*, *Voluta Sayana?* *Cardium Nicolleti*, and *Infundibulum trochiformis*. The specimens appear to have been submitted to Mr. Conrad, who considered the determinations of Tuomey as, at least in part, imperfect, and substituted the following specific names (*Am. Journ. Science*, new series, xl, p. 266): *Ostrea Carolinensis* (species from the Santee Canal, South Carolina), *Volutilithes* [*Athleta*] *Tuomeyi* (described by Conrad [Proc. Acad. Nat. Sciences, vi, p. 449] in 1853 from Bashia Creek), and *Protocardia Virginiana?* The following remark in pencil occurs in the volume of Toumey's Reports, contained in the library of the Academy: "All doubtful except *Venericardia planicosta*. T. A. Conrad." Tuomey's *Rostellaria velata* and *Actæon pomilius* were in all probability *Rostellaria trinodifera* and *Tornatella bella*, which would better agree with the descriptions of obviously the same fossils as given in Hale's report (C. S. Hale: The Geology of South Alabama, Am. Journ. Science, new series, vi, p. 355).

SECTION ON BASHIA CREEK.

1	Hard Limestone.	4 feet.
2	Marl, highly fossiliferous.	25 feet.
3	Blue Sand.	Variable.
4	Lignite and Clay.	6 feet.
5	Laminated Clay, Sand and Mud.	Thickness undetermined.
6	Lignite.	Thickness undetermined.

(Tuomey: First Biennial Report, p. 145.)

NOTE.—Beds 5 and 6 do not properly belong to the section, but "represent beds seen on another part of the stream below the preceding." (*Loc. cit.* p. 146.)

The fossils from Wood's Bluff, some 15 miles W. of Choctaw Corner, were obtained by Dr. Smith from a bed of indurated green sand rising about 10–15 feet above water line, which bed may possibly represent the lowermost portion of bed No. 2 of the Bashia section. Some support is given to this view by the circumstance that at this point—Wood's Bluff—the basal lignite (which in the above named section has a thickness of 6 feet) has disappeared, and more especially (at least, as showing it to possess a distinctive character) by the general facies of the representative molluscous fauna. Although there exists a close similarity between the general assemblage of its fossils and those of the two "Branches" of Bashia Creek, yet the number of peculiar forms is considerably greater, and consequently the aggregate possesses a much more decided individuality than obtains with either of the deposits in question. Moreover, I am informed by Dr. Smith that the fossil fauna of Knight's and Cave Branches corresponds most closely with that of bed No. 4 [1] of the Wood's Bluff section, an aluminous deposit about 21–26 feet above water level, and containing species of *Dentalium*, *Tornatella*, *Solarium*, *Turritella*, and *Rostellaria* identical with forms from the two first named localities. The disappearance of the basal lignites at Wood's

[1] Section as yet unpublished, but communicated by letter to the author.

Bluff may be accounted for on the supposition that they have dipped under, which would be in harmony with what we know concerning the dip of the beds in this region. This is but locally or at best, but partially indicated in Tuomey's reports, but judging from the contour lines of the cretaceous formation on the general maps appended to the first and second Reports, and from the north and south sections on the map of 1849, as well as from the facts obtained in Mississippi, it must be in a direction west of the southern line, or in other words, S. by W. Dr. Smith has found the loss by dip in a southerly direction on the Tombigbee River to be about 10 feet to the mile, which accords well with Hilgard's observations on the Upper Eocene and Oligocene formations of Mississippi.[1]

From palæontological evidence alone the three exposures in question might readily be taken to represent rather an Upper than a Lower Eocene horizon, for in addition to the species typical of the American Middle Eocene, or Claiborne group proper (Calcareous Claiborne of Hilgard), and to the new or undescribed forms, we have the following which have not been hitherto recognized as belonging to the formation, and which, on the contrary, were originally described (at least the majority of them) from deposits of newer date.

Caricella (Voluta) Bandoni, Deshayes, sp. (*Animaux s. Vertébr., Bassin de Paris*, II, Pl. 102, figs. 13 and 14), from the "calcaire grossier," Middle Eocene of most geologists, Upper Eocene of Judd. Knight's Branch.

Natica Mississippiensis, Conrad (J. A. N. S. 2d series, i, p. 114), originally described from the Vicksburg (Oligocene) group, but also found in the Jackson (Upper Eocene) deposits. Cave Branch.

Pleurotoma acuminata, Sowerby (Mineral Conchology, Vol. ii, p. 105), from the London Clay of Highgate (Lower Eocene of most geologists, Middle Eocene of Judd), and Barton clay (Upper Eocene)? (I have had no specimens of this species with which to institute direct comparisons, but from a careful examination of Sowerby's and Edwards' figures and descriptions there appear to me to be no justifiable grounds for separating the species figured on Pl. 20, fig. 10, from its European ally. Cave Branch.

Pyrula tricostata, Deshayes (*Coquilles Fossiles*, ii, p. 584), from Rétheuil and Cuise-Lamothe, Middle Eocene (Suessonian of d'Orbigny). Cave Branch.

[1] Hilgard found the dip of the Jackson and Vicksburg strata to be from 10 to 12 feet per mile S. by W., at "points where the great regularity of succession for a considerable distance seemed to indicate a normal contiguration." (A. J. Science, new series, xliii, p. 36.)

Pecten Poulsoni, Morton (Synopsis Org. Rem. Cret. Group, p. 59), a companion of *Orbitoides Mantelli,* Mort. sp., and, according to Hilgard, an *essentially* Vicksburg (Oligocene) fossil. Wood's Bluff.

Cancellaria evulsa, Sowerby [*Buccinum evulsum,* Brander] (Miner. Conchol., iv, p. 84), from the Barton clay (Upper Eocene) of England, and Grignon ("Calcaire grossier") of France.[1] Wood's Bluff.

Pleurotoma (Cochlespira) cristata, Conr. (J. A. N. S., 2d ser. i, p. 115), originally described from the Vicksburg group, but doubtful whether differing from the *Pleurotoma bella,* Conr., from the Upper Eocene of Texas. Wood's Bluff.

In addition to the above, there is among the fossils from Wood's Bluff an immature *Cardium* (*Protocardia*), which may possibly represent the young of *C. Nicolleti* (Jackson group), with which it agrees in outline and general ornamentation, or that of *C. Virginiana,* Conr. (Pamunkey River), an undescribed species, but of which a labeled specimen is in the collections of the Academy. The absence of asperulations on the posterior slope of the specimen in question, however, rendering it uncertain whether they were ever present, or whether they are merely abraded or water-worn, allows of no absolute specific determination.

Whatever may be the palæontological facies of the deposits in question, however, there can be no reasonable doubt as to their true position, since Dr. Smith, as he informs me, has traced bed No. 6 (or the uppermost bed immediately underlying the stratified drift) of his Wood's Bluff section to the mouth of Witch Creek, about 2 miles below on the Tombigbee River, where its relation to the overlying "Buhrstone" is made manifest in an exposure just beyond the mouth of the creek. White Bluff, about 250 to 275 feet in height, beautifully exhibits the white siliceous clay stones and silicified shells so characteristic of the southern Buhrstone formation. These occupy the uppermost portion of the bluff, and make up fully 100 feet of its vertical height; the intermediate portion extending to the water's level, is mainly composed of laminated lignitic clays, with occasional intercalated beds of pure lignite. It becomes manifest from what has just been stated that the fossiliferous beds of Wood's Bluff (*et conseq.* the equivalent deposits on Knight's and Cave Branches and Bashia Creek) must be between 150 and 200 feet below the *base* of the Buhrstone

[1] A very closely allied species, the *Tritonium*(?) *paucivaricatum* of Gabb, occurs in the Téjon group (Upper Cretaceous—Eocene?) of California, associated with *Cardita planicosta* and other characteristic forms of Tertiary fossils.

(Siliceous Clairborne of Hilgard) formation, or what has hitherto been considered as the base of the Eocene formation in South Carolina. Allowing a uniform southerly dip of 10 feet to the mile, these same beds must be about 250 to 280 feet below the "bed of green sand" mentioned by Tuomey (1st Biennial Report, p. 148) as occurring at Baker's Bluff, a few miles above St. Stephens, (stated to be "rich in organic remains, identical with the fossils of Claiborne") and which, immediately above St. Stephens (Tuomey, *loc cit.*, p. 149), dips beneath the water-line. This approximate determination of position agrees closely with the observations made in the northeastern portion of the county, for Dr. Smith found by actual barometric measurements that the "chalk hills" (Buhrstone) near Lower Peach Tree on the Alabama River, and at a locality about 7 to 8 miles south of Choctaw Corner, were about 250 feet above Knight's and Cave Branches, and the marl bed (No. 2) of Tuomey's Bashia section.

Whether these older Eocene deposits underly the bluff at Claiborne has not yet been proved, but it is but fair to presume that they do. Likewise, it remains to be shown what relation the basal lignite on Bashia Creek bears to the "Northern Lignite" of Hilgard.

CYTHEREA, Lam.

Cytherea Nuttalliopsis, n. sp. Pl. 20, fig. 1.

Shell sub-elliptical, moderately ventricose, its surface covered with fine concentric striæ, which are apt to become roughly imbricate on the basal margin; umbones not very prominent, rather anterior; lunule cordate, deeply impressed at about its middle, its outline clearly pronounced by a sharply impressed line; posterior extremity regularly rounded, the anterior somewhat produced; margin entire; pallial sinus somewhat angular, pointing toward the centre of the shell.

Length, 1½ inch. Knight's Branch, Clarke Co., Ala.

This species most resembles among American species of *Cytherea* the *C. Nuttalli*, Conr., from which it may be distinguished by the greater production forward of the anterior extremity, and by the median depression in the lunule. In this last character it agrees with *C. Poulsoni*, Conr., from which, however, it very materially differs in form, and in the much lesser development of the umbones.

PSEUDOLIVA, Swainson.

Pseudoliva scalina, n. sp. Pl. 20, fig 12.

Shell bucciniform, of about seven volutions; the whorls roughly plicated; the folds on the body whorl appearing as shoulder nodules; dentiferous sulcus well pronounced, followed by about five impressed revolving lines, which slightly crenulate the margin of the outer lip; revolving lines on the body-whorl above the sulcus almost obsolete; aperture slightly exceeding the spire in length; columella callous; suture deeply channeled.

Length, $1\frac{1}{2}$ inch. Wood's Bluff, Clarke Co., Ala.

LÆVIBUCCINUM, Conrad.

(Amer. Jour. Conchol., i, p. 21. Genus not characterized.)

Shell having the general form of *Metula*, H. & A. Adams, but destitute of all traces of a posterior canal; aperture between bucciniform and fusiform, about the length of the spire. This genus is distinct from *Buccinanops* of d'Orbigny, under which the *Buccinum* (*Lævibuccinum*) *prorsum*, Conr., is erroneously classed in the *Prodrome de Paléontologie*, ii, p. 369.

Lævibuccinum lineatum, n. sp. Pl. 20, fig. 5.

Shell fusiform, of about seven convex volutions, which are throughout their whole extent covered by fine, but distinct, revolving lines; aperture slightly exceeding the spire in length, sub-canaliculate anteriorly; columella gently arcuate; outer lip striate within.

Length, 1 inch. Knight's Branch, Clarke Co., Ala.

This species mainly differs from the *L. prorsum*, Conr., in having the revolving lines equally distinct over the entire surface of the whorls. The *Murex* (*Fusus et Buccinum auct.*) *mitræformis* of Brocchi, from the Oligocene and Miocene deposits of France, Austria, and Italy, is a closely related species.

FUSUS, Lamarck.

Fusus subtenuis, n. sp. Pl. 20, fig. 4.

Shell fusiform, of about seven sub-angular volutions; whorls ornamented with somewhat obscure longitudinal folds, about twelve on the body-whorl, which are cut by several prominent revolving ridges commencing at the shoulder angulation; shoulder of the whorls more or less smooth, with an obscure median revolving line, and a prominent sub-sutural one; aperture about the length of the spire, or slightly exceeding it, the canal gently curved, moderately contracted, and somewhat expanding at the extremity; outer lip thin, and showing internally the external ornamentation; base with numerous revolving lines, which alternate in coarseness.

Length, $1\frac{1}{4}$ inch. Knight's Branch; Cave Branch, Clarke Co., Alabama.

Fusus interstriatus, n. sp. Pl. 20, fig. 11.

Shell fusiform, slender, composed of about ten convex volutions, the first three of which are smooth; whorls ornamented with both longitudinal plications and revolving lines, the last of which (about eight in the upper whorls) alternate with finer intermediate striæ; the longitudinal plications distinct on the earlier whorls, but becoming much less so on the body-whorl, and the one preceding; aperture about the length of spire; the canal somewhat tortuous; outer lip thin, dentate within.

Length, 2 inches. Knight's Branch; Cave Branch, Clarke Co., Alabama.

Subgenus HEMIFUSUS?

Fusus (Hemifusus?) engonatus, n. sp. Pl. 20, fig. 8.

Shell turreted, of about ten volutions, the first three whorls smooth and convex, the remainder strongly carinated, and traversed by numerous fine revolving lines, which on the median portion of the body-whorl alternate with intermediate finer striæ; body-whorl impressed immediately below the carination (shoulder angulation); lines of growth sinuous, and approximating the characteristic lines of the Pleurotomidæ; aperture considerably exceeding the spire in length; columella slightly arcuate, and presenting a rudimentary fold at about its central portion.

Length, $1\frac{1}{3}$ inch. Wood's Bluff, Clarke Co., Ala.

This species resembles the *Fusus bifasciatus* of Deshayes (*Animaux sans Vertèbres*, *Bassin de Paris*, II, pl. 84, figs. 15 and 16) from the Paris basin, but may be readily distinguished from that species by its more slender form.

Subgenus STREPSIDURA, Swainson.

Fusus (Strepsidura) subscalarinus, n. sp. Pl. 20, fig. 7.

Shell somewhat bucciniform, whorls about eight, sub-angular, the first three or four smooth, the remainder ornamented with both longitudinal costæ and revolving striæ, the latter showing a tendency to alternate in size; the costæ are arcuate, not in a regular continuous series, those on the body-whorl extending considerably below the middle of the whorl; aperture about the length of spire, the canal somewhat reflected; columella covered with a callous deposit, considerably twisted; outer lip dentate within.

Length, 1 inch. Knight's Branch; Cave Branch, Clarke Co., Alabama.

This species greatly resembles the *Fusus scalarinus* of Deshayes (*Coquilles Fossiles*, II, p. 574, Pl. LXXIII, figs. 27 and 28), but may be distinguished by the lesser prominence of its costæ, and by the presence of well defined striæ over the entire surface of the whorls. In this last respect, as well as in the subangulated form of the whorls, it also differs from the *Fusus scalariformis*, Nyst (*Coquilles et Polypiers Fossiles*, p. 504, Pl. XL, figs. 5a, 6), from Lethen, Belgium.

TURBINELLA, Lamarck.

Subgenus CARICELLA, Conrad.

Turbinella (Caricella) Bandoni, Deshayes, sp. Pl. 20, fig. 15.

The large species of *Caricella* from Knight's Branch agrees so closely with the figures of *Voluta Bandoni*, Desh. (*Animaux sans Vertèbres, Bassin de Paris*, II, pl. 102, figs. 13 and 14), from the Paris basin, that I do not feel justified in considering it a distinct species. The American form appears to have been somewhat more elevated, but this is probably no more than a varietal circumstance.

Length, 4 inches. Knight's Branch, Clarke Co., Ala.

PLEUROTOMA.

Pleurotoma moniliata, n. sp. Pl. 20, fig. 9.

Shell fusiform, elevated, of about eight volutions, the whorls considerably contracted above the shoulder; whorls ornamented with a double series of nodes, the lower much the most strongly developed, which gives to the upper portion of the spire a moniliform appearance; surface of entire shell traversed by fine revolving lines, which become more distant, very prominent, and alternate on the median portion of the body-whorl; aperture about the length of spire; the relative position of the upper and lower nodes corresponds to the sinuous lines of growth.

Length, 1 inch. Cave Branch, Clarke Co., Ala.

Pleurotoma acuminata? Sowerby. Pl. 20, fig. 10.

(Mineral Conchology, II, p. 105.)

Shell fusiform, acuminate, of about nine volutions; whorls flattened, longitudinally plicated and traversed by fine revolving lines, which become crowded on the concave upper portion of the whorls, and alternate on the basal portion of the body-whorl; suture bordered inferiorly by an elevated line, which is somewhat crenulated by the sinuous lines of growth; aperture less than one-half the length of shell.

Length, 1 inch. Cave Branch, Clarke Co., Ala.

This *Pleurotoma* corresponds very closely with the descriptions and figures of *P. acuminata* as given by Sowerby in the "Mineral Conchology," and by Edwards in his monograph of the English Eocene mollusca (Palæontographical Society Reports, 1854, p. 230, pl. xxvii, figs. 3*a*, *b*, *c*, *d*), and will probably prove, on direct comparison, to be referable to that species.

PYRULA, Lamarck.

(*Ficula*, Swainson.)

Pyrula multangulata, n. sp. Pl. 20, fig. 2.

Shell elongated, sub-claviform; apex of spire obtuse, consisting of three smooth volutions; whorls about seven, covered with revolving striæ, which are very fine on the upper portion and shoulder of the body-whorl, but less so and attenuate on the basal portion; body-whorl occupying about three-fourths of the entire shell, marked by two prominent and one lesser carinæ, and a single row of crenulations on the shoulder angulation; the fourth whorl (the first one bearing ornamentation) appears cancellated; columella curved.

Length, 1 inch. Cave Branch; Wood's Bluff, Clarke Co., Ala.

Pyrula tricostata, Deshayes. Pl. 20, fig. 6.

(Coquilles Fossiles, ii, p. 584, Atlas, Pl. 79, figs. 10 and 11.)

Although I have no specimen of *Pyrula tricostata* for direct comparison, I have, nevertheless, but very little hesitation in referring the Alabama form above figured to the same species, as it agrees in all essential respects with the figures and descriptions of that form as given by Deshayes in the *Coquilles Fossiles*. Three unnamed specimens of a *Pyrula* in the Academy collection from Dax, France, which I believe to be the *P. clava* (Oligocene?) of Basterot, somewhat resemble the Alabama species, but are comparatively much more robust, and have the costal nodes and revolving striæ considerably more developed.

SOLARIUM, Lamarck.

Solarium cupola, n. sp. Pl. 20, fig. 14.

Shell convexly conical, mound-like, of about five volutions; whorls ornamented with alternating coarse and very fine concentric lines, and appearing double from a medial impression (the shell apparently of twice the number of volutions that it actually possesses); base similarly ornamented as the upper surface, convex, and strongly margined by the prolongation interiorly of the outer wall; umbilical margin finely crenulated, the umbilicus broadly open, and exhibiting the concentrically striated internal volutions of the apex; aperture rhomboidal.

Length, $\frac{2}{3}$ inch; diameter, $1\frac{1}{4}$ inch. Cave Branch; Knight's Branch; Wood's Bluff, Clarke Co., Ala.

Solarium delphinuloïdes, n. sp. Pl. 20, fig. 13.

Shell convexly conical, of about seven volutions; the whorls ornamented with several beaded revolving lines, two or more of which near the upper margin, and one near the basal margin being the most prominently defined; base convex, sub-marginally channeled, and ornamented with numerous finely beaded revolving lines, which become most prominent in the umbilical region; umbilical volutions distinct to the apex, transversely striated, supermedially carinated; umbilical margin crenulated; aperture subcircular.

Length, $\frac{1}{2}$ inch; diameter, $\frac{3}{4}$ inch. Wood's Bluff, Clarke Co., Ala.

DENTALIUM, L.

Dentalium micro-stria, n. sp. Pl. 20, fig. 3.

Shell slender, considerably curved and greatly attenuated, faintly striated, the striæ most conspicuous on the attenuated portion; posterior aperture entire, there being no fissure; anterior aperture circular.

Length, $1\frac{1}{2}$ to 2 inches. Cave Branch; Wood's Bluff, Clarke Co., Ala.

Fusus pagodiformis (*Pleurotoma? pagoda*, Heilpr., Proceedings of the U. S. National Museum, 1880), specific name *pagoda* pre-occupied by Adams and Reeve.

THE SHINING SLAVEMAKER.—NOTES ON THE ARCHITECTURE AND HABITS OF THE AMERICAN SLAVE-MAKING ANT, POLYERGUS LUCIDUS.

BY REV. HENRY C. McCOOK, D. D.

August 21st, 1878, at the foot of the Allegheny Mountains, near Altoona (Bellwood, Pa.), I discovered a nest of *Polyergus lucidus*, Mayr, the American representative of the well-known European *P. rufescens.* The latter is the Amazon or Legionary Ant of Huber, and is associated with that author's discovery of compound ant-hills, the term applied to those nests in which certain ants have associated with them, in a sort of slavery, ants of another species. Huber made a full and interesting account of the predatory excursions of *P. rufescens*,[1] and other interesting behavior, which Forel[2] has recently fully confirmed and completed. It is, however, of interest, to discover the existence of the same habits in a closely allied species in America, and this record is therefore presented. Moreover, there are here some details of architecture which may prove of value in themselves.

The nest of Lucidus above referred to was situated in the gravelly soil of a valley between the mountains and the Juniata River. The field was sown in clover, and had not been plowed for several years. While passing through the field, I observed several ants resembling at first sight the common mound-makers, *Formica exsectoides*, issuing from a hole. I stopped to note them more carefully and saw a worker of *Polyergus lucidus* come out and return to the same nest. I at once began an exploration of the nest, as my time was limited, and professional duties prevented extended studies of the out-door habits of the creatures. There were four gates (fig. 1, Pl. 19), separated a few inches from each other. Two were simple tubular openings into the ground, about three-fourths of an inch in diameter; the others were two similar openings removed several inches from the first named, and united by a worn concave road, like a half tube. The four were arranged upon the arc of a circle. The nature of the soil, which was filled with coarse gravel and stones, prevented me from noting (as per-

[1] "Natural History of Ants," Johnson's translation. London, 1820.

[2] "Les Fourmis de la Suisse."

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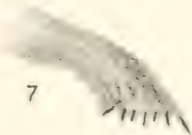

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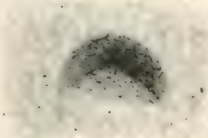

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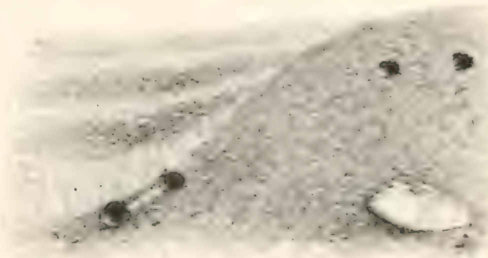

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J W Ross. Lith. Arch St., Phila.

McCook on Slave-making Ants

haps it had prevented the ants from making) any orderly arrangement of galleries and rooms in stories. But chambers were discovered, placed one above the other, united by tubular galleries, and extending down at least twenty-two inches, the depth to which the excavation was carried. The general character of these may be shown by the following examples. Twelve inches from the surface the trowel uncovered an opening into a cavity. By gently removing the earth, a similar opening was made just opposite (fig. 2, Pl. 19). When the little bridge between the two was cut away there was exposed an ovoid room (fig. 3, Pl. 19), in which were a number of ants, chiefly males and females of Lucidus. The room was an inch high at the middle, and an inch and a half across from wall to wall; a tubular gallery led from it into the earth beyond. Another chamber, found at ten inches below the surface, was a large irregular cavity, which appeared, on removing a smooth stone, flush up against which it had been mined (fig. 4, Pl. 19). It was three inches long, one inch and a quarter high, at the highest point, and extended inward at the deepest point nearly two inches. The line of the roof against the stone was irregular, falling to seven-eighths of an inch to five-eighths, rising to seven-eighths, and at one end terminating in a gallery-like extension of half an inch. A gallery opened downward near the stone and one opened inward at the innermost point. This chamber was also occupied chiefly by males and females. This sufficiently characterizes the internal architecture.

Mingled with the Lucidus ants in large numbers were workers in three forms, major, minor, and dwarf, of the species *Formica Schauffussi*.

August 23d, the excavated nest was visited, and these ants were found to be busy in part upon the galleries, which they were cleaning out, dragging the pellets of sand to the opening with the design apparently of closing them. None of the Lucidus ants were engaged in this work. Another portion of the slaves was engaged in an extensive migration.[1] A few of the slaves were carrying their fellows, but for the most part the deportation was confined to the males and females of Lucidus. The manner in which the latter were seized and carried off was well observed and is as follows: The slave approached the winged queen (for example)

[1] I have referred to this migration in "The Agricultural Ant of Texas," p. 154.

and after the usual touching and crossing of antennæ the mandibles were tightly interlocked (fig. 5, Pl. 19); the head of the slave was then raised, and simultaneously the body of the queen drawn back, stretched quite out in a straight line, and then doubled under, the abdomen being thrown upward apparently resting against the lower part of the face and the fore-part of the thorax (fig. 6, Pl. 19). In this position the large virgin queens were carried up the perpendicular face of the cutting for eighteen or twenty inches, and then for the distance of six feet over the ground and through the grass. The time consumed in this journey was a few seconds over one minute. I frequently observed this carrying of the workers of Lucidus, in the artificial colonies which I afterwards formed and brought to Philadelphia. The process was substantially the same, although often the master was simply dragged along the surface. More than once a slight opposition was made to this treatment. The slaves, or at least certain individuals of them (for I am persuaded that ants have their personal peculiarities of disposition and moods like larger animals) seemed at times to have a prejudice against the presence of the Lucidus ants above ground, and would unceremoniously seize them and carry them below. I have seen a master or more properly "mistress," thus served several times, each time returning in a dogged sort of resistance to the will of her servitor. These emmet mistresses too, apparently know something of the bitterness of bondage to a capricious domestic "help."

The wonderful muscular force of the grip which Lucidus takes with her mandibles was thus illustrated: One worker had for some reason fallen under the displeasure of another, who held her firmly grasped by the middle thorax. Anxious to preserve my colony from unnecessary loss, I lifted the two out on the point of a quill toothpick, laid them in my hand, and thrust the fine point of the quill between the jaws of the aggressor, and so teased her until she released her hold of her fellow. The rescued ant instantly clasped the palm of my hand, threw her abdomen under, and thus with back curved up like an angry cat, sawed and tugged at the skin until an abrasion had been made. While watching this operation the other ant was still clinging to the quill, and to her I next turned my attention. She was holding fast in her mandibles the point of the toothpick, with her body stretched straight out into space, her limbs stretched outward, except one hind leg, which was a little bent upward. Thus, without any perceptible support, except that which her jaws gave her upon the quill point, she hung outstretched for several minutes. How long she would have kept this position I know not, for I dropped her into the nest by clipping off with scissors the point of the quill, which, after hugging fiercely for a while, she finally abandoned as an unresponsive and unworthy foe.

In the course of the above migration, one queen was seen to resist carriage so vigorously that she was finally dropped, and, refusing to give the slave a hold upon the mandibles, was seized by the wing and dragged off. The Lucidus ants seemed to have no volition in nor direction of this movement. I released a number from their porters during various stages of the transit, who always wandered about with a confused, aimless and irritated manner until again seized and borne off by slaves.

The locality to which the formicary was being thus transported was about six feet distant from the gates of the original nest. It was either an old nest or a portion of the one just disturbed. The quarters at least appeared to have been formerly prepared and occupied. The gates of the nest were placed in one sloping side and in the angle of a deep cross-furrow, and were quite well concealed by tall grass and clover, tufts of sheep-shaw and various small weeds (see fig. 7). In the angle of the furrow was a cleft in the earth nearly two inches long, one end of which was rounded into a gate of the size and character of those first described, and at the other end into a smaller similar vertical tube. This entrance was so well concealed by grass that I did not see it for some time (fig. 8, Pl. 19). Two and a half inches diagonally above this was a lateral cleft, three inches long, from a half to three-fourths of an inch high, and penetrating into the earth laterally at various points by galleries. The stalks of grass growing upon the side of the slope above sent down their roots through the roof of this cleft vestibule into the floor. On one side of the cleft, half an inch above it, was an entrance, with a dome-shaped vestibule. On the other side, three inches above, was a fourth gate, opening under a round stone. While some slaves were engaged in deporting their Formica fellows and Polyergus associates into the new home, others were busy bringing out straws and sand as though preparing the galleries and chambers within. Occasionally a Lucidus worker would show herself for a moment at the gate with outreached antennæ and open mandibles, as though on the watch for intruders, and then slowly return to the interior.

September 17th, twenty-seven days after the discovery of this formicary, I was again at Bellwood, and revisited it. The new nest seemed to be deserted; the ground around the gates seemed to have been recently disturbed by a visitor, and no ants were visible. The old nest, however, was abundantly peopled, and numbers were found two and a half feet below the surface, from which I was enabled to gather a large colony of slaves and workers of Lucidus. The winged forms were gone. Mr. Edgar Kay, who had assisted me in the excavations at the first visit, and had kept an eye upon the nest, reported that a few days after my departure (in the latter part of August), he had seen one male and several females taking flight. They perched upon grasses, etc., and thence flew eastward, at a height of forty or fifty feet, to the end of the field, some 300 feet distant. It is probable that after this marriage flight of the sexes, the workers returned to the old home.

After these ants were colonized, I was able to observe several facts, chiefly confirmatory of those recorded by Huber, Forel and others, of the European *Polyergus*. The masters never work; the colony was changed several times in order to incite to new work in mining galleries and rooms; clusters of Lucidus were placed by themselves; always they remained idle. The slaves wrought with the greatest industry and energy as long as there was any need; the masters would crowd into the galleries, and move about in an aimless way, but I never could trace any attempt either at directing or aiding in the work. So also I never saw one attempt to eat. Sugar was fed freely and the slaves freely partook, until they became gorged, and their abdomens grew transparent with the pouched supply of liquid sweets. The masters strode over the grains of sugar, and even when I had supposed that I had prepared them with a good appetite by previous fasting, they partook of nothing. Yet they are in good condition, and evidently well fed. They doubtless are fed by the workers who must disgorge the food, as when feeding larvæ, callows, males, females, and even each other. I have, however, never yet seen the actual passing of nutriment from one to another, although often observing Lucidus and Schauffussi in the posture which is commonly assumed when this mode of conveying food is being practiced.

In galleries and rooms the Lucidi hang upon the sides or to the ceiling, or are snugged in little clusters with the slaves. In changing formicaries they were found thus rolled together in balls, slaves and masters—or more properly, mistresses, for all workers are undeveloped females—mingled in a promiscuous mass.

One such change was made October 14th, the weather at the time being chilly, and the furnaces not yet fired in the house. But little effort was made to dig new galleries until evening, when I warmed up the glass globes by a gas-lamp. My experience here has been quite the opposite of Huber's, who took such pains to keep his artificial nests of *P. rufescens* from the light. Just as with my agricultural ants, so *P. lucidus* at once turned to the genial warmth and light, gathering in a great ball within the comfortable glow. A few of the slaves mounted the glass in the warmest place to be found. As often as I would revolve the globe, the cluster of snugging ants would unravel and transfer itself in new mass upon the side toward the flame. The slaves also cheerfully work on the side toward the light, and indeed seem to prefer to do so.

Lucidus cleanses herself quite freely, but also I have very frequently seen her soliciting the slaves to this service, who sometimes consent, and go over the body from antennæ to abdomen, licking and scraping it. The need of this service especially appeared upon examining a dead Lucidus. Its body at various parts was covered with minute white, ovoid objects, apparently parasite eggs. I thought them parasites, but could discover no trace of life, or appearance of being living creatures. One seemed to be suspended to the ant's body by a thread-like attachment. Many of the slave-makers are thus affected. While taking out the colony one slave was found upon which were fastened two small white insects, apparently mites, which I could not then examine, and unfortunately lost among my specimens. I have often observed ants to be infested with mites in natural site, and particularly in artificial nests. The greatest care is required to keep them in healthy condition while in confinement. The admirable structural provision for cleansing the person given to ants,[1] is certainly needed in view of the liability to such dangers.

The listless, heavy manner that is characteristic of Lucidus in common, is wholly changed at any alarm, or the presence of an enemy. Her true character and duty to the community then

[1] See "Agricultural Ant of Texas," p. 130.

appear. Various experiments established the fact that some of these slave-makers (apparently) always keep on guard, and that certainly some are ready to spring at once to repel any attack. For example, one of the slave-making *Formica sanguinea*, found in the same neighborhood, was dropped into the Polyergus colony. The hostile presence was instantly discerned and a Lucidus worker sprung upon the Sanguinea and seized her near the throat. Several slaves ran to the fray, and took part by seizing legs and antennæ of the intruder. Not wishing such an unequal conflict, I lifted the principal combatants out, having teased away the others, and set them down to fight it out fairly. Lucidus had Sanguinea grasped by the face at the eye with her mandibles when first removed. This was not satisfactory, for she began cautiously and deftly to release her hold, preparing herself meanwhile, so that with a quick snap she seized her foe by the neck, then turned up the abdomen, and, as I suppose, ejected poison upon the face and mouth of Sanguinea. I separated the two before either had been mortally hurt. However, Lucidus had lost the flagellum of one antenna. I put her back into her nest. The battle-scarred warrior had no sooner struck the soil which she had so gallantly defended, than she was violently seized by a slave, and dragged up and down by her sound antenna, the poor jointless scape meanwhile thrust out and waving piteously. The late exalted mien and ferocious aspect were now gone, and the warrior cringed her body and drooped her limbs like—it is no mere fancy word-painting this—a sullen criminal in the hands of a policeman. The two disappeared from my sight in the mouth of a gallery; but half an hour afterward I saw the same warrior, whom I recognized by the mutilated antenna, in the clutch of one of her scarlet fellow-soldiers, who was mounted upon her back and holding her by the neck.

I am happy to record that two days thereafter I saw the same veteran, evidently again in "good odor," perambulating the surface of the formicary. It is probable that in the battle her body had been tainted by some odor peculiar to her adversary, which had made her obnoxious. It may be, indeed, that the loss of the upper part of the antenna may have impaired recognition, and so caused this hostile treatment. At all events I could not but wonder whether any thought went through the little creature's brain analogous to our meditations upon the ingratitude of Republies, and the vanity of military glory! This incident, and many other observations, go to establish that in the function of the warrior is the true economy of this ant. The manner in which her European congener Rufescens makes her raids upon the nests of *Formica fusca* and *F. cunicularia*, marching in solid column, and conducting war with activity, intelligence and success, may be read in the fascinating pages of Huber and Forel. There is no doubt that our American species has precisely the same habit. Mr. Joseph Jeanes, a well-known member of this Academy, has described to me the raids of an ant observed by him upon his country-place at Fox Chase, which, from his description of the insect, without a specimen, I should have little hesitation in identifying as our *P. lucidus*.

The slaves, however, are not deficient in the combative faculty They spring to repel a hostile attack as freely and fiercely as the masters. They do this independently, too, just as they conduct their mining operations, and their ability to wage successful warfare seems to be quite in keeping with their martial spirit. Dr. Darwin has conjectured,[1] that the slave-making instinct may have originated from the unintentional rearing of pupæ collected for food, who proving themselves useful and congenial inmates of the nest, suggested the collecting of pupæ to be reared. Thus originated a habit, which by natural selection was strengthened and made permanent, and finally increased and modified, until an ant was formed as abjectly dependent on its slaves as *P. rufescens*. Whatever credit we may give to this ingenious hypothesis, it must be said, that in the case of our *F. Schauffussi*, natural selection has not operated to degenerate the soldierly courage and faculty, and remand the duty of defense to those associates in whom the military faculty has been specialized. In other words, if Lucidus has become specialized as a warrior, dropping an original disposition and ability to labor, her slave has not become specialized as a worker, nor dropped her combative faculty, but seems to be possessed in all respects of the normal habits and nature of ants of her species. At least I could trace in her no effects of slavery, other than the strange association with and care of her abductor. One, therefore, who accepts Dr. Darwin's suggestion, must allow that natural selection has wrought toward specialization in one section of the colony, but has been suspended

[1] Origin of Species, p. 26.

in its operations upon the other section. It is doubtful if the anomalous conditions thus raised by Dr. Darwin's explanation, be not more difficult to explain than the original conditions to which the hypothesis was applied.

It is important to note the wide distribution of this insect across the American Continent. During the summer of 1879, while encamped in the Garden of the gods, studying the Honey and Occidental Ants, a nest of Lucidus was discovered just inside my tent door. Its gate was a simple opening into the ground, into which both Lucidus and her slaves were frequently passing. There was a similar opening under a small bush about three feet distant. The slave, or worker, was here precisely the same, *Formica Schauffussi*, which is found so often in the compound nests of both *F. sanguinea* and Lucidus in the Eastern States. On one occasion I captured a slave carrying a winged queen from one opening to another.

A comparison of a Lucidus taken at Bellwood, at the foot of the Allegheny Mountains, Pennsylvania, with the Colorado specimens, shows no difference except that the Pennsylvania example is slightly more robust and of a somewhat darker color. The peculiar uniform gloss which gives the American ant its specific or varietal name, as distinguished from the duller color of the European species, *P. rufescens*, marks equally the Eastern and Western representatives. The European ant is decidedly smaller than her American congener. The Colorado *F. Schauffussi* is of a more uniform and darker brown color than the Allegheny Mountain specimen.

I have no specimens of Lucidus from points intermediate of the localities above named, but no doubt the species is spread over the whole of our Continent.[1] That it carries with it its characteristic habits, even its favorite domestic servant and associate, and that in these respects it exhibits the habits of its closely allied congener of Europe, affords another interesting point in the geographical distribution of our insect fauna.

[1] *P. rufescens* of Europe has not yet been found in the warm plains of the South of that Continent. (Catalogue EMORY-FOREL, p. 450, Mitth. d. Schweizerischen Entomol. Gesellschaft.) It would be a valuable contribution to our knowledge of distribution were we to know whether or not *P. lucidus* is found in our Southern States. We might venture the anological prediction from the above habit of its European congener, that it is not found in the Gulf States.

ON THE TEMPORAL AND MASSETER MUSCLES OF MAMMALS.

BY HARRISON ALLEN, M. D.

Systematic writers have described the temporal and masseter muscles in mammals as being distinct from one another. I hope to show that they are, in the great majority of forms, parts of the same muscle.

I have found in my dissections that the temporal muscle,[1] as a rule, has a deep and a superficial set of fibres. The deep set arises from the floor of the temporal fossa, and makes up the greater part of the muscle. Most of the fibres unite to form a tendon, which is inserted upon the apex of the coronoid process of the lower jaw. Many of the fibres which do not so unite are inserted upon the median surface of the coronoid process; others again are continuous with the superficial fibres. The superficial set of fibres arise from the temporal aponeurosis. It is continuous in the main with the deep fibres of the masseter, and the fibres are inserted upon the lateral surface of the coronoid process. A partially distinct slip arising from the median aspect of the malar bone, and the ridge on the squama over the external auditory meatus, is an accession to the superficial fibres, but possesses a tendency to unite with the fibres of the deep set in the anterior portion of the fossa. These fibres may receive the name of the supra-zygomatic portion of the masseter. They are inserted at the base of the coronoid process, forming a thin glistening tendon within and a little posterior to the anterior border of the body of the masseter. The supra-zygomatic slip is merged with the large superficial mass in the dog.

I believe that I have detected as part of the general plan of the masseter muscle, when well developed, that it is composed first of a tendino-muscular layer, rising tendinously from the anterior part of the zygoma or the maxilla near the infra-orbital foramen, and is inserted muscularly into the angle; second, of a nearly vertical layer, tendinous below near the angle, muscular near the zygoma; third, of a nearly vertical layer, having a disposition to become tendinous, both near the angle and at the malar bone; fourth, of a smaller layer occupying the fossa on the lateral surface of the ramus, and which exhibits a glistening layer of

[1] For convenience the temporal and masseter will be held as distinct in the descriptions.

tendon at the origin from the malar bone. The fibres beneath this are continuous, in most mammals, with the superficial layer of fibres of the temporal muscle, including the supra-zygomatic slip, which, in some animals, is distinct in great part from the fibres arising from the temporal aponeurosis. The masseter presents a general resemblance to the internal pterygoid muscle, which, wherever exampled, has shown these imperfect attempts at planal cleavage.

This outline being borne in mind, it may be well to turn to the descriptions employed by writers on comparative anatomy.

The descriptions of the muscles in Meckel (Vergleich. Anat., iv, 495) are very general. The temporal is said to be covered by a conspicuous aponeurosis; the muscle to be more or less fan-shaped, and gradually narrowed from above downward. The masseter is said to be divided ordinarily into an outer, longer, stouter and straight layer and an inner, shorter, weaker layer, in which the fibres are more or less obliquely placed from above downward and before backward.

Cuvier (Leçons d'Anat. Comp., 2d Ed , iv, 1me Part, 64 *infra*) describes the temporal in the apes, bats, insectivora, rodents, two-toed ant-eater, hog, ruminants and the cony. None of these includes the arrangement of fibres above given. It is true that in the ant-eater the masseter and temporal muscles are united, but no detail of the character of the union is presented. Mivart (Elements of Anatomy, 310) repeats this statement. It is evident that the union of the muscles is here thought to be exceptional. Cuvier and Laurillard further describe the masseter in the bats, rodents, artiodactyles, ant-eater and the cony as composed of two portions, a zygomatic and a maxillary. The former is present in all; the latter is seen in the rodents, artiodactyles, the ant-eater and the cony.

Mivart (l. c., p. 309) describes the masseter in *Lagostomus* and *Dasyprocta* as follows, as of " great development:" " The masseter is divided into three portions, and traverses the singularly enlarged infra-orbital foramen spoken of in describing the skeleton." According to the interpretation used in this paper, the masseter in rodents has even fewer subdivisions than in some other mammals. Of these, at least one only passes in such direction as to permit the expression that it " traverses the infra-orbital foramen;" and this part is not separable from all the fibres lying on a plane lower than that of the zygoma.

The descriptions of Cuvier and Laurillard of animals I have not dissected, may be here epitomized:

In the horse a small superficial slip of the temporal exists, which does not conceal the main tendon.

In the lion (Pl. 143 and 144, fig. 2) the parts marked *vertico-soutien* and *jugo-soutien* answer in position to the superficial and supra-zygomatic fasiculi. The slips are identified, however, with the muscles of the external ear.

In the description of the myology of *Erinaceus ecaudatus* the authors use the following language: "Between the crotophytæ (temporal) and the masseter muscles in the position of the absent malar bone a red muscle-fasicle is seen, which we have been unable to identify. It is lost posteriorly upon the temporal aponeurosis, and passes under the masseter to be inserted upon the anterior border of the ascending ramus of the mandible."

I do not hesitate to classify this slip with the supra-zygomatic slip of the masseter (see fig. 2, Pl. 77 of C. & L.). Nothing to invalidate such identification can be presented excepting the fact that the slip has an alleged origin from the temporal aponeurosis. It is in every way likely that either the glistening main tendon or the aponeurotic texture of the superficial portion of the temporal is here described.

In the above descriptions no mention is made of the union of temporal and masseter except in the ant-eater, and in none is the method of description the same as employed in this paper.

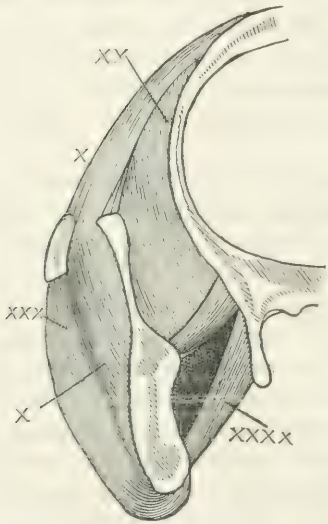
In making the dissections it was found convenient, after preparing the superficies, to dissect the masseter as far as the retention of the zygomatic arch in position would permit. Then this arch was sawn through at either end, and turned down. This exhibited the continuity of the fibres attached to it, and the temporal. The latter muscle was then studied carefully. After this the head was sawed through from right to left vertically (frontal cut) in order to expose the arrangement of fibres on the median aspect of mandible in rodents, or, in lieu of this, an antero-posterior section was made.

Attention will now be invited to the detailed arrangement of the parts in different mammalian types.

In *Macacus nemestrinus* we find the fibres of aponeurotic origin (superficial fibres) arising as in man. In addition, a slip of fibres, arising from the inner surface of the malar bone and the occipital crest, passes forward and obliquely downward, to be continuous with the deep masseteric fibres. This slip is the supra-zygomatic, and is believed to be an upward prolongation of the deep masseteric fibres. It joins the superficial fibres on a line with the coronoid process. The deep fibres furnish a brilliant tendon, which extends forwards quite to the orbito-temporal septum; thus differing strikingly from the arrangement in man. The deep fibres are further seen to be imperfectly differentiated from the internal pterygoid muscle.

The masseter muscle is composed of the following:—1st. A layer arising aponeurotically from the anterior third of the zygomatic arch, and passing obliquely downward and backward to the angle. 2d. A layer resembling the foregoing; it arises from the zygomatic arch at its middle. The fibres are nearly vertical and end tendinously at the angle. 3d. A layer arising tendino-muscularly from the posterior third of the zygomatic arch. Its fibres are inserted upon the upper half of the ascending ramus of the lower jaw. These layers merge anteriorly; indeed, are indistinguishable at the anterior border.

FIG. 1.



Transverse section through masseter and temporal muscles (one inch behind the eye). *Canis familiaris.*
X, Superficial temporal fibres.
XX, Deep temporal fibres.
XXX, Superficial masseteric fibre, separated from *X* by a tendinous sheet.
XXXX, Internal pherygoid muscle, cut transversely.

In the dog the superficial fibres are much better developed than in either the macaque or man, and cover in the deeper fibres, while they do not form at any part a supra-zygomatic slip; the general arrangement of both temporal and masseter muscles as in other mammals. The masseter exhibits six cleavages, of which the last or deepest occupies the fossa on the outer surface of the ramus, and is directly continuous with the superficial fibres of the temporal (fig. 1).

In the coati, *Nasua narica*, the superficial fibres, as in the dog, completely conceal the deep fibres. The supra-zygomatic slip is beautifully distinct. Branches of a conspicuous venule which can be seen lying upon the superficial portion disappear abruptly as they approach the upper border of the supra-zygomatic slip. Subsequently dissection detects the trunk of this vein lying between the masseter and temporal masses, behind the zygoma. The central tendon is thicker at the root of the zygoma and the bone over the external auditory meatus than any other locality in the temporal fossa.

The masseter has fine layers, closely resembling those in the dog. The deepest layer, namely, that one whose fibres occupy the ramal fossa, has a much thicker aponeurosis than the other layers, the anterior portion of the first alone excepted.

In the opossum, *Didelphys virginianus*, the superficial fibres of the temporal are everywhere thick. The aponeurosis is well developed. The supra-zygomatic slip is not distinct. The deep portion of the muscle exhibits a white glistening tendon, which does not, however, extend as far as the orbito-temporal septum. The anterior portion of the muscle is made up as is usual by the union of the deep and superficial portion. In addition to its forming the slip passing down to the front of the base of the coronoid, it sends a powerful bundle to the median side of the coronoid, a thin movable layer of muscular tissue, which passes in front of the coronoid, between the medio-coronoid and pre-coronoid portions.

The masseter is highly tendinous superficially. The tendency to cleavage is not pronounced, and the continuity of the deep fibres with the superficial fibres of the temporal is very noticeable.

In the squirrel, *Sciurus hudsonicus*, the superficial portion of the temporal is less distinct than in man, and the supra-zygomatic slip, while demonstrable, is not large. The superficial tendinous layer of the masseter arises from a spur on the maxilla below the infra-orbital foramen. It passes, as is usual, downward and backward toward the angle. This layer does not, as in most mammals, form the entire superficies. A second layer arises from entire inferior border of the zygoma, which appears to be lost upon the foregoing about midway between the zygoma and the angle. Upon turning this last layer downward, the third and last layer is seen, which is continuous in the ordinary manner with the temporal fibres. The arrangement of fibres on the median surface of the mandible was not examined.

In the North American porcupine, *Erethizon dorsatus*, the masseter consists of a superficial set of fibres arising tendinously from the malar bone, and passing downward and backward to the angle of the mandible. It arises from the anterior three-fourths of the lower border of the malar bone, the entire lower border of the enormous infra-orbital foramen. Its insertion is not only upon the angle but the median surface of the ramus as well. The last-named insertion occurs as follows: The anterior edge of the muscle becomes stout and broad as it approaches the rounded border of the bone in front of the angle. It winds round this border, receiving as it does so a large accession from the angle, and a portion of the adjacent median surface from the lower jaw. This portion of the masseter lies below the jaw on the soft parts of the neck. In addition to the above, a long, stout, fusiform belly is inserted by fleshy fibres at a point half way up the ramus in front, and above the upper border of the insertion of the internal pterygoid muscle.

Beneath the superficial fibres just described, the masseter in *Erethizon* exhibits the usual tendinous fibres arising from the angle and passing upward and forward. The third set is of great importance in this animal. It agrees with the general plan of arrangement in other mammals examined, but is remarkable for its extent. It arises from the lower and median border of the zygoma by tendinous fibres, from the side of the maxilla, at the nasal region and supra-orbital surface of the same bone by fleshy slips, also fleshy from the upper concave border of the zygoma, where fibres form the supra-zygomatic slip; tendinous and fleshy from the anterior and lower half of the inner wall of the orbit. The insertion of this set of fibres is upon the ramus, between the angle and the sigmoid notch. The anterior part of the insertion is rounded and tendinous. It lies beneath the corresponding border of the surperficial portion, and receives the fibres passing through the infra-orbital foramen. The remaining portions unite to be inserted as already indicated.

The temporal muscle possesses a superficial portion, which everywhere covers in the main muscle. Its aponeurosis arises from the vertex, the upper border of the posterior half of the orbit and the posterior and upper half of the inner wall of the same depression. It thus covers in the post-orbital process of the frontal bone. It is inserted entirely upon the main tendon, and receives no fasiculus from the masseter. The deep or main portion extends its aponeurosis forward, to be inserted stoutly upon the post orbital process of the frontal bone. A thin aponeurosis passes downward, thence to the mandible behind the coronoid.

It will be seen that the plan of the muscles is the same as in other mammals, but is remarkable for the muscles' subdivisions remaining distinct from one another. In rodents having the large infra-orbital foramen, the masseter muscle is described as having a separate portion passing there through. Mivart, in his Elements of Anatomy, page 309, says, in this connection: "In certain rodents, *e. g.*, *Lagostomus* and the Agouti, the masseter divides into three portions, and traverses (that is, one of these portions traverses) the singularly enlarged infra-orbital foramen." This is a correct expression of the view usually taught. According to the plan of description followed in this paper the masseter of *Erethizon* in nowise differs from the muscles of the same name in other mammals, except in the extent of development of the layer to which the pre-foraminal fibres belong. I have had no opportunity of examining *Lagostomus*, but it is probable that the masseters are much alike in all. The porcupine is further of interest in the extent of encroachment of the muscular fibres upon the orbital space. Both masseter and temporal appropriate large surfaces. It is noteworthy in addition to find that the post-orbital process is here purely muscular in significance. It is, indeed, *imbedded* in muscle. Notwithstanding its size, the process has no septal significance in this rodent.

In *Cœlogenys* the temporal is thin in the temporal fossa but thick and massive on posterior wall of the orbital space. The superficial layer and supra-zygomatic slip are distinct. Raising these two portions of the temporal from the temporal fossa no muscular fibres are seen beneath. A distinct tendon becomes visible, however, underlying the junction of the superficial and supra-zygomatic portions In the orbital space the superficial portion is exceedingly robust and extends medianly the entire depth of the posterior wall. The temporal is inserted into the lower jaw as follows: The superficial portion arising from the temporal fossa, and the zygomatic portion are inserted through the main tendon upon the apex of the coronoid process; the orbital portion upon the median side of the same tendon and the median surface of the coronoid its entire length.

Comparing the plan of this muscle to the others described it may be said that the deep part of the muscle is absent, unless the greater bulk of the orbital portion is assigned to the deep part. It has been generally found that the deep and superficial portions are continuous anteriorly. It is probable that while the deep part is absent from the temporal fossa proper, it remains in position in the orbital space at a point answering to the post-septal depression in animals having a partition between the orbit and the temporal fossa. But while the deep part is absent from the proper temporal fossa, a stout glistening tendon is here in the usual position of the central tendon, and, as in *Erethizon*, is concealed from without. It is interesting to note that the supra-zygomatic slip is temporal; it being doubtful whether any of its fibres are continuous with the masseter.

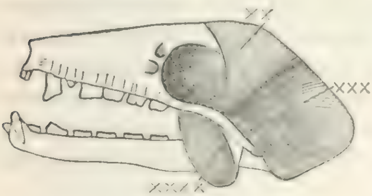
The masseter bears a general arrangement to the muscle in *Erethizon*. The anterior edge is less muscular than in the latter genus. The mandibulo-zygomatic portion, whose origin from the mandibular angle occupies the lower one-third of the surface, constitutes the massive fleshy belly. The fibres are for the most part nearly horizontal. It is covered for the upper half of its surface by the enormous malar bone. The slip from the median surface of the mandible is arranged as in *Erethizon*. It lies in part in front, and in part beneath the internal pterygoid. Its junction with the main body of the masseter conceals the tendinous anterior edge thereof and is continuous with those fibres arising from the angle and the basal third of median surface. The deep mandibulo-maxillary portion is as in *Erethizon* in all essential features. It is continuous with the superficial parts. A thin layer of orbital fibres overlies the temporal muscle in the orbit. Another layer is apparently continuous with the buccinator.

In *Dasyprocta* the general plan of arrangement seen in *Cœlogenys* is followed. The minute points of distinction therefrom not being noteworthy save the continuance of the main tendon within the orbital space, where it overlies the deep anterior vertical fibres.

In Cuvier and Laurillard (Pl. 245) the slips of the temporal are represented as parts of a bi-peniform muscle. I find the supra-zygomatic fibres more horizontal in position, darker in color and more convex than the remainder of the muscle.

In the bats the superficial portion of the temporal may be small or well developed. In the first variety a good example is seen in *Phyllostoma hastatum* and other American leaf-nosed bats in which forms the superficial portion is confined to the anterior fourth of the temporal fossa. The supra-zygomatic slip is also very conspicuous. In *Artibeus* the superficial fibres occupy the anterior half of the fossa. In *Desmodus* the fibres are confined to the anterior portion of the fossa; they are weak and unimportant. The supra-zygomatic slip overlies the tendon of the main muscle above the zygoma. In *Lonchoglossa* the muscle is poorly developed throughout. The superficial fibres are reduced to mere rudiments. The supra-zygomatic slip is present. The deep portion does not reach the vertex.

Fig. 2.



The temporal and masseter muscles in a Fox Bat (*Epomophorus*).

XX, Superficial fibres of same.
XXX, Supra-zygomatic slip of masseter muscle.
XXXX, Masseter muscle.

The muscles in Pteropine bats resemble those in the American leaf-nosed forms. The superficial fibres are confined to the anterior third or half of the temporal fossa as seen in *Pteropus medius*, *Epomophorus* and *Cyonycteris amplexicaudata*. The supra-zygomatic slip is relatively smaller than in the Phyllostomidæ.

In *Megaderma frons* and *Phyllorhina bidens* the parts bear a general resemblance to the above group. The supra-zygomatic slip is absent in the latter species.

In *Molossus* the superficial fibres are enormously developed, they entirely cover the deep, and arise from a continuous osseous surface at the vertex which, being broad anteriorly, narrows gradually toward the occiput. The fibres arising from the vertex-crest, when such is present, are those belonging to the superficial set. The supra-zygomatic slip is present. A similar arrangement is seen in *Noctilio*, in which form the main mass of fibres possess an unusually deep set central tendon, and the superficial layer extends backward along the line of the vertex to the occiput. *Lasionycteris*, *Atalapha*, *Vesperus* and *Vesperugo* have an arrangement of the temporal fibres similar to the above but vary in the degree of development of the anterior slip.

To sum up the knowledge possessed of the temporal muscle in the Chiroptera it may be said that the deep portion is most exposed in *Pteropus* and its congeners, and the family Phyllostomididæ, owing to the small development of the anterior fibres. In Vespertilionidæ and Molossi the deep portion of the temporal is more concealed owing to the greater development of the anterior fibres. Those in *Noctilio* appear to be directly continuous with fibres arising from the occipital crest and inserted on the outer surface of the main tendon. With respect to the masseter it may be said to be simpler than the typical description given at the beginning of this paper. It possesses but slight tendency to planal cleavage.

In the bovine type of the ruminants as seen in the head of a calf the first or superficial layer of the temporal is continuous with the masseter as shown in the above forms, the deep layer is much less conspicuously developed than in them. The temporal fossa being shallow—and not high—the central tendon is produced backward and is relatively small and insignificant. It is not traceable over a short distance beyond the top of the coronoid.

The masseter muscle possesses six layers. The first is broad and attached to the superior maxilla by an oblique line extending the entire distance from the inferior border of the orbit to the gum line over the first molar. The second arises tendinously from the angle of the lower jaw and extends obliquely upward and forward, half way up the ascending ramus. The third layer is tendinous at the anterior superficies of the malar bone, the fibres arising thence including the anterior half of the surface of the zygoma. The fourth layer arises from the inferior border of the zygoma at its anterior two-thirds, and is inserted muscularly upon the ramus about midway between the zygoma and the lower border of the mandible. It is this layer which is continuous with the temporal as in other quadrupeds.

The masseter exhibits a fifth slip which appears to be a differential from the second or third layers, it overlies the temporo-maxillary articulation in the form of a well-defined bundle which arises tendinously from the root of the zygoma. It is inserted on the ramus near the posterior border at about its middle. A sixth layer exists in the form of a narrow, bright tendon and associated fibres arising from the root of zygoma beneath the foregoing.

Nothing similar to the fifth and sixth layers were seen in the other animals examined. The sixth layer of the dog being rather a sub-division over the ramus in front of and remote from the joint. It is every way likely, however, that the number of the layers in masseter will be found to be variable. The parts in the masseter of the Virginian deer (*Cariacus virginianus*) presented essentially the same features as in the calf. The superficial layer of the temporal resembles that of the calf, but the main tendon is small and is without muscular fibres, as it lies behind the orbito-temporal septum. The superficial portion is small. It lies behind the coronoid, in the posterior superior portion of the temporal fossa.

It must be said that the human anatomist seems warranted in treating the masseter and temporal muscles distinct. Quain, indeed, affirms that some of the posterior temporal fibres arising from the temporal fascia blend with the deep fibres of the masseter, but the union of the muscles in man is a rare anomaly. Macalister (Muscular Anomalies in Human Anatomy. Trans. of the Royal Irish Academy, xxv, 1872, 18.) has met with it but once. I have seen it once only.[1] No mention is anywhere made of the presence of the supra-zygomatic slip. It is quite likely that it may be occasionally seen in the cellulo-adipose tissue above the zygoma. Of the presence of any peculiarities in the anthropoid apes in these muscles I am uninformed.

The arrangement of the superficial layer of the temporal muscle in man is very similar to that seen in the quadruped. This layer arises from the temporal aponeurosis, and while thin posteriorly is thick anteriorly, behind the orbital septum. If this layer of fibres be divided posteriorly and the anterior portion turned forward, a thick radiated tendon is displayed beneath. This is the tendon of the deep set of fibres which here as in quadrupeds constitute the mass of the muscle. The fibres of the superficial and deep sets are continuous behind the orbital septum. This method of displaying the temporal muscle has been for many years employed by Prof. Joseph Leidy in his demonstrations at the University of Pennsylvania.

From the above examination I have come to the following conclusions:—

(1) While it is convenient to separate these muscles it must be remembered that in many mammalia the tendency is for the masseter and temporal muscles to unite—the deep part of the former being continuous with the superficial part of the latter.

[1] In a dissection of the muscles in a mulatto child at term, I found the deeper plane of masseteric fibres arising from the external surface of the temporal tendon.

(2) Man, and some of the Rodents—the latter illustrated in *Erethizon*—are exceptions to the tendency. In these forms the temporal is distinct from the masseter. In the same order, as in *Cœlogenys* and *Dasyprocta*, the deep portion of the temporal is either absent or represented in a single orbitally disposed mass of vertical fibres.

(3) The muscles in question have been much neglected. They should be carefully dissected in all myological studies of the mammalia.

The following reports were read and referred to the Publication Committee:—

REPORT OF THE PRESIDENT

For the Year ending November 30, 1880.

Nothing has occurred during the year to disturb the Society in its usual course. It is a source of satisfaction that its financial condition is better now than it was at the close of last year. Although its current income is not yet quite equal to the sum it needs or desires, it still remains free from debt.

The effort begun more than a year ago to collect subscriptions for the purpose of establishing a maintenance or working-fund, has not been as successful as was expected. The aggregate of subscriptions is now $2680, of which $1550 have been paid. It may be hoped that at the close of 1881 the Treasurer will be able to report that the Maintenance Fund has been largely increased. The effort should not be abandoned in despair.

In this connection it may be mentioned that an addition of $3000 to the permanent fund of the Academy has been made by reserving for investment, under a by-law (Chapter IX) enacted May, 1876, all moneys received from members for commuting their semi-annual contributions, as long as they may retain their membership. This commutation fee is designated life-membership, and the fund accruing from it is conveniently called the Life-membership Fund. The income from it is applicable to the payment of the ordinary expenses of the society.

The Charlotte M. Eckfeldt Fund, formed of money received, June, 1879, from the executors of the late Mrs. C. M. Eckfeldt, who made the Academy one of her residuary legatees, amounts to $2466.86. The income from it has been temporarily assigned to the use of the Publication Committee.

The heirs of the late Mr. Joshua T. Jeanes, who died suddenly January 3d, 1880, have generously given to the Academy twenty thousand dollars, the sum which he had indicated his intention to bequeath to the Society in an unsigned codicil to his last will. The money has been invested in approved mortgages, and by order of the Academy constitutes the Joshua T. Jeanes Fund, the income from which has been duly made applicable, like that of the Maintenance Fund, to the general purposes of the society.

The Thomas B. Wilson Fund, the Elizabeth Phyle Stott, the Isaac Barton, and Publication Funds are unchanged. Owing to circumstances over which the Academy has no control, the income of the year from the I. V. Williamson Library Fund has been somewhat diminished. But it is confidently conjectured that in a short time it will be the same that it has been in the past.

The financial condition of the Academy will be found detailed in the Report of the Treasurer, to whom the society is much indebted for the time, care and labor which he bestows in the discharge of the duties of his office.

Five young men have been receiving the benefit of the Jessup Fund; two for two months each, one for five, one for six, and one for eight months during the year.

A brief account of the origin of this fund, and the manner of its application, may interest those especially who have become members of the Society within the past few years.

Mr. Augustus E. Jessup, who became a member of the Academy November, 1818, and died in Wilmington, Del., December 17th, 1859, gave the institution and its purposes a high place in his estimation. He had expressed his intention to bestow on the Academy, if ever able, a sum of money to constitute a perpetual fund for specified purposes. His children determined that this intention of their father should be realized, although he left no written instructions on the subject.

In a letter dated March 6th, 1860, and addressed to Dr. Isaac Lea, then President of the Academy, they stated that, in accordance with what they believed to be the intention of their father, they proposed "to pay to the Academy one hundred and twenty dollars per annum to be applied to its Publication Fund; and the further sum of four hundred and eighty dollars per annum, to be used for the support of one or more deserving poor young man or men who may desire to devote the whole of his or their time and energies to the study of the natural sciences; and that they looked forward to investing in trust, at some not distant time, the principals of the sums named, for the purpose of creating a perpetual fund for the above-named uses."

Substantially these are all the instructions given to the Academy for its guidance in the administration of these two funds—one to be applied to its publications, and the other to the support of students—aggregating six hundred dollars a year. They paid this sum regularly from March, 1860, until February, 1872, when they transferred to the Academy—"the principals of the sums named"—ten consolidated mortgage bonds of the Philadelphia and Reading Railroad Company. Thus Mr. Jessup's children generously fulfilled their promise and realized their father's intention. They have also consented that women may enjoy the benefits of the student fund.

The action and language of the Messrs. Jessup imply, without any doubt whatever, that their intention was to give to the Academy six hundred dollars per annum: one hundred and twenty dollars applicable only to the Publication Fund, and four hundred and eighty dollars to the support of students. And to secure this sum to the Academy annually forever, they gave to it in trust an investment, the par value of which is ten thousand dollars, an amount equal, at the rate of six per cent per annum, to "the principals of the sums named for the purpose of creating a perpetual fund," designed to be the impersonal successor and never-dying agent of the Messrs. Jessup for the payment of six hundred dollars annually to the Academy.

As trustee, the Academy is bound in honor, if not in law, to adopt such proper measures as may be necessary from time to time, to preserve entire not only the principal sum, but also to prevent, if possible, the income from ever becoming less than six hundred dollars, the specified sum it has been authorized and directed to expend annually for the purposes named. Reduction of this income must be detrimental to those who may properly ask assistance from it, to the extent of any diminution it may suffer. It is designed to benefit students of the future as well as those of the current time. The interests of those of the coming centuries in it are entitled to present consideration and protection, if needed.

The instructions under which the Jessup Fund for students was established, describe in general terms the requisite qualifications of those upon whom the Academy may bestow its benefits.

An eligible candidate for aid from the Jessup Fund, is required by those instructions to possess the following qualifications:

1. Evident "desire" to devote the whole of his time and energies to the study of the natural sciences.

2. He must be so poor as to be dependent on his own labor for a livelihood, and therefore, unless he can be otherwise supported,

he cannot devote the whole of his time and energies to the study of the natural sciences, to which he seeks to dedicate himself.

3. He must be "deserving" of support in this connection. This condition means much. To deserve any support from the Jessup Fund, he should possess a quick natural intelligence, above the average; a good and sufficient education, including, perhaps, a knowledge of the German and French languages; industrious and orderly ways; integrity in every sense beyond suspicion, and lastly, a manifest intention to dedicate his lifetime and energies to the study of the natural sciences.

4. He must be "young"—say under twenty-five years of age.

Under such conditions, and with faculties suitably equipped and disposed, the candidate may pass through an apprenticeship here provided, and become a practical naturalist.

The application of the fund is entirely at the discretion of the Academy. It would not violate the letter of the trust by using it to support approved students of the natural sciences without giving them instruction, or granting them the use of its library or museum or its hall as their workshop. The trust does not require that the Academy shall be the preceptor of the beneficiaries of the Jessup Fund in any degree. But inasmuch as one of the functions which the society has prescribed for itself is to impart and diffuse knowledge, it seems peculiarly proper that it should direct and facilitate the studies of these beneficiaries.

The four hundred and eighty dollars may be given annually to support one, or be divided between two or more, as may seem to the Academy expedient. The time during which any one may receive assistance from the fund, is limited at the discretion of the Academy.

After due consideration of the subject at the start, it was determined that the approved candidate should be received at first on probation, for one month, and if the trial were satisfactory, he might be appointed a beneficiary for two years, and then retire in favor of another, unless there should be special reasons for his continuance.

Inasmuch as the members of the society pay dues for their right to use the library and museum, it is considered proper to require the beneficiaries of the Jessup Fund to give, daily, a part of their time and labor to the Academy, under the direction of the curators, as compensation for instruction, and the use of the

Academy's property. This time is employed in work incident to taking care of, mounting, and arranging specimens in the museum, such as cleaning them when necessary, labeling, etc., a kind of work which is pertinent to the vocation of a naturalist, and through which the beneficiaries become familiarized with natural objects, more perfectly than they can be in any other way. It should not be forgotten that the Academy has always been dependent, almost exclusively, upon the unpaid labor of its members for the care of its museum, and this circumstance, perhaps, explains why beneficiaries of the Jessup Fund are expected to do any kind of work in the Academy that the curators and other members are in the habit of doing. They are, in fact, regarded as almost apprentices, who should be ever ready to avail themselves of the opportunities afforded to learn everything pertinent to the career of a naturalist.

Applications for the benefits of the Jessup Fund, are considered and decided by the Council of the Academy.

Between March, 1860, and November, 1880, thirty-four persons have received aid from the fund, for a longer or shorter period than two years. Of these, five have died, well known and much respected naturalists. Five of those, now living, are professors and eminent men. It is believed that all of this class of gentlemen have acquitted themselves satisfactorily, and that all gratefully appreciate the benificence of the Jessup Fund, as well as the advantages derivable from it; and it is hoped that none will ever regret any of the work he has done, or the time he has spent in the Academy.

The annual reports of the curators and librarian show the extent of increase of the museum and library; and those from the several sections of the Academy indicate that they are active and prosperous.

During the year, more than 600 pages of the Proceedings have been published, and the fourth part of the eighth quarto volume of the Journal of the Academy is passing through the press.

The proceedings of the Entomological Section are printed on the premises by some of its members, and issued separately. This section has published more than 370 pages and 7 plates during the year.

The second volume of a "Manual of Conchology, Structural and Systematic, with Illustrations of the Species," by George W.

Tryon, Jr., published by the author and issued from the Academy, has been published during the year. It includes 289 pages of text, 70 plates with 975 figures.

Professor Leidy's admirable work on "Fresh-Water Rhizopods of North America," forming Vol. XII of the final reports of the United States Geological and Geographical Survey of the Territories, under the direction of Dr. F. V. Hayden, is so closely connected with the Academy, that its publication during the year may be mentioned here. Dr. Leidy, at the stated meetings of the society, gave verbal accounts of very many fresh-water rhizopods which are described in his work, and the Academy's library was the sole source from which he was enabled to prepare the bibliography of the subject.

Few persons devote their whole time and energies to natural history for a living. Generally, the study is an occupation for leisure hours, and may be regarded as a secondary pursuit among us, which yields little or nothing towards a livelihood. Satisfactory study of natural history requires so much to aid its votaries, in the way of collections and books, that it is extremely rare to find any one person rich enough to procure all that is needed. For this reason many of like tastes associate, each contributing his quota, for the purpose of gathering what is necessary or desirable to be used in common for self-instruction.

In one sense the Academy may be regarded as an association of this kind.

A prominent object of the Society is to afford opportunity to those who desire to undertake self-culture in any or all the departments of the natural sciences. From its beginning in 1812, continuously to the present time, members have freely contributed specimens to its museum, and books to its library. Besides materials of this kind they have given money liberally, established permanent funds for several specific purposes, and employed whatever time they could fairly take from their daily avocations in working with their own hands to render the constantly increasing means of study as easily available as possible. The value of personal labor gratuitously given to establish and promote the growth of this institution cannot be over-estimated. A result of the joint efforts of the members of the society since its foundation is the opportunity of self-instruction here liberally afforded to those who may choose to avail themselves of it.

Although the museum is deficient in many of its departments, it is remarkably sufficient in some, and as a whole is very extensive, and in every sense very valuable. The unequal development or growth of the several departments is ascribable to the dependence of the collections for increase on donations exclusively, and the want of money to purchase desiderata, and not to indifference or ignorance of those to whom the immediate care of the museum is confided.

At this time the library as a whole, though not complete, is perhaps the best collection of works on natural history in this country, and the Library Fund, given by Mr. I. V. Williamson, provides liberally for its increase.

The opportunity for self-culture to be found now in the museum and library, with all their deficiencies, is a result of the generosity, goodwill, industry and benevolence of very many members and friends of the Society. Some expert naturalists may disparage this opportunity of self-culture, such as it is, and take pleasure in pointing out its defects and deficiencies, but those just entering the field, as well as those not yet proficient will find it fully sufficient for their use and worthy of cordial approbation.

Objection has been made to the regulation which restricts the use of specimens and books to the premises of the Academy, suggesting that study would be very much facilitated by loaning specimens and books to members, especially to those who are advanced students and experts. The answer is that the loan of specimens and books, which may be regarded as a luxury rather than as a necessity to students, would somewhat facilitate the work of one borrower, but while they were in his possession the studies of several persons having occasion to consult the same specimens and books might be much retarded or hindered. Besides, loaning books and specimens increases the chance of their loss and injury.

After ample experience in the practice of loaning, and due consideration of the whole question, the Academy adopted the existing regulation of loaning specimens only on a recommendation of a majority of the curators, approved by a vote of the Academy; and by prohibiting the circulation of books, has made the library a library of reference exclusively. It is confidently believed that the common interests of all concerned are best served by strict adherence to this practice. It promises "the greatest good to the greatest number" of those who have occasion to examine specimens or consult books, because, come when they may, from far or near, they are reasonably sure to find in the building whatever belongs to the museum or library.

The regulation in question is approved by an experience of more than a quarter of a century. It is supposable that it would have been changed long ago had the members of the society believed it to be injurious to their common interests.

It may be freely granted, however, that there are persons—those who are seldom spontaneously considerate of the convenience and rights of others to the use of property held in common, to whom all restrictive rules appear unwise—especially when they are an obstacle to the satisfaction of some transient interest or desire. The same individuals would probably discover a grievance in the loaning system, should they find that those very specimens and books which they desire to refer to at the moment, had just been borrowed and taken out of the building, to be returned at the end of a fortnight or possibly a month. Persons of such temperament, unhappily for themselves as well as their associates, are prone to find that " All goes wrong, and nothing as it ought," where others of more happy constitution discover nothing unpleasant.

The opportunity of self-instruction in the Academy is good as it now is. It is accessible to those who may desire to make use of it under the rules of the society. They must come spontaneously. The Academy is not prepared to enlist regulars, hire mercenaries, or solicit volunteers in order to bring into more extensive use the opportunity of self-instruction which it has built up.

When both the museum and library were easily contained in one small room, the effort of the Academy to increase its means and opportunities of self-instruction was approved. No one complained of its deficiencies. All cheerfully endeavored to use profitably what it had. The propriety of admitting to its membership those who possessed no other qualifications than friendliness to scientific pursuits and personal respectability was not questioned. But since the possessions of the Academy have grown to be extensive and of great value in every sense, there are individuals who lament that they are not greater, and seem pleased to disparage its condition, its course and its organization. Ignoring all that is recorded in the sixteen volumes of the first and second series of the Journal of the Academy and in the thirty-two volumes of its Proceedings, they imagine that it sadly lacks the afflatus of pure science and does nothing to promote research. Their tone implies that the capabilities of the institution, the potentialities of its possessions might be made more useful to truly qualified investigators by reforming the present system and policy, which are too broadly in the interest of beginners and amateurs in science. They seem to believe that the collections should be placed under the control of expert specialists, with power to loan specimens at their discretion; that the books of the library should be allowed to circulate freely, and finally, that the society should consist of proficients exclusively, or at least include a privileged class of experts.

Whether the Academy should now permit its extensive museum and library, which have cost so much time, labor and money to form, to be diverted from their present ways of usefulness to students generally, and appropriated by skilled investigators, is a question too important to be hastily decided.[1]

The by-law of May, 1876, which provides for the appointment of professors, remains inoperative. No candidate has presented himself during the year. No report has been received from the Professor of Histology and Microscopic Technology, who was appointed April 16, 1877.

In conclusion, it may be said that the condition of the Academy has never been better since its foundation than it is at the present time. It is independent of debt, and its income has been so far increased that it is hoped, under a careful administration of its financial affairs, it will soon be sufficient to meet the usual demands.

The whole is submitted.

W. S. W. Ruschenberger.

[1] A society composed exclusively of proficients may be desirable and even essential to the progress of original investigation in Philadelphia. Those who are of this opinion might possibly form such a society at once, and in the course of time acquire all it may need; and, without coveting or attempting to appropriate its possessions, permit the Academy to exist for the benefit of those proficients who approve of its organization as well as of beginners and amateurs. Some of these might become qualified to be admitted to membership of any society composed exclusively of generally recognized masters in science.

REPORT OF THE RECORDING SECRETARY.

The Recording Secretary respectfully reports that during the year ending November 30th, 1880, twenty-six members and twenty correspondents have been elected.

Resignations of membership have been received from D. E. Dallam and J. D. Thomas.

Records of the death of twenty members and four correspondents have been published in the Proceedings under the dates of announcement.

Twenty-five papers have been accepted for publication as follows: H. C. Lewis, 7; J. S. Kingsley, 3; Jos. Leidy, 3; H. C. Chapman, 2; Harrison Allen, 1; R. Bergh, 1; Andrew Garrett, 1; A. W. Vogdes, 1; W. N. Lockington, 1; W. D. Hartman, 1; Wm. Barbeck, 1; Angelo Heilprin, 1; T. D. Rand, 1, and F. A. Genth, Jr., 1.

Twenty-two of these papers have been published in the Proceedings and three in the Journal. In addition, nine papers published in the Proceedings, together with reports of a number of important verbal communications, formed the Proceedings of the Mineralogical and Geological Section of the Academy for the years 1877 to 1879.

Two hundred and eighty-eight pages of the Proceedings for 1879 and three hundred and fifty-two pages of the volume for 1880 have been printed during the year. The concluding number of Volume VIII of the Journal will be issued early in January.

The list of those making verbal communications at the meetings includes the names of Messrs. Leidy, Meehan, Allen, A. J. Parker, Wilcox, Koenig, Cope, Kelly, Ryder, Evarts, Frazer, Dercum, Horn, McCook, Barbeck, Kingsley, Chapman, Potts, Canby, Foote, Coates, Tasker, Martindale, Pike, Ford, Haldeman, Redfield, Porter and Hough.

At the meeting held January 13th, 1880, Messrs. Aubrey H. Smith and Geo. Vaux were elected to fill vacancies in the Council caused by the absence from the meetings thereof for six consecutive months of Dr. C. Newlin Peirce and Prof. Edw. D. Cope, and on November 16, 1880, Mr. Ezra T. Cresson was elected to fill a vacancy caused by the resignation of Mr. Geo. Vaux.

All of which is respectfully submitted.

Edw. J. Nolan,
Recording Secretary.

REPORT OF THE CORRESPONDING SECRETARY.

In accordance with the By-Laws of the Academy, the Corresponding Secretary presents the following Report of the business of his office during the year ending November 30th, 1880.

There have been elected twenty Correspondents, as follows:

Angelo Heilprin,* New York City; Dr. C. A. White,* Washington, D. C.; Albert de Selle,* Paris, France; Victor Raulin,* Bordeaux, France; R. Hœrnes,* Vienna, Austria; Georges Rolland, Paris, France; A. Inostranzeff,* St. Petersburg, Russia; Dr. Robert Schomburgh* Adelaide, Australia; Dr. Herman T. Geyler, Frankfort a. M., Germany; Robert Casparis, Konigsberg, Germany; Agostino Todaro, Palermo, Italy; J. E. Bommer, Brussels, Belgium; Prof. Teodoro Caruel,* Pisa, Italy; Lionel S. Beale,* London, England; Prof. Richard Hertwig,* Jena, Austria; Prof. Oscar Hertwig,* Jena, Austria; Dr. Carl Ochsenius,* Marburg, Prussia; Dr. M. H. De Bey, Aix-la-Chapelle, Prussia; Prof. Adolf E. Nordenskjöld,* Stockholm, Sweden; Prof. Torquato Taramelli,* Pavia, Italy; all of whom have been promptly notified, and acceptances have been received from those whose names are marked with an asterisk, *.

The donations to the Museum have been numerous and valuable, as will be learned from the Curators' report, and prompt acknowledgments have been sent to the various donors, numbering in all 228.

Letters transmitting publications have been received from Corresponding Societies or Institutions, at home and abroad, to the number of fifty-one; from individuals, four.

Letters or other acknowledgments of the reception of the publications of the Academy have been received to the number of fifty-two.

In addition to the above, thirteen letters of a miscellaneous nature have been received, and those requiring an answer have been in all cases replied to.

Respectfully submitted,

George H. Horn,
Corresponding Secretary.

REPORT OF THE LIBRARIAN.

During the past year, from December 1st, 1879, to November 30th, 1880, the library of the Academy has been increased by 2744 additions, mainly exchanges received for the publications of the Academy. The accessions have included 310 volumes, 2345 pamphlets and parts of periodicals and 89 maps, photographs, portraits, etc.

They were derived from the following sources:—

Societies 1018.
I. V. Williamson Fund 522.
Editors 487.
Authors 218
Dr. I. Minis Hayes 118.
Wm. S. Beebe 61.
Wilson Fund 50.
Department of Mines, Nova Scotia, 23.
Geological Survey of Sweden 23.
Geological Survey of Belgium 19.
Department of the Interior 17.
Isaac Lea 14.
Jos. Leidy 14.
Geological Survey of Pennsylvania 13.
University of Chili 12.
Dr. F. V. Hayden 11.
Wm. S. Vaux 10.
Geological Survey of Canada 10.
Department of Agriculture 10.
Smithsonian Institution 8.
Engineer Department, U. S. Army 7.
Geological Survey of India 6.
J. H. Redfield 6.
Geological Survey of Wisconsin 5.
Colonial Secretary N. S. Wales 5.
Geological Survey of Minnesota 5.
Treasury Department 5.
Geol. Surv. N. Zealand 4.
Yale College 4.
Minist. of Pub. Instruction, Belgium 4.
British Museum 3.
War Department 2.
U. S. Coast Survey 2.
Kansas State Board of Agriculture 2.
Geol. Surv. N. J. 2.
Jos. M. Gazzam 2.
R. Schomburgh 2.
John Brazier 2.
Mrs. Charles Pickering.
S. S. Haldeman.
Rathmell Wilson.
U. S. Commission of Fish and Fisheries 1.
Commissioners of Fisheries, California.
Mines Commissioners of Maryland.
Geol. Surv. Kentucky.
Geol. Surv. Indiana.
Geological Survey of Japan.
University of Minnesota.
Directors of City Trusts.
Meteorological Office, Canada.
South African Museum.
Government of Victoria.
Commissioners of Public Charities, Penna.
East Indian Government.
Bureau of Education.
Public Library, Milwaukee.
Astor Library.
Library Co. Phila.
Mercantile Library Associations of San Francisco, St. Louis, New York and Cincinnati, each 1.

The books and pamphlets thus acquired were distributed to the several departments of the library as follows:—

Journals 1969.
Geology 132.
General Natural History 169.
Anthropology 88.
Conchology 68.
Botany 61.
Anatomy and Physiology 41.
Entomology 36.

Ornithology 34.
Bibliography 26.
Physical Science 21.
Mineralogy 16.
Helminthology 16.
Agriculture 13.
Chemistry 11.
Encyclopedias 10.
Mammalogy 9.
Ichthyology 4.
Voyages and Travels 4.
Herpetology 3.
Microscopy 1.
Miscellaneous (History, Statistics, Politics, etc.) 12.

From the above statistics and the accompanying list of additions it will be seen that, apart from exchanges received from societies and editors, the growth of the library has been mainly dependent upon the I. V. Williamson Fund.

It gives the Librarian pleasure to be able to report the completion of the card catalogue of all the special departments of the library coming within the province of the Academy. It is to be hoped that some of the remaining sections, at present arranged on the gallery, may soon be disposed of by sale or exchange, as they embrace books of a character rarely or never consulted in the Academy; although many of them would be of importance and value elsewhere. The revision of the catalogue of journals and periodicals is progressing slowly, as time is taken after the completion of each geographical section to apply for all deficiencies noted. The answers to such applications thus far made have been so satisfactory as to warrant the hope that important additions will be received from this source during the coming year.

The collection of portraits of the Presidents and benefactors of the Academy has been increased by the addition of a fine oil painting of Isaac Lea, LL. D., by Uhle, one of Dr. Isaac Hays, by Waugh and a life-sized crayon portrait of Mr. Isaiah V. Williamson. For these gifts, interesting not only as works of art, but also as memorials of men to whom the society is indebted for many and permanent benefits, the thanks of the Academy are due to Dr. Lea, Mrs. Dr. Isaac Hays and Mr. Williamson. The Academy now possesses the portraits of eight out of its ten presidents, those of Dr. Thos. B. Wilson and Dr. Robert Bridges being yet lacking. It is to be hoped that these may be supplied, and that the series, which will certainly be of great interest hereafter, may be kept complete.

Fine framed photographs of Dr. Jos. Leidy and the late Prof. Henry have been received from Mr. F. Gutekunst, and Dr. C. W. De Lannoy has presented a death mask of Dr. James Aitken Meigs.

For the amount expended from the various funds for books you are respectfully referred to the report of the Treasurer.

EDW. J. NOLAN,
Librarian.

REPORT OF THE CURATORS.

The Curators respectfully report that the Museum of the Academy continues in its usual good state of preservation. The following report of the Curator in charge gives brief notice of what has been done, and the additions which have been made during the year.

Sir:—I would respectfully report, that during the year all the collections of the Museum have been carefully inspected and cared for, and that they are in good condition. The vertebrate fossils are in process of arrangement.

Dr. J. Allen Kite has been engaged in the arrangement of the collection of Bird-skeletons, and Mr. Angelo Heilprin in the arrangement of the Invertebrate fossils.

The specimens received during the year have been labeled and placed in their proper positions.

The contributions in the various departments during the year, excepting those reported on by some of the special sections, are as follows:—

Mammals.—Zoological Society of Philadelphia: Two *Macacus ocreatus*, *Macacus maurus*, *Ateles ater*, *Cercopithecus lalandi*, *Pteropus vulgaris*, *Herpestes griseus*, *Bassaris astuta*, *Viverra indica*, two *Tragulus Javanicus*, *Dasyprocta acouchi*, *Cœlogenys paca*, *Sciurus variabilis*, *Hypsiprymnus rufescens*. Jacob Binder: A colloidal mass with nodules of osteo-dentine embedded, from the tusk of an Elephant. Dr. H. C. Chapman: Placenta of Asiatic Elephant, born in Philadelphia. Dr. Geo. H. Horn: Two *Atalapha* (*Lasiurus*) *noveboracensis*, Phila. Jos. Jeanes: Two young Elephant skulls, *Elephas indicus* and *E. africanus*. Albert Koebele: *Nycticejus crepuscularis*, Florida. Dr. Jos. Leidy: *Hesperomys* (sp.). Roan Mt., N. C.; Buffalo jaw, from a forest in the Uintah Mts., portion of the great part of a skeleton observed by him in the locality in which it is now extinct. Miss Miller: Horns of Chamois, Alps. W. S. Vaux: Young Orang-Outang, from Philadelphia Zoological Gardens.

Birds.—Philadelphia Zoological Society: *Sycalis flaveola*, *Brotogerys xanthoptera*, Brazil; *Anser indicus*. F. W. Allen: *Dio-*

medea exulans. Hill: *Otus vulgaris.* Mrs. Herbert Russell Walsh: Two hundred and ninety-seven (one hundred and twenty-one species) Bird skins, collected and prepared by the late Robert Frazer.

Amphibians and Fishes.—Albert Koebele: Eleven species Amphibians, Florida. Dr. Jos. Leidy: Two species Salamanders, two do. Fishes, Roan Mt., N. C. Dr. H. Allport: *Erimyzon sucetta*, Centre Co., Pa. S. W. Ayer: Opercular bones, etc., *Megalops thrissoides.* Mr. Holbrook: *Argyricosus* (Vomer) *setipinnis*, Atlantic coast, Md. Dr. W. H. Jones: Nine species of Fishes, Atlantic and Pacific Oceans. J. E. Mitchell: *Amblyopsis spelaeus*, Mammoth Cave, Ky. National Mus., through Smiths. Inst.: Fifty-two species of North American Fishes.

Articulates.—J. J. Brown: *Lepas pectinata*, *Balanus*, etc., Florida. Dr. H. C. Chapman: *Lepidnotus*, and *Nymphon*, Mt. Desert, Me. C. Chambers: *Grillotalpa longipennis*, Philadelphia. John Ford: *Libinia canaliculata*, Atlantic City, N. J. Geo. Heberton: *Libinia canaliculata*, *Limulus polyphemus*, Cape May, N. J. Dr. W. H. Jones: Thirty-four species Crustacea, Atlantic and Pacific Oceans; *Nautilograpsus minutus*, taken from side of ship Acapulco. J. S. Kingsley: Six species Crustacea, in exchange. Dr. J. A. Kite, Wasps' nest, Morgan Co., Pa. Albert Koebele: Two species Crustaceans; two species Myriopoda, from Florida. J. E. Mitchell: Nest of Tarantula, California. Dr. T. H. Streets: Forty-two specimens Lepidoptera, Mantis (sp.), Yokohama, Japan. U. S. Fish Commission, through Smiths. Inst.: Thirty named species of Crustacea, Coast of New England.

Vermes, Echinoderms, Cœlenterates, Bryozoans and Porifera.—U. S. Fish Commission, through Smiths. Inst.: Thirteen species of Annelida, Coast of New England. Dr. W. H. Jones: Four species of Annelida, Pacific Ocean. Dr. Jos. Leidy: Lice from the interior of pouch of White Pelican (*Menopon perale*, Leidy), Florida. Laura M. Towne: *Filaria immitis*, from heart of dog, Beaufort, S. C. J. J. Brown: *Cidaris tribuloides*, Haiti. John Ford: *Euryale* (sp.), Palermo, Italy. U. S. Fish Commission, through Smiths. Inst.: Sixteen species Echinodermata, Coast of New England. Dr. W. D. Hartman: Rotula (sp.), Madagascar? U. S. Fish Commission, through Smiths. Inst.: Eleven species of Cœlenterata, Coast of New England. Dr. W. H. Jones: Thirteen species Cœlenterata, Pacific Ocean. Dr. H. C. Chapman: Hydroids, from Mt. Desert, Me. U. S. Fish Commission, through Smiths. Inst.: Fifteen species Bryozoans and Porifera, Coast of New England.

Anna T. Jeanes: Glass models of *Physophora magnifica*, *Diphyes Sieboldi*, *Cyanea capillata*, *Oceania phosphorica*, *Sagartia bellis*, *Palythoa auricula*, *Phellia picta*, *Corynactis clavigera*, *Nemacula primula*, *Peachia hastata*, *Phymactis florida*, *Eractis artemisia*, *Tubularia indivisa*, *Corymorpha nutans*, *Laomedea amphora*, *Bougainvillia fruticosa*.

Fossils.—Dr. Carter, through Dr. Jos. Leidy: Fragments of bones of *Uintatherium*, *Palæosyops*, and fossil turtle-eggs, near Ft. Bridger, Wyoming. Walter Collins: Eight species of Fossils from the cretaceous marl, Blackwoodtown, N. J. Dr. Corson, through Dr. Jos. Leidy: Femur and fragments of jaw of *Palæosyops major*, and foot-bones of *Uintatherium*, near Fort Bridger, Wyoming. Persifor Frazer: Two fossils. Wm. M. Gabb: Fish teeth, Martinez, Contra Costa Co., Cal. G. N. P. Gale: Shark's teeth and fragments of bone, Ashley River beds, S. C. Gustavus Guttenberg: Fossil Fucoid? near Erie, Pa. M. Hotchkiss and John Gibb: Three fossils, Central coal shaft, Fairburg, Ill. Dr. Geo. M. Lawrence: *Ammonites* (sp.), Cretaceous of Hemstead Co., Ark. R. L. Lamborn: Fish tooth (carboniferous), Irwin Station, Westmoreland Co., Pa. Dr. Jos. Leidy: Ivory of Mastodon, bored by mollusks, Rib of Manatee, and two fish vertebræ, Phosphate beds, Ashley River, S. C.; Tibia of *Palæosyops*, fossil turtle-eggs, near Ft. Bridger, Wyoming. Thomas Meehan: Four coal fossils, Schuylkill Co., Pa. J. W. Pike: Forty-eight specimens of fossil ferns, etc., Mazon Creek, Grundy Co., Ill. J. H. Redfield: *Pentremites Gordonii* (subcarboniferous). E. S. Reinhold: Thirty-six specimens coal fossils, Mahanoy City, Pa. A. L. Siler: Fossil (sacrum), West branch of South fork of Rio Virgin River, above Glendale, Utah. Wm. Spillman: *Cœlorhynchus ornatus*, Clark Co., Miss. Charles Wachsmuth: Forty-five species of Crinoids, from the Burlington Limestone, Burlington, Iowa. Harry H. Wheeler: Crinoid, cut from a side-walk paved with upper Silurian Limestone, Wabash, Ind.; Four fossil Fishes, near Fort Bridger, Wyoming.

Ethnological and Miscellaneous.—Stephen Bowers: Sixteen Indian skulls, from a burial place, Santa Barbara, Cal.; Skull of Flathead Indian, Oregon; Skull of Peruvian, Onca, Peru. Miss E. S. Boyd: Hawaiian skull, Sandwich Islands. W. C. Desmont: Dart, used in salmon fishing by the Digger Indians, Sacramento River, Cal., 1858. Jacob Geismar: Stone axe and arrow-head, Haddonfield, N. J. Prof. S. S. Haldeman: Eight pieces modern Pueblo pottery, New Mexico; Tunisian drum, Tunis, N. Africa; Stone tomahawk, two hammers, chisel and pestle, Gloucester Co., N. J.; Stone chisel, Indiana; Pestle, Ohio; Stone implement found on the farm of Mr. Wittmer, Lancaster Co., Pa.; twelve pieces Pueblo pottery, New Mexico; two stone hammers, modern Sioux, and fragments of an earthen pot, from a cave, E. Tenn.; fifty-seven pieces of native pottery, two Sorcerer's chairs, Conjuror's rattle, Necklace, three bowls made of the gourd-like fruit of the calabash tree (*Crescentia cujeta*), by the Indians of British Guiana; Native cloth, Island of Corisco. Prof. W. de M. Hooper: Stone implement, used for skinning, Misner's Farm, Pittsburg, Carroll Co., Ind. Wm. L. Mactier: Snow-shoes, made by the Otonagon Indians of Michigan. Miss Miller: Antique linen shawl, vase, lamp, mummied human hand, ibis, etc., Egypt. Wm. J.

Potts: Fragments of Indian skeletons, pottery, etc., bank of the Delaware River, below Kaighn's Point, Camden, N. J. Jos. Willcox: Fragments of pottery, from a mound, St. John's River, Fla.: Stone axe, pestle and arrow-head, Mitchell Co., N. C. ? —— Two pieces Ancient Peruvian pottery.

C. F. Parker.

Respectfully submitted by

Joseph Leidy,

Chairman Curators.

REPORT OF THE BIOLOGICAL AND MICROSCOPICAL SECTION.

During the past year eighteen (18) meetings were held; the average attendance being thirty (30) persons.

The Annual exhibition was held on the evening of October 15th, at which time a large and interested company was present.

The following is a summary of the principal subjects presented during the year:—

Dec. 1st, 1879.—Filariæ in the Bronchial Tubes of Cattle, by Dr. James McCoart.

Dec. 15th, 1879.—Modern Microscopical Work, by Dr. J. Gibbons Hunt.

Dec. 15th, 1879.—Description of Psorosperms found in Cysts of Fishes, by John Ryder.

Jan. 5th, 1880.—Pleuro-Pneumonia of Cattle, by Dr. John Gadsden.

Jan. 15th, 1880.—The Microscope as a means of Investigation, by Dr. Carl Seiler.

Feb. 2d, 1880.—The Preparation of Material for Microscopical Examination, by Dr. Seiler.

Feb. 2d, 1880.—Nuclei of the Eggs of the Common Limpet, by Mr. John Ryder.

Feb. 2d, 1880.—Observations upon the Nervous System of the Common Centipede, by Mr. John Ryder.

Feb. 2d, 1880.—Observations upon a specimen of *Actinophrium*, by Mr. Edward Potts.

Feb. 16th, 1880.—The Mounting of Microscopic Objects, by Dr. Seiler.

Feb. 16th, 1880.—Description of *Rhipidodendron* and *Halteria*, by Mr. John Ryder.

March 1st, 1880.—Injecting and Special Methods of mounting Microscopical Objects, by Dr. Carl Seiler.

March 1st, 1880.—Observations upon Sponges, by Mr. John Ryder.

March 1st, 1880.—A Plan to show Opaque Objects with the Gas Microscope, by Persifor Frazer.

March 15th, 1880.—Lithological Studies with the Microscope, by Persifor Frazer.

April 5th, 1880.—Histological Studies, by Dr. Seiler.

April 19th, 1880.—Lantern Exhibition, by Mr. Holman and Mr. Ryder.

May 3d, 1880.—Communication upon Fresh-water Sponges, by Mr. E. Potts.

May 17th, 1880.—Communication upon the Eggs of the *matica*, by Mr. E. Potts.

Sept. 6th, 1880.—Life Forms at Atlantic City, by Mr. E. Potts.

Sept. 20th, 1880.—Communication upon the Larvæ of King Crabs, by Mr. E. Potts.

Oct. 14th and 15th, 1880.—Annual Exhibition.

Nov. 1st, 1880.—Report of the Committee on Exhibits and Improvements in Microscopical Science at the Annual Exhibition, by Dr. Hunt.

Nov. 15th, 1880.—Communication upon the Development of the Pyrulla, by Mr. Charles Perot.

The following Members and Associates were elected during the year.

Members:—John C. Wilson, Otto Luthy, Howard Kelly.

Associates:—Dr. Joseph Simsohn, Dr. James A. McCoart, Dr. Edward T. Bruen, Dr. John W. Gadsden, Dr. Monroe Bond, Dr. J. H. Wills.

Robt. J. Hess,
Recorder.

REPORT OF THE CONCHOLOGICAL SECTION.

The Recorder of the Conchological Section respectfully reports that during 1880, Dr. R. Bergh, Dr. W. D. Hartman, and Mr. Angelo Heilprin have presented papers upon the Mollusca, which have been accepted and published in the Academy's Proceedings.

The Section has again lost a valued member, Professor S. S. Haldeman, who died September 10th, 1880. Professor Haldeman manifested his interest by frequent contributions to our Museum, as well as by papers published in the American Journal of Conchology. He also presented to us a number of copies of text and plates of his celebrated monograph upon the Fresh-water Univalve Mollusca of the United States. These the Section reissued, the work having been long out of print, and the sale resulted to its pecuniary advantage.

Mr. George W. Tryon, Jr., Conservator of the Section, reports as follows:

About fifty distinct donations and purchases of recent shells will be found recorded in the detailed list hereunto appended, aggregating 1216 species, represented by 4574 specimens. These have all been carefully determined, labeled, mounted, and placed in the cases.

Mr. Charles F. Parker has, as usual, afforded valuable assistance in preparing these specimens for exhibition.

Mr. John Ford continues to prepare for us sections of univalve shells, showing their internal form and structure. He has presented over fifty of these during the year. We are indebted to Miss Anna T. Jeanes for a number of beautiful glass models of mollusks, and to Mr. Joseph Jeanes for a fine suite of California shells, and mounted linguals of *Chitonidæ*, etc.

Mr. John H. Redfield has presented his entire and very complete collection of *Marginellidæ*.

The U. S. Fish Commission, and Dr W. H. Jones, U. S. N., have presented numerous specimens, both in alcohol and dry.

We have received from Dr. Isaac Lea, the type series of Claiborne (Ala.) Eocene fossils, described and figured in his "Contributions to Geology," numbering 228 species.

Mr. John A. Ryder has prepared a drawing in outline of the gigantic *Architeuthis princeps*, Verrill; although only $\frac{1}{13}$ of the natural size, this drawing is upon a canvas twelve feet in length. It is exhibited upon the wall of the Conchological gallery.

Our collection of fossil shells, the systematic arrangement of which has been so long neglected, has at length, under the competent supervision of Mr. Angelo Heilprin, received that attention which its importance merits. Mr. Heilprin has critically studied and arranged the whole of the North American Eocene Collection, and is now engaged upon the Miocene. These shells have all been labeled and mounted by Mr. Parker. A suitable label has been placed upon the drawers containing the " Swift Collection," and these have been made accessible to the public. The *Cephalopoda*, *Muricidæ*, *Purpuridæ*, *Fusidæ*, and *Buccinidæ* of the general collection have been rearranged in accordance with the latest information upon these groups; and it is proposed to continue this work of revision upon the other families of marine shells as opportunity offers.

A rearrangement of the Land shells in accordance with the natural groups of Dr. Louis Pfeiffer's " Nomenclator Heliceorum Viventium," and of the Unionidæ, in accordance with the latest edition of Dr. Lea's " Synopsis," will be commenced as soon as possible.

The Museum of Recent Conchology now contains 38,624 trays and 136,387 specimens.

There have been no changes made in the By-Laws of the Section. The officers for 1881 are:

Director—W. S. W. Ruschenberger.
Vice-Director—John Ford.
Recorder—S. Raymond Roberts.
Secretary—John H. Redfield.
Treasurer—Wm. L. Mactier.
Conservator—Geo. W. Tryon, Jr.
Librarian—Edw. J. Nolan.

Respectfully submitted,

S. Raymond Roberts,
Recorder.

The following are the additions to the Conchological Cabinet received during 1880:

R. Arango. Two hundred and seventy-four species and varieties of Cuban shells.

W. G. Binney. *Helix Mayrani*, Algiers. *Testacella haliotoidea*, England.

John Brazier. *Bythinia hyalina*, from New South Wales. Eighty-four species Land, Fresh-water, and Marine shells from Australia.

J. J. Brown. A collection of mollusks from Florida and Haiti.

W. W. Calkins. *Unio Blandingianus* and *Tritonidea tincta*, Florida.

Caleb Cooke. *Melania scabra*, Zanzibar.

W. H. Dougherty. *Bulimus Schiedeanus*, Coahuila, Mexico.

John Ford. *Arca pexata*, Say, Newport, R. I. Five species of marine shells, Atlantic City, N. J. *Mytilus hamatus*, Say, from Seekonk River, Providence, R. I. *Helix tuberculosa*, Conrad, Sinaitic Desert. *Natica duplicata* and *N. heros*, with nidus, ova capsules of *Nassa trivittata*, Atlantic City, N. J. Fine specimen of *Cassis tuberosa*, Bahamas. Over fifty specimens, sections of shells.

Andrew Garrett. *Partula decussata* and *P. ganymedes*, Dominique Is., Marquesas. *P. inflata*, Taiwata, Marquesas. *Partula* (sp.), Moorea, Society Isles. *Trochus trochoidea*, Society Isles. *Cardium* (sp.), Paumotus Is.

E. Hall. A collection of land and fresh-water shells from various localities. Twenty-six species of fresh-water shells.

Dr. W. D. Hartman. Embryonic Partulæ. *Cyclostoma incomptus*, near Bogota, S. A. *Helix similaris*, Fer., Japan. Three species of *Partula* from Marquesas Islands. *Partula Raiatensis* (type) from Raiatea. *Partula approximata*, Raiatea.

Henry Hemphill. Over two hundred species and varieties of California shells.

J. G. Hidalgo. *Murex Tryoni* (type), Lesser Antilles. *Ricinula nodosa*, Brazil.

Anna T. Jeanes. Glass models of twelve species of nudibranchiate mollusks.

Joseph Jeanes. Mounted linguals of thirty-seven species of mollusks. Ninety-nine species and varieties of land, fresh-water and marine shells from California.

Dr. W. H. Jones. Twenty-five species of pelagic mollusks from the Atlantic and Pacific Oceans. *Scyllæa pelagica*. *Oxygyrus Keraudrenii*.

Henry C. Lea. Twenty-four species of Claiborne Eocene fossil shells, types of his descriptions.

Dr. Isaac Lea. Type collection of Claiborne (Ala), Eocene shells, consisting of 228 species; arranged as described and figured in his "Contributions to Geology." *Voluta Junonia*, Edgmont Key, Fla.

Joseph Leidy. *Goniobasis proxima*, Say, Piedmont Springs, North Carolina

E. T. Nelson, *Eupleura Tampaensis*, Conr., Tampa Bay, Fla.

T. R. Peale. *Astarte castanea*, Say, Sandy Hook, N. J.

John H. Redfield. Collection of Marginellidæ, including several hundred specimens of about two hundred species and varieties. *Spirifer mucronatus*, Hamilton group.

S. R. Roberts. *Macoma balthica*, Linn., Collins' Beach, Del. *Helix cinnamomea*. *Trivia pellucidula*, Sandwich Isles. *Cylindrella gracilicollis*, *Macroceramus Klatteanus*, Bld. (ex auct.), Port-au-Prince, Hayti.

Dr. W. S. W. Ruschenberger, *Dione lupinaria*, San Blas.

Prof. D. S. Sheldon. *Physa gyrina*, young, Davenport, Iowa.

Hon. F. E. Spinner. Seven lots of marine shells (fifty-six species) from the mouth of St. John's River. Fla.

U. S. Fish Commission. Fifty-four species of marine Mollusca from the New England coast.

H. A. Ward (purchased). Glass models of six species of Cephalopods.

J. F. Whiteaves. Eight species of fluviatile and marine shells, from Queen Charlotte's Isl. and Gulf of St. Lawrence.

REPORT OF THE BOTANICAL SECTION.

The Vice-Director takes much pleasure in reporting to the Academy the continued prosperity of the botanical department, which, in fact, is quite equal to all that can be expected of it, until, by the good fortune of an endowment, funds can be supplied regularly to extend its work. Meetings have been held every month throughout the year except July and August, at each of which valuable communications have been made by various members. Some of the more important of these have been communicated to the general meetings of the Academy, and have found a place in its published proceedings.

The Section now consists of thirty-one members, one having been added during the year.

The Conservator's report to the Section of the condition of the Herbarium has been adopted by the Section as its report to the Academy, and is as follows:—

The accessions to the Academy's Herbarium during the past year have been large and valuable, and the mounting and distribution of the plants received have made large demands upon the time of the Conservator and of the members of the Section who have kindly aided him.

Among the valuable contributions received were the collections of the late Dr. Charles Pickering, made in the years 1844–5, during a journey to Malta, Egypt, Arabia and India, and presented to the Academy by his widow, Mrs. Sarah S. Pickering. The number of species is estimated at about 1500, and, as none of them were named, the labor of distributing them in their proper natural order (which has been performed by Messrs. Meehan and Burk), has been slow, but is now completed.

From Dr. Gray, of Cambridge, important contributions have been received. Dr. Garber has presented a collection of 100 species collected by himself recently in Porto Rico, while some 250 species of Mexican plants, collected by Drs. Parry and Palmer, have been added.

In the department of the Lower Cryptogams the additions have been of a nearly complete series of the Mosses and Hepaticæ of N. America, collected and named by the late lamented Austin, and presented by the liberality of members of the Section, and of 200 species of N. American Fungi, collected, determined and prepared by J. B. Ellis, and presented by Mr. Martindale.

The total number of species contributed during the year is estimated at 3100, a very large proportion of them being new to the Herbarium.

Some progress has been made in the mounting of the North American Herbarium, the orders from Polemoniaceæ to Scrophulariaceæ inclusive having been completed. Mr. Scribner has continued his work upon the determination and the mounting of the Grasses, though interrupted by long and serious illness. Those familiar with Herbarium work can appreciate the amount of labor yet required to sift the material now upon our shelves, to determine the doubtful species and to mount the whole. Volunteer labor is hardly adequate to take care of the new accessions, and, until some endowment shall secure to the Academy the constant work of a competent botanist, the completion of the task must remain for the future.

Much inconvenience has been heretofore experienced from the want of a proper place to receive and display such seed-vessels and vegetable products as were too large to place in the herbarium sheets. Such objects have necessarily been placed in the gallery of the Museum, too distant from the botanical working-room to be readily consulted. The liberality of a member of the Academy, whose aid has often supplemented its needs and sustained the hands of its workers, has removed this difficulty, and we have now in the botanical room a most convenient and capacious working table, containing sixty-four large drawers for the reception of seed-vessels, pine-cones, wood-sections, etc.

The Conservator must acknowledge, as heretofore, the efficient aid received from Mr. Chas. F. Parker in the work of poisoning and arranging the collections received during the year and for other material assistance.

JOHN H. REDFIELD,
Conservator.

December 13th, 1880.

The officers elected for the forthcoming year are:

Director.—Dr. W. S. W. Ruschenberger.

Vice-Director.—Thomas Meehan.

Recorder.—F. L. Scribner.

Cor. Secretary.—Isaac C. Martindale.

Conservator.—John H. Redfield.

Treasurer.—J. O. Schimmel.

Respectfully submitted,

THOMAS MEEHAN,
Vice-Director.

Donations to Herbarium and Museum.—Mrs. Sarah S. Pickering, of Cambridge, Mass.: 1200 species plants, collected by the late Dr. Chas. Pickering, in the years 1844 and 1845, in Malta, Egypt, Arabia, Zanzibar and India, also lot of seed-vessels, etc. Chas. F. Parker: *Lechea Novæ Cesariæ* Austin, Bergen Co., N. Y., (author's type); *Fragaria Gillmani*, Clinton, Detroit, Mich. (author's type); *Guizotia oleifera*, D. C., African species, from Ballast, Camden, N. J.; *Lycopus sessilifolius*, Gr., Batsto, N. J.; *Lycopus Europæus*, Ballast, Camden, N. J. Wm. M. Canby: *Phlox Stellaria*, Gr., Nashville, Tenn.; 5 species plants from California, new to the collection; 111 species of plants from Europe, Syria, S. Africa, etc., many of them new to the collection. Dr. Asa Gray: 161 species plants from California, Arizona, Oregon, Washington Terr., Turkistan, and Micronesian Islands, mostly new to the collection. Prof. C. J. Sargent: *Aster Herveyi*, Gr., Tiverton, R. I.; Photographs of Coniferæ, from Oregon. Geo. E. Davenport, Boston: *Cheilanthes viscida*, Davenp., California. Isaac C. Martindale: Third and fourth centuries of Ellis' North American Fungi; *Corethrogyne filaginifolia*, Nutt, San Diego Co., Cal.; specimens of *Castanea vesca*, L., var. *Americana*, with abnormal fertile spikes, from Pitman's Grove, N. J.; Bark of *Pinus mitis*, Mx.; *Brickellia Vincentiana*, Greene, new species, New Mexico; *Corrigiola litteralis*, L., Ballast, near Philadelphia. Dr. C. C. Parry, Davenport, Ia.: *Tithonia tubæformis*, Cass., cult. at Davenport, from Mexican seed; Mexican mats and rope made from fibre of *Agave heteracantha*; Fibre of *Agave Americana*. A. L. Siler, Utah: *Pentstemon Sileri*, Gr., nov. sp., Beaver Dam Mts., Utah. Mrs. M. J. Myers, Syracuse, N. Y.: *Epipactis Hel-*

leborine Rich., var. *viridans* Gr., near Syracuse, N. Y. Dr. Thos. Lancaster: *Polyporus*, growing on Hemlock Spruce, McKean Co., Pa. Wm. H. Dougherty: Skeleton of stem of *Opuntia imbricata;* Capsule of *Hanburia;* Stems of *Euphorbia antisyphilitica*, all from Chihuahua, Mexico. Aubrey H. Smith: *Myosotis versicolor*, Pers., Cobb's Creek, Darby, Pa. Thomas Bland, N. York: Wax, from the leaves of the Carnauba Palm (*Copernicia cerifera*); Whip from the bark of ———, Jamaica; Paper from the fibre of Plantain and Banana, Jamaica; *Myristica fragrans*, Houtt., Nutmeg with its Mace and outer husk, Jamaica; Seeds of the following plants from West Indies: *Lucuma mammosa*, Gris., *Feuillea cordifolia*, Ser., *Coix lachryma*, L., *Sapindus saponaria*, L., *Adenanthera pavonina*, L., *Abrus precatorius*, L., *Guilandina Bonduc*, L., *Anacardium occidentale*, L., *Guilandina Bonducella*, L.: Wood of the Down tree (*Ochroma Lagopus*). Thos. Meehan: *Pellaea atropurpurea*, Link., collected in Southern Utah, by A. L. Siler; *Sedum Meehani*, Gray, collected in Southern Utah, by A. D. Siler. Isaac Burk: Wood of *Heritiera*, Africa. Dr. A. P. Garber: 95 species of plants, collected by him at Yauco, Porto Rico, in 1880, named by Dr. Gray and Mr. Oliver of Kentucky. John H. Redfield: 217 species plants collected by Dr. C. C. Parry and Dr. E. Palmer, near San Luis Potosi, Mexico, named at Kew and Cambridge; 57 species Ferns, collected by A. Fendler, in the Island of Trinidad, W. I., in 1879–80, supplementary to a collection presented in 1878, named by Prof. D. C. Eaton; 7 species plants from Florida and Tropical America. J. H. Redfield, J. C. Martindale, Thos. Meehan, Wm. M. Canby, Dr. Chas. E. Schaffer, Dr. J. Bernard Brinton: Complete set of the Mosses and Hepaticæ of N. America, collected and named by the late Coe F. Austin, consisting of 518 species of Mosses and 124 species of Hepaticæ.

REPORT OF THE ENTOMOLOGICAL SECTION.

The Entomological Section, throughout the past year has held its regular meetings, excepting during the months of July and August. Most of the meetings have been quite interesting, owing to the many original communications, both verbal and written, that have been presented. These lectures, as they may be called, were devoted to illustrating some of the variations of form, etc., of many entomological species and genera. At the same time opportunity has been afforded to those so desiring, to describe new species of the entomological fauna, and to present their observations to the public. That the claims of priority of description thus made, might not be lost by the several authors, such communications have been condensed and published in the Proceedings of the Section. The more full and complete papers are, as heretofore, published in the Transactions of the American Entomological Society. There have been eight papers presented and published by the latter society during the year, comprising 338 pages of printed matter in octavo form, illustrated by seven plates. This, in connection with 24 pages of the published Proceedings of the Section make a total of 362 pages of entomological publications issued since last annual meeting.

The entomological collections of the Academy have been carefully attended to through the year, by the Conservator, Mr. Geo. B. Cresson, and have been preserved from all infection or loss.

By the death of Mr. James Ridings, in July, the section lost one of its most valued members. Mr. Ridings was one of the founders of the American Entomological Society, and through his many valuable discoveries was well known among the entomologists of the United States.

At the annual meeting of the section, held December 13th, the following gentlemen were re-elected as officers for the ensuing year:

Director.—John L. LeConte, M. D.

Vice-Director.—George H. Horn, M. D.

Treasurer.—E. T. Cresson.

Recorder.—J. H. Ridings.

Conservator.—Geo. B. Cresson.

Publication Committee.—George H. Horn, M. D.
Samuel Lewis, M. D.

At the last annual meeting of the American Entomological Society the sum of seventy-five dollars was contributed towards the funds of the Academy.

Respectfully submitted,

JAMES H. RIDINGS,
Recorder.

REPORT OF MINERALOGICAL AND GEOLOGICAL SECTION.

The Director of the Mineralogical and Geological Section would respectfully report:

Meetings of the Section have been held monthly, except during July and August. The attendance has been good. A number of interesting papers were read, and many valuable communications and donations made. During the year, the first volume of its proceedings was published, containing scientific papers and communications to January 1st, 1880. The collection of local rocks and minerals has outgrown the place provided for it. It is almost complete as to the rocks of Philadelphia, and of Delaware, Montgomery and Bucks counties. Believing, as he does, that this collection will grow into one of great importance and interest, he is glad to state that the desire of the Section for a better location for it has been granted by the Council of the Academy.

Respectfully submitted,

THEO. D. RAND,
Director.

PHILADELPHIA, *December 27th, 1880.*

To the Director of the Mineralogical and Geological Section:

The mineral collection of the Academy has been improved during the past year by the addition of the usual number of donations. These have been carefully labeled and placed in the cases by Mr. Charles F. Parker, to whose industry and care we are chiefly indebted for the satisfactory arrangement and labeling of all our specimens. I submit with this a list of the donations during the past year. The collection is in a satisfactory condition.

JOSEPH WILLCOX,
Conservator.

Additions to Mineralogical Cabinet during the year 1880:—Jas. W. Beath: Twenty-five specimens of polished Agates, from Oberstein, Germany, and Paraguay; Crocidolite, S. Africa. C. S. Boutcher: Proustite, Gunnison. Co., Colorado. Walter Collins: Asphaltum, Cretaceous Marl, Blackwoodtown, N. J. Chas. Doble: Millerite, Chalcopyrite and Niccoliferous Pyrrhotite, Gap Mine, Lancaster Co., Pa. W. H. Dougherty: Native Gold, also a fine collection of Native Silver, Silver ores, Argentiferous Galena, Ruby Silver, Cassiterite, etc., Mexico; Green Sand, San Antonio River, Texas. John Ford: Stilbite, Frankford, Philada.; Actinolite, Hornblende, Lafayette, Montgomery Co., Pa. John Garvin: Native Gold in Quartz, Battle Branch, Ga. E. Goldsmith: Lignite, containing Fichtelite, Brazil Prof. S. S. Haldeman: Stalactite, and six specimens of Agates, Argentine Republic. E. P. Hancock: Two specimens Jeffersonite, Sterling, Sussex Co., N. J.; Thorite, Brevig, Norway. W. W. Jefferis: Quartz pseud. after Dog-tooth Spar; Picrolite (Slickenside,) Newlin, Chester Co., Pa.; Wavellite, E. Whiteland, Chester Co., Pa. Dr. G. A. Koenig: Jarosite, Chaffee Co., Colorado. Dr. Isaac Lea: Amazonstone, and a fine specimen of Sunstone, near Media, Del. Co., Pa. Dr. Jos. Leidy: Three specimens of Talcose Slate, Soapstone Quarry, shore of the Delaware River, above Easton, Pa.; Corundum, Laurens Co., S. C.; Biotite, Steatite Quarry on Bushkill Creek, near Easton, Pa. H. C. Lewis: Philadelphite, Phila.; Hyalite, Germantown, Phila.;

Halite, Saltville, Va. Wm. Lorenz: Chrysotile, Canada. Mr. Loyer: Corundum, Chester Co., Pa. Miss Miller: Crystals of Silver, Lake Superior; Hematite, Gypsum, Stalactite, Chlorastrolite, Halite, etc., from various localities. Dr. Weir Mitchell: Silicified Wood, Missouri River, above Bismarck. L. Palmer: Albite, Vermiculite, Del. Co., Pa. Theo. D. Rand: Kammererite and Chromite, Radnor, Del. Co., Pa.; Crystallized Quartz in Potsdam Sandstone, Mont. Co., Pa.; Herrengrundite, Herrengrund, Hungary; Orileyite, Burmah. J. L. Reed: Asbestus, Italy; Chrysotile, Ontario, Canada. T. W. Ried: Chalcopyrite, Montgomery Co., Pa. Dr. W. S. W. Ruschenberger: Copper Slag, Caldera, Chile, 1856. Dr. J. Richard Taylor: Cerargyrite, Chloride of Silver, with fractured Wavellite crystals, Galena with free Sulphur, Millerite, and argentiferous Carbonate of Lead, Leadville, Colorado; Ore from the Ohio Mine, bearing Gold, Silver and Copper, Breckenridge, Col. C. M. Wheatley: Fine specimen of Byssolite, Chester Co., Pa.; Azurite on Chalcopyrite, Upper Salford Mine, Montgomery Co., Pa.; Aurichalcite on Calcite, and white Apatite with Byssolite; Chalcopyrite, Pyrite and Melaconite, Jones Mine, Berks Co., Pa. Dr. Jas. W. White: Corundum, Zircon, Storeville, Anderson Co., S. C.; Corundum, Concord, N. C.; Andesite with Corundum, Hog-back Mt, N. C.; a collection consisting of Zincite, Rutile, Phlogopite, Graphic Granite, Chesterlite, Fibrolite, Garnet, Damourite, Stalagmite, etc., from various localities. Joseph Willcox: Autunite (Uranite), Mitchell Co., N. C.; Pyroxene, Biotite?, Apatite, Burgess, Ontario, Canada; Corundum coated with Margarite, Iredell Co., N. C.; Danburite, Russel, St. Lawrence Co., N. Y.; Black Tourmaline, Westport, Ontario, Canada; Scapolite, Pyroxene, and four specimens of Apatite, Bob Lake, Ontario, Canada. A. E. Foote, in exchange for duplicate books: nine specimens of Apatite, Renfrew, Ontario, Canada; Chrysotile, four specimens of Titanite (Sphene), Titanite (Lederite), two Vesuvianite, Beryl, Triphyllite, Celestite, Wollastonite, Gummite, Uranotile, Tourmaline, Octahedral Crystals of Fluorite, with Apatite and Calcite, from various localities. Purchased: Limonite, Superior Mine, Michigan.

Additions to Rock Collection.—John Ford: Hornblende, Soapstone Quarry, Lafayette Pa.: Tourmaline and Hornblende Schist, Tunnel near Girard Ave. Bridge; Decomposing Gneiss with Mica, ditto with Quartz, ditto with Manganese?, near west end of Callowhill St. Bridge, Philadelphia. G. H. Ivens: Geode of Limonite, Kent Co., Md. W. W. Jefferis: Gneiss. John Hartman: Two specimens of Crystalline Slag, taken from hearth of Blast Furnace, Charlotte, N. Y. Dr. Jos. Leidy: Talcose Slate, Soapstone Quarry, Pot Rock, Delaware River, above Easton, Pa.; Indurated Clay (Bridger Eocene), near Fort Bridger, Wyoming. H. C. Lewis: Glacier-scratched boulder, Belvidere, N. J. Theo. D. Rand: Twenty-seven specimens of Rocks, from the neighborhood of Philadelphia, for Local Rock collection; three specimens of slags, from Puddling Furnace, Coatesville, Pa. Joseph H. Tull: Six specimens of Ruby Silver, near Austin, Nevada.

SUMMARY OF THE REPORT OF WM. C. HENSZEY, TREASURER, FOR THE YEAR ENDING NOV. 30, 1880.

DR.

To Balance from last account	$1032 99	
" Initiation fees	230 00	
" Contributions (semi-annual contributions)	2214 98	
" Life Memberships	500 00	
" Voluntary Contributions from Life Members	615 00	
" Admissions to Museum	455 30	
" Sale of Guide to Museum	62 00	
" " Duplicate Books	7 75	
" Donation from Mineralogical and G. Section towards Proceedings	35 00	
" Donations towards Plates for Proceedings	10 00	
" Interest on Deposits	[illegible]	
" Interest on Phil. and Erie Railroad Bonds	30 00	
" Life Member Fund. Interest on Investment	120 00	
" Maintenance Fund. " " "	30 06	
" Publication Committee. W. S. Vaux, Treasurer	507 04	
" Publication Fund. Interest on Investments	280 00	
" Barton Fund. " " "	240 00	
" Wilson Fund. Towards Salary Librarian	300 00	
" Freight returned	4 30	
" Phila. and Erie Railroad Bond, Transferred to Maintenance Fund	1000 00	
		$7763 40

CR.

Salaries, Janitors, etc.	[illegible]	
Freight	60 59	
Inspecting Boiler	10 20	
Repairs	188 05	
Insurance	30 00	
Jars and Bottles	74 11	
Coal	195 50	
Gas	[illegible]	
Mounting Bird	1 25	
Stationery and Postage Stamps	136 55	
Books	[illegible]	
Alcohol	37 60	
Publication Committee. W. S. Vaux, Treasurer	93 33	
Newspaper Reports	64 00	
Water Rents	26 15	
Trays	42 00	
Binding	118 40	
Printing and Paper	1539 63	
Plates and Printing	[illegible]	
Miscellaneous	448 54	
Life Memberships transferred to Life Membership Fund.	500 00	
		6852 19
Balance[1]		[illegible]

[1] During the year there was received from voluntary contributions and donations $660, which, with a Bond for $1000, used for general purposes, indicates that the current expenses exceed the regular income over $1600, the balance at the close of the year being a little less than at the commencement.

LIFE MEMBERSHIP FUND. (For Maintenance.)

Balance per last Statement		$500 00
Life Memberships Transferred to this account		500 00
Interest		120 00
		$1120 00
Transferred to General Account		120 00
To Balance for Investment		$1000 00

BARTON FUND. (For Printing and Illustrating Publications.)

Balance per last Statement		$240 00
Interest		240 00
		$480 00
Transferred to General Account		240 00
Balance		$240 00

JESSUP FUND. (For Support of Students.)

Balance last Statement		$551 67
Interest on Investments		560 00
		$1111 67
Disbursed		590 00
Balance		$521 67

MAINTENANCE FUND.

Total amount received		$1550 00
Interest		30 00
		$1580 00
Less paid for Printing	$23 65	
Invested in Bonds Phila. and Erie Railroad	1000 00	
Interest Transferred to General Account	30 00	
		1053 65
Balance		$526 35

I. V. WILLIAMSON LIBRARY FUND.

Balance		$330 26
Rents Collected		97 00
Ground-rents Collected		1096 00
		$1523 32
For Books	$577 56	
Expenses Sale of Prop'ty for arrearages of Ground-rent	167 25	
Costs, Insurances, etc	37 47	
Repairs to Properties	232 37	
Taxes	204 02	
Water Rents	41 40	
Collecting	53 70	
		1313 77
Balance		$209 55

PUBLICATION FUND.

Balance last Statement		$[illegible]
Income from Investments		350 00
		$688 25
Transferred to General Account		280 00
To Balance		$408 25

THOMAS B. WILSON LIBRARY FUND

Balance last Statement		$141 57
Interests on Investments		570 00
Received from W. S. Vaux for Duplicate Books		8 00
		$719 57
Paid for Books	$300 00	
" Binding	11 55	
To General Account towards salary of Librarian	300 00	
		$611 55
Balance		$108 02

MRS. STOTT FUND. (For Publication.)

Twelve Months' Interest	$112 00
Paid to (W. S. Vaux) Publication Committee	114 00

JOSHUA T. JEANES FUND. (For Maintenance.)

Bequest by him paid by Heirs		$20,000 00
Invested in three Mortgages	$7000 00	
"	3000 00	
"	10,000 00	
		$20,000 00

ECKFELT FUND.

To be invested	$2466 86

The election of officers for 1881 was held, with the following result:—

President, . . .	W. S. W. Ruschenberger, M. D.
Vice-Presidents, . .	Wm. S. Vaux,
	Thomas Meehan.
Recording Secretary, .	Edward J. Nolan, M. D.
Corresponding Secretary,	Geo. H. Horn, M. D.
Treasurer, . . .	Wm. C. Henszey.
Librarian, . . .	Edward J. Nolan, M. D.
Curators, . . .	Joseph Leidy, M. D.,
	Wm. S. Vaux,
	Chas. F. Parker,
	R. S. Kenderdine, M. D.
Councillors to serve three years, ...	Wm. L. Mactier,
	Aubrey H. Smith,
	Henry C. Chapman, M. D.,
	Geo. Y. Shoemaker.
Finance Committee, .	Edw. S. Whelen,
	Clarence S. Bement,
	Aubrey H. Smith,
	S. Fisher Corlies,
	Geo. Y. Shoemaker.

ELECTIONS DURING 1880.

MEMBERS.

January 27.—A. R. Thomas, M. D., Wm. H. Jenks, John S. Jenks, Chas. W. Pickering, Henry F. Formad, M. D., Charles P. Tasker, John Wagner, Ferris W. Price, Geo. W. Biddle.

February 24.—R. S. Huidekoper, M. D., Frances Emily White, M. D., David Townsend, Thos. Miles, John S. Capp.

March 30.—Paris Haldeman, Geo. B. Heckel, Emlen Physick, M. D.

May 25.—Henry S. Gratz, R. S. Peabody, Mrs. R. S. Peabody, Wm. Barbeck.

October 26.—Rev. Wm. F. C. Morsell, Samuel R. Knight, M. D.

November 30.—Charles S. Turnbull, M. D., James M. Anders, M. D.

For list of Correspondents elected see Report of the Corresponding Secretary.

ADDITIONS TO LIBRARY.

December 1st, 1879—November 30th, 1880.

Abbot, E. H. Physics and hydraulics of the Mississippi River. Dr. I. Minis Hays.
Allen, J. A. U. S. Geol and Geogr. Surv. of Ter. Miscellaneous publications, No. 12. History of North American Pinnipeds, 1880. The Department of the Interior.
Allen, T. F. Characeæ of America. Pts. 1 and 2. I. V. Williamson Fund.
Allis, O. A. Deformity from fractures at the lower end of the humerus. The Author.
Alumni Association, Philadelphia College of Pharmacy. 16th annual report. The Society.
American Angler's Guide. 3d Ed., 1849. S S. Haldeman.
American Museum of Natural History. 11th annual report. The Director.
Annual record of science and industry for 1878. I. V. Williamson Fund.
Arango, R. Contribucion a la fauna malacologica Cubana. The Author.
Archæological Section of the St. Louis Academy of Sciences. Contributions to the archæology of Missouri. Part I, Pottery. The Academy.
Astor Library. 31st annual report, 1880. The Trustees.
Baillon, M. H Dictionnaire de botanique. 12me Fasc.
Natural history of plants. Vol. 6. I. V. Williamson Fund.
Balfour, F. M. Comparative embryology. I. V. Williamson Fund.
Barber, E. A. Comparative vocabulary of Utah dialects. The Author.
Bárcena, Mariano. Terremoto del 17 de Mayo de 1879
Viaje a la Caverna de Cacahuamilpa, 1874. The Author.
Datos para el estudio de las rocas mesozoicas de Mexico, y sus fosiles caracteristicos, 1875. Dr. Jos. Leidy.
Barrande, J. Brachiopodes. Vol. 5, 1879. The Author.
Beale, L. S. How to work with the microscope. 5th Ed. I. V. Williamson Fund.
Bentham, G. and J. D. Hooker. Genera plantarum. Vol. 3, Pt. I. I. V Williamson Fund.
Berg, Dr. C. Observaciones acerca de la familia Hyponomeutidæ.
Apuntes Lepidopterologiques.
Hemiptera argentina, 1879.
La Reina de las Flores, 1880. The Author.
Binney, W. G. North American species of Zonites. The Author.
Board of Directors of City Trusts. 10th annual report. The Board.
Bocage, J. V. Barboza de. Melanges ornithologiques, V.
Liste des Antilopes d'Angola.
Algumas observações e additamentos ao artigo do Sr. A. C. Smith intitulado "A sketch of the birds of Portugal."
Note sur une nouvelle espèce africaine du genre "Coracias."
Aves das possesões portuguezas d'Africa occidental, 14th and 16th List.
Subsidios para a fauna das pos. portuguezas d'Africa occidental.
Aves da Zambezia e do Transvaal. The Author.
Bohnensieg, G. C. W. and W. Burck. Repertorium annuum literaturæ botanicæ periodicæ. T. 5, 1879.
Encyklopædie der Naturwissenschaften. 1e Abth., 8 Lief., 1880. I. V. Williamson Fund.
Bolton, H. Carrington. Table showing the behavior of certain minerals with Citric Acid alone and with reagents. The Author.
Bommer, J. E. Monographie de la classe des Fougères, 1867. Dr. F. V. Hayden.

Borre, A. Preudhomme de. Espèces de la tribu des Féronides qui se rencontrent en Belgique. 1re Partie.
Espèces des tribus des Panageides, des Loricerides, des Licindes, des Chlæniides et des Broscides qui se rencontrent en Belgique.
De la meilleure disposition à donner aux caisses et cartons des collections d'insects.
Note sur le Breyeria Borinensis. The Author.
Brazier, J. Synonyms of, and remarks upon Port Jackson, New Caledonian and other shells, with their distribution.
Brief account of the natives of western Australia, 1879. The Author.
Brehms Thierleben. 8 Bd., 1–8 Heft. I. V. Williamson Fund.
Breviére, L. Catalogue des mollusques observés dans le Départment de la Nièvre. I. V. Williamson Fund.
Bronn, H. G. Morphologische Studien über die Gestaltung-Gesetze der Naturkörper überhaupt, und der organischen insbesondere. 1858. Dr. Jos. Leidy.
Thier-Reichs. 6er Bd., III. Abth., 2–12 Lief. Wilson Fund.
Brühl, C. B. Zootomie aller Thierklassen. Atlas. Lief. 14 & 15. I. V. Williamson Fund.
Brun, J. Diatomées des Alpes et du Jura. I. V. Williamson Fund.
Brush, Geo. J. Mineral locality at Branchville, Connecticut. 4th paper. The Author.
Buchanan, J. Manual of indigenous grasses of New Zealand. Wellington, 1880. Geological Survey of New Zealand.
Bureau of Education, circulars of information, Nos. 2 and 3. Department of the Interior.
Bureau of Statistics, Treasury Department, quarterly reports, Sept. 30, 1879–June 20, 1880. The Department
Butler, A. G. Illustrations of typical specimens of Lepidoptera heterocera in the collection of the British Museum. Pt. 14. The British Museum.
Calkins, W. W. American conchology. Catalogue of Uniones. 1880. The Author.
Cameletti, J. Il binomio di Newton. The Author.
Catalogue of the Queensland Court, International Exhibition. Sydney, 1879. J. Brazier.
Catalogue of the officers and students of Yale College, 1879–80. The College.
Catalogus der ethnologische Afdeeling van het Museum van het Bataviaasch Genootschap van Kunsten en Wetenschappen. 2e Druck. The Society.
Central Park Menagerie, report of Directors, 1879. The Directors.
Chambers, V. T. President of Cincinnati Society of Natural History, annual address, 1879. The Author.
Chapman, H. C. Memoir of James Aitken Meigs, M. D.
Lecture introductory to the course of Jefferson Medical College for the session of 1880–81. The Author.
Chatin, J. Les organes des sens dans la série animale. I. V. Williamson Fund.
Chief of Engineers, report, 1878. Parts 1, 2 and 3. Engineers' Department, U. S. A.
Chief Gold Commissioner for the Province of Nova Scotia, report, 1863. Department of Mines, Nova Scotia.
Chief of Ordnance, annual report, 1879. War Department.
Chili. Memoria de Guerra i Marina, 1878.
Memoria de Relaciones Esteriores, 1879.
Memoria de Ministro de Justicia, etc. 1879.
Memoria de Ministro del Interior, 1879.
Projecto de Codigo rural, 1879.
Anuaria bidrografico de la Marina de Chili, Ano V.
Anuaria de la Oficina central meteorologica, 1874.
Anuaria estadistico, 1876–77.

Sessiones estraordinarias de la Camara de Senadores, 1878, Nos. 1 & 2.
Sessiones estraordinarias de la Camara de Disputados, 1878, Nos. 1, 2 & 4.
Estadistica Agricola 1877–78.
Estadistica bibliografica de la Literatura Chilena, T. 2. University of Chili.

Church, J. A. New methods of ore concentration and gold amalgamation.
The heat of the Comstock lode. The Author.

Clément, Ch. Constitution Geologique de Luxembourg. 1861. Dr. F. V. Hayden.

Cobbold, T. S. Parasites. 1879. I. V. Williamson Fund.

Cohn, Ferd. Biologie der Pflanzen. III, 1. I. V. Williamson Fund.

Colbeau, J. A. J. Matériaux pour la Faune malacologique de Belique. I. The Author.

Colonial Museum and Geological Survey of New Zealand, 14th Annual report. 1879.
Report of Geological Explorations, 1878–79. The Author.

Commission de la Carte géologique de Belgique. Hoboken et Contich, Anvers, Lennick-St-Quentin, Malines, Lierre, Heyst-op-den-Berg, Putte and Boom, with maps. The Commission.

Commissioner of agriculture, report, 1878. The Author.

Commissioner of Fisheries of the State of California Report 1878 and 1879. The Commissioners.

Commissioners of Public Charities of the State of Pennsylvania. Tenth annual report, Jan. 1880. The Board.

Comptroller of the Currency, annual report, 1879. The Author.

Cope, E. D. On the foramina perforating the posterior part of the squamosal bone of the mammalia.
On the genera of the Creodonta. The Author.

Cresson, E. T. and Edw. Norton. Tenthredinidæ and Uroceridæ of North America. The Author.

Cuvier, G. Revolutions of the surface of the globe. 1831. Dr. I. M. Hays.

Dana, J. D. Manual of geology, 3d Ed., 1880. I. V. Williamson Fund.

Dawkins, W. B. Early Man in Britain and his place in the Tertiary period, 1880. I. V. Williamson Fund.
The classification of the tertiary period by means of the mammalia.
Further discoveries in the Cresswell Caves, 1879. The Author.

Dawson, Geo. M. Geological map of a portion of the southern interior of British Columbia. Geological Survey of Canada.

DeCandolle, A. and C. Monographiae phanerogamarum prodromi. Vol. 2. 1870. Wilson Fund.

Decken, C. van der. Reisen in Ost-Afrika. 3er Bd., III. Abth. I. V. Williamson Fund.

De Clercq, F. S. A. Het Maleisch der Molukken, 1876. Batavian Academy of Sciences.

Department of Agriculture. Special Report, Nos. 20–27.
Circular regarding needs of. The Department.

Department of Mines, Nova Scotia, reports, 1862, 1864, 1865, 1867–1879. Department of Mines, Nova Scotia.
Same, 1864. Dr. Jos. Leidy.

Department of Statistics and Geology of the State of Indiana, 1st annual report, 1879. The Department.

Deshayes, G. P. Animaux sans vertèbres découvertes dans le bassin de Paris. T. 2me, texte, pp. 641, et seq. Atlas, planches 40–107. I. V. Williamson Fund.

Dohrn, A. Catalogus Hemipterorum, 1869. Dr. Jos. Leidy.

Doremus, C. A. and R. A. Witthaus. Chemistry of the Cobb-Bishop poisoning. The Authors.

Draper, J. W. Experiments on solar light. Dr. I. Minis Hays.

Duméril, A. and Bocourt. Mission scientifique au Mexique et dans l'Amerique Centrale. Recherches Zoologiques. 3me Partie. Etudes sur les reptiles et les batraciens. I. V. Williamson Fund.
Eaton, D. C. Ferns of North America. Pts. 22–27 and Title and Index to Vol. 2. J. H. Redfield.
Ellet, C., Jr. The mountain top track, 1856. Dr. I. M. Hays.
Elliott, D. G. Monograph of the Bucerotidæ. Pts. 7 and 8.
Monograph of the Felidæ. Pt. 5.
Encyclopedia Britannica. 9th Ed. Vols. 10 and 11. I. V. Williamson Fund.
Encyklopædia der Naturwissenschaften. 1 Abth., 6–13 Lief. I. V. Williamson Fund.
Engelman, Geo. Revision of the genus Pinus and description of Pinus Elliottii, 1880.
Acorns and their germination. The Author.
Engler, A. Entwicklungsgeschichte der Pflanzenwelt. I. Th. I. V. Williamson Fund.
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