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EDW. J. NOLAN, M. D., THOMAS MEEHAN,
JOHN H. REDFIELD.

EDITOR: EDWARD J. NOLAN, M. D.

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EDWARD J. NOLAN,
Recording Secretary.

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With reference to the several articles contributed by each.

For Verbal Communications see General Index.

PROCEEDINGS

OF THE

ACADEMY OF NATURAL SCIENCES

OF

PHILADELPHIA.

1889.

January 1, 1889.

The President, Dr. Joseph Leidy, in the chair.

Seventeen persons present.

On several Gregarines, and a singular mode of conjugation of one of them.—Prof. Leidy communicated the following on some species of *Gregarina*: Among coleopterous insects the family of Tenebrionidae appears to be constantly infested with gregarine parasites. A remarkable species observed in one of our common beetles, *Nyctobates pennsylvanicus*, I propose to distinguish by the name of Gregarina philica. The body is elongated clavate, variably thickened and rounded in front, somewhat tapering behind, and with the posterior end conical. Cephalic division campanulate, with the summit somewhat prolonged and surmounted by a horizontal circular disk with a rounded, milled border. Conjugating individuals with the cephalic extremity conical and simple, or without the terminal disk. Length from 0·3 to 2 mm.; breadth 0·6 to 0·15 mm.

In conjugation the species is remarkable and so far as I know peculiar. In the pairing of most described species of *Gregarina*, two individuals, commonly of the same size, conjoin in the same line, the cephalic extremity of one attached to the caudal end of the other,

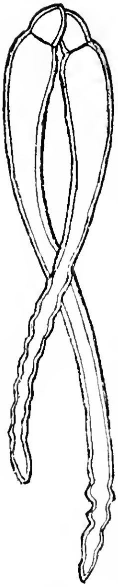


FIG. 1.
Gregarina philica.
40 diam.

In the species under consideration I have observed that the pairs conjoin, as represented in the accompanying figure, with the heads together and the bodies side by side. In numerous instances the position was invariable, and in all, the couples variably differed in size. Thus in one pair the longer individual was 1·75 mm. long and the smaller one 0·75 mm. long, and in another pair the larger individual was 2 mm. long and the other 1·75 mm.

The species is pretty constantly found in the proventriculus of *Nyctobates pennsylvanicus.*

Another interesting Gregarina is frequent in a common myriapod of our forests, the *Scolopocryptops sexspinosus.* It resembles the forms described by Kölliker as *G. Sieboldii* and by Siebold as *G. oligacantha*, referred by Stein to *Stylorhynchus*, and by Schneider to *Hoplorhynchus.* These are common in Europe in the larva of a dragon-fly, *Callopteryx virgo.* The species under consideration I propose to name GREGARINA ACTINOTUS. The body is elongated conical, thickest and rounded in advance and acute behind. The cephalic division is depressed spheroid and broader than long, and is surmounted by a long vase-like rostrum expanding at the top in a horizontal wheel-like disk divided at the border into short digitiform rays. Length from 0·06 to 0·52 mm.; breadth to 0·08 mm.; rostrum 0·08 to 0·1 mm. long.

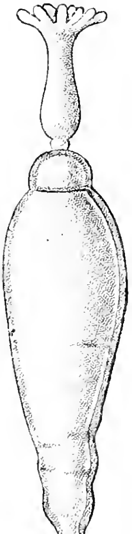


FIG. 2.
Gregarina actinotus.
175 diam.

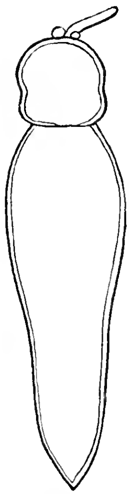


FIG. 3.
Gregarina megacephala. 80 diam.

The accompanying figure represents the parasite. It is commonly found in considerable numbers, adherent by the rostrum to the inner surface of the proventriculus, looking like minute Echinorhynchi.

After finding the curious Gregarine of *Scolopocryptops*, one morning subsequently I found a fine *Cermatia forceps* in my bed room. In it was another species which may be named *Gregarina megacephala.* The body is elongated ovate and acute or short clavate and obtuse with an unusually large ovoid and often constricted head, surmounted by a small rounded or elongated appendage. Length 0·42 to 0·75 mm. to 0·24 broad; head about one-fourth the length of the body. It approximates *Dufouria agilis* of Schneider, found in the larva of a Hydracantharis.

In some little green beetles, *Hoplocephala bicornis*, one of the Tenebrionidae, I found a number of Gregarines remarkable for the small size of the head and hence the species may be named *Gregarina microcephala.* The body is clavate; the head like a watch crystal with a little ball at the summit. Length 0·35 mm. by 0·1 wide; head 0·012 long by 0·04 wide.

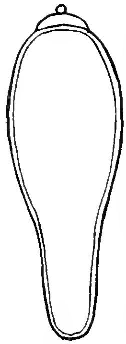
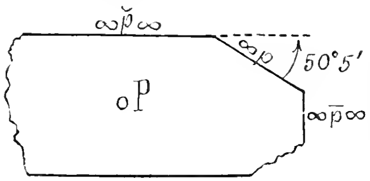


FIG. 4. Gregarina microcephala, 125 diam.

It bears a close resemblance to *Echinocephalus hispidus* of Schneider, found in *Lithobius forcipatus*, but in the one described I at no time found digitiform appendages to the head.

On Anhydrite.—A remarkable occurrence of *Anhydrite* was brought to the attention of the Academy by PROF. GEORGE A. KOENIG. The specimen was found by Mr. Frank Keeley, among the ballast of the Baltimore and Ohio Railroad track south of the tunnel at Darby, Del. Co., Pa. Upon a rock of granular structure, which was determined to be *Diabase*, the anhydrite formed a patch about one inch long, one-half inch wide and one-eighth inch thick. It is of a fine pinkish purple color and pearly lustre. The structure is composite, being an aggregate of prismatic individuals showing an obtuse angle. On closer examination it is found that this angle does not belong to a prism in a crystallographic sense. It is made by two cleavage planes of unequal cleavability, intersecting at about 130°. In the adjoining figure the fragment which was measured is projected on the basal plane (oP). The cleavage along $\infty\breve{P}\infty$ is less than along $\infty\bar{P}\infty$ (which reflected a perfect image). The cleavage along oP is good. The cleavage along $\infty\breve{P}$ is not mentioned in Dana's Handbook.



Specific gravity = 2·949 (0·^{g}938 substance). B. B. fuses at thin edge to a grayish white enamel, coloring the flame orange. Strong hepar reaction, no color with fluxes. At red heat the color is destroyed. No water in the closed tube. Dissolves in strong HCL.

Analysis gave:

A. Substance 0·207 gr. Ignition 0·0018; $BaSo^4$ = 0·3355; CaO = 0·838.

B. Substance 0·6463 gr. 0·0025 insoluble; $BaSo^4$ =1·0485; CaO = 0·2575.

	A	B
Ignition	= 0·90	0·90.
Insoluble	= 0·40	0·40.
SO^3	= 55·80	55·78.
CaO	= 40·49	39·84.
	97·59	96·92.

The filtrate from B, after CaC^2O^4 had been removed, was evapoporated, and residuum ignited. It yielded a sodium reaction, but not sufficient to account for the lack of three per cent in the analyses.

Iron was found in very small quantity.

The pigment appears to be a carbon compound.

Pyrite is visible in several places surrounding the anhydrite.

A thin section of the rock showed essentially an emerald green mineral (black when thick) which polarized very weakly and showed little dichroism. With it a white, very transparent mineral, which polarizes like a plagioclase. Besides these only small grains of a bluish purple mineral could be seen. It was possible to separate, by Mercuric iodide, the white mineral in a pure state.

Its analysis, made with 0·20 gr. gave

CaO = 0·0228		(*diff.*)	SiO^2 = 55·88
Al^2O^3 = 0·0568 (*white*)			Al^2O = 28·40
Na^2SO^4 = 0·0210			CaO = 11·14
			Na^2O = 4·58.
			100·00

The plagioclase is therefore *Labradorite.*

The green mineral could not be freed either from the plagioclase nor from the dark brown grains. The analysis gave

(*diff.*) SiO^2	= 47·45	SiO^2	= 10·92	Labradorite
Al^2O^3	= 7·40	Al^2O^3	= 5·55	
FeO	= 12·08	CaO	= 2·15	
CaO	= 21·95	Na^2O	= 0·92	
MgO	= 9·75			
Na^2O	= 0·92	SiO^2	= 36·53	Pyroxene
Ignition	= 0·47	Al^2O^3	= 1·85	
		FeO	= 12·08	
	100·00	CaO	= 19·78	
		MgO	= 9.75	
		Ignition	= 0·47	

That the green mineral must be taken as a Pyroxene follows from its optical behavior and also from the fact that the splinters show under the microscope a nearly rectangular cleavage. The nature of the roundish brown grains could not be ascertained.

We have here the existence of anhydrite as a secondary crystallization on an undoubtedly intrusive rock. It's elements are to be found in the calcium of Labradorite and Pyroxene, and the sulphur of the Pyrite. But one should expect to see Selenite crystallizing under these conditions. Some years ago (Proc. Acad. 1873,) the author showed how anhydrite falls from a solution of calcium sulphate at 150°C. in a sealed tube, but selenite at the boiling point at atmospheric pressure. The existence of high pressure with or without heat would account therefore for the anhydrite on Diabase. The author is not aware that this mineral has heretofore been found among the epigenetic products of crystalline intrusive rocks.

JANUARY 8.

MR. EDWARD GOLDSMITH in the chair.

Eighteen persons present.

JANUARY 15.

MR. CHARLES MORRIS in the chair.

Nineteen persons present.

JANUARY 22.

MR. JOHN H. REDFEILD in the chair.

Fifteen persons present.

JANUARY 29.

MR. CHARLES MORRIS in the chair.

Thirteen persons present.

A paper entitled "The Sternalis Muscle." By S. W. Williston, M. D., was presented for publication.

Messrs W. Moylan Lansdale, Henry Phillips Coleman, Edward Bancroft and W. Xavier Sudduth were elected members.

Signor José N. Roverosa of San Juan Bautista, Mexico, and Sir John Lubbock of London were elected correspondents.

The following were ordered to be printed :

OBSERVATIONS UPON THE DEVELOPMENT OF THE SKULL IN NEOTOMA FUSCIPES; A CONTRIBUTION TO THE MORPHOLOGY OF THE RODENTIA

BY R. W. SHUFELDT, C. M. Z. S.

While collecting in the vicinity of San Bernardino, California, during the spring of 1887, Mr. F. Stephens secured a female specimen of *Neotoma fuscipes* which was far advanced in pregnancy at the time of capture.

From this source I obtained an embryo of this wood rat, and am under great obligations to Mr. Stephens for the opportunity it has given me to record something in reference to its developmental anatomy, and my observations upon it will form the subject of the present paper.

Neotoma fuscipes is by no means a common species, being restricted in its geographical range to certain parts of the Pacific coast and northern Mexico. I have never personally taken this representative of the genus, but I have on numerous occasions secured its near relative, the form found throughout New Mexico, *Neotoma cinerea*, of which I have a series of skeletons at my hand, of my own preparing.

Just prior to birth, the embryo of *N. fuscipes* is quite hairless, and measures in its total length about 4cms between vertex and tip of tail, presenting all the general characteristics of the embryo of this genus of the Muridæ. For its total length, the head measures 1 centimetre and some few millimetres and in drawing my plates which illustrate this account of its skull, I have enlarged these parts six diameters.

In working out the skull of this little rodent I have had to make constant reference to the following works, which, though the only ones available to me at the time, by no means pretend to be a complete bibliography of the subject, while, on the other hand, they constitute the best aids we possess to embryological research upon the mammalia:

Allen, Harrison, M. D. On a revision of the Ethmoid Bone in the Mammalia. Bull. Mus. Comp. Anat. Harvard College, Cambridge, Mass. Nov. 1882, pls. 1–7, pp. 135–164.

Balfour, F. M. A Treatise on Comparative Embryology. London, 1881.

Flower, W. H. An Introduction to the Osteology of the Mammalia, 1885. Article, "Mammalia" Encyc. Brit. 9th Edition, 1883.

Forbes, W. A. Coll. Scientific Memoirs.

Garrod, A. H. Coll. Scientific Memoirs.

Huxley, T. H. Elements of Comparative Anatomy. London. 1864. A Manual of the Anatomy of Vertebrated Animals, London, 1871.

Owen, Sir Richard. Comparative Anatomy and Physiology of Vertebrates.

Parker, W. K. The Morphology of the Skull. 1887.
On the Structure and Development of the Skull in the Mammalia. Phil. Trans. of the Royal Soc. 1885.

Parker, W. N. Wiedersheim's Comparative Anatomy of Vertebrates. 1886.

Parker, T. J. Zoötomy. London, 1884.

Besides numerous special memoirs of other authors and laborers in similar fields.

A general survey of the Skull and of the investing bones.

Professor Parker, I think, would say that the embryo before me was in the "fourth stage," inasmuch as endostosis has at many points invaded the cartilaginous parts, while ossification is more than apparent in such investing bones of the primordial skull as the interparietal and the supraoccipital, which latter is as yet in two distinct lateral moieties.

We might describe the form of the skull of this embryo as being subconoid, the apex being represented by the snout, and the hemispherical base by the region of the cranial vault and infraoccipital parts.

Judging from the skull of an adult of another species, *Neotoma cinerea*, this form materially changes by the time the animal arrives at maturity, for then the skull is quite flat for its entire superior aspect, and from incisor teeth to occipital condyles. Most of the structures of the basis cranii are to be found in a plane parallel to this superior surface. Then, too, frontal, parietal, and interparietal bones do not quite fulfil in the skull of the adult what they promise in the embryo; by this I mean that as growth proceeds the mesial portions gain area over the first and last mentioned elements, and come to be the chief agents in forming the cranial roof.

In our embryo the *nasals* have advanced to no inconsiderable degree of calcification after the manner of the membrane bones among the higher mammalia generally. By chafing their superior surfaces with the edge of the scalpel the grit of the ossificatory state can at once be detected, though they are yet thin and easily punctured. Each one is in contact, laterally, for its entire length with the premaxillary of its own side. In front they overlap the cartilaginous snout, while posteriorly they are separated from the frontals by a membranous suture, the coronal suture of anthropotomy. They curve downwards mesially, and are in contact with each other for their entire lengths.

A *frontal*, as another investing membrane bone, seems to be rather further advanced towards ossification than we found a nasal to be, and this pair of bones are, as before remarked, the chief roofing elements at this stage of the middle area of the skull. Behind and towards the middle line each one presents a rounded angle to the "fontanelle" (fig. 2, *fo.*), and is separated from the parietal of its own side by a membranous interval. Within either orbit a frontal is in contact with the nascent maxillary margin in front and below, while mesoposteriorly, and at the side, the bone is juxtaposed to the growing margins of the ali- and orbitosphenoids and the squamosal. (Plate I, Fig. 1).

Mesially, the *parietals* are well separated from each other by the intervention of the "fontanelle" (Plate I, Fig. 2, *fo.*). Here, they are at this stage antero-posteriorly rather narrow, but each one becomes gradually broader as it proceeds outwards and curves downwards towards the lateral aspect of the cranium, where the bone is separated by a considerable membranous sutural interval from the squamosal for its anterior marginal moiety; its posterior border jutting freely into the unossified tract above and behind the auditory bulla of the same side. Either parietal shows even better evidence of ossification than the frontal in front of it, being best marked at the middle of the bone, while the periphery is yet largely membranous, which fact no doubt allows the bones to assume the position they eventually attain to in the skull of the adult *Neotoma*.

There is a large and distinct *interparietal*, which the writer is inclined to think ossifies from *two* centres, one on either side of the middle line, though at the present stage it is one piece, and more thoroughly ossified than any of the elements described in the last few paragraphs (Plate II, Figs. 1, 2 and 4, *i. p.*). It has the form of a lune, its straight edge being directed anteriorly, and the middle third of the same forming the hinder boundary for the "fontanelle," while its arc behind is juxtaposed to the non-united supraoccipitals, the extremities of the bone jutting at either lateral aspect into the unossified area above the auditory bulla. In an adult *Neotoma cinerea* the interparietal can be easily made out by its sutural margins, and it will be seen that it comes there more to contribute to the cranial roof, rather than to close in the back of the brain-case as it does in our embryo *N. fuscipes*.

Of all the investing bones of the outer surface of the cranium in our specimen none possess a greater interest than the *squamosal*. One of these (*sq*) stands between the frontal and parietal of the same side above, and the primary structures of the ear and associate parts below. Essentially, at this stage the squamosal is a flat bone of a pear-shaped outline, the smaller part being directed backwards, and the larger oval moiety forwards, which latter bears near its anterior periphery the forward-projecting zygomatic process. It articulates with the posterior extremity of the jugal of the corresponding side. Even in the adult *Neotoma*, the glenoid facette of the squamosal is not nearly as definitely marked as we find it in many other forms of eutherian mammals, so in this embryo the feature is still less pronounced at the stage of development in the specimen before us. In figure 1 of my plates I have intentionally slightly dislodged the mandible from its normal position the better to show the embryonic otic structures, which latter have to a less degree been similarly dealt with.

Apparently one of the scale-like, small, and fairly well ossified *lacrymals* presents a greater surface to the facial aspect of the skull than it does to the orbital, and at this stage the lacrymal canal (Plate I, Fig. 1, *l. c.*) may be seen just anterior to the slit-like and extensive infra-orbital foramen.

Professor Flower has said that this orifice "is always well within the margin of the orbit,"[1] but this wood rat undoubtedly constitutes an exception to the rule, for in the embryo it is found as I have just described it, and in the skulls of the adult specimens of *N. cinerea* at my hand, the lacrymal canal is found within that vertical fissure which in these rodents represents the infra-orbital foramen. It is here quite large, wedge-shaped, the edge being below, and its roof above formed by its maxillary, which base also forms the verti-

[1] Flower, W. H. Osteology of the Mammalia, 3d Edition, p. 181.

cal plate of its outer boundary, while its inner wall is formed chiefly by the lacrymal, and to a very small degree, posteriorly, by the frontal. The jugal takes no part in its formation in *Neotoma*.

Rodents are notorious for the large size of the premaxillary bones in their skulls, and to this rule the genus now under consideration forms no exception. Here a *premaxillary* of either side stands between the corresponding nasal and maxillary, preventing those elements of the face from coming in contact at any point. Superiorly, it sends backwards a lanceolate-shaped apophysis to overlap the frontal of the same side, and this feature is distinctly shown in Plate I, Figs. 1 and 2.

Laterally, it makes up the chief side-wall of the conical fore-part of the skull of this embryo, and rounds under to form the roof of the anterior part of the mouth, though here a mesially oval foramen largely prevents it from suturally uniting with the fellow of the opposite side down the middle line (Plate I, Fig. 3). Each one anteriorly and beneath shows a diminutive pitlet, in which the incisor tooth is budding out, the latter not quite filling the hole closely, and withal being yet in an elementary state. Either premaxillary in the oval foramen above referred to, and on the outer aspect of the nasal septum in front, send backwards a teat-like process, into the spinal space; and in the skull of the adult *Neotoma*, these processes seem to have finally each pressed down upon the vomer and fused with its infero-anterior part. A premaxillary articulates with a nasal, a frontal, a lacrymal, the vomer, the ethmoidal mass, and with the fellow of the opposite side, and at this stage it seems to have progressed in its ossification, about as far as the nasals have, already described above.

The *maxillary*, on either side, is a very important, not to say interesting, investing bone of the face and roof of the mouth (*mx*). It sends backwards a delicate zygomatic process, which *underlaps* the jugal to complete the zygoma. To some extent anteriorly, it contributes to the formation of the bony walls of the orbit, especially where it articulates with the lacrymal. In front, just beyond the infra-orbital foramen, it articulates by a vertical suture with the premaxillary of the same side, while behind this it sweeps downwards and inwards, to complete the posterior moiety of its own side of the periphery of the incisor foramen, or "the anterior palatine foramen" of Flower, after which it contributes to the osseous oral roof, articulating by a transverse zigzag suture with the palatine, and at the lateral aspect developing at this stage the elementary alveolar "process" for the lodgment of the molar teeth. These latter are now in a very primitive condition, though their form can be made out with no little distinctness. As in the case of the incisor teeth, their pristine sockets are larger than is necessary to lodge their dental occupants.

According to Wiedersheim, the *jugal* (Plate I, Figs. 1, 2 and 3 *j*) is considered to be one of the investing bones of the outer side of the mouth cavity, as the vomer is considered an investing bone of the mouth cavity proper. In *Neotoma*, as in some other rodents, the jugal has an uncommon disposition, as it is *overlapped* by the zygomatic process of the squamosal, and *underlapped* by the maxillary. For the most part it is to be found lying along on the superior aspect of the maxillary, while but a limited portion of it is to be seen upon a better view of the arch, at the middle of its continuity. In neither the embryo *N. fuscipes*, nor in adult specimens of the genus, does the jugal possess any salient characteristics, its sole function being to complete the slender zygomatic arch, and were it not that the demands of a universal law exacted its presence, its actual use might easily be dispensed with, for the zygomatic arch could just as well be completed by a meeting of the maxiilary and zygomatic process. Indeed in some adult skulls of *N. cinerea*, it takes a good lens and careful observation to detect the presence of the jugal bone at all, so perfectly is it moulded to the conformation of this delicate osseous rod, which curves below and well out beyond the orbital cavity, in one way defining its limits, and lending to the skull of this species its well-known and characteristic form.

The *vomer* presents nothing peculiar, contributing as it does to the hinder moiety of the nasal septum, and ossifying rather late in the growth of the skull. We may refer to this bone further on, when we come to investigate the formation of the rhinal chambers.

We next pass to a brief consideration of some of the most interesting structures in this or any other mammalian skull; I refer to the mandible and those parts at its posterior extremity which are concerned in the elaboration of the auditory apparatus. Here, to some extent, we are upon debatable premises, and are brought face to face with yet mooted questions in morphology, and consequently must proceed with caution. Plate I, Fig. 1 shows very well the form of the *mandible* upon its lateral aspect. At this stage it is deep and thick, although the symphysis anteriorly has not as yet coössified, the two halves here being held in juxtaposition by the not inextensive union between the fore ends of the Meckelian cartilaginous rod. Those toothsacs for the lower incisor teeth are about as far advanced as those described for the premaxillary bones, and this applies with equal truth to the molars of this lower jaw, though perhaps these are not quite as far advanced as the molars of the maxillary above.

For the most part the mandible has to no small degree ossified. We are to note, however, that the summit of the low and ill-defined "coronoid process" is tipped with nascent cartilage, and this state obtains also with the yet growing condyle, here harbored in the shallow glenoid cavity of the squamosal on either side. Below these protuberances a prominent angular process is to be observed, also cartilage-tipped as in the case of the condyle and coronoid. These several prominences of the posterior end of either ramus of the lower jaw in this embryo rodent, gives it a very marked vertical depth and a fan-like form, which renders it quite conspicuous. Through the ramus and thoroughly ensheathed by it, longitudinally courses the slender Meckelian rod of cartilage, to fuse anteriorly, as already stated, with its fellow of the opposite side.

At its hinder and free end, the Meckelian cartilage becomes clubbed and of a peculiar form; the extremity proper is cupped to receive in articulation the *incus*, while below this cup the rod sends forwards and downwards a very delicate, cylindrical spur of cartilage, here incorporated in the plane of the *membrana tympani*, within the semi-arc of the *tympanic annulus*. These parts seem yet to be largely performed in cartilage, and we see the *malleus* in the hinder end of this Meckelian cartilage, while the labors of Salensky, Fraser and Kitchen Parker seem to have at last definitely decided that "the *incus* is the upper element of the first or mandibular arch." Here in this embryo *Neotoma*, the incus develops an unusually long posterior crus, as shown in Figure 1, extending over towards the auditory bulla (*an*). As in the vast majority of the higher groups of the mammalia, the *stapes* is stirrup-shaped, and its foot-piece closes up the fenestra ovalis, and this stapes according to the most recent researches has been said to correspond with the hyomandibular of fishes, or in other words is the upper element of the hyoid arch, as the incus, as we have just said, is the off-constricted piece of the proximal extremity of the mandibular arch. Agreeing with the first two described auditory ossicles, the stapes at this stage in *Neotoma fuscipes*, seems yet to be wholly in cartilage. I failed to detect the rudimentary *interhyal* in the tendon of the stapedius muscle, but might do so were additional material at hand. These wood rats have tympanic bullæ of no inconsiderable size, and in the dried skull of an old *N. cinerea* their lower surfaces are quite transparent, each being somewhat laterally compressed and inclined towards each other, so that were their imaginary horizontal long axes produced to the front they would intersect at a point just slightly anterior to the posterior narial aperture.

In form, then, these bullæ are subcompressed ovoid, where mesially they are moulded upon the bones they come in contact with at the base of the cranium at its infero-external aspect, which have to do with the auditory chamber.

Turning for the moment from our consideration of the proper "investing bones," I desire to pass a few remarks upon the "hyoidean apparatus." Essentially, this seems to be built up upon the plan of these parts as we find them in the more highly organized eutherian mammalia generally. In the specimen before us, however, ossification even at this stage appears but to have advanced slowly, the several segments of the arch yet being largely in cartilage.

All the elements of these parts seem to be present in this embryo, and the most notable feature to me is the form of the basi-branchial as I make it out. It is far more extensively curved than Parker found it to be in the hedge-hog, by which I mean the curved rod of cartilage composing it is longer (Plate I, *b. h. br.*). By examining the arch in an adult *N. cinerea*, the same feature seems to be present, for the "body of the hyoid" is there larger and curved. Another mammal, the dog, as drawn by Flower, also shows a curved basi-branchial, whereas in the armadillo it is a medium piece united apparently with the thyrohyals (Parker). The thyrohyals in the embryo *Neotoma* are but feebly developed (*t. hy*), and remain inconspicuous after ossification in them is completed. Agreeing with most ordinary mammals the three remaining pieces of the hyoid present nothing of marked peculiarity.

Returning to the investing bones of the skull, there yet remains two of them to be described in the present connection, viz.:—the palatine and the pterygoid.

If there be any superficial ossific deposit yet in either pterygoid (Plate I, Fig. 3, *pg*) the writer failed to discover it after a very careful investigation. We are aware that in the pig at the fourth stage of its development the pterygoids are somewhat advanced in their ossification, but here in our specimen each pterygoid proper now consists in a well-pronounced subcylindrical cartilaginous rodlet to some extent centrally ossified, which, on either hand, projects out from behind the ossifying palatine of its own side. External to either one of these we observe the continuation of the bone in its 'external pterygoid plate,' which is also in cartilage, and arises both from the ali- and basisphenoidal regions. *Neotoma cinerea*, in the skull of the adult, shows well how the pterygoids are finally fashioned in bone at maturity, and if they represent the condition for the genus, we find that the external plate in each is nearly horizontal in position, and raised above the frontal and sphenoidal regions; the sutural traces remain quite distinct; the "hamular processes" have their extremities produced, and turned slightly outwards, while these apophyses are not far apart mesially, nor do their ends lack much of reaching the auditory bulla on either side, where the Eustachian tube opens.

Passing next to a *palatine* bone, we find it to be ossified to no inconsiderable extent, with the salient angles of its horizontal portion rounded off. its borders being yet membranous, or in an imperfect cartilaginous stroma, a tissue furnished by the epiblast during the growth of the embryo, and now taking on ossification.

The "posterior palatine foramina" are easily found, while the hinder margins of these bones unite to form the lower free edge of the posterior bases.

Having the most usual relations to the nasal septum and surrounding parts, the ascending lamina of a palatine is not so thoroughly ossified as the horizontal portion of the bone; and at this stage of its growth, this embryo *Neotoma* may be said to have a cleft palate, so wide are the medial sutures between the elements.

Of the endocranium, and the development of the cartilage bones.

To Professor Kitchen Parker are we indebted more than to any other single writer since the dawn of anatomical science to the present time for our knowledge of the morphology of the vertebrate skull, and from his recent writings, the mammalian skull in particular. Under the influence of his never weary hand, has this, one of the most difficult problems which man has ever investigated, grown out into the light with all the beauty associated with the budding of a complete flower. In reading his "Structure and Development of the Skull in the Mammalia" one loses himself as though he were perusing pages of the most fascinating romance, and is led on step by step, as "the thing" grows, and shapes, and matures, with an almost irresistible passion for the marvelous story. Omitting those parts which I have referred to above, and confining ourselves to the structures which properly fall within the present section, we are clearly shown how in the endocranium in its pristine membranous condition there is laid down at its base in primitive cartilage the pair of rods which are the ground plan of the future brain-case, the harborage of that most powerful of all organs, the encephala. These rods of the *trabeculæ cranii*, which behind embrace the notochord (the parachordals), while anteriorly their segmentations become the *trabeculæ* proper and enclose the primitive pituitary space.

From these simple beginnings, part after part, grows and evolves, until in due time we have before us the mature skull with all its associated structures. At the appointed instant sense-capsules are born and elaborated *pari passu* as the cranial moulding proceeds; and nerves and vessels burrow with precision through tracts and by-ways long known to their kind in the ancestral types of the species, guided by the ceaselessly acting laws of variation and evolution.

Turning to the nether aspect of the basis cranii in our embryo *Neotoma fuscipes* we find the *foramen magnum* (Plate I, Fig. 3, *f. m.*) to be of a subelliptical outline, a form retained probably throughout life, as it obtains in the skulls of other adult Neotomas which I have examined. The *supraoccipital* is still in two parts, the medial vertical suture being very evident. It is, however, rapidly ossifying, bone having advanced to the superior arc of the foramen, and no doubt that early in the next stage the supraoccipital would be in one piece (*s. o.*).

The condyles show very prettily, and as structures developed by the *exoccipitals* (*e. o.*) they are well started in the process of ossification, though their ossific centres have not yet impinged upon either the supra or basioccipital. Much cartilage is still to be found, both above them and at their sides.

Embedded in this material below, we are to observe just in front of the occipital foramen the subquadrilateral form of the *basioccipital*, already nicely started in bone. This osseous part does not as yet reach the auditory bulla on either hand, though posteriorly it arrives at the margin of the foramen magnum. Anteriorly, a cartilaginous tract intervenes between the concave border of the basioccipital and the ossific centre which represents the future *basisphe-*

noid. This latter (*bs*) is at present but a small, squarish piece of bone occurring in the basic cartilage, just posterior to the pterygoid, which in the skull of an old *N. cinerea*, is wedge-shaped in outline for its exposed surface, and stands between the pterygoids, the narrow end to the front, separated by a distinct suture from the presphenoid, and the broad end behind, separated by a similar suture from the basi-occipital; the three bones, thus continuous, making a characteristic area having the form of an acute isosceles triangle. Nearly every trace of the notochord has disappeared in our embryo *Neotoma* at this stage, its former presence being but faintly indicated by a whitish line traversing the basi-occipital plate in a mediolongitudinal direction, and entirely disappearing near its middle. Beyond, the *presphenoid* shows commencing osseous deposit in a narrow line down its length, but is still chiefly performed in cartilage, the former being barely perceptible. Referring again to skulls of the *N. cinerea*, adult specimens, it becomes worthy of remark, that the supraoccipital region and the foramen magnum are both in nearly the same plane, it being quite vertical, and almost at right angles with the horizontal plane in which the interparietal and parietals lie. This part of the cranium in our embryo, as already stated above, is more or less rounded as shown in the figures. To the outer side of either exoccipital is seen a distinct and spine-like paroccipital, which feature I fail to find in so early a stage as the embryo before us represents.

Professor Parker in his famous work upon the 'Morphology of the Skull' in alluding to the development of the pig at its 'fourth stage,' contends that there the notochord is not yet quite obliterated in the basioccipital, though it is rapidly becoming so. He also points out that a separate ossific centre, in that animal, is to be found in either massive condyle, but they soon coalesce with the exoccipitals on either side. Agreeing with *Neotoma fuscipes*, the supraoccipital in the pig at this stage is in two pieces, or "patches" as Professor Parker expresses it, and they "run into one another in a day or two" (p. 288).

Of the three bones that unite to form the *periotic* ossification, I find but one that as yet appears in any way advanced beyond a cartilaginous condition; and this is the *opisthotic* (Plate II, Fig. 5, *o. p.*) After the membrane bones which form the vault of the skull have been duly removed, this auditory osseous element may be detected posterior to, and to the other side of the periotic capsule, which is otherwise in nascent cartilage, though quite dense and on the verge of ossifying. This internal view of the cranial casket, reveals the fact that at this stage at least the periotic mass is but slightly elevated above the general level of the floor of the brain-case, and in no way as prominent as the external auditory bulla on either side. It still, however, is more or less rounded, and it is only later in life apparently that this projection becomes somewhat angulated as we see it in the adult skull. In this region in the cranium of the embryo *Neotoma* the usual vascular and nerve foramina can be easily made out.

Already in another paragraph, I have alluded to the state in which we find the basi- and presphenoid (Plate II, Fig. 6, *b. s.* and *p. s.*) and it will be seen that the anterior part of the cranial floor is fairly well-paved by two other ossifications of mammalian skull. I refer to the rather large and squarish *alisphenoids* (*al. s.*), one on either side of the first-named element, and the more oval *orbitosphenoids*, one on either side of the presphenoidal cartilage. These bones are already well-ossified and are pierced by the usual nerve foramina; the latter by the optic (II), and the former by the third branch of the fifth (V^3) through the *foramen ovale.* A slight *pituitary depression* is to be observed at its most usual site upon the presphenoid. The arrangement of these parts then, with its true stirrup-shaped stapes, indicates that *Neotoma* holds quite an exalted position, structurally, among the eutherian mammalia.

Beyond the sphenoidal region the endocranium gradually but rapidly narrows, and just posterior to the nasal structures and chambers we meet with a sub-vertical *cribriform plate* (*cr. p.*) showing minute perforations for the passage of the nerves. Mesially, a posteriorly rounded *crista galli* (Plate II, Fig. 5, *cr. g.*) is to be seen. These parts are as yet all performed in cartilage.

By carefully removing the investing bones from the fore part of the skull we at once bring into view the chondrified elements of the nasal organs. We have already alluded to the vomer, and now it can be easily detached from the cartilaginous lamina perpendicularis, with which it is articulated by a longitudinal median groove traversing its entire superior margin.

The base, for the vomer at this stage is entirely in bone, is some 3 cms. long, and sharp, or more or less sharp, along its inferior edge. As in most rodents the *lamina perpendiculars* is produced forwards as the *septum nasi* (Fig. 6, *s. n.*). Cribriform plate and lamina perpendicularis together form the *mesethmoid.*

Jacobson's Organs, one on either side of the septum, are, as in the vast majority of the rodentia, well developed in this embryo; and as in the case of *Lepus* appear to be ensheathed by the backward, extending, posteriorly free terminating palatine processes of the snout, as seen in Figure 6 (*re. c.*). These "organs" have been described by Prof. Wiedersheim (Parker's translation) as being "a paired accessory nasal cavity, which in an early embryonic stage becomes entirely separated from the nasal chamber, and which is supplied by the olfactory and trigeminal nerves." They are surrounded by the *cartilages of Jacobson*, likewise paired and of a scroll-like form. Uniting with the antero-ventral aspect of the septum nasi beneath, we are to note the *ali-nasal cartilage* on either hand, encircling the external nostrils (*e. n.* and *al. n.*), while the *ali-septal*, one on each side of the septum on the dorsal aspect, run the entire length and roof over the nasal chambers (Plate II, Fig. 5, *al. sp.*) Large and of peculiar form, the *aliethmoids* form a striking feature here, and may be seen both upon dorsal and ventral aspects. To some extent they form the roof of each rhinal chamber, as well as the sides and floor. Inferiorly, they become much expanded behind, rounded, encircling submesial vacuities, as shown in Figure 6, (Plate II, *al. e.*).

Finally, turning to the ventral aspect of this minute endocranium we see external to either recurrent cartilage, right and left of the median ossified vomer (*v*), the inferior turbinal proper (*i. tb.*), each one in addition to its usual attachments in mammals of this order is here connected with the septum nasi anteriorly, and terminates behind in a teat-like process, extending somewhat further in that direction than does the vomer. They swell at the middle of their continuity, being convex externally and concave upon their vomerine aspects. In a former paragraph, I have already alluded to the "recurrent cartilages," so designated by Parker (*re. c*), and these may now be seen upon this view. Especial attention is invited to them as they are the essential capsules which enclose the organs of Jacobson. To study them properly it becomes necessary to gently press outwards the inferior turbinals. At present they are in cartilage entirely, thin, and of an elegant scroll-like form, being for the most part open superiorly, and in contact with the vomer, mesially, being in either case outgrowths of the *alæ nasi.*

With this I close the present account of the cranium in this embryo of one of our not abundant species of American rodents. Upon some future occasion I trust to compare it quite extensively with the development and morphology of the skull in other types of mammals of this country, especially the rodentia.

Explanation of Plates I and II.

Note.—The figures of these two plates were drawn and colored by the author directly from his dissections, and in them the membrane bones have been simply shaded; the cartilage bones colored orange; and the endocranium and other cartilaginous parts, purple.

In all the figures the structures are increased six times the size of life, and the following letters used as abbreviations:

ag. p.	Angular process.
al. e.	Aliethmoid.
al. n.	Alinasal.
al. s.	Alisphenoid.
al. sp.	Aliseptal.
a. ty.	Annulus tympanicus.
au.	Auditory capsule.
b. h. br.	Basihyobranchial.
b. o.	Basioccipital.
b. s.	Basisphenoid.
cr. g.	Crista galli.
cr. p.	Coronoid process.
cr. pl.	Cribriform plate.
d.	Dentary.
e. hy.	Epihyal.
e. n.	External nostrils.
f.	Frontal.
f. m.	Foramen magnum.
fo.	Fontanelle.
gl. f.	Glenoid cavity.
i.	Incus.
i. p.	Interparietal.
i. tb.	Inferior turbinal.
j.	Jugal.
l.	Lacrymal.
l. c.	Lacrymal canal.
mk.	Meckel's cartilage.

ml.	Malleus.
m. ty.	Membrana tympani.
mx.	Maxillary.
n.	Nasal.
nf.	Nasal floor.
n. v.	Nasial valve.
oc. c.	Occipital condyle.
op.	Opisthotic.
o. s.	Orbitosphenoid.
p.	Parietal.
pa.	Palatine.
p. e.	Perpendicular ethmoid.
pg.	Pterygoid.
ps.	Presphenoid.
pm.	Premaxillary.
py.	Pituitary region.
rc. c.	Recurrent cartilage.
s. n.	Septum nasi.
s. o.	Supraoccipital.
sq.	Squamosal.
st.	Stapes.
t. hy.	Thyrohyal.
v.	Vomer.

PLATE I.

Fig. 1. Left lateral view of the skull of an embryo *Neotoma fuscipes*, with hyoidean apparatus attached ; × 6.

Fig. 2. The same specimen seen from above ; mandible removed.

Fig. 3. The same from below ; mandible removed. Roman numerals indicate nerves or their foramina.

PLATE II.

Fig. 4. Posterior view of the skull of an embryo *Neotoma fuscipes ;* same specimen as figured in Plate I, (× 6) ; mandible removed.

Fig. 5. The endocranium of a specimen of an embryo of *Neotoma fuscipes ;* the same skull as is figured in Plate I, fig. 1 (× 6). All the investing bones have been removed, and superfluous parts dissected away.

Fig. 6. The same specimen shown in Fig. 5, under view.

FEBRUARY 5.

Mr. CHARLES MORRIS in the chair.

Thirty-two persons present.

Messrs Joseph Leidy, J. P. Lesley, Persifor Frazer, Angelo Heilprin and W. B. Scott were elected to constitute the Committee on the Hayden Memorial Geological Award.

FEBRUARY 12.

Mr. WM. W. JEFFERIS in the chair.

Seventeen persons present.

The following papers were presented for publication :—

"New Species of Shells from New Hebrides." By W. D. Hartman, M. D.

"Note on Elagastis bipinnulatus." By Seth E. Meek and Charles H. Bollman.

FEBRUARY 19.

The President, Dr. JOSEPH LEIDY, in the chair.

Sixteen persons present.

The Sabre-tooth Tiger of Florida.—PROF. LEIDY directed attention to a specimen recently received from our fellow member, Joseph Willcox, now in Florida. Mr. Willcox writes that he found it in a limestone quarry and that it appeared to him to possess some interest. This it certainly does, as it proves to be the skull of that most formidable of felines, the extinct Sabre-tooth Tiger, variously described under the names of *Drepanodon*, *Machairodus* and *Smilodon.* The specimen consists of the nearly complete cranium with the greater portion of one side of the face, which has lost the teeth but retains all the alveoli. Of the molar teeth the first and last of the series had been shed and the alveoli obliterated. The skull indicates an animal approximating in size the existing Tiger and Lion. It also approximates in size that of *Machairodus neogaeus* of South America, than which it is rather more than an inch less in length, breadth and depth. It exhibits other slight differences, but all may be only of varietal or even individual significance. Regarding the specimen as indicating a distinct variety or species it may be named DREPANDON, or MACHAIRODUS FLORIDANUS. Its sabre-tooth canine is of less breadth than in the former, and the hiatus in advance is considerably less, indicating a proportionately smaller inferior canine. The zygoma is absolutely deeper and flatter. Of *Machairodus neogaeus*, we possess the cast of a skull, from the bone-caverns of Brazil, the original of which is in the natural history museum of Paris. Dr. H. Burmeister has described and figured a complete skeleton of this species, from the pampas formation of the Argentine Republic, preserved in the museum of Buenos Ayres. Prof. Cope, in the "American Naturalist" of 1880, notices another skeleton from the same region, under the name of *Smilodon necator*. With Dr. Burmeister, Dr. Leidy regarded all these as pertaining to one species, and thought it probable that the Florida skull might also belong to the same.

Comparative measurements of the Florida skull, the cast of the Brazil skull and Dr. Burmeister's figures of the Argentine skull are given below, but some of them, from the imperfection of the means are to be regarded as only approximatively correct. The measurements are given in millemetres.

	Florida.	Argentine.	Brazil.
Length of skull from occipital condyles to incisive border	285	330	330
Breadth of skull at widest part of zygoma	190	230	230 ?
Depth of skull at post-glenoid tubercle	125	164	160 ?
Length of skull from behind zygoma to incisive alveoli	210	245	225
Breadth at mastoid processes	126	143	140
Breadth of narrowest portion of cranium	57	57	
Breadth at occipital condyles	105	112	
Breadth of face at sectorial molars	150	170	
Breadth of face at canines	94	112	110 ?
Fore and aft space of the teeth	140	146	163
Fore and aft space of two molars	55	62	63
Transverse space of the incisors	58	66	55
Breadth fore and aft of sectorial molar alveolus	37	43	42
Breadth fore and aft of second pre-molar alveolus	16	18	18
Breadth fore and aft of canine alveolus	40	45	53
Breadth transverse of canine alveolus	20	20	25
Breadth fore and aft of glenoid articulation	25	25	
Breadth transverse of glenoid articulation	50	50	
Depth of face at infra-orbital margin	60	55	53
Depth of zygoma	46	38	43

In association with the skull of the Tiger, Mr. Willcox found a cervical vertebra, six lower molars and five incisors of a Horse. They have the same appearance of preservation as the former and are probably cotemporary fossils, though they present no distinctive characters from the corresponding parts of the Domestic Horse. With them there was also found a lower molar of a Llama, *Auchenia minor*.

Linguatula Diesingii from the Sooty Mangabey.—Mr. J. E. Ives remarked that in preparing for maceration a specimen of *Cercocebus fuliginosus*, he found that the great omentum contained a large number of encysted specimens of *Linguatula Diesingii*. The cysts occurred almost invariably in the fatty portions of the membrane. A few specimens also existed in the lungs and pleuræ, and in the peritoneal lining of the abdominal cavity. This form has not been recorded before from *Cercocebus fuliginosus*. In 1848, Van Beneden described the species from the mesentery of *Cynocephalus mormon*. In 1849, under the synonym of *Pentastomum tornatum* Creplin placed on record the finding of it by Gurlt in the greater omentum of *Macacus Cynomolgus*, and by Schultze in the omentum and mesentery of *Cynocephalus mormon*. In 1850, under the name of *Pentastomum euryzonum*, Diesing redescribed Van Beneden's form, and Dr. Leidy recorded it "from the surface of the liver beneath the peritoneum" in *Cynocephalus porcarius*. The monkey in which this parasite was found had recently died in the Zoological Garden, and had been presented to the Academy by the Society.

February 26.

Mr. Charles Morris in the chair.

Fourteen persons present.

The following papers were presented for publication:—

"On two minerals from Delaware Co., Penna." By F. A. Genth.

"Contribution to the Life-Histories of Plants, No. IV." By Thomas Meehan.

Mr. Edwin J. Houston, was elected a member.

The following were ordered to be printed:—

NOTES ON GEOLOGY AND MINERALOGY.

BY JOHN EYERMAN.

Fossil Foot-prints from the Jura (?)-Trias of New Jersey.—The specimens to be described were collected two years ago at the quarries of the Messrs. Clark, near Milford, Hunterdon Co., and after making brief descriptions and drawings of the more interesting specimens, they were immediately forwarded to the Museum of Comparative Zoölogy, at Cambridge. No less than two hundred specimens were collected; many of them, however, were too indistinct to be determined.

The following tracks have been accurately determined:

The grouping is after Hitchcock.

PACHYDACTYLOUS GROUP.

Genus I. BRONTOZOUM.

B. isodactylum. (Hitchcock.)

Two feet of three toes each. Length of foot 4 to 5 inches. Step 5 to 6 inches. The predominant species at this locality. On gray sand-stone.

Genus III. GRALLATOR.

G. cuneatus. (Hitchcock.)

Two feet of three toes each. Length of foot 4 to 5 inches. Step 22 to 24 inches. On gray sand-stone.

G. tenuis. (Hitchcock.)

Two feet of three toes each. Length of foot 2 to 3 inches. Step 9 inches. On gray sand-stone.

MARSUPIALOID GROUP.

Genus II. ANOMŒPUS.

A. minor.

Two hind-feet of three toes each and two fore-feet of five toes each. Length of hind-foot 8½ inches; of heel 4 inches. Step 9 inches. This track was first observed by Dr. T. C. Porter, in the quarry of Smith Clark, about a half mile west of the quarry which furnished the above (*Brontozoum and Grallator.*) The track is on the red shale, and is rather indistinct. No other tracks have been found at this locality.

Tracks of Invertebrates.

Harpagopus dubius Hitchcock.

Two toes. Length of foot $2\frac{1}{4}$ inches.

Tracks of Annelids. Hitchcock.

Unisulcus Marshi Hitchcock.

This track forms a beautiful loop; the groove is about $\frac{1}{4}$ inch wide.

Unisulcus minutus.

This track is about $\frac{1}{16}$ inch wide.

Jura (?)-Trias flora, from Milford.

Only two specimens have been obtained; both undoubtedly *Clathropteris platyphylla* (Saporta.)

Some New Pennsylvania and New Jersey Mineral Localities:—

Calamine occurs in stalactitic, botryoidal and granular massive forms, coating limonite on the farm of S. D. Von Steuben, near Dryland Station, Northampton Co. It resembles the Friedensville calamine

Friedensville Calamine:—An analysis of this calamine from the Ueberroth mine made several years ago, afforded me

$Si\,O_2$	24·32
$Fe_2\,O_3$	2·12
$H_2\,O$	7·86
$Zn\,O$	65·05
	99·35

I believe this to be the first recorded analysis of calamine from this well-known locality.

Molybdenite occurs in thin plates incrusting quartz, at Marble Hill, in Warren Co., N. J., opposite Easton.

Graphite also occurs at the same locality incrusting granite.

Malachite occurs at Flint Hill, near Bingen, Northampton Co., in light-green masses associated with quartz, and incrusting the Mesozoic conglomerate it is found near Leithsville.

It is also found at the sand-stone quarry of the Messrs. Clark, near Milford, N. J.

Chalcocite.—Several years ago I observed a single specimen of chalcocite in quartz at the Ecton whim shaft near Shannonville, Montgomery Co.

Aragonite occurs at Sherrer's quarry on the Delaware river road, about a mile above Easton, in beautiful snow-white masses, associated with serpentine; also in silky fibers.

Quartz.—Perfect quartz crystals (one of which is $3\frac{1}{2}$ inches in length) have been found at the "Court House lot" Easton, and in large groups at Flint Hill, near Bingen, Northampton Co.

Pyrite from St. Peter's, Chester Co.—I have observed the following forms and planes of pyrite from this well-known locality:

O (H), $3\frac{5}{2}$, 1, 2-2, *i*, *i*-2.

2 and some combinations as follows:

$1 \wedge i\text{-}2$	$O \wedge 2$
$O \wedge i\text{-}2$	$O \wedge 3\frac{5}{2}$
$(O)\ H \wedge 1$	$\frac{1}{2}\ (i \times 2)$

Melaconite and Malachite have been obtained at Franklintown, Adams Co.

Apophyllite from St. Peter's.

One perfect crystal in my possession measures $\frac{1}{2}$ in. + $\frac{1}{2}$ in. The form is O. 1. *i-i.* Other planes observed are I. *i*-2. *i.-i.* O. 1. An analysis made in June afforded me

$Si\ O_2$	51·63
$Ca\ O$	25·42
$K_2\ O$	6·25
$H_2\ O$	16·58
	99·90

Sp. gr. 2.35.

A complete and revised list of the minerals occurring at this locality is here annexed. * Indicates occurrence in small quantities.

Stilbite* apophyllite, aragonite, pyroxene (massive and in crystals) pyrite (many forms) chalcopyrite, chrysocolla* malachite* calcite (and Iceland spar) byssolite* byssolitic calcite, melanite, actolitein magnetite (massive and in crystals) serpentine, erythrite*, pyrallolite, glauconite, orthoclase (radiated) bornite.*

New Minerals from Cornwall, Lebanon Co.—I have been able to identify the following new minerals, all of which occur on the "Big Hill":—

Neolite.—In radiated masses of grayish-white color.

Chrysolite.—Small crystals of brown color associated with magnetite.

Andradite.—Small crystals of brownish-red color imbedded in quartzose rock.

Lepidolite.—A small quantity of this mineral was found as an incrustation upon quartz.

Analcite.—This interesting species was found in cavities in the magnetite. This mineral and lepidolite are new minerals for Pennsylvania.

Chloropal and Repidolite are found in considerable quantities.

DESCRIPTION OF A NEW SPECIES OF ORTHOPRISTIS FROM THE GALAPAGOS ISLANDS.

BY DAVID S. JORDAN AND BERT FESLER.

Orthopristis lethopristis. Sp. nov.

Head $3\frac{1}{4}$ in length to base of caudal; depth 3; D. XII, 14; A. III, 11; scales $8\text{-}65^{ca}\ 15$; length of type 15 inches. Maxillary 3 in head; eye $4\frac{3}{4}$; preorbital as broad as eye; snout $2\frac{4}{5}$ in head; pectoral $1\frac{1}{10}$; 4th dorsal spine $2\frac{4}{5}$; 2nd anal spine $6\frac{1}{2}$; first soft ray of anal $3\frac{1}{3}$; base soft dorsal $1\frac{1}{3}$ times in base of spinous dorsal.

Type, No. 26,947, Museum of Comparative Zoölogy. From the Galapagos Islands.

Body rather elongate in form, intermediate between that of *O. brevipinnis* and that of *O. chalceus;* back elevated and compressed, especially anteriorly, the profile regularly rounded. Snout long, moderately sharp. Mouth larger than in any other *Orthopristis,* the maxillary reaching to opposite front of eye. Eye moderate. Anterior nostrils large. Preopercle entire, the border scarcely crenulate, no projecting serræ of any sort. Lips thick; teeth small, the outer above longer, slender and close-set. Gill rakers x + 14, of moderate length, a little shorter than pupil.

Pectoral falcate, rather long. Dorsal low, rather sharply notched, the spines low and slender, the soft rays low, highest toward the front. Anal long and rather low, with straight, free border, the small spines graduated, the third scarcely half height of first ray. Caudal peduncle long. Caudal deeply forked. Some series of scales on soft dorsal and anal, a row close behind each ray, much as in *O. brevipinnis.*

Color in spirits dark gray, not silvery; center of each scale dark, these spots forming continuous streaks along the rows of scales on back and sides much as in *Hæmulon parra,* but the scales are smaller and the spots fully continuous; the stripes above are straight or gently curved, not wavy; above lateral line they run upward and backward at an angle which grows less posteriorly, those on caudal peduncle being horizontal; those below lateral line rather less distinct but straight and horizontal; fins rather dark; opercular edge, membrane and axil dusky.

This species is described from a single example, 15 inches long, No. 26,947, of the Museum of Comparative Zoölogy, from the Galapagos Islands. It is apparently most nearly related to *Orthopristis brevipinnis* (Steindachner), differing in the entire preopercle and in other respects.

THE STERNALIS MUSCLE.

BY S. W. WILLISTON, M. D.

Of the many interesting muscular anomalies of the human subject, few, if any, have been more enigmatical than the sternalis. At various times, and by various observers, since the days of Albinus, and earlier, it has been regarded as a continuation of the rectus abdominis, perhaps the most prevalent view, and endorsed by Bardeleben; as a part of the sterno-mastoid; as pertaining to the panniculus carnosus group, a view which the eminent anatomist Turner has favored; as a muscle *sui generis*, without homologue in other animals; or as a muscle of the pectoral group, which seems to be the most probable, as well as most recent theory. Neither can we say whether the muscle is vestigial or rudimentary—I use the words in Ryder's sense—though evidence points to the former. But if a vestige, and not a muscle developing, we ought to find a counterpart of it in other animals, which, so far, has not been done, unless indeed, we call it a skin-muscle, which seems very improbable. What then is it, and what are its functions?

From Gruber's[1] and Turner's[2] researches, it appears to occur in the normal human subject, in some form or other, in about three per cent. of all cases. In its normal or typical form, as represented in the case figured herewith, it appears to occur in less than one per cent. of all cases. But, while so abnormal in the normal subject, it appears to be normal in the abnormal subject,—that is, it is almost invariably present in anencephalous monsters. Abraham[3] found it in six out of seven anencephali, Shepherd[4] in eight out of nine. The latter adds " the fact that this muscle occurs so commonly in the brainless monsters would point rather to its being a rudiment than a new muscle appearing in man." Anencephali are usually females; perhaps that fact may add strength to Albrecht's argument that woman approaches the brutes in structure more than does man!

However, as first suggested by Abraham, affirmed by Cunningham[5] and confirmed by Shepherd, it seems probable that the muscle belongs

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[1] Mem. de l'Acad. Imp. de St. Petersbourg, iii, 1860.

[2] Journ. Anat. and Phys. 1, 246, 1867.

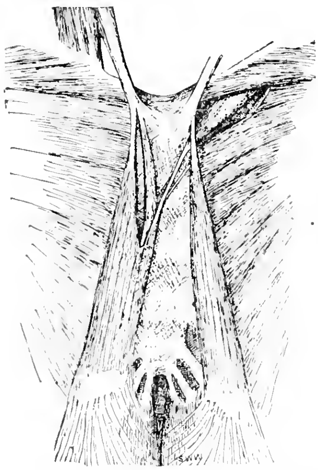
[3] Trans. Acad. Med. in Ireland, i, 1883.

[4] Jour. Anat. and Phys. xix, 1885; ibid, xxiii, 1889.

[5] Journal Anat. and Phys. xviii, 1884.

to the pectoral group, and is apparently a muscle of respiration, when functionable. Its nerve supply was found uniformly to come from the anterior thoracic by Cunningham; Shepherd found the same innervation in each of twelve muscles, two of which, however, had also an additional supply from the intercostals. Bardeleben,* who, however, completely ignores the researches of Cunningham and Shepherd, states that the nerve supply, wherever he has traced it, has been invariably from the third and fourth intercostals. The evidence, however, seems to be against Bardeleben. Based upon this innervation, Bardeleben gives the following opinion: "Die Innervirung dieser typischer Varietät, wie ich sie bezeichnen möchte, geschicht soweit Untersuchungen vorlegen, durch intercostal" and, as the rectus abdominis has the same innervation, we must consider the sternalis as a continuation of that muscle. He would call the muscle "Rectus thoracis superficialis". He believes the muscle to be vestigial. His "typscher Varietät" is that here figured.

The case here described would be worthy of record, if only for the extraordinary development of the muscle, on both sides, but there are other facts connected therewith that give it an additional interest. My attention was called to the muscles by two students, Messrs. C. A. Tuttle and W. P. Baldwin, in the practical anatomy room of Yale. The subject was that of a male above thirty years of age, much below the ordinary stature, and of slender, almost delicate structure throughout. On the left side the muscle was nearly an inch and a half in its greatest width, flattened, and nearly symmetrically narrowed to its tendinous "insertion." The round tendon began a little below the cartilage of the second rib, and was continuous with the outer part of the tendon of the sternomastoid, on which there were no fleshy fibres for some distance above the upper border of the manubrium. Over the cartilage of the fifth rib the muscle became rather suddenly aponeurotic and continuous with the sheath of the rectus abdominis. The glistening aponeurotic fibres diverged, fan-shaped, the larger part



*Anatomischer Anzeiger iii, 324, 1888.

turning inwards to pass over the inner border of the rectus; others passed directly downward, while still others turned outwards and downwards over the external oblique. There were no fibres continuous with those of the abdominal muscles, and none inserted into the ribs or sternum. This arrangement of the muscle seems to be the normal one; though, in the majority of cases either origin or insertion, or both, may be materially different. The chief arterial supply was derived from a branch, of considerable size, from the internal mammary artery, which perforated the third intercostal space. I regret my inability to trace the nerve supply. Shepherd found the nerve almost constantly lying between the upper and lower divisions of the pectoral.

On the right side, the muscle was quite the same in origin and insertion, and of similar size, except for the additional portion that will now be described. The subclavian muscle of the left side was larger, and more fleshy than the normal one of the right side, and none of its fibres were inserted into the costal cartilage, the upper ones uniting with the manubrium, but the larger number passing downward and inwards, through a space left in the origin of the pectoral from the sternum, and, forming a slender, round tendon which passed obliquely to the right side of the sternum to be inserted, partly into the side of the sternum and upper border of the costal cartilage of the fourth rib, but chiefly to blend with the sternalis. As though to correct the oblique action that it otherwise would have had, there was an additional sternalis on the right side, arising from the middle fibres of the sterno-mastoid tendon to blend partly with the muscular fibres of the subclavius tendon, but also terminating in a long tendon of its own that had an insertion into the costal cartilage of the fifth rib. This accessory sternalis, in its widest part, was a half inch in width. Some fibres of the pectoralis also sent a small tendon to join that of the subclavius.

The thorax was unusually long and cylindrical, and contracted below the cartilage of the fifth rib, as though constricted by a bandage. Traction in the freshly dissected parts produced but little effect upon the sterno-mastoid, notwithstanding the fact that the sternal portion was distinct from the clavicular portion for an unusually long distance. Traction upward, however, produced a very distinct tightening of the abdominal sheath and constriction of the lower part of the thorax. The muscle here certainly was a "Spanner der Bauchaponeurose."* The recti muscles were well developed, but the pectorales poorly.

The muscle has been believed to be one of inspiration, where functionable. In this case, their large size certainly indicated function, and I cannot resist the belief that that function was not one of inspiration and that the deformity of the chest had been due to their action.

As was to be expected, there were numerous anomalies in other parts of the body. The circulation of the upper extremities showed abnormalities throughout, so much so that it was difficult to homologize the arterial branches in axilla, arm and hand. Circumstances did not permit the careful search for variations, but two striking ones may be noticed. The tendon of the digastric muscles gave off two anterior bellies, one normal in size and position, the other a flattened, triangular belly, meeting its fellow in a median raphé, and connected at its upper angle with the maxillary symphysis. Another subject, dissected at the same time, had a very similar anomaly, consisting of two fleshy bellies arising from the maxilla and passing down half way to the hyoid bone, there uniting in a short raphé, then diverging to be inserted by a tendon into the tendon of the digastric; in both subjects the genio-hyoid was normal. Another anomaly in the first-mentioned subject consisted of a double insertion, by two equal tendons, of the extensor indicis, into the index and middle finger.

An examination of this subject's lungs showed that death had resulted from phthisis. This is the fourth subject in which I have noticed numerous muscular and arterial anomalies coincident with tuberculosis, and which incline me to the belief that persons possessing such are more predisposed to this disease than those of more normal structure; or, in other words, that numerous anomalies show impaired development and lessened vitality.

*Schultze, Anatom. Anzeiger. iii, 234, 1888.

NOTE ON ELAGATIS BIPINNULATUS.

BY SETH E. MEEK AND CHARLES H. BOLLMAN.

While Mr. Meek was in the employ of the New York State Fish Commission, during the summer of 1886, it was his privilege to examine two specimens of *Elagatis* taken off Long Island. So far as we know, this is the first positive record of the species on the United States coast.[1]

Dr. Jordan visited the Key West and Havana markets during December, 1883, and January, 1884, and in neither of them found any specimens of *Elagatis*. Our specimens agree very well with Prof. Poey's description of *Seriola pinnulatus*, and there seems to be no doubt that the West Indian *E. bipinnulatus* is identical with the East Indian species *E. bipinnulatus*, as Lütken has already indicated.

The following is the synonymy of *Elagatis*, with that of its single known species.

ELAGATIS.

1835.—*Elagatis* Bennett, Whaling Voyage, 11,283 (*bipinnulatus*).

1854.—*Seriolichthys* Bleeker, Naturk. Tidschr. Ned. Ind., 1, 195 (*bipinnulatus*).

1860.—*Decaptus* Poey, Memorias, 11, 374 (*pinnulatus*, *nonem nudum*).

Type *Seriola bipinnulata* Quoy and Gaimard.

Elagatis bipinnulatus Bennett.

The Yellow-tail.

Seriola bipinnulata Quoy and Gaimard, Voy. Uran., Zool., 1, 363, pl. 61, fig. 3, 1824; Cuvier, Regne Anim. Ill. Poiss. 130, 18; Jenyns, Zool. Beagle, Fish. 72, 1841 (*Keeling Islands*).

Elagatis bipinnulatus Bennett, Whaling Voy., 11, 283, 1835; Poey, Enumeratio Pisc. Cubensium, 83, 1875.

Seriolichthys bipinnulatus Bleeker, Nat. Tidschr. Ned. Ind. 4, 196, 1854; Bleeker, Nat. Tidschr. Ned. Ind., 392, 1858; Günther, Cat. Fish. Brit. Mus., 468, 1860.

Seriola pinnulata Poey, Memorias, 11, 233, 1860 (*Havana*).

Decaptus pinnulatus Poey, Memorias, 11, 374, 1860.

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[1] Stearns' note in regard to the occurrence of this species at Key West apparently has reference to *Aligoplites samus*, and not to the *Elagatis* (Nat. Hist. Aquat. Animals. 332, 1884).

Elagatis pinnulatus Poey, Synopsis, 13, 273, 1868; Goode and Bean, Proc. U. S. Nat. Mus., 130, 1879 (West Florida?); Goode and Bean, U. S. Fish Com., 43, 1881; Goode and Bean, Proc. U. S. Nat. Mus., 237, 1882; Bean, Lond. Fish Exhib., 54, 1883; Jordan and Gilbert, Synopsis Fish N. A., 446, 1883; Jordan, Proc. U. S. Nat. Mus., 149, 1884; Jordan, Cat. Fish N. A., 72, 1885; Jordan, Proc. U. S. Nat. Mus., 576, 1886.

E. bipinnulatus.

Head $3\frac{5}{6}$ in body (5 including caudal); depth, $3\frac{3}{5}$.

D. VI, I–27–2; A. II, I–17–2. Scales in lateral line about 100.

Body oblong, elliptical, the back little elevated.

Head rather long and pointed; mouth terminal; lower jaw slightly projecting beyond upper.

Maxillary triangular, its greatest width, $2\frac{1}{5}$ in its length; supplementary bone long and linear, all except its caudo-ventral margin slipping under preorbital.

Preorbital and preopercle entire.

Teeth in both jaws small, conical, equal, narrowing posteriorly; symphysis bare; villiform teeth on palatines, vomer and tongue, those on vomer in a diamond-shaped patch with a caudal diverticulum.

Eye $5\frac{1}{2}$ in head ($4\frac{2}{3}$ in smaller) end of maxillary reaching about three-fourths distance from nostril to vertical from cephalic margin of orbit.

Snout $2\frac{3}{4}$ in head. Length of mandible equal to distance from tip of snout to center of pupil; distance from tip of upper jaw to posterior end of maxillary, $3\frac{1}{5}$ in head. Gill rakers about all below angle, cephalic ones gradually shorter, longest about $\frac{2}{3}$ diameter of eye.

A slight occipital keel.

Lateral line wavy, origin at dorsal edge of opercle, the cephalic end of lateral line runs slightly dorsal to opposite origin of spinous dorsal; here it turns slightly ventral until opposite origin of anal and then median to caudal fin.

Origin of soft dorsal slightly nearer tip of snout than base of caudal. Spinous dorsal low, the third and fourth spines longest, about $5\frac{1}{2}$ in length of head. Soft dorsal and anal similar, slightly falcate; longest dorsal rays $2\frac{3}{4}$ in length of head, the thirteenth smallest, $6\frac{1}{2}$ in head; second ray of dorsal finlet is about twice the length of first, its length 4 in head.

Largest anal rays $3\frac{1}{2}$ in head; about as long as second ray of finlet; the two small anal spines remote from the rest. Pectorals short and broad, nearly 2 in head. Ventrals short, 2 in head, folding in a ventral depression. Caudal fin widely forked, lobes attenuated and slightly larger than head.

Body covered with small cycloid scales. Head not scaly, except portions of cheeks and part of its dorso-caudal margin. Scales on cheeks in about six series. Scales in regions of nape smaller than those on upper portions of body, long and narrow.

Color dark blue or lead above, becoming pale yellowish below. Two conspicuous blue bands on sides of body; the dorsal one begins at the orbit and passes caudal to dorsal margin of caudal peduncle, its width about equal to diameter of eyes; the second begins at snout, passes along ventral margin of orbit across opercle and a little dorsal of base of pectoral fin to caudal.

Caudal yellowish, with a darker margin; ventrals, pectorals and caudal yellowish, with more or less blue.

The only difference we have been able to find between our specimens and the description of *E. bipinnulatus* is, that in the latter the preopercle is said to be crenulate, while in ours the preopercle is entire; but as this is a character subject to variation at different ages, we strongly adhere to Dr. Lütken's opinion that *bipinnulatus* and *pinnulatus* are identical. Our description is taken from two specimens, the larger of which was caught in Gravesend Bay, September 21, 1885, and is in the Museum of the Indiana University; the smaller (nine inches in length) was caught off Coney Island, August 6, 1887; it is in the possession of the well-known fish dealer, Mr. E. G. Blackford, of New York City.

MARCH 5.

The President, Dr. JOS. LEIDY, in the chair.

Seventeen persons present.

Note on Gonyleptes and Solpuga.—DR. LEIDY exhibited a curious spider, presented by Dr. W. H. Jones, who obtained it in Rimac valley, in the vicinity of Lima, Peru. It is a large form related to our Daddy-long-legs, *Phalangium*, and is the *Gonyleptes curvipes*. The species was originally described from Chili. It is represented in Fig. 176, in Kingsley's Standard Natural History.

Another specimen exhibited, was presented by Mr. Joseph Willcox, who collected it in Florida. It is a *Solpuga*, differing from ordinary spiders in having both thorax and abdomen segmented. The species, according to Putnam (Proc. Davenport Acad. 1883, 264), was previously collected in the same locality. It agrees in size, 20 mm., and other characters, with the *Galeodes cubæ*, of Cuba, described by Lucas (Hist. de l'Isle de Cuba, Atlas, Tab. v., fig. 6.)

Mazapilite, a new mineral species.—PROF. GEORGE A. KŒNIG recalled to the Academy, that he had given a preliminary notice on July 3, 1888, of a new mineral of which he had not yet made a quantitative analysis or measured the angles accurately, as he was then on the point of leaving for his summer vacation. The mineral was then described as an *arsenite* of iron and calcium. The full examination showed this description to be erroneous. When first examined the mineral yielded in the closed tube a sublimate of $As^2\ O^3$ and water. This sublimate was not obtained in repeated later trials. The mineral is an *arseniate* of calcium and iron.

Mazapilite occurs only in well-developed crystals, which are imbedded in white calcite and aragonite. The crystals vary in length from $\frac{1}{2}$ to $\frac{1}{8}$ inch, and $\frac{1}{10}$ to $\frac{1}{50}$ inch in breadth. They are all developed at both ends and fall easily from the matrix, in which they leave an ochre-yellow impression. Minute warty particles of a grayish color were observed in some of these cavities.

The crystals are black, deep brown-red on the fracture. They are slightly translucent at the thinnest edges with blood-red color.

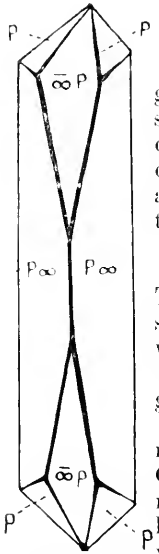
The streak is ochre-yellow. The luster is submetallic.

The crystals possess the habitus of the combination represented in the cut, without exception.

The four faces designated($\bar{\infty}$ P) are found to lie in *one zone* and therefore the symmetry of the combination is *orthorhombic*.

The following angles were measured:

$$P : P = 115^\circ\ 10' \text{ (over } \bar{\infty}\ P.)$$
$$P : P = 100^\circ\ 35' \text{ (over brachi-axis.)}$$



$\infty P : \bar{\infty} P = 44° \; 56'$ (over the pole.)

$\infty P : P\infty = 60° \; 10' = 119° \; 50'$

The angle of 115° 10′ is uncertain within 5′.

One of the faces of P measured, was very small and gave a dim reflection. All the other faces reflect satisfactorily, even excellently. On one very small crystal, the faces of a brachidome were observed, but could not be measured. No cleavage has been observed and therefore the longest dimension was chosen for the main axis, in the position represented by the cut.

The parameters of the fundamental pyramid are:

$$a : b : c = 0.73104 : 1 : 1.1640.$$

The optical properties could not be studied by reason of the failure to obtain a thin section which would transmit any light; the color is so intense.

The specific gravity was determined with 1.2475 grs. of pure crystals and found = 3. 582 B. B.

When the powder is heated in closed tube it yields much water without change of the ochre-yellow color. Only at a red heat the color changes to a light brick-red. In the oxydizing flame the mineral fuses to a black scoria which is magnetic. On charcoal a light volatile sublimate is produced and the garlic odor of arsenic is developed.

With borax only the reaction for iron is obtained. The mineral dissolves easily in hot concentrated hydrochloric acid without effervescence. The solution does not precipitate gold chloride (absent Fe 0 and $As^2 \, 0^3$.)

In the course of the analysis, care was taken to obtain complete precipitation of arsenic. Hydrogen sulphide was passed through the solution three times, allowing the solution to stand 24 hours after each separation. Only upon saturating the fourth time, no precipitation resulted. $As^2 \, S^3 + S$ was weighed; a portion oxydized and precipitated by $Mg \, Cl^2$. After filtering $(N \, H^4), {}^2O$ was removed by heat, H Cl added and $H^2 \, S$ passed through the solution. A small quantity of $Sb^2 \, S^3$ was obtained. After igniting the ferric hydrate, it was redissolved and by molybdic solution a slight yellow precipitate produced. This proved to be due to phosphorus. Water was determined in a separate portion.

0. 5520 of the substance gave.

0. 3430 $As^2 \, S^3 + S$.

0. 3125 $As^2 \, S^3 + S$ gave 0.2960 $Mg^2 \, As^2 \, O7$.

0. 1685 $Fe^2 \, O^3$.

0. 0820 Ca O

0. 3050 substance lost by successive heating.

0. 0020 at 130° C.

. 0130 at 279° C.

0. 0159 up to 360° C.
. 0240 up to beginning red-heat; the color of the powder remains unchanged up to this point.
. 0290 the powder becomes partly red.
0. 0300 at full red-heat. The powder is light brick-red.

These numbers furnished:

$$
\begin{aligned}
As^2\,O^5 &= 43.60 \\
Sb^2\,O^5 &= 0.25 \\
P^2\,O^5 &= 0.14 \\
Fe^2\,O^3 &= 30.53 \\
Ca\,O &= 14.82 \\
H^2\,O &= 9.83 \\
\hline
&\ 99.17
\end{aligned}
$$

From this follows the ratio:

$$As^2\,O^5 : Fe^2\,O^3 : Ca\,O : H^2\,O.$$
$$1 : 1.09 : 1.49 : 3.09.$$

or very nearly

$$Ca^3\,\overset{\text{III}}{Fe^2}\,[As\,O^4]^4\,[Fe\,O.\,H\,O]^2 + 5\,H^2\,O.$$

In view of the fact that the color remains unchanged up to red heat and then turns brick-red, the assumption of one molecule of ferric hydrate is well justified as is likewise the consideration of the remaining water as not being constitutional.

If we compare this composition with that of Arseniosiderite (Rammelsberg, Mineralchemie, Aufl. II, p. 347), we find a close affinity between the two substances. It may hereafter be shown that the composition of the doubtful mineral from Romanèche is identical with the Mazapilite, but for the present it seems proper to distinguish the latter as a perfectly well-established species.

The mineral Mazapilite occurs at the Mine Jesus Maria, District of Mazapil, Zacatecas, Mex. It was brought thence by Dr. A. E. Foote, to whose kindness the author is indebted for the material.

March 12.

The President, Dr. Jos. Leidy, in the chair.

Eighteen persons present.

A paper entitled "The Boring Sponge, Cliona", by Jos. Leidy, M. D., was presented for publication.

The death of Isaiah V. Williamson, a member, was announced.

MARCH 19.

DR. CHARLES SCHAEFFER in the chair.

Thirty-three persons present.

The following papers were presented for publication:—

"Color variations in Ophuira Panamensis and Ophuira teres," by J. E. Ives.

"On Pratincola Salax Verr, and Allied Species," by Witmer Stone.

"On new and little-known American Mollusca. No. I.," by H. H. Pilsbry.

A meeting of the Biological and Microscopical Section, Mr. HAROLD WINGATE, Director, was held conjointly with the meeting of the Academy.

Tilmadoche compacta, Wing., n. sp.—Mr. HAROLD WINGATE reported that this Myxomycete has been found during several summers in Fairmount Park, Phila., also at Wawa, Pa., and in Ohio, (Morgan). The speaker not being able to identify it with the description of any *Tilmadoche* as found in the literature, sent it to many correspondents under the mss. name as above. Later, a note to the description of *Tilmadoche columbina* B., in Dr. Rostafinski's Monograph, was found to contain points which caused the writer to think that the plant was not a new species, and as sufficient material had been collected by himself and Dr. Geo. A. Rex, it was sent to Mr. J. B. Ellis, and issued by him in vol. XXI, of North Amer. Fungi (No. 2087), under the name of *Tilmadoche columbina* B.

In Grevillea (Vol. 17), No. 81, fol. 18, a note of Mr. G. Massee's says that the type specimen of *T. columbina* in the Berkeley Herbarium is very different from the plant in N. A. F., so we now return to our original name. The following is a description of the species:

TILMADOCHE COMPACTA Wing., n. sp.—Sporangia brownish-white, flattened globose, occasionally globose, nodding, borne on subulate, yellowish-white stipes, which have a brown or blackish base, and reach to a height of three or four times the width of the sporangium; sporangium-wall studded with numerous, snow-white lime-granules, the remainder of the wall bronze-color, with a metallic luster, splitting on maturity in a floriform manner, with from six to twelve laciniæ; capillitium, after removal of the spores, white, with a faint bluish tint under reflected light owing to the translucence or iridescence of its delicate threads; the latter originate from a central lime-granule which is generally quite large, branch several times as they proceed towards the surface of the sporangium, and join into a dense, compact net, the ends of the last branches attached to the inner side of the sporangium-wall; lime-granules in the capillitium, very few, small, white, fusiform; spores bright brown-violet (brown in the mass), very delicately warted, 7–9 mk.

Fairmount Park, Phila., Pa. and Ohio (Morgan.)

This *Tilmadoche* has marked characteristics. The stipe for a short distance from the base is very dark, but suddenly changes to a yellowish-white. When the sporangium bursts, the top part of the wall generally pulls out the capillitium immediately over the central lime-granule, so that the latter is exposed to view. In some cases, when quite large, the granule falls out leaving a circular empty space in the center of the sporangium, without disturbing the outline of the capillitium. The capillitium is very flimsy, and its faint bluish tint in the mass quite marked under a parabolic reflector. The metallic luster of the sporangium-wall is constant in the specimens collected during different summers.

March 26.

Rev. Henry C. McCook, D. D., Vice-President, in the chair.

It was resolved that evenings as follow be assigned to the sections named for the purpose of holding meetings in conjunction with the Academy:—Biological and Microscopical Section, the third Tuesday of each month; the Mineralogical and Geological Section, the first Tuesday of each alternate month beginning with April; the Conchological Section, the second Tuesday of each alternate month beginning with May; the Botanical Section, the first Tuesday of each alternate month beginning with May.

Mr. Louis Schneider was elected a member.

The following were ordered to be printed:—

ON TWO MINERALS FROM DELAWARE COUNTY, PA.

BY F. A. GENTH.

Gahnite.

In the summer of 1887, Mr. John H. Smedley observed in his feldspar quarry, in Delaware County, some dark green crystals, partly imbedded in muscovite and associated with quartz, albite and garnet.

I am indebted to Col. Joseph Willcox and Dr. John M. Cardeza for a few of these which furnished the material for an analysis proving them to be *Gahnite.*

The crystals, from 2 to 15^{mm} in size, are mostly very imperfect; only the smallest show smooth faces of the octahedron in combination with the dodecahedron; generally their faces are rough and frequently show impressions from the associated minerals. The larger crystals are much distorted, the dodecahedral planes sometimes deeply striated, producing, with the octahedral, rounded, ragged faces upon which, occasionally, minute octahedral planes are visible. In some of the crystals an indistinct octahedral cleavage and frequent interlaminations with scales of muscovite may be observed. A few have been partly altered into muscovite and are coated with a thin fibrous crust of this mineral, in a similar manner as the gahnite from the Deake Mine, Mitchell County, N. C., described by me in Am. Phil. Soc. Proc., August 18, 1882.

Their color is blackish-green, in thin splinters translucent with bright dark-green color.

The crystals are so much mixed with muscovite that only with great difficulty and the aid of a strong lens, a small quantity of pure material could be obtained for analysis.

Spec. Grav. = 4.587.

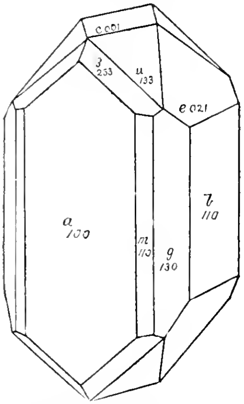
The analysis gave:

$$
\begin{array}{lr}
Al^2\,O^3 = & 57.22 \\
Zn\ O = & 38.14 \\
Cu\ O = & 0.06 \\
Mn\ O = & 0.70 \\
Fe\ O = & 3.55 \\
Mg\ O = & 0.26 \\
\hline
 & 99.93
\end{array}
$$

Scarcity of material prevented a direct determination of the ferrous oxide which was calculated from the amount of ferric oxide found.

Columbite.

At Mineral Hill, Middletown Twp., Delaware County, Pa., as a great rarity, a few specimens of columbite have been found; amongst which were two crystals, the larger and better in the W. S. Vaux Collection of the Academy of Natural Sciences, the smaller in the cabinet of Mr. Clarence S. Bement, who kindly loaned it for a crystallographic determination, which was made at the suggestion of Dr. Edward S. Dana by Mr. H. S. Washington, who very kindly made the following measurements of such angles as were worth recording, and prepared the accompanying drawing. For comparison, Dr. Dana gave the angles of the Standish columbite:



	Mineral Hill.		Standish.
$100 \wedge 110$	$= 40° 1'$		$39° 38\frac{1}{2}'$
$010 \wedge 130$	$= 21° 49'$		$21° 55'$
$100 \wedge 233$	$= 63° 41'$		$61° 52'$
$233 \wedge 133$	$= 12° 4'$	Not very	$13° 10'$
$001 \wedge 133$	$= 42° 57'$	good.	$43° 48'$

Besides these two crystals, two or three crystalline masses were found, one of which has been presented to me for investigation by Mr. Thos. S. Ash.

It weighed a little over 30 grams, was 28^{mm} long, by 20 and 18^{mm}, tapering at both ends. A small quantity of black mica was associated with it. The exterior had a brownish-black to a reddish-brown color, a subconchoidal fracture and a submetallic luster, inclining to resinous; the interior of the lump was more compact, with an uneven fracture, iron-black color and very little luster.

With great care the blackest and less lustrous, which formed the greater portion of the specimen, was selected for analysis. Fracture uneven, no sign of cleavage. The spec. grav. was found in two different portions $=5.262$ and 5.259, which is, I believe, the lowest specific gravity ever observed for any columbite.

The analyses were made in the usual way; an approximate separation of $Ta^2 O^5$ from $Cb^2 O^5$ was obtained by Marignac's method.

The results were as follows :

		Purest.		Less Pure.
Ta_2O_5	=	0.83	—	0.83
Cb_2O_5	=	76.26	—	76.64
SnO_2	=	0.16	—	not det'd
ZrO_2	=	0.67	—	0.62
WO_3?	=	trace	—	——
UO_3	=	0.18	—	0.18
Ce_2O_3 &c.	=	0.34	—	0.48
Y_2O_3 &c.	=	1.78	—	3.00
Fe O	=	7.65	—	6.95
Mn O	=	11.29	—	10.25
Mg O	=	0.07	—	0.25
Ca O	=	0.66	—	0.56
Ignition	=	0.33	—	not det'd
		100.22		

CONTRIBUTIONS TO THE LIFE HISTORIES OF PLANTS. No. IV.

BY THOMAS MEEHAN.

On Secund Inflorescence. So far as the author of this paper knows, no explanation has been given as to why flowers are often secund on the rachis. Sachs goes into the subject somewhat (Text Book of Botany, English Ed., p. 189), but evidently without being clear in his own mind as to the proper method of accounting for it, under the prevalent conceptions of phyllotaxis.

To those who have been able to examine many species of the thick-stemmed Begonias, to which this author refers as having leaves from one side of the stems only, it must be evident that they are but herbaceous species that have learned to become erect. What are thickened, creeping rhizomes in some species, have become ascending upright stems in these shrubby ones; and they have carried along in this evolutionary movement the unilateral character of producing the foliage, which must of necessity prevail in a procumbent stem.

This change of the horizontal to the erect position is apparent in many plants, especially in ferns. Tree ferns have no rhizomes, because the trunk of the tree fern is itself but an erect rhizome. In draining old swamps, the author has taken out old rhizomes of *Osmunda regalis*, many feet in length, and three inches in diameter, in no way differing from the trunks of the smaller arborescent ferns except a vertical tendency in the remains of the stipes. There are instances on record where this fern has become wholly arborescent,—that is to say, instead of producing the usual creeping rhizoma, the rhizome has become erect. But whether that rhizome, when erect, continued the lateral arrangement of its former position, as in the allied case of *Begonia*, it did not seem to occur to the observer to note. Again, there is no difference in character between the thick underground rhizome of *Yucca filamentosa* (which never has an erect stem) from the erect stems of its allies (*Y. aloifolia*, *Y. gloriosa*, &c.) which have no creeeping rhizomas. That the latter are but herbaceous species that have learned to elevate their rhizomes while assuming other characters, will be acknowledged by any reflective mind. That this is true of other stoloniferous or rhizomatous plants horticulturists have experience in the strawberry. Leaves, and an occasional root, will sometimes appear from the apex of the common peduncle which some accident has bent in early stages to the ground. But a perfect illustration is seen in a variety known as the "Brush strawberry," which never makes any stolons or, as they are technically called, "runners," because, as is readily seen, what should have been runners in the usual varieties have become erect, and, with erection, have changed their character to flower scapes. The leaves are quite abundant among the flowers, and are on one side, as they are on the thick stemmed Begonias, and as they would be on a strawberry runner trailing on the ground.

It is evident that under the conception of a continuous spiral arrangement, the leaves, from a stem arranged for horizontal growth, could not all spring from one side as in the Begonias and other plants referred to; nor is there any method conceivable except that each leaf or bud in succession should be made to twist in contrary directions. We can see that this is so in the thick flowering shoots of the *Yucca filamentosa*, where the suppressed leaves, reduced to mere bracts, show the alternate twisting from right to left, and from left to right. (Fig. 1.) Examining the flowers on the branchlets of the panicle, we see that they also alternately twist in opposite directions, and that they are secund. In fact, the flower scape of this *Yucca* is but a rhizoma, forced to assume an erect position, changed in many of its characters by that unknown law which comes in a highly accelerated growth, and results in changing leaves and stem into inflorescence, although not wholly affecting the unilateral character that prevailed in its horizontal condition.


Fig. 1.

If we examine any cases of secund inflorescence, we may in most instances see that this condition arises from the alternate twisting of the pedicels in contrary directions.

So far as the author can now recall, the secund inflorescence, aside from that classed as scorpioid, does not exist among annuals, and we may assume that it is rare in that class. In perennial herbaceous plants it is common. Conceding that, as a general law, plants in time come to adapt themselves to the best conditions of existence, and that as a general law it would be better for leaves and flowers to be scattered equally around an axis than to be crowded on one side, the conclusion is rationally reached that a secund inflorescence is a comparatively recent stage in evolution, wherein a geotropic stem has assumed an erect condition.

Again, the author does not know that it has been so recorded by phyto-biological authors, but growth in plants evidently follows the law that prevails in most forms of motion, and is rhythmic and not continuous. Rest and activity follow in rapid succession as the parts of a plant grow. It is during these various stages of rest and activity that the successive morphological changes take place. It is probable that during these resting spells, the changes in the torsional direction occur. It has been shown by the author of this paper (see Proceedings of Academy, 1886, page 291) that after the resting spell that follows the expansion of some malvaceous flowers, they take the opposite direction in twisting as they close. The plants there noted are annuals, and the inflorescence is not secund. The alternate twists are in contrary directions, during successive resting periods in the same flower.

Noting that in an allied order a member, *Mahernia verticillata* had secund flowers, it was thought probable the expanding corolla itself, might show alternate twisting in contrary directions. This proved to be the case, the lower flower of the two twisting against the sun, and the upper with the sun. Fig. 2 represents a front-face outline, showing the opposite direction of the twists in the two flowers of the commom peduncle. Notwithstanding the flower does not expand to the extent the malvaceous plants referred to above do, and the consequent difficulty the separate petals must have in changing the over-lap in fading, yet numbers succeed, showing that here also the return spiral twist is in a different direction and is not a mere coiling up of the same expanded spiral chain.

FIG. 2.

Distinct spiral directions in the growth of branches on the same plant have been occasionally noted (see Goodale Bot. Text Book, p. 407). The object of this paper is to show that it is very common in the inflorescence, and that it is indeed the cause of that section known as *secund*. The author would show that the inverse of Dr. Gray's definition of a stolon may be accepted. He says,—" A stolon is a prostrate or reclined branch which strikes root at the tip, and then develops an ascending growth, which becomes an independent plant." We now see that the stolon itself, with its unilateral arrangements, may again ascend and become a branch.

The author confines himself in this paper to those forms of scorpioidal inflorescence, that are not usually considered in connection with the subject, and which evidently occur by the twisting of the spiral growths. Those forms of unilateral inflorescence, more properly regarded as scorpioidal, and treated at some length in Gray's Botanical Text Book, Sixth Edition, page 163, would have to be examined from a different stand-point.

Note on Pinus pungens and its allies. Until comparatively few years ago, the Table Mountain Pine, *Pinus pungens* Mx., was not found north of the Potomac. Professor Porter found old cones at Huntingdon, Pennsylvania, and an aged local botanist at Bethlehem in the same State, told the author of this, that he had found old cones there. Since then the author found living trees in abundance at Port Clinton, subsequently in Dauphin County, near Harrisburg, and in January of this year near Lewistown in Mifflin County. It is safe to say it is found in the whole Allegheny range through the breadth of the State.

It is remarkable that a tree so widely scattered in this region should have been so long overlooked, and that the only person reported as having collected it in a living condition, should be the writer.

An interesting fact is that in all the Pennsylvania localities it seems to be found only in the upper Silurian formation

In the recently discovered Lewistown locality the rock is fossiliferous, being full of the casts of Brachiapodic shells. It is just possible it may reach the lower Devonian formation.

Another interesting point is that at Lewistown all five of the Pennsylvania species of the true Pines, are growing together: *Pinus Strobus*, *P. mitis*, *P. inops*, *P. rigida*, and *P. pungens*. *P. Strobus* and *P. mitis* make fine trees; some of the latter taller, and four feet in circumference.

One of the distinctive features of the species of Pine, and which cannot often be described among their specific character, is their habit of growth. By this they can be distinguished at a distance. *Pinus pungens* in this respect is seen to be more closely related to *Pinus rigida*, than to any of its neighbors. The side branches often branch and re-branch in *Pinus rigida*, taking on in this respect the character of a deciduous tree. Besides this the spurs, which in all pines are at the base of the fascicles of leaves growing towards the circumference of the branch year after year as the branch increases in thickness, but rarely getting far enough forward to form "secondary" leaves; in *Pinus rigida* manage in time to get beyond the bark of the main branches, again become foliaceous, and produce a dense annual crop of "needles" or secondary leaves along the whole surface. This has not been noted on *Pinus pungens*, though it has the character of making vigorous and much ramifying side branches more strongly developed. In many cases, the side-branches compete in vigor with the leaders, till the tree loses the specific character of most pines in having a distinctive trunk or leading stem, after it has reached no great height from the ground.

Another feature in which it agrees with *Pinus rigida*, is in the habit of bearing flowers, both male and female, on comparatively young plants. In the general characteristics of branches, foliage, and cones, it is easy to see the general relationship to *P. rigida*.

In one respect, however, there is a remarkable difference. *Pinus rigida*, is, in its cones, among the most variable of Pines. In his paper on "Variations in nature" read by the author of this before the American Association for the Advancement of Science, at its Montreal meeting, a series of cones was used in illustration showing a complete line between *P. rigida*, *P. serotina*, and *P. Tæda*, the changes being so gradual that, so far as the cones evidenced, no line could be drawn between the three, distinct enough as they are when the intermediates become "missing links." In the hills about Lewistown, some trees of *P. rigida*, were noted with cones little larger than good-sized Filberts. *Pinus inops* also varies very much in the form of its cones. But *Pinus pungens*, owing its parentage, as it probably does, to *P. rigida*, is remarkably constant in the size and form of its cones. Of the hundreds of trees that I have seen in the whole Allegheny range, from North Carolina to the Schuylkill river, the cones seem uniform in size and other characters.

In the unexpected appearance of a plant with which we are familiar in another region, we not only look for similarity in the geological features, but for companion plants as well. In the author's memory, *Polypodium incanum* is associated growing on rocks and trees with *Pinus pungens* in Virginia. It was natural to look for it here, but only its ally, *Polypodium vulgare*, was to be seen. It is possibly a low-land fern in its origin, pressing up into these higher regions long after the exposure of the Silurian rock in these upper elevations. At this dreary winter (January) season, the following few companions could only be noted:

Quercus coccinea, Q. Prinus monticola, Q. tinctoria, Juglans nigra, Carya tomentosa, Castanea Americana, Betula lenta, Acer rubrum, Ostrya Virginica, Rubus Canadensis, Rosa humilis, Juniperus Virginiana, Corydalis flavula, a wholly spineless *Cratægus* making a dense bush six feet high, *Danthonia spicata, Pycnanthemum muticum*, and numerous introduced plants that we expect to find everywhere.

On Corydalis flavula D. C. In January, in Pine woods near Lewistown, I noted some *Corydalis*, growing abundantly under *Pinus rigida*, and *Pinus Strobus*, plants of which I brought home, potted, and kept in a cool greenhouse. By the end of February they were in flower, and proved to be *Corydalis flavula*, D. C., *Fumaria flavula*, Rafinesque. Being able to watch their growth from day to day, I found a few points seemingly worth recording.

It is customary to say of this and allied species that the "racemes are opposite the leaves, or supra-axillary" (Torrey & Gray, p. 691) as describing that which is apparent. This is fair, but it is deceptive as to the actual fact. A raceme is but a branch arrested in its full axial development, and it is doubtful whether an axial growth, no matter what form of infloreseence it may assume, ever appears except from the axis of a leaf, or from the axis of the point where a leaf ought to be. To my mind it is a question as to whether every flower—each flower being regarded, morphologically, as an arrested branch—must not of necessity be terminal as regards its immediate axis; and whatever lateral direction it may subsequently assume, comes from a renewal of growth near or within the same axial line, the more or less horizontal positions assumed resulting by a pushing over, when the new axial growth is resumed.

That this is the case in this *Corydalis* is evident. The[1] raceme is at first a terminal spike. At its base is a leaf with an axillary bud. This bud, as it grows to a shoot, displaces the spike, assumes the central position, and the spike then becomes a "supra-axillary raceme," with the newly made axis, between it and the leaf to which it is axillary.

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[1] Since this paper was prepared for publication the author notes that the raceme, so called, continues its growth to a number of nodes after the last flower has been produced, though the leaves at each node are still bractiform. Only for the fact that the leaves on the axis are reduced to mere bracts, it would be nearly as proper to say that the flowers are "axillary and solitary along the branches," as to say they are racemose.

An interesting fact is that at this node, where the terminal growth becomes a supra-axillary raceme, the petiole has assumed a sheathing base, and the two lower minute leaf blades are attached to the sheath in such a way that in ordinary cases we should be likely to conclude they were stipules. But we can see that the petiole of the normal leaf has been arrested in its growth, without affecting the laminal portion. It is as if an inch and a half of the normal petiole had been cut out, and a petiolar leaf rendered sessile. With this arrest of growth has come a tendency to dilation, resulting in the sheathing base to the leaf stalk. The observation is important as furnishing the key to other changes as the inflorescence advances in growth. Along the raceme are bracts, from the axils of which the flower springs. These are broad and oval, and in neither form nor texture like the laminal portions of the ordinary leaf. They are evidently formed by a dilation of the petiole, in the line of, and to a greater extent, than in the sheathing condition already noticed.

The fertilization of the flower is of peculiar interest. Mr. Darwin treats of *Corydalis* under the head of self-sterile plants (Cross- and Self-fertilization, chap. 14), though noting there that some species are occasionally self-fertile. This species as growing in my greenhouse, is fully self-fertile—not one flower failing to produce perfect pods and seeds. It is very interesting to observe the developing seed vessel, as it pushes through the maturing petal, carrying on its up-curved stigma a mass of white pollen, looking like a snow cap on the top of a green mountain. Examining the unopened flowers, we find that the pollen matures, and is actually placed on the stigma, long before the corolla has completed its growth—long before it is in any condition to receive the visits of insects. It is in fact as truly fertilized in the bud, as that class of apetalous conditions known as cleistogene flowers can possibly be. This can be readily understood by observing that in a raceme of ten flowers, the lower one only with the pistil having emerged from the closed flower, all but the two upper had pollen on their stigmas. It is a case in which the flowers are arranged for self-fertilization, with perfect productive results.

Dimorphism in Polygona. "Flores hermaphrodite," is said of the whole section of *Polygonaceæ* in which *Polygonum* is included; but though hermaphrodite they be, the hermaphrodism, so far as an examination of species growing near the author is concerned, is of a character hitherto unsuspected by botanists.

While preparing the chapter on *Polygonum arifolium* for *Native Flowers and Ferns of the United States* (1879, Vol. II, p. 154, series I), a double system of flowers was noted—one smaller than the other—but as both of them seemed to have the sexual organs perfect with anthers abundantly polliniferous, no reference was made to the fact, but the whole matter was laid over for future investigation.

Attention was drawn to the subject a few years subsequently, by noting numbers of nectar-loving *Vespæ*, as well as the common honey-bee vigorously at work on the smaller flowers of *Polygonum Virginianum*. These smaller flowers are pure white, and, after mid-day, expand sufficiently to expose the whole sexual organs to easy ocular examination. There are two series of stamens. The exterior lean outwardly, the inner bend inwards and the abundantly polliniferous anthers are in actual contact with the apparently perfect stigmas. The whole gynoecial system seems perfect. Those who speculate in these matters would surely say the flowers were specialized for self-fertilization. At the base of the inner series of stamens are glands which copiously exude nectar, attracting the insects above noted. It was evident, however, that none of these small, though apparently perfect, flowers, ever produced seeds. On the same plant are other flowers, larger, and of a greenish purple tint. From these flowers the styles with their hooked apices protruding, extend considerably beyond the sepals. These flowers always produce perfect seeds. Though the smaller flowers seem specialized for self-fertilization, in view of the fact that they produce no seeds, that they are abundantly nectariferous and polliniferous, and that the larger flowers project the pistils beyond the closed sepals, apparently out of reach of own-pollen, and yet are abundantly fertile, the general conclusion that the whole arrangement is for cross-fertilization would surely be pardonable.

During the several years past in which continuous observations were made, no insect has been noted visiting the fertile flowers. It is safe to say they are not fertilized by insect agency. The nectar in the infertile flowers doubtless serves some good purpose, but it certainly has no reference to cross-fertilization by insect agency.

Setting aside as wholly out of the question the production of nectar, and the visits of insects in connection with the fertilization of the productive flowers, it still remained to be considered whether the pollen, notwithstanding its sub-gelatinous character, might not be carried by the wind.

It was subsequently made clear that the pistils did not emerge from the floral envelopes till after fertilization had been accomplished. Indeed the seed had advanced considerably towards maturity before the styles were projected. It was only by the increased growth of the achenium following fertilization that the styles became exposed at all. The flowers are fertilized in the bud; there is no possibility of cross-fertilization. It may be remarked here, that the word "cross-fertilization" is used to express the pollination of a flower by another on the same plant. The physiological speculations involving questions of benefit to the plant or to the race, require the cross to be between different plants growing under separate conditions.

It was but natural to examine other Polygoni, in the light of the facts developed by *P. Virginianum*. The characters given were found in all cases, and still more strongly marked. These were the smaller, lighter colored, apparently perfect, flowers—expanding in the afternoon, gland bearing and nectariferous; abundantly polliniferous, but yet infertile. And there were the larger, colored, always-closed, and yet perfect flowers, resulting, without an apparent exception, in perfect seeds. In many cases the styles are bent in the bud, and the stigmas and anthers are brought together so as to make self-fertilization absolutely certain. Many are in fact truly cleistogamous. Occasionally with the growth of the fertilized achenium, as noted in the case of *P. Virginianum*, the remains of the pistils protrude through the floral envelopes, but this is not always the case.

In the light of so much that has been developed in connection with the relations between insects and flowers, these studies of Polygoni present an intricate puzzle. Here are all the facts, positively presented, required in the theory of cross-fertilization in this way. There is nectar, perfect pollen in abundance, and insect visitors. But there are no flowers to be fertilized. Those that are fertile—the only fertile flowers are absolutely closed to the insects,—are in fact cleistogamous.

The following is the list of species on which these observations are founded:—

P. orientale L.	*P. Pennsylvanicum* L.,
P. Persicaria L.	*P. Hydropiper* L.
P. acre, H. B K.	*P. Virginianum* L.
P. aviculare, L	*P. arifolium* L.

P. sagittatum L.

On the nature and office of Stipules. The author has printed a paper in the Proceedings of the Academy, 1870, pp. 114–117, on the Stipules of *Magnolia*, showing that the stipules not only performed the office of bud-scales, but that the petals were transformed stipules, and not metamorphosed leaves as we usually understand them to be. The good friend whose loss we all deplore, Prof. Asa Gray, generously examined the manuscript before publication, and expressed himself much pleased with the deductions drawn, observing, however, that if his memory served him right some German observer had before suggested that petals are occasionally but modified stipules. This is so obvious, that it would be surprising if the matter had not been discussed somewhere, but the author has never been able to discover the treatise that Professor Asa Gray believed he had read on the subject. It is safe to say that, as a general rule, stipules are not regarded as of any material importance in the economy of plant life. In the treatment of this subject they are simply spoken of as "appendages to the leaves," referred to as occasionally serving as a bud-scale, and then dismissed from consideration.

There is no essential difference between a stipule and the dilated base of a petiole. In some natural orders the presence of stipules characterizes every genus ; in allied orders the complete stipule may be wanting, but the bases of the leaves are widened and become thin. The leaves are then characterized as having petioles dilated at the base.

It is worthy of remark that in plants having dilated petioles the leaves with the petioles so dilated have much shorter petioles than those on the same plant not dilated ; in Ranunculaceæ and Umbelliferæ for instance. The same rule obtains in those genera where there is a difference in the size of the stipules in the same plant—some *Rosaceæ*. The size of the stipules is in inverse proportion to the length of the petioles. It is important to note that elongation is in a measure suppressed in proportion to the development of the stipule or the dilated petiolar base. This may be seen in the case of *Corydalis flavula* (see Contributions IV, page 58). It may also be noted in an examination of a stalk of clover, or a flowering branch of the rose. The stipules become larger and the petioles shorter as the flower bud is reached.

Exactly the same order follows the production of bud-scales, when a branch is about finishing its season's growth. Towards the end of the season the ends of the petioles widen; the petioles themselves shorten; and careful observations in many plants will show that the final result of this process is the bud-scale. When, again, the season for a renewal of growth occurs, the same process appears inverted. The small scale grows larger and wider. Often a perfect petiole is reached before a trace of leaf appears. In some species of Ash, and in the Dwarf Horse-chestnut (*Aesculus parviflora*), this transition is particularly evident. The result of the examination will clearly establish the fact that a bud scale is a transformed leaf to be sure, but a leaf in which the longitudinal growth has been arrested, and a quickened growth secured for the base of the petiole or stipule. We may more correctly say that a bud-scale is a transformed stipule, or dilated petiolar base.

Examining carefully the same growth-course in the clover or the rose, there is seen the same gradual modification. The stipules are enlarged until the leaf blades wholly disappear in the sepals; the petals, still the same modified stipule, widen and enlarge. No other conclusion can be reached. But in the rose the sepals sometimes narrow, and the leaf-blade reappears at the apex. In some varieties grown in winter forcing houses, a perfect pinnate rose leaf appears. This is the case, notably, with a variety known to florists as Madame Ferdinand Jamain (in America "American Beauty.") Clear as it is to the mind that when carefully traced, the petal of a rose is formed of an enlarged stipule, and not of a fully planned leaf, the positive evidence is not furnished as freely as in the case of the sepal, but specimens of *Rosa humilis*, sent to me in 1883 by Miss Jennie E. Whiteside, of Harmonsburg, Pennsylvania, give an excellent illustration. This form has been figured and described by Mr. Sereno Watson in the *Garden and Forest* for February 13th, 1889 as *Rosa humilis*, var *triloba*. The trilobed petal is simply a case in which the usual stipule forming the petal of the rose, has again had its normal growth accelerated towards a perfect leaf. The central lobe is in fact no more than a dilated petiole, with the stipule represented by the two lateral lobes, in its normal position at its base. The same process from the total arrestation of petiole and leaf blade to the abnormal dilation of the stipule to form the petal, can be traced in magnolia, as made plain in the paper above cited.

When we come to formulate the general proposition that the bud-scales of branches, and the sepals and petals of flowers are modified stipules (or dilated bases of petioles), it will not be surprising if instances should be adduced where these organs are evidently modified leaf-blade rather than stipular. Nature seems so exhaustive in her efforts at variety, that though the morphologist should be able to prove his position in the greater percentage of cases, he learns, by experience, that "never" and "always" are dangerous terms.

With this clearly conceived nature of bud-scales and floral envelopes before us, we get a nobler view of the office they have to perform in the economy of plant-life. We cease to look on them as mere "appendages" of so little account as to be usually dismissed with a few words in treatises on structural and morphological botany. They are the police force of vegetation, the defenders of the weak, the protectors of infancy in the vegetable world. From the scale of a Lily bulb, to the full-formed petal of the beautiful rose, we see the self-same chord with myriads of tones in perfect harmony. It is a good illustration of the unity of plan on which nature rings such varied changes.

And this conception of the nature and the office of stipules harmonizes the morphological conceptions heretofore prevailing as to the formation of the flower. We have long since ceased to say that a flower is modified leaves; we now teach that a whole branch is modified when nature undertakes to mould a flower. Now if we propose that bud-scales are modified stipules, and that their office is protection, when the organs of a branch are so modified as to produce a flower, the stipular conceptions should lead to protection also; and this is conceded to be the chief duty of sepals and petals. They are mainly for the protection of the tender parts they enclose.

Bud scales and the floral envelopes are modified stipules, and their office is protection to weaker portions of the plant structure.

On parallel habits in allied species from widely separated localities. In a paper published in the Proceedings of the Academy for 1862, page 10, the author of this paper pointed out that the variations in many allied species of Europe and America were always in the same line. For instance, if a European species had shorter internodes, larger buds, more serrate or thicker leaves, duller foliage in the fall, denser growth of branches than an American ally, species of other genera would also differ in the same comparative characters. In other words, the variations in character which distinguish the species of America from the species of Europe, are all on the same general plan.

It may now be noted that in two species of *Euonymus*—one of America and one of Japan—both remarkably dimorphic—the dimorphic one also has a remarkable correspondence. In our country we have *Euonymus Americanus.* L., which we sometimes find growing up as an arborescent shrub, of four or six feet, with a round head on a single stem of near two inches in diameter, and with thick, ovate, bright green leaves. At other times it is found as a low-trailing plant with thin linear-lanceolate pale green leaves, having, so far as I know, flowers but rarely in this trailing state. Many a young botanist, in his earlier experience, must have wondered, as the author has, whether they were not wholly distinct species. Riper years with accumulated knowledge of the range of variation, alone teaches the identity of the two.


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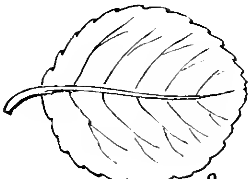
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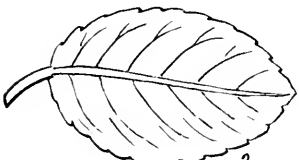
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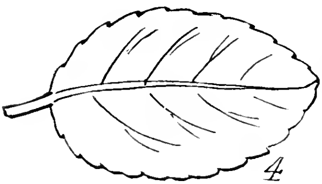
4

Euonymus Japonicus, of Japan, presents the same conditions. This was long ago described by Thunberg under this name, and has been many years cultivated in American gardens. A leaf of this is given in Fig. 4. Laer has introduced *E. radicans* of Siebold, Fig. 1, representing a leaf of this form. For many years it was grown in our gardens as a simple low bush in shrubberies. Some plants growing near a low stone wall, took to climbing up as the well-known English Ivy or the American Trumpet creeper does, doing full justice to Siebold's specific name *radicans.* As soon as it reached the top of the wall, the leaves increased in size and general character, till it was difficult to trace any difference between them and *Euonymus Japonicus.* That they were dimorphic forms of one species admitted of no doubt. Cuttings of the upper branches with the enlarged leaves were made, but the young earlier branches pushing out from the cuttings, gave the true radicant form of Siebold, but eventually stronger branches pushed out with an erect habit. Fig. 1, 2, 3, are all graduated leaves from one of these plants. Fig. 3 will be seen to have reached very nearly the size and form of a true *E. Japonicus*, Fig. 4, but it is not quite so thick and shining.

As the two species are not distantly related, it is certainly interesting to note that the dimorphic one is of the same relative character in each case, the climbing habit being still wanting in the American species.

APRIL 2.

The President, Dr. JOSEPH LEIDY, in the chair.

Thirty-nine persons present.

The production of aerating organs on the roots of swamp and other plants:—The following communication was read from PROF. WILLIAM P. WILSON:—In the winter of 1885–86 I was in South Florida. While studying the plants about Lake Butler in Hillsborough Co., my attention was called to the excrescences on the roots of the bald cypress, *Taxodium distichum* Richard, generally called "knees." The water in the lake was very low. During high water the waves had washed bare the roots of many of the cypress trees along the shore. In this way an occasional tree was found whose earlier formed root-system was almost completely exposed.

These exposed roots offered excellent opportunity for the study of some of the points in the development of the so-called "knees." The very early stages were secured by digging up the complete root-system of young trees which were just beginning to show "knees," and also by cultivating at a later date seedlings under varying conditions. Some of the results early obtained led to the growing of other plants under varying conditions of moisture and dryness.

Certain points concerning the development and function of roots under the influence of excessive moisture, which seem to be clearly made out, will be very briefly stated in this paper. A more extended discussion of the same subject, including the anatomy of some of the roots with explanatory cuts will, I hope, soon follow in the Proceedings of this Academy.

Taxodium distichum produces whenever it grows in wet places, excrescences on its roots called "knees." These knees vary in size, in height and in number in accordance with the depth of water or amount of moisture existing under the trees. When the water for a part of the year is deep the knees grow correspondingly high. If the ground is simply overflowed and kept saturated with moisture most of the season these knees grow low but multiply themselves in great numbers. Fifty to one hundred may be produced from the root-system of one tree. If the overflow is considerable in depth the knees may exceed eight or ten feet in height. They are strictly root productions as will be shown later both by their development and anatomy.

The development of these knees is by two very distinct methods.

First, if the seed germinates and the plant begins its growth in a very wet place, many of the small roots which are only six or eight inches below the soil grow upward towards the surface at slightly varying angles of from 20° to 35°. Upon reaching the surface these same roots turn and go down into the soil at about the same angle. Some of them may, if the soil is very wet, or if under the water for a part of the season, repeat this method of growth several times in the course of six or eight feet. At each point where the root comes to the surface begins later the development on its upper side of the so-called " knees."

A remarkably rapid increase of cells on one side takes place at this point, which results in the constant elongation of the club shaped body, the knee. This point of growth I shall discuss in a following article.

The second method of knee formation takes place on old roots either horizontally or otherwise disposed to the surface. If the tree requires from inundation or other causes more aerating surface than can be readily or rapidly produced by young and growing roots, then either the whole upper surface of the root in question may become more active and rapid in its growth or the places of growth may be limited to certain definite points.

In the first case the whole root becomes widened, ribbon like and corrugated in general appearance. In the second, separate and distinct knees are formed. All knees cannot, however, be explained from these two simple methods. The cypress roots seem to have a very great tendency toward natural grafting. Whenever two roots cross each other and later through increase in diameter press upon each other they develop a natural union. In many cases when the ascending and descending part of the root which forms the basis of a knee approach parallelism they become later, through increasing diameter, wholly consolidated in the formation of the knee. It may happen that several knees begin their development within a few inches of each other. In such cases they may later become consolidated into one. The external parts of the knee above the soil in such cases may give little or no evidence of such consolidation. In the first mentioned method of knee formation the root passing from the tree to the " knee " is always less in diameter than the one leaving the knee. On the root descending from the forming knee there generally develops a cluster of roots, these often become consolidated later with the "knee." Roots which branch from the ascending part of the forming " knee " develop new " knees."

I do not propose at this time to discuss the function of these knees further than to say that their *location* and *occurrence* indicate beyond a doubt that they are for purposes of aerating the plant. Given conditions of sufficient dryness and plants of *Taxodium distichum* may be produced without a sign of these excrescences. The same or other plants may be placed under conditions of extreme moisture when after a time the " knees " will appear on both old and newly formed roots. The Taxodium seems to prefer swamps and inundated locations and in such places always produces the " knees." When cultivated in gardens and parks in dryer soils, where it readily grows, it never produces them.

The possibility of causing the development of these aerating organs in the cypress or, by changed conditions, of making them fail to appear at all, naturally leads one to examine other plants which from choice inhabit similar locations. There are numbers of trees and smaller plants which when flooded part of the season or grown in too wet soil will either form knees something like the cypress or send their roots up into the air above the water.

I have succeeded in causing common Indian corn to push up one or more roots from each plant above the soil by keeping the same saturated with moisture. Such roots grow up into the air and then turn downward and enter the soil, forming perfect knees for aerating the plant.

In Georgia on slopes remaining inundated during the wet season I have found the Pond pine, *Pinus serotina* Michx. making perfect knees on the water side something like the cypress, while the roots on the upper or dry side of the tree did not appear on the surface at all.

One of the most striking cases in which roots are sent up above the surface of the soil and water may be found in one of the sour gums the Water Tupelo, *Nyssa aquatica* L. of the Southern states. This tree sometimes grows in water holes associated with no other tree, thus resembling a Cypress head. I found such Tupelo-heads frequently in Georgia. In such cases the base of each tree was enlarged to double the diameter five to eight feet from the ground. Around the base of each tree extending six or eight inches above the high water line was a compact mass of roots, each one growing vertically up out of the water and after making a sharp bend growing down parallel with the upright part into the water again. There were sometimes dozens of these roots surrounding one tree closely appressed to its base. These roots varied in size from that of the finger to several inches in diameter.

The genus *Sonneratia*, and also *Avicennia* L. both furnish interesting trees which, growing in soils or ooze always saturated with water, have contrived to send up vertical roots for purposes of aeration.

Avicennia nitida grows in our own tropics and along the southern shores of Florida. These vertical roots which extend up above the soil from 6 to 10 inches are always in the air at low tide. They are covered with numerous lenticells through which the air enters the plant when they are not flooded.

There is no doubt but that all swamp plants and others growing between tide waters which are flooded during a part of the day have provided themselves in one way or another with means for root aeration. See interesting papers by K. Goebel[1] L. Jost,[2] and Shaler.[3]

The following were ordered to be printed:—

[1] Berichte der deutschen botanischen Gesellschaft, Jahrg. 1886, S. 249.

[2] Botanische Zeitung, Nr. 37, 38 u. 39—1887—S. 601.

[3] Memoirs of the Museum of Comparative Zoology at Harvard College, Vol. XVI. No. 1, June 1887; Science, Vol. XIII. No. 318 p. 176.

THE BORING-SPONGE, CLIONA.

BY JOSEPH LEIDY, M. D.

Among the ocean debris of the neighboring Atlantic coast, shells of the oyster, *Ostrea Virginiensis*, and of the clam, *Venus mercenaria*, conspicuous from their being riddled with holes, are frequent. When I first saw such shells I suspected that the numerous perforations were due to an annelid or perhaps a boring mollusk. In 1856, while at Beasley's Point, on Great Egg Harbor, New Jersey, I had the opportunity of observing the shells of both dead and living oysters drilled in the same manner and with the borings occupied by a living, soft, yellow, silicious sponge. A notice of my observations on the sponge, attributed to the genus *Cliona*, with its character, peculiar habit, and incidental importance in the economy of nature, was published the same year in the Proceedings of this Academy, Vol. VIII, p. 162.

Apparently the massive form of the same sponge, was previously described by Desor, under the name of *Spongia sulphurea*, occurring in Vineyard Sound (Proc. Boston Nat. Hist. Soc., 1846, 68).

Later, the sponge of the same locality was noticed by Prof. Verrill as *Cliona sulphurea*, and is described as commencing in the condition of a boring form on dead shells and subsequently growing into masses six or eight inches in diameter (Rep. U. S. Fish Commission, 1873, 421).

In Little Egg Harbor, in the vicinity of Beach Haven, N. J., I have observed the boring-sponge in various stages from the condition in which it occupies the shells of oysters and clams with its sensitive papillæ and oscules protruding from perforations of the surface of the shell, to variously massive forms enclosing at their base the riddled shells from which they sprung. Sometimes I have observed a mass enveloping a pair of open, perforated, shells of an oyster or clam in which the shells were still united at the hinge. Often too, a massive sponge envelops, together with its original cradle, fragments of other shells, pebbles and sand. To the fishermen of Beach Haven, the massive sponge is familiar under the name of Bay-pumpkin; often growing to the size of one's head.

In the oyster beds, the boring-sponge especially invades the upper or more exposed shell, and the living oyster incessantly protects itself by the formation of new shell-layers. The sedentary habit of the oyster favors the invasion of its boring enemy. The free moving clam, while alive, appears to be exempt from its attack, but the shells of the dead clam are as thoroughly invaded and riddled as those of the oyster. I have occasionally met with an isolated valve of the *Mactra solidissima*, *Pecten irradians*, and the horse-mussel, *Modiola plicatula*, which exhibited the perforations of the boring-sponge, but none containing the living sponge. In one instance I obtained a clam shell having attached to it a shell of *Ilyanassa obsoleta* and tubes of *Serpula*, all together, drilled by the living *Cliona*. On the cultivated oyster beds the massive *Cliona* is less frequent than upon accumulations of dead oyster and clam shells elsewhere, probably from the circumstance that it is more liable to disturbance in its growth in collecting oysters from the beds.

A boring-sponge closely resembling, if it is not identical with ours, and having the same habits, occurs in European seas. It was first definitely noticed by Dr. R. E. Grant, in the Edinburgh New Philosophical Journal, 1826, p. 78, and found on the shells of dead and living oysters (*Ostrea edulis*), in the Frith of Forth, Scotland. The description of the sponge accords with my observations on the boring-sponge as above indicated. From the accidental attachment of some polyps to the sponge, observed by Dr. Grant, supposing the polyps to belong to the sponge, he described it as a zoophyte and named it *Cliona celata*. He also regarded the borings occupied by it as not due to the sponge, but to annelids, though in the concluding part of his account he remarks that it may be questioned whether the shape of the silicious spicules and constant currents of the papillæ do not exert an influence in forming or enlarging the habitation of the zoophyte.

In 1840, Dr. G. D. Nardo, announced the occurrence of the boring-sponge of the oyster in the Adriatic, and gave to it the name of *Vioa* (Un nuovo genere di Spongoli silicei.) Shortly after, Duvernoy noticed the boring-sponge in the *Ostrea hippopus*, at Dieppe, and gave to it the name of *Spongia terebrans* (Comptes rendus, 1841, 683).

Dr. George Johnston, in 1842, in his History of British Sponges, p. 125, described the boring-sponge of the oyster, under the name of *Halichondria celata*, from the oyster beds of Inchkeith and from the Frith of Forth. He also referred to the same species a massive variety dredged in Butribuy Bay.

In 1849, Mr. Albany Hancock, in a paper "On the excavating Power of certain Sponges belonging to the genus *Cliona*," described the *Cliona celata*, which he observes is the most destructive species to oyster shells, and abounds in the Frith of Forth. His paper is accompanied by a figure of the sponge occupying an oyster shell, and the author remarks that the *Cliona* undoubtedly works out the cavities it inhabits, whether mechanically or otherwise. He attributes the boring power to silicious granules on the surface of the sponge and to its contractility. The silicious granules are figured as hexagonal plates with hexagonal markings. Mr. Hancock also describes boring-sponges found in a number of other molluscous shells, which sponges he referred to several other different species of *Cliona* (Annals and Magazine of Natural History, Vol. VIII, p. 321).

N. Lieberkuhn, in 1859, described the *Cliona celata* as living in oyster shells at Heligoland, and attributed the boring of the shells to the sponge (Archiv für Anatomie, Vol. 26, 515).

Dr. Bowerbank, in his work on the British Spongidæ, II, 1866, 212, referred the *Cliona celata* of Dr. Grant, to another genus, with the name of *Hymeniacidon celata*, to which he also refers the other boring-sponges described by Mr. Hancock. He reports it as occurring in all parts of Great Britain in oyster and other shells, and also in limestone rocks of Tenby. Dr. Bowerbank doubted the boring power of the sponge and regarded it as merely occupying the deserted habitations of living annelids. Rev. A. M. Norman, editor of the fourth volume of the same work, remarks that Dr. Bowerbank persistently refused to entertain any other opinion than that the *Cliona* only occupied previously-formed excavations, and had no power of penetrating shell or stone.

Dr. Johnston is the only European authority who ascribes a massive form of sponge to the same species as the ordinary boring form of oyster shells. Dr. Bowerbank describes and figures a large massive sponge, common on the British coast, under the name of *Raphyrus Griffithsii*, and refers to it the massive variety of *Halichondria celata* of Dr. Johnston, observing that it is not a matter of surprise that it should have been confounded with Dr. Grant's *Cliona celata*, the spicula of the species being so very similar in size and form.

Dr. O. Schmidt describes *Cliona celata*, under the name of *Vioa celata*, occurring on oysters and stones in the Adriatic, and remarks that its spicules are pin-like and of one kind only, (Supplement der-Spongien des Adriatischen Meeres, 1864, 40). His distinctive char acter of *Vioa* is that it is parasitic, and lives in perforations of shells and stones (Die Spongien der Adriatischen Meeres, 1862, p. 40). He also describes what he considers to be a new genus of sponges, *Papillina*, which, except in name, I cannot distinguish from *Cliona*. The species *Papillina suberea* he describes as yellow with numerous warts on the surface and with only pin-like spicules. Bowerbank regards it the same as *Raphyrus Griffithsii*, corresponding with the *Halichondria celata* of Johnston, who described it as a variety of Dr. Grant's *Cliona celata*, and this is admitted by Schmidt (Spongien der Atlantischen Gebietes, 1870, 77). The latter further describes a cushion-like (*polsterförmiger*) *Papillina*, from the coast of Florida, which likewise appears to be a *Cliona*.

As the massive form of *Halichondria celata* of Johnston, synonymous with *Raphyrus Griffithsii* of Bowerbank and *Papillina suberea* of Schmidt, accords in color and structure, and in the form and size of its silicious spicules, with *Cliona celata*, it seems to be related to this, as our massive *Cliona sulphurea* is to the boring form of the oyster and clam. It remains to determine whether our boring-sponge of the oyster is the same species as that of European seas. So far as we may judge from the descriptions of the European sponge in comparison with ours they appear to be identical in color, form, structure and habits. Both also have but one kind and form of silicious spicules. But in these, if the records are correct, we find a very considerable difference in size. Grant, Hancock, Bowerbank, and Lieberkuhn give as the size of the spicules of *Cliona celata*, about $\frac{1}{50}$th of an inch, while in all our forms of *Cliona*, in the oyster and clam and in the largest massive varieties, the size of the spicules is only about $\frac{1}{70}$th of an inch. Moreover, if the observation of Mr. Hancock is correct and I have not erred in my own, there is still a more remarkable difference.

In the boring-sponge of our oyster and clam I could detect no trace of the silicious, hexagonal granules, which Mr. Hancock regards as the instruments of boring of *Cliona celata*. In the position indicated for these granules, in repeated examinations, I could find nothing but a few scattered irregular particles of quartz sand. The only distinction then, if future observations prove them really to exist, between *Cliona sulphurea* and *Cliona celata*, are the considerably longer, silicious, pin-like spicules of the latter and the presence in the boring form of additional haxagonal, silicious granules; otherwise both would pertain to the single species *Cliona celata*.

A different and pretty form of *Cliona*, and probably an undescribed species, is exemplified by specimens obtained on the coast of Florida by Mr. Joseph Willcox. Though from the same locality, they do not appear to accord with the descriptions of Schmidt of *Papillina cribrosa* and *arenosa* (Spongien des Atlantischen Gebietes, p. 48).

In four specimens, of which one is a twin, making, according to the ordinary view, five individuals, all accord in their upright cylindrical, sausage-like form. In their present state all but one are somewhat dusky-white spotted by brownish rings and smooth as if water-worn. The remaining specimen, shorter and more robust than the others, is dark-brown with a yellow tinge on one side of the base and is covered with warts. It resembles in the same condition the appearance of surface of the massive form of *Cliona sulphurea*, and probably like this, in the fresh state was sulphur-colored.

The specimens range in length from 90 to 175^{mm} and from 35 to 50^{mm} in breadth. The summit is rounded truncate, depressed centrally, and in the unworn or more recent specimen imperforate with a short, stem-like tubercle. The base in the latter specimen is truncate, and looks as if it had been cut away from a fixed attachment. Two of the other specimens are rounded in the same position, broken along a semicircle where they seem to have been attached, and have a depression or cave on one side communicating with a central perforation. A specimen, 130^{mm} long and 35^{mm} broad, cut across the middle, exhibits a central cavity extending the length of the sponge, 16^{mm} wide, and with smooth imperforate sides. The surface of the worn sponges is divided into mostly haxagonal areas 3 or 4^{mm} wide, with a central circular spot and darker border. In the unworn sponge the hexagonal areas are occupied by a central circular papilla variably prominent, level, or slightly depressed. The exterior of the sponge is composed of a more compact, thin lamina or skeleton of silicious spicules with comparatively little of the softer sponge-structure, while the interior greatly thicker portion extending to the inner cavity is composed of a looser texture of the same kind of spicules with a large proportion of the softer structure, pervaded by bands of the more compact substance extending inward from the exterior layer. The silicious spicules of the sponge are of one kind only, pin-like in form, and identical in all other respects, including size, with these of *Cliona sulphurea*.

In the shape of the sponge with its interior chimney-like cavity it resembles the tubular form of individuals of many keratose sponges, and is so unlike the more familiar forms of the living sponge that if not a different species, as a marked variety it might be distinguished as CLIONA PHALLICA.

Mr. Willcox, who is now in Florida, writes that the *Cliona phallica* is one of the most common sponges of the coast. He observes that when alive it is of a yellow color, and has an opening at the summit nearly as large as the end of the little finger. It is very sensitive and when disturbed contracts and closes the orifice. The dead specimens never exhibit the latter open. Mr. Willcox says that he observed the sponge at Clear-water Harbor, near Tarpin Springs. At low tide, when covered with only five or six inches of water, this was seen to be in active movement above the sponge indicating a current flowing from the aperture. In wading, when Mr. Willcox approached within four or five feet of the sponges, the currents flowing from them would cease and on touching them they would close the terminal aperture.

VARIATION IN OPHIURA PANAMENSIS AND OPHIURA TERES.

BY J. E. IVES.

Among the Ophiurans in the collection of the Academy there are a number of specimens from the Pacific Coast of North and Central America which appear to me to belong respectively to *Ophiura Panamensis* Lütken and *Ophiura teres* Lyman. I have had occasion, while identifying these forms, to correlate the descriptions of Messrs. Lütken, Lyman & Verrill (Lütken, Vidensk. Selsk. Skrift. 1859, p. 193; Lyman, Proc. Bost. Soc. N. H. vii, pp. 198, 257, 1860, and Ill. Cat. Mus. Comp. Zool., No. 1, pp. 32, 37, 1865; Verrill, Trans. Conn. Acad., i p. 253), and as the specimens above mentioned appear to add to our knowledge of the variation in color and pattern, I propose, therefore, to briefly consider some of the characteristic features of these two species. In addition to the specimens in the collection of the Academy I have had the opportunity of examining three specimens kindly loaned by the Museum of Comparative Zoology. Mr. W. N. Lockington, who made a study of *O. Panamensis* during his residence on the West Coast, has also courteously placed at my disposal some manuscript notes.

The different varieties of *O. Panamensis* appear to range themselves into two groups, as follows:

1. Upper surface of disk dark green, greenish gray or brownish, sometimes speckled with darker, and sometimes with a white mark in the center; upper surface of arms, same, banded with lighter and darker, with outer edges of upper arm-plates occasionally marked with dark longitudinal lines, presenting a toothed appearance (Panama to Cape St. Lucas).

2. Disk olive green, mottled with black and red, or of various shades of brown; arms, same, banded with lighter; darker bands sometimes mottled with lighter, and the light bands so dark as almost to obliterate the banding. (West Coast of Mexico, Lower California and California.) Mr. Lockington records a variety with a brown disk and olive green, arms without bands except at the tips.

The various specimens of this species agree in having the upper arm-plates little or not at all broken; the radial shields naked and the mouth shields about as long as broad, convex outwardly and with a slight, rounded angle on the inside. The larger specimens have eleven arm spines at the base of the arm.

In these structural characters they differ from *O. teres* in which the upper arm-plates are broken into two or more pieces, the radial shields covered and the mouth shields usually broad and short with a nearly straight outer edge, concave sides and a rounded lobe projecting inwards. The arm spines usually number nine in specimens corresponding in size to those of *O. Panamensis* in which eleven are found.

One of the specimens loaned by the Museum of Comparative Zoology and labeled "Gulf of California," agrees in general character with *O. teres*, but possesses uncovered radial shields. There is also a very young (four-armed) alcoholic specimen in the collection of the Academy in which the radial shields are naked. Mr. Lyman has described the young of *O. teres* as having uncovered radial shields. Prof. Verrill, however, states that this is not the case with the young forms in the museum of Yale College, and I find that the young specimens of *O. teres*, in the collection of the Academy, with the single exception of the specimen above mentioned, have the radial shields granulated as in the adult. These two specimens and those mentioned by Mr. Lyman (Proc. Bost. Soc., vii, p. 257) seem to indicate, nevertheless, that the young occasionally have the radial shields uncovered.

The color of the upper surface of the disk and arms of *O. teres* is of various shades of brown, sometimes speckled with grayish white. In an alcoholic specimen from Nicaragua the arms are very irregularly banded with light brown, the outer and inner plates of a dark band being darker than the other plates forming the band.

The darkest variety of *O. teres* closely resembles the darkest variety of *O. Panamensis*. In both forms some of the upper arm-plates of the outer portion of the arm have white markings, which form segments of two broken parallel longitudinal lines, one on each side of the arm. Each segment occupies one or more plates and is separated from the next segment by an also variable number of plates without any such markings.

It will be seen from the above that *O. Panamensis* presents a very great variety of color pattern. This variation is probably due to the wide north and south range of the species, viz: from Panama to California. It is noticeable that the darker varieties are found northwards, the darkest specimens in the collection of the Academy coming from San Diego.

ON PRATINCOLA SALAX VERR. AND ALLIED SPECIES.

BY WITMER STONE.

While engaged in studying the Pratincolas in the Academy's collection, I observed a specimen bearing Verreaux's printed label marked as the type of *Pratincola salax* Verr.* A comparison of this specimen with the description of *P. salax* in Sharpe's Catalogue of the Birds in the British Museum (Vol iv, p. 184), and with the original description (Rev. et. Mag. de Zoöl. 1851, p. 307), led to some interesting results.

P. salax of Sharpe's Catalogue is evidently one of the *P. rubetra* group, with a light-colored throat, while the type specimen now before me belongs to the *P. rubicola* group, with the throat uniformly black, and seems to be identical with *P. sybilla* from Madagascar.

It is curious that the bird described by Sharpe should have been referred to *P. salax* of Verreaux, as the original description distinctly refers to a black-throated bird. Verreaux first describes the bird as black—and then enumerates the parts which are differently colored ("Nigerrima; uropygio, collari interrupto, macula alarum magna interna, abdomine albis; pectore castaneo.") As no special mention is made of the throat it is certainly understood to be black. The more minute description following the Latin diagnosis agrees precisely with the specimen before me, placing its authenticity beyond a doubt.

Verreaux's bird is from the Gaboon, and with the exception of some specimens collected by Du Chaillu at Cape Lopez and River Camma (Cassin, Proc. Phil. Acad., 1859, p. 39) is the only black-throated specimen recorded from this part of Africa. I cannot say whether or not Cassin's determination of these birds was correct, as a careful search through the Academy's collection has failed to discover Du Chaillu's specimens.

The type specimen seems identical both in size and coloration with one of *P. sybilla* from Madagascar and differs from the south African form, *P. torquata*, in its smaller size, narrower bill, and in the chestnut color being confined to the fore part of the breast.

*This bird (No. 722 Acad. Catalogue) together with several others of Verreaux's types, was purchased by Dr. Thos. B. Wilson and presented to the Academy with the rest of the Wilson collection.

P. axillaris Shelly (Proc. Zoöl. Soc., 1884, p. 556), from Mt. Kilimanjaro, seems closely allied to *P. sybilla*, but differs from it in its larger size, black axillaries, and in the diminution of the white on the inner edge of the secondaries beneath.

It may be that a series of Gaboon specimens may show some distinctive race characters, but certainly the form does not differ specifically from the Madagascar bird, and perhaps *P. axillaris* may fall under the same head.

In that case *P. sybilla* would be considered as ranging across all central Africa, *P. salax* representing the western race, typical *P. sybilla* the Madagascar race and *P. axillaris* a mountain form of the same; while on the south the species would be replaced by *P. torquata*.

All the species just mentioned including the white-tailed species *P. hemprichii*, may be distinguished from the group consisting of *P. rubicola*, *P. maura and P. leucura*, by the color of the breast in the males which in the former is dark chestnut and in the latter lighter, orange rufous.

This difference in coloration of the breast seems to correspond with the geographical distribution, the lighter forms being found in Europe and Asia, while the darker are confined to Africa.

The identification of *P. salax* Verr. with *P. sybilla* Linn., leaves the bird described as *P. salax* in Sharpe's catalogue without a name. Although the species is apparently distinct from any described form, nevertheless, as there are no specimens in the Academy collection, and as I have never had an opportunity of examining any, I hesitate to propose a name for it and thereby, perhaps, add to the already complicated synonymy of the genus. The species forming the *P. rubicola* group to which *P. sybilla* belongs may be arranged as follows:

Eur. Asiatic Group. Breast orange rufous:—

No white visible on the tail.

P. rubicola (Linn.)

Europe and Western Asia.

P. maura (Pall) (=*P. indica*, Blyth.)

Asia; range coalescing with that of the former somewhere in the water shed of the Volga (Sharpe.) Several geographical races of this species have been described, but do not seem worthy of specific rank.

Basal portion of tail white for two-thirds of its length.

P. leucura Blyth.

India and Burmese countries.

African group. Breast dark chestnut:—

No white visible on the tail.

P. sybilla (L.) (=*P. salax* Verr.)

Madagascar and Gaboon, perhaps extending across central Africa and exhibiting several geographical races of which the following may be one:

P. axillaris Shelly.

Kilimanjaro.

P. torquata (L.) (=*P. pastor* Voigt.)

South Africa.

Basal portion of the tail white.

P. hemprichii(Ehrenb.)

N. E. Africa, ranging into S. E. Europe (Severtzoff). Of course the two white-tailed species are closely related, and are separated here merely to carry out the geographical division.

NEW AND LITTLE-KNOWN AMERICAN MOLLUSCS. No. 1.

BY HENRY A. PILSBRY.

Under the above title I propose to describe and figure the species of American mollusks, either new to science or imperfectly understood, accumulating from time to time in the collection of this Academy. In this first contribution are presented the results of my study of a number of forms received from various collectors and localities in the Southern States, Mexico, etc.

Holospira elizabethæ Pilsbry. Pl. III, figs. 1 to 5.

Shell imperforated, cylindrical, becoming narrower toward the base, rather solid, white, opaque, the apex flesh-colored; whorls 17 to 22, slightly convex, slightly, irregularly striate near the sutures, nearly smooth in the middle, the last whorl costulate-striate, flesh-tinted beneath, narrower than the preceding whorls, its last half rounded, not carinated beneath, produced forward, expanded toward the peristome; aperture round, truncate above; peristome expanded, thin, continuous, its upper margin slightly sinuous. Spire wider above; terminating in a short flesh-colored cone; apex obtuse, the apical whorl rather large and prominent. Internal column wide above, tapering toward the base, hollow, marked by regularly spaced longitudinal fold-like ridges.

Alt. 21, diam. maj. 5, of penult. whorl 4 mill.

Alt. 15, diam. maj. 5½ of penult. whorl 4½ mill.

Alt. 16, diam. maj. 5½ of penult. whorl 4 mill.

Aperture: alt. 3, diam. 3 mill.

Village of Amula, between Tixtla and Chilapa, State of Guerrero, S. W. Mexico.

Although the proportions of length to diameter are so variable, the aperture is nearly the same size in all of the specimens. The species is decidedly larger than any described *Holospira*. Its nearest allies seem to be H. *Goldii* H. Ad., *H. imbricata* Mart., *H. microstoma* Crosse and Fischer; but I need not here compare these species with *H. elizabethæ*, for they can be separated at a glance. I am indebted to Mr. Herbert H. Smith, the well-known entomologist, for specimens.

The animal is whitish, the whole surface reticulated and granose, the granules elongated, brown. The foot is about 6 mill. in length, 2 mill. broad. The mantle is about central. It is very timid According to Mr. Smith, the species is abundant at the locality given above, although not found in the surrounding country. Like the other species of Holospira it lives upon rocks. Movement upon a horizontal surface is evidently a difficult feat, the heavy shell rolling from side to side in a most embarrassing way; but on the perpendicular sides of a glass jar, Elizabeth's Holospira is quite at home, moving slowly but easily in any direction, the graceful shell always hanging vertically.

Helix (**Microphysa**) **hypolepta** Shuttleworth. Pl. III, figs. 6, 7, 8.

Of this minute form no diagnosis or figures have been published, although the name has been upon the lists for many years. The shell was apparently unknown to Pfeiffer except by the remarks of Shuttleworth, who says under his diagnosis of *H. minuscula* Binn.: "Altera species proxima, sed testa aperte umbilicate, et anfr. ultimo basi devio distincta, in insula Bermuda occurrit, cujus specimina plurima ab am. Bland accepti, atque *H. hypolepta* nominavi."

The shell is minute, discoidal, whitish, subtranslucent and shining, with wrinkles of increment above, nearly smooth beneath. The four whorls are very convex, quite gradually widening, the last one with the periphery above its middle, the lower lateral surfaces sloping somewhat as in *H. vortex* Pfr. The aperture is small, not very oblique, oval. The lip is acute, upper and basal margins quite arcuate, the baso-columellar margin slightly expanded. The umbilicus is broad, more than one-third the diameter of the shell.

Alt. 1, diam. 2¼ mill.

It is evidently allied to *H.* (*Microphysa*) *vortex* Pfr., but is much smaller, flatter, with broader umbilicus. I need not compare *Zonites minusculus* with this shell; a glance at the figures will show at once the difference.

Helix hypolepta. Shuttleworth, Diagnosen neuer Mollusken, no. 6, from the Bern. Mittheil., March, 1854, p. 129.

The group *Microphysa*, in which I have placed this shell has been a stumbling block to most of the authors who have recognized it. It consists of small, umbilicated, thin, hyaline shells, with sharp lip to the lunar-oval aperture, convex whorls and impressed sutures. There is little in all this to separate it from certain forms of *Zonites* (*Z. minusculus*, for example). But the *Zonites* have narrow aculeate marginal teeth to the radula, while these shells, typified by *H. boothiana* Pfr., have the dentition of *Patula*. The marginal teeth are low, wide, with several denticles.

Of course the miscellaneous collection of small Helices under *Microphysa* in Albers-Marten's Die Heliceen should be to some extent dismembered (although most of them are probably true Microphysæ), as well as the genus as constituted by Binney (Terr. Moll. v.), and only the species agreeing in characters of shell and dentition with *H. boothiana*, *H. vortex*, *H. incrustata* etc. be included. This group then, after the elimination of all snails with narrow, thorn-shaped marginal teeth, will comprise about twenty species of West Indian shells. Its relations are probably with *Patula*. The jaw so far as I know is ribbed; but this is a character of secondary importance. *Microphysa* has nothing to do with the *minusculus* group of small *Zonites*. It belongs to a different family.

Zonites dallianus Simpson. Pl. III. figs. 9, 10, 11.

Shell minute, depressed, narrowly umbilicated, fragile, pale straw-colored, somewhat shining; under a lens seen to be marked with delicate growth-lines above, smoother beneath. Spire a little convex; apex subacute; sutures scarcely impressed. Whorls three and one-half, scarcely convex, the last wide. Aperture oblong-lunate, oblique, upper and lower margins sub-parallel, slightly converging; peristome acute.

Alt. 1½, diam. maj. 3, min. 2½ mill.

West Florida, at Shaw's Point, Manatee Co., and Little Sarasota Bay.

Differs from *Z. arboreus* Say in the smaller spire and wider last whorl; fewer whorls; differently shaped aperture. It is about half the size of *Z. arboreus*, and the sculpture is the same as in that species. The *Helix ottonis* of Pfeiffer, of which specimens from Cuba and Hayti are before me, has no special relationship to this species, but is undoubtedly a synonym of *Z. arboreus*, as Pfeiffer himself concluded. *H. ottonis* differs from *arboreus* in nothing but the lighter color; the form and dimensions are precisely as in *arboreus*. (See Pfr. in *Wiegm. Archiv für Naturgeschichte*, 1840, p. 251; the species was never described in the "*Monographia Heliceorum*.")

The aperture in *Z. dallianus* is less lunate than in *Z. arboreus*, embracing less of the penultimate whorl; seen from beneath, the greater portion of the aperture lies outside of the periphery of the penultimate whorl; whilst in *Z. arboreus* the reverse is the case. The much smaller size of *dallianus* also separates it from *Z. arboreus*.

This species was sent me under the above name by Mr. Chas. T. Simpson, the well-known student of Floridan shells. The same form I find in the museum of the Academy, collected by Mr. Henry Hemphill.

Zonites singleyanus Pilsbry. Proc. A. N. S. Philada., 1888, Pl. xvii, figs. M,M,M.

Shell minute, broadly umbilicate, planorboid, the spire scarcely perceptibly exserted; subtranslucent, waxen white, shining, smooth, under a strong lens seen to be slightly wrinkled by growth-lines; whorls three, rather rapidly increasing, separated by well-impressed sutures, convex, the apex rather large; body-whorl depressed, slightly descending, indented below around the umbilicus; aperture small, semilunar, oblique; peristome simple, acute. Umbilicus nearly one-third the diameter of the shell, wide, showing all the whorls.

Alt. 1, diam. 2 mill.

New Braunfels, Comal Co., Texas.

Allied to *Z. minusculus*, but much more depressed, more shining, smoother, smaller, with broader umbilicus and a complete whorl less than *minusculus*.

This species, one of the most distinct of the smaller forms of *Hyalina*, was communicated to me by Mr. J. A. Singley, in whose honor it is named. I have also found a few specimens among the shells collected by myself in central Texas, during the winter of 1885-'86. With *Z. singleyanus* at New Braunfels are found quantities of *Z. minusculus*. The latter species exhibits some variation, being often more depressed than most northern specimen. This depressed form has been noticed in Mexico by Strebel,* who proposes for *Z. minusculus* the new generic title of *Chanomphalus*, which of course is completely synonymous with *Pseudohyalina* Morse, 1864, and this again is not different enough from Hyalina to warrant the erection of a new genus or sub-genus. There is some variation in the width of the umbilicus in Texan specimens of *Z. minusculus*, but I have not seen specimens with it so wide as Dr. Dall indicates for his var. *alachuana*, from Florida. *H. elegantulus* Pfr. is about the size and form of my *Zonites singleyanus*, but it is a strongly sculptured species.

It may not be out of place here to note the fact that the *Helix* (*Polygyra*) *hippocrepis* Pfr. has been rediscovered by Mr. Singley, near New Braunfels; as typical examples sent me attest. This species has been heretofore known by but one specimen in America

* Vide Beitrag zur Kenntniss der Fauna mexikanischer Land und Süsswasser Conchylien, Theil iv, p. 19, pl. iv, fig. 10. (1880.)

as far as I am aware. The shell exhibits a type of aperture complications different from any other species of *Polygyra*.

Pœcilozonites reinianus Pfr. var. **goodei** Pilsbry. Pl. III, figs. 12 and 13.

This form is similar in coloration and texture to *P. reinianus*. It is more broadly umbilicated, planorboid, the spire flat, or even sub-immersed; whorls six.

Alt. 3, diam, 10 mill.

Among the Bermudan shells sent to Prof. Heilprin from the U. S. Nat. Mus., were a number of this variety, which seems to me distinct enough for a name. The types of the variety are No. 94,424 of the National Museum register. Collected by G. Browne Goode.

Pœcilozonites bermudensis Pfr.

The result of my dissection of this species was a surprise to me, for I had expected the same form of genitalia found in *Zonites*. The genitalia are figured on plate xvii of the Proceedings of this Academy for 1888, figs. N, O. The penis (p.) is rather short, *convoluted*, thick, the vas deferens inserted at its termination, is rather short. The cloaca is large, wide; below the penis there is a long club-shaped sac (d.), its base dilated where it enters the cloaca. This is probably a dart-sack, although the specimens examined by me contained no dart. On the penis near its base arises a duct (d.), which uniting with another (d.) arising opposite the penis, is continued into a long duct coiled around the vagina, and ends in a small oval bulb, the receptaculum seminis or spermatheca (sp.). The way it is coiled around the vagina is shown also in fig. O, which represents another specimen. The albumen gland, etc. offer no unusual characters. I did not dissect out the ovo-testis. My specimens were quite hard, having been in strong spirit.

The connection of the duct of the spermatheca with the penis is unique as far as I know, in the Pulmonata, and suggests the probability of self-impregnation.

Mr. W. G. Binney has kindly called my attention to his note upon the dentition and jaw of H. bermudensis and the dentition of H. circumfirmata in the Ann. N. Y. Acad. Sci., iii, p. 86, 105. The first species is placed by him with doubt in *Zonites* with the remark that "it seems to belong to no described genus." H. circumfirmata is left in *Microphysa*, for want of a better place, but Mr. Binney points out the fact that the species belongs to the *Vitrinea* rather than to the *Helicea*.

Mr. Mazyck, of Charleston, S. C., has also published a note upon H. bermudensis, since my own paper was issued, and I am indebted to him for a copy of it. H. bermudensis is recognized by Mazyck as the type of a new genus, *Juno*, which of course becomes a synonym of *Pœcilozonites*.

Mr. C. F. Ancey has likewise bestowed a subgeneric name upon H. bermudensis; and I suppose that for some years to come we will have an annual harvest of "genera" for one or another member of this little group! I would suggest that *P. circumfirmatus* or *P. reinianus* be selected as "types" for future "genera," as the synonymy of *bermudensis* is becoming inconveniently cumbersome!

The synonymy of *Pœcilozonites* is as follows:

Helix Pfeiffer, Monographia Heliceorum Viventium i, p. 188, and of most authors.

Hyalinia Pfeiffer-Clessin, Nomenclator Hel. Viv. p. 69. 1881.

Hyalosagda Pfeiffer-Clessin, Noment. Hel. Viv. p. 75.

Sagda (*Hyalosagda*) Tryon, Manual of Conchology, 2d series, iii, p. 9.

Trochomorpha Albers, Die Heliceen, 1850, p. 116.

Caracolus Albers-Martens, Die Heliceen, 1860, p. 156.

Zonites? and *Microphysa?* W. G. Binney, Ann. N. Y. Acad. Sci. iii, p. 86, 105.

Pœcilozonites Böttger, Jahrb. f. Min. Geol. u. Paleont. 1884, ii Bd., p. 139.

Pœcilozonites ("Sandb") Tryon, Manual of Conchology, 2d series, iii, p. 19, 95.

Bermudia Ancey, Conchologists' Exchange, i, p. 53, 1887.

Juno Mazyck, Proc. Elliott Soc. Nat. Hist., 1888, p. 210 (issued Mar. 19, 1889).

Pœcilozonites Pilsbry, Proc. Phila. Acad. Nat. Sci. 1888, p. 285.

H. bermudensis Pfr. is the type of the three genera—*Pœcilozonites*, *Bermudia* and *Juno*.

Bythinella æquicostata Pilsbry. Pl. III, fig. 16.

Shell sub-imperforate, narrow, elongated, composed of about $6\frac{1}{2}$ very convex whorls, separated by profound sutures; the spire is long, tapering, a trifle obtuse at the apex. The color is corneo-olivaceous; the whorls are slightly marked by delicate growth-lines. The spire has longitudinal low, fold-like ribs, which are sometimes nearly obsolete upon the body-whorl. Aperture oval or somewhat quadrate in outline, less than one-third the length of the shell; peristome thin, acute, continuous, but closely adnate on the parietal wall above the sub-perforate umbilicus; columella slightly folded.

Alt. 5–6, diam. 2 mill.

Sumter Co. and Haulover Canal, at the head of Indian River, Fla.

This shell is similar to the form of *B. nickliniana* called *B. attenuata* Hald. in shape. It is distinguished by the low folds of the surface. When these are well developed the shell has somewhat the aspect of a tiny *Goniobasis plicifera* Lea. Mr. John Campbell of Germantown, Pa., presented me with numerous specimens from the locality last named. The apex is frequently eroded, as in most Floridan fresh-water shells. The folds of the surface are a unique character in American Bythinellæ, but I do not doubt that it belongs to this genus. I have seen specimens of *Tryonia* very similar to the *B. æquicostata*, but usually Tryonia is more strongly ribbed. I think it likely that this is the same form that was dredged by Professor Heilprin in Lake Okeechobee.*

Hydrobia monroensis Frauenfeld. pl. III, figs. 17, 18, 19.

My attention was first called to Frauenfeld's descriptions of Floridan Rissoidæ when engaged in identifying a number of species sent me by Mr. C. T. Simpson. About that time Dr. Dall published descriptions of several Floridan Rissoids,† among them one which he called *Bythinella monroensis;* writing under it as a doubtful synonym *Hy. monroensis* Frauenfeld. Upon looking over the Academy collection I found a specimen of *H. monroensis* marked by Frauenfeld himself, and sent by him to Mr. Tryon many years ago. This specimen is drawn in fig. 17 of pl. iii, and corresponds exactly with Frauenfeld's description, which is as follows:

"Eine Verwandte von jamaicensis Ad. oder cristallina [*sic*] Pfr. durch mehr oder minder gerandete Naht unterschieden. Schale keglich, nicht sehr stark, graugrün, ölglänzend. 5½ Windungen, *leicht gewölbt, Naht gerandet. Mündung länglich, nach unten stark vorgezogen, oben etwas gewinkelt,* Saum nicht scharf, *an der Windung lang angelegt.* Nabelspalte fein. Länge 3.8 mill., Breite 2.1 mill."

All of Frauenfeld's specimens were from Lake Monroe.

Note in this description the passages which I have italicized, and which agree perfectly with the shells I have figured, but not at all with Dr. Dall's species, which is quite a distinct form.

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*Explorations on the West Coast of Florida, etc. Trans. Wagner Free Inst. i, 1887, p. 42.

†Proc. U. S. Nat. Mus. viii, 1885, p. 256, *et seq.*

The synonymy is as follows:

Hydrobia monroensis Frauenfeld, Verh. der k. k. zool-bot Gesell. Wien, 1863, p. 1023.

Bythinella monroensis (Frau.) Tryon, Continuation of Haldeman's Monog. Fresh-water univalve Moll. U. S., p. 48.

Not *B. monroensis* Dall, Proc. U. S. Nat. Mus. viii, 1885, p. 256, pl. xvii, fig. 9.

Figures 18 and 19 of the plate are drawn from specimens collected by Mr. C. T. Simpson in Hillsborough River, W. Florida. I have also seen specimens from Florida Springs, Fla.

Amnicola peracuta Pilsbry & Walker. Pl. III fig. 20.

Shell ovate-conoidal, rather thin, narrowly perforate, light olivaceous or a little tinged with yellowish, quite smooth, somewhat shining. Whorls about 5, or a trifle less, convex, the sutures well-impressed. The spire is rather slender, acute at the apex. Aperture about one-half the total length of the shell or a little less, ovate, angular above, broadly rounded beneath; peristome adnate to the whorl above the umbilicus.

Alt. 4, diam 2.8 mill.

Spivey's Lake, Navarro Co., Texas.

This species is most nearly allied to *A. cincinnatiensis* Anth., but is smaller, more slender, more narrowly perforate, the whorls, especially the last, less convex, more sloping above. The spire of *A. peracuta* is longer, the peristome is adherent to the body-whorl for a greater distance, and is not thickened within. The peculiar dentition of A. cincinnatiensis is shared by this species.

The types were collected by Mr. G. C. Heron, and sent me by Mr. Bryant Walker of Detroit, Mich., under the above mss. name. I have received the same shell from Comal Co., collected by Mr. Singley.

Sphærium (Limosina) singleyi Pilsbry. Pl. III, figs. 14, 15.

This is a small species allied to S. meridionale, S. maculatum, S. cubense, etc. The shell is small, inequilateral, wide and truncate posteriorly, narrower and rounded anteriorly, ventral margin gently curved, the hinge line curved a little less than the lower outline; beaks small, not calyculate. Surface shining, striatulate. Color corneous yellow, variegated with large and small irregular maculations of blackish-brown. The blotches seem to be composed of close clusters of dots.

Length 5, alt. (at the beaks) $3\frac{1}{2}$, diam. 2 mill.

Cedar Creek, Hudson Co. (G. C. Heron) and Guadalupe River, Comal Co., Texas. (J. A. Singley.)

The shells from Comal Co. are smaller than the specimen figured, but are precisely the same in form and coloration. *S. cubense* is a differently-proportioned shell, its valves are more convex, and the dark spots are small.

S. meridionale and *S. maculatum* have similar large color-blotches, but they are both decidedly larger species and differ from *S. singleyi* in outline. This is the first species of the group *Limosina* which has been found within the borders of the United States.

April 9.

Dr. W. S. W. Ruschenberger in the chair.

Thirty-one persons present.

The death of Prof. M. C. Chevreul, a correspondent, was announced.

The following was ordered to be printed :—

NEW SPECIES OF SHELLS FROM NEW HEBRIDES.

BY W. D. HARTMAN, M. D.

Charis bicolor, Nobis. Pl. V, fig. 1, 1 a.

Shell ovate, rather thin, translucent, smooth, lines of growth fine; whorls $4\frac{1}{2}$, strongly convex, the last ovate and much inflated; spire short conoid, of a red saffron color; body-whorl a soiled white, with traces of a brown epidermis; aperture ovate, direct; labium reflected and thickened; a heavy deposit on the columella with a broad fold over the umbilicus, but not concealing it; labium a dull silvery white or red for one-fourth of an inch within the aperture, which is white.

Alt. 31 to 41, diam. 19; aperture, alt. 20, breadth 11 mill.

Habitat, Aura Island, N. Hebrides.

E. L. Layard, Esqr.

Obs. This species is near *C. ochrostomus* Garrett. All examples received thus far are weatherbeaten.

Charis Rossiteri, Nobis. Pl. V, fig. 2, 2 a.

Shell acutely ovate, thin and translucent; whorls $4\frac{1}{2}$, convex, the last elongate-ovate; apical whorls acute, the first $2\frac{1}{2}$ of a reddish, saffron color; epidermis brown fugacious, with darker striations; body-whorl white beneath the epidermis; aperture ovate, direct, white; labium thin and reflected, with a slight deposit on the columella and a broad fold over the compressed umbilicus, but not concealing it.

Alt. 38, diam. 16; aperture, alt. 20, breadth 9 mill.

Habitat, Aura Island, N. Hebrides.

E. L. Layard, Esqr.

Obs. A smaller species than the preceding.

Oxychona Layardi, Nobis. Pl. V, fig. 3.

Shell acutely conical, imperforate; whorls 7, the four apical whorls slightly rounded, translucent and a pale reddish color; lower whorls flat, the last acutely carinate at the periphery; labium simple and slightly reflected, with an acute notch at the outer margin; aperture subquadrate, of a pale color; color white, with flecks and zigzagged lines of gray; two black thread-like lines with a brown one between on the basal carina, extending to the third whorl, and visible within the aperture; color of the base a dusky white, with numerous radii of a darker color, extending from the closed unbilicus to the periphery.

Alt. 16, diam. 16; aperture, alt. 4, breadth 7 mill.

Habitat, Aura Island, N. Hebrides.

Obs. I have much pleasure in dedicating this beautiful and unique species to H. B. M. Consul, E. L. Layard, Esqr., of Noumea, N. Caledonia, to whom conchologists are indebted, for many new species from various sections of the world.

Melania Auroriana, Nobis. Pl. V, fig. 4.

Shell thick, very elongate, ovate conic, decollate; whorls 10 or more, smooth and slightly convex; body whorl somewhat inflated; a few sparse revolving striæ at the base, often continued to the apex; color dark olivaceous, lighter at the apex; aperture white, ovate, round at base and expanded, a heavy white deposit on the pillar lip. Operele black, thick, with the polar point very near the base.

Alt. 56, diam. 14; aperture, alt. 18, breadth 9½ mill.

Habitat, Aurora Island, N. Hebrides.

From E. L. Layard, Esqr.

Melania Schmacheri, Nobis. Pl. V, fig. 5.

Shell attenuately conical, rather thick, color dark greenish, lighter at the suture, decollate; whorls probably 8 or 9, all but the two lower with elevated longitudinal ribs, which are decussated by impressed spiral striae, giving the surface a granulated appearance; the two lower whorls have the incised spiral striae continued from the base with the interspaces smooth; outer lip sharp and sinuous; columella with a narrow white deposit and a moderately twisted aperture, oval, white; opercle sub-triangular, corneous, chestnut brown, with the polar point near the base.

H. 43, W. 15, apt. 17, W. apt. 15 mill.

Hab. Hamma Island, near Hong-Kong, China.

This shell was sent me for *M. crenularis* Desh. by Mr. Schmacher. It is a smaller shell than *crenularis* which is from the Philippines, but resembles it somewhat in sculpture.

Diplomorpha Brazieri, Nobis. Pl. V, fig. 6.

Shell dexal, thin, abbreviately ovate; whorls 4, rounded; body whorl inflated, more than half the length; suture well impressed; umbilicus open; aperture perpendicular, ovate; lip slightly reflected; apex and aperture reddish orange; surface with coarse longitudinal striae; epidermis absent, H. 19, W. 12, apt. 14, D. apt. 9 mill., Hab. Aura. Island, E. L. Layard, Esqr.

Obs. Certainly distinct from *D. de Latouri* from the same Island. All examples received are destitute of epidermis.

Trochomorpha convexa, Nobis. Pl. V. fig. 7.

Shell sub-lenticular, thin, very convex above; whorls six, convex above and beneath, acutely carinate, finely and transversely striate; base smooth; umbilicus perspective one-sixth the diameter of the shell; aperture oblique; peritreme simple; color reddish brown with a narrow darker line on the carina; H. 7, D. 12½, H. apt. 2½, D. apt. 6 mill. Hab. Aura Island, New Hebrides, E. L. Layard.

Obs. A more stout, convex shell, with more whorls than *T. rubens* from the same Island.

Helicina Bourailensis, Nobis. Pl. V. fig. 8.

Shell thin and translucent, depressly conoid; base convex; spire subacute; whorls 5, striate with fine oblique lines of growth, which are decussated by strong-spiral striae; suture linear, impressed; basal callus white, thin, and minutely foveate; aperture sub-ovate, very oblique; peritreme augulated at its junction with the short columella; outer lip slightly thickened; suborbicular; color a pale yellow or reddish; color of the aperture partaking of the color of the shell.

Height 3, diam 5 mill.

Hab. Bourail Island, N. Caledonia. E. L. Layard, Esqr.

Helicina Nehoueensis, Nobis. Pl. V. fig. 9.

Shell thin, polished, depressly conoid, convex beneath; spire subacute; whorls 5; lines of growth fine, decussated above and beneath by very fine interrupted spiral striae, in V-shaped fasciculi; suture linear, impressed; aperture sub-oval, very oblique, of a reddish color; lip white, thin and slightly reflected; peritreme augulated with the short columella; color pale reddish brown, darker beneath; callous thin, silvery white and corrugated. Height 2½ to 4, wide, 4 to 6 mill.

Hab. Nehoue, New Caledonia.

E. L. Layard, Esqr.

Helicina Saxoniana, Nobis. Pl. V, fig. 10.

Shell thin, depressed conoid, convex beneath; whorls 4, rounded above; suture impressed; lines of growth regular, parallel and very fine, which are decussated by interrupted spiral striae; spire subacute; aperture sub-triangular, oblique, pale reddish; lip thin, white and foveate; callous thin, white; peristome angulated at its junction with the short columella; color reddish brown. Opercle sub-triangular, reddish

Height 3, wide 5, mill.

Hab. West Coast, N. Caledonia.

Obs. Mr. Saxon, per E. L. Layard, Esqr.

Another example marked No. 1, *Chalcei,* N. Caledonia, is probably the same species.

APRIL 16.

The President, Dr. JOSEPH LEIDY, in the chair.

Thirty-four persons present.

The following papers were presented for publication :—

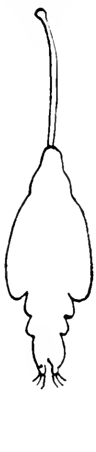
"A contribution to the Spider fauna of the Bermuda Islands," by Dr. Geo. Marx.

"Notes on a small collection of Myriapods from the Bermuda Islands," by Charles H. Bollman.

"A contribution to the Actinology of the Bermudas," by J. Playfair McMurrich, Ph. D.

"On some new species of Mollusca from the Bermuda Islands," by Angelo Heilprin.

A Parasitic Copepod.—Prof. LEIDY remarked that last summer while at Beach Haven, N. J., there was brought to him from the surf a living specimen of the singular, transparent fish *Leptocephalus*. In examining it he observed attached to the tail-fin a minute copepod crustacean, apparently of the genus *Chalimus*. The parasite was attached by a long filiform rostrum and resembled in this and other respects more the *Chalimus scomberi*, as represented by Baird, in fig. 5, tab. xxxiii, of the British Entomostraca, than it does the original of this species as represented by Burmeister in the Nova Acta N. C. of Bonn, xvii, tab. 23, fig. 13. The species which may be distinguished as *Chalimus tenuis* is considerably less than half the size of *C. scomberi*. The cephalothorax nearly twice the length of the breadth, is obcordate and proportionately much narrower than in the latter species. The frontal segment is narrow and not prominent laterally, and the biarticulate antennae are concealed beneath. The abdomen, half the length of the cephalothorax, exhibits three conspicuous divisions, and the short caudal appendages end in three minute setae. Abdominal feet ending in biramous leaf-like segments fringed with short setae. Rostrum linear and almost as long as the cephalothorax. Whole length 1.125 mm; length of cephalothorax 0.5 mm; breadth 0.275; length of rostrum 10.5; length of abdomen 0.25 mm.



The accompanying outline represents the animal magnified forty-four diameters.

APRIL 23.

The President, Dr. JOSEPH LEIDY, in the chair.

Twenty-two persons present.

A paper entitled "On a new genus and two new species of Ophiurans," by J. E. Ives, was presented for publication.

Fossil Vertebrates from Florida.—Dr. LEIDY exhibited some remains of *Zeuglodon* recently obtained by Mr. Joseph Willcox, from a quarry of nummulitic limestone, near Ocala, Marion Co., Florida. They consist of a portion of the mandible with the mutilated remains of two two-fanged molars, embedded in a mass of the limestone, portions of several vertebrae and the crown of an anterior tooth. They pertain to a large but immature animal, probably the *Z. cetoides* In a crevice of the same quarry there was found an accumulation of bones of quaternary age. Among those preserved and obtained by Mr. Willcox, was the skull of the Machairodus described a few weeks ago, a number of teeth of a horse, the tooth of a llama, and a premolar of the *Elephas columbi.*

While in Florida Mr. Willcox, with his friend Wm. M. Meigs, visited Arcadia, on Peace Creek, where, through the kindness of Mr. T. S. Morehead, superintendent of the Phosphate Mining Company, they procured the collection of fossils now exhibited. They mainly consist of the vertebræ of several small cetaceans, many teeth of a horse not differing from those of the domestic animal, fragments of deer antlers, of bones of other animals, and of turtle shells, teeth of sharks, &c. Among them are some well-preserved teeth of a tapir, *Tapirus americanus.* On a former occasion, through the Smithsonian Institution, from the Peace Creek locality, a collection was received chiefly consisting of remains of a huge turtle and molar teeth and the ramus of a mandible with a tooth of the *Elephas columbi.*

A specimen of particular interest in the collection under inspection is a first ungual phalanx or pastern bone of a diminutive three-toed horse *Hippotherium* or *Hipparion.* It accords in size with an upper molar tooth, from Archer, Fl., on which was founded *H. ingenuum*, described in the Proceedings for 1885, p. 33. The bone not much larger and nearly of the proportions of the corresponding joint of our own middle finger indicates an animal of unusually slender build. Since describing the remains from Archer, on which was founded the larger species, *H. plicatile*, in the Proceedings for 1887, p. 309, a pastern bone attributable to it has been received from the same locality. It is actually shorter but of much more robust form than that from Peace Creek, referred to *H. ingenuum.* The comparative measurements of the two pasterns are as follows:—

	H. ingenuum.	*H. plicatile.*
Length of pastern laterally..................	57 mm.	50 mm.
Transverse width of proximal extremity	24 "	34 "
" " distal "	19 "	28 "
" " shaft, at middle	15 "	25 "

The specimens of greatest interest in the Peace Creek collection are three osseous plates, attributable to a species of the wonderful giant armadillo, *Glyptodon*. The plates though possessing the usual breadth, do not present the great proportionate thickness common in the South American Glyptodons. They bear a near resemblance to those of *Hoplophorus ornatus*, as represented by Dr. Burmeister in the Annals of the Public Museum of Buenos Ayres, 1870–74, pl. xvii, fig. 3. Two of the plates are hexagonal, the other pentagonal, and their thickness is from a fifth to a fourth of their breadth. The outer surface presents a low discoid eminence reaching to within a couple of lines of the border, feebly depressed concentrically and with a slight eccentric elliptical prominence. It is pitted; more coarsely at the depressed borders, and more thickly and coarsely in the pentagonal than in the hexagonal plates. The inner surface is concave and even; the borders are tubercular.

The largest hexagonal plate is 26 lines in its widest and 18 lines in its shortest diameter, and is from 4 to 5 lines thick. The pentagonal plate is 22 lines where widest and from 3 to 5½ lines thick. The species represented by the plates may be distinguished as the GLYPTODON SEPTENTRIONALIS.

Among the fragments of turtle shells is the nuchal plate of a carapace remarkable for its deeply sculptured character, greatly exceeding in this respect the condition observed in any of our recent ones. The areas of the different scutes impressing the plate are traversed by deep valleys and correspondingly prominent ridges. The median length of the plate is 27 lines; its transverse breadth 33 lines. The specimen may be considered as distinctive of a species with the name of EMYS EUGLYPHA.

APRIL 30.

Mr. ISAAC C. MARTINDALE in the chair.

Eighteen members present.

Messrs. Charles E. Redinauer and W. B. Van Lennep, M. D., were elected members.

Max Fürbringer, of Jena, was elected a correspondent.

The following were ordered to be printed:—

A CONTRIBUTION TO THE KNOWLEDGE OF THE SPIDER FAUNA OF THE BERMUDA ISLANDS.

BY DR. GEO. MARX.

Little has been heretofore known of the spider fauna of the Bermudas. Mr. Blackwall described six species in the Ann. and Mag. of Nat. Hist., 1868; and Prof. E. Simon, in speaking of the Arachnida of the Atlantic Islands in the Annales d. l. Soc. Entom. de France, 1883, has none to add to the list of Mr. Blackwall. He, however, alludes to the character of the Bermuda spider fauna as appearing to be related to that of the Azores and the Canary Islands.

Lately, Prof. Angelo Heilprin, of Philadelphia, visited the Bermudas and collected there twelve species, and by his kindness I have been able to study this addition to the spider fauna of that region.

Mr. Blackwall described the following species:

1. *Loxosceles rufescens*, Luc.
2. *Epeira gracilipes*, Blackw.
3. *Xysticus pallidus*, Blackw.
4. *Salticus diversus*, Blackw.
5. *Heteropoda venatoria*, Lin.
6. *Filistata depressa*, Koch.

The collection of Prof. Heilprin contains the following species:

1. *Uloborus Zosis*, Walk.
2. *Nephila clavipes*, Koch.
3. *Epeira caudata*, Hentz.
4. *Epeira labyrinthea*, Hentz.
5. *Theridium tepidariorum*, Koch.
6. *Argyrodes nephilæ*, Taez.
7. *Pholcus tipuloides*, Koch.
8. *Dysdera crocata*, Koch.
9. *Menemerus Paykullii*, Aud.
10. *Menemerus melanognathus*, Luc.
11. *Heteropoda venatoria*, Lin.
12. *Lycosa atlantica*, nov. spec.

Loxosceles rufescens, Luc., has been found in the West Indies, Central America and Florida.

Heteropoda venatoria, Lin., seems to occur, under a certain latitude, everywhere around the globe.*

Filistata depressa, synonymous (according to Simon) with *Filistata capitata*, Hentz, is quite common in the southern part of the United States.

Uloborus Zosis, Walk., is recorded from the West India Islands, Central and South America, and occurs also sometimes in Southern Florida.

Nephila clavipes, Koch, found in Brazil, Central America and Florida, Texas, Mississippi.

Eperia caudata, Hentz, inhabits the United States from Massachusetts to Georgia.

Epeira labyrinthea, Hentz, is also common in the United States, and has been collected in the West Indies, Central and South America, as far south as the Straits of Magellan, and in Lower and Upper California.

Theridium tepidariorum, Koch, is common to Europe and America.

Argyrodes nephilæ, reported from Peru, Cayenne and the southern states of the United States.

Pholcus tipuloides, Koch, has been described by this author in his work, "Die Arachniden Australiens," page 281, from specimens collected at the Samoa Islands.

Dysdera crocata, Koch, is recorded from Greece, France and Germany, and is also common in the United States.

Menemerus Paykullii, Aud., and *Menemerus melanognathus*, Luc., have been found nearly everywhere on the globe.

From this material it is difficult to infer the true character of the fauna of these Islands. The frequent arrival of vessels from many foreign ports, the drift of the Gulf Stream, and other causes, have introduced into this region a number of species originally foreign to that locality, but which, in time, not only have acclimatized themselves, but have, in a more or less marked degree, driven away and extinguished the indigenous spider fauna.

This fact has been noticed in all localities open to the importation of a foreign element. These species are then called *cosmopolitan*, and by far the greatest number of those brought to notice by Mr. Blackwall and Prof. Heilprin bear this character; but drawing

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* See an article by Rev. H. C. McCook, in Proceed. of Academy of Nat. Sc. Philad., 1878.

a superficial conclusion from this material it seems that the spider fauna of the Bermudas is more American than anything else, for out of the seventeen species now known, only four are original (so far) to these Islands and nine are found also in the limits of the United States.

Lycosa atlantica, nov. spec.

Cephalothorax dark olivaceous brown, with a narrow, longitudinal yellow band over the middle, which begins at the posterior margin and runs over the whole length into the region of the first eye row. Another, equally colored, but somewhat broader band runs at the sides, above the lateral margin, terminating at the sides of the pars cephalica. Mandibles dark brown with long, thick and black pubescence. Maxillæ and labium more reddish brown; sternum lighter, olivaceous yellow with a lighter border, hairy. Palpi and legs uniformly light olivaceous yellow, with black hairs and without rings or markings, tarsal joints of the former infuscated. Abdomen: dorsum dark olivaceous brown with a narrow, whitish slightly spear-shaped figure, which is edged by a very narrow blackish line; behind this a row of four rather indistinct white small round spots which reach the apex. Venter light yellow, middle region still lighter.

Cephalothorax as long as patella X, tibia IV; one-third longer than wide; back straight evenly sloping in back and front, face nearly perpendicular. Lower eye row longer than second. Middle eyes of lower row about twice as large as the lateral eyes. Distance between the large eyes of the second row smaller than their diameter; eyes of the third row as large as middle ones of the first row. Mandibles as long as tibia III. Cephalothorax long, 6 mm.; broad, 4·5 in the middle region; in front, 2·2.

Abdomen, long, 6 mm. Mandibles, 2·7.

Femur	I 4	Patella	2	Tibia	3·3	Metatarsus	2·8	Tarsus	2·2	Total,	14·3
"	II 3·8	"	2	"	3	"	2·7	"	2	"	13·5
"	III 3·4	"	1·8	"	2·8	"	3	"	1 5	"	12·5
"	IV 5	"	2·1	"	4	"	5·5	"	2·4	"	19

EXPLANATION OF PLATE IV.

Fig. 1. *Uloborus Zosis*, Walk. Female.

1.a. Abdomen from the side.

1.b. Epigynum.

1.c. Male palpus.

Fig. 2. *Menemerus Paykullii*, Aud.

2.a. Male palpus.
2.b. Epigynum.

Fig. 3. *Menemerus melanognathus*, Luc.
3.a. Male palpus from above.
3.b. Male palpus from below.

Fig. 4. *Lycosa atlantica*, nov. spec., Epigynum.

Fig. 5. *Pholus tipuloides*, Koch.
5.a. frons.
5.b. Epigynum and lungs.

A CONTRIBUTION TO THE ACTINOLOGY OF THE BERMUDAS.

BY J. PLAYFAIR MCMURRICH, PH. D.

I recently received from Professor Heilprin a number of Actinians which he had collected in the summer of 1888, during a visit to the Bermuda Islands. They were entrusted to me for identification and study, and I gladly availed myself of the opportunity thus afforded of comparing the Actinian fauna of the Bermudas with that of the Bahamas, which I had previously studied.* I may state here that, so far as can be judged from the material studied, there is very great similarity between the two faunas, most of the species from the Bermudas occurring also either in the Bahamas or in the West Indian Islands. Unfortunately it was impossible to adopt the best methods of preserving the material obtained in the Bermudas, the expedition to the islands having been undertaken mainly for geological purposes, and consequently the specific relationships of some of the forms could not be determined with perfect certainty.

Tribe HEXACTINIÆ.

Sub-tribe ACTININÆ.

Family SAGARTIDÆ.

1. Aiptasia. sp? (Pl. VI, figs. 1 and 2.)

In the collection were four specimens of a form which I refer to the genus *Aiptasia*, inasmuch as in the majority of respects they resemble forms of that genus, although it was impossible to ascertain the presence of an equatorial row of cinclides owing to the ectoderm having been almost completely macerated away. Nematocysts were quite abundant in the macerated substance contained in the inter- and intra-mesenterial chambers, but it was not possible to be certain that they belonged to acontia though such was probably the case.

The specimens are about 1 cm. in length and 0.65 cm. in diameter. The color as ascertained from the alcoholic material is in the upper one-third of the column and in the tentacles grass-green, while the rest of the column presents the dirty grayish-brown color frequent in alcoholic specimens. About one-third of the way down the col-

*See Journal of Morphology, vol. iii. This paper is now in print and will shortly appear.

umn each specimen presents a well-marked constriction, below which the column is cylindrical, while above it it gradually expands, the disc not being at all infolded in contraction. The base is evidently adherent, but in two of the specimens it is much smaller than the column, and is almost covered by the infolding of the column walls over it; this apparently, however, is an abnormal condition. The column is smooth, and no traces of cinclides could be seen as stated above. Sections (Pl. VI, fig. 2) show that the mesoglœa is thin throughout, and that the circular muscles (cm) are only feebly developed. There is a special sphincter (sp) imbedded in the mesoglœa, immediately below the margin, and, though not very powerful, is yet quite apparent. The only species of *Aiptasia* in which such a sphincter has been observed as yet is *A. pallida* of our Eastern coast. Immediately below this the mesoglœal muscular processes which support the circular muscles are weak, but further down they enlarge gradually and form a second sphincter (sp^1) similar to what has been described by R. Hertwig[1] in *Leiotealia nymphœa.* It is to the presence of this lower sphincter that the contraction of the column mentioned above is due.

The tentacles are 48 in number and are arranged in four cycles. They are strongly entacmæous, and are not infolded during contraction. Those of the first cycle measure 1.1 cm, and those of the outermost cycle 0.3 cm. The ectodermal and endodermal muscular processes are present, but do not call for a special description. The disc is flat and the stomatodæum is without well-marked gonidial angles; sections show that the grooves are hardly developed.

The mesenteries are in four cycles. The six pairs of the first cycle are alone perfect; those of the second cycle are shorter but provided with well-developed longitudinal muscles and while neither those of the third nor those of the fourth cycle have the longitudinal muscles, the members of the latter cycle not projecting above the surface of the endoderm. The parieto-basilar muscles seem to be wanting, or at least have no marked mesoglœal processes. The reproductive organs are borne by the mesenteries of the second cycle, and also by those of the first cycle (except the directives) below the internal opening of the stomatodæum. This is the only Sagartid, with the exception of *A. pallida*, in which I have observed reproductive organs on the mesenteries of the first cycle, and it is a case of con-

[1] *R. Hertwig*—Report on the Actiniaria. Zoology of the voyage of H. M. S. Challenger. Vol. vi. Pt. xv, 1882.

siderable importance inasmuch as it necessitates an alteration in the definition of the family Sagartidæ as given by R. Hertwig[1] One of the essentials of the family is that "the principal septa, or septa of the first order, only are perfect and at the same time sterile." The last portion of this statement, though true for the majority of Sagartidæ, fails in the case of the Aiptasiæ mentioned. It is not possible to separate *Aiptasia* from the Sagartidæ; the members of the genus possess acontia, cinclides, the primary mesenteries alone perfect, and a mesodermal muscle in some cases, and these must be considered as the chief characteristics of the family.

As regards the species to which the form under consideration belongs, the probabilities are that it is identical with *A. pallida* of our Eastern coast, since in its anatomical peculiarities it agrees very closely with that form. The impossibility however of ascertaining the coloration, and, what is of much more importance, the occurence and arrangement of the cinclides, have prevented a certain identification and I have preferred to leave the species in doubt.

Family ANTHEADÆ.

2. Condylactis passiflora. Duch. and Mich. (Plate vi, fig. 3.)

Several specimens were obtained of a large form, measuring 3.3-2.3 cm. in height and 2.6-3.8 cm. in diameter when preserved, which resembled in coloration, external characters, and for the most part in internal structure also, the West Indian form *Condylactis passiflora*. In the alcoholic specimens the column is of a brick-red color wherever the ectoderm has been preserved, and the tentacles are grass-green, this color evidently being due to the enormous number of zooxanthellæ contained in the endoderm. Professor Heilprin informs me to the best of his recollection the tentacles in the living specimens were as a rule tipped with crimson. In a separate bottle is a single specimen evidently identical with the others, and accompanying it is a note stating that the column was red and the tentacles brown. This specimen was found freely floating near the surface, but had evidently become detached as its base shows that normally it is an attached form.

The ectoderm having been macerated away, the outer surface of the mesoglœa is exposed to view, and is seen to be divided by fine longitudinal and transverse grooves into small quadrangular areas. These grooves are continued over the limbus upon the surface of

[1] Loc. cit.

the base, the longitudinal grooves there becoming radiating and the transverse ones concentric.

The only character which is markedly different from what occurs in the West Indian specimens of the species is presented by the longitudinal muscles of the mesenteries. The middle portion of a section through the muscle-band presents an appearance quite similar to that to be seen in the West Indian form, and the internal edge is also the same, the long mesogleal processes terminating abruptly, and being followed by smaller processes which extend to the commencement of the reproductive region of the mesentery; but toward the insertion of the mesenteries into the column wall the arrangement is slightly different (Pl. VI, fig. 3). In the Bahama specimens the mesoglœa between the outer edge of the muscle-band and the insertion of the mesentery into the column wall is thin, and the muscle-band gradually thins out externally. In the Bermuda forms, however, the longitudinal muscle begins abruptly, and the mesoglœa external to it is thick with short, stout muscle processes; or, as in the directives, with the muscle cells, instead of appearing to cover processes, presenting rather the appearance of here and there dipping down slightly into the mesoglœa.

It is not probable however that this slight difference is to be regarded as specific, and since in other respects there is almost exact correspondence, the Bermuda forms must be considered identical with those from the Bahamas.

Family PHYLLACTIDÆ.

Some points of considerable importance as regards the characteristic structure of the members of this family have been obtained from the study of the two forms which I include here within it. The family was established by Andres[1] for forms in which the disc is furnished towards the center with simple tentacles and towards the periphery with foliaceous fronds. In one of the forms about to be described the fronds are replaced by short digitiform tentacles arranged in a single cycle, but nevertheless it agrees in other structural points with *Oulactis*, and I have therefore found it necessary to alter the definition of the family, placing importance on internal anatomical structures rather than upon external characteristics.

In the first place in the *Oulactis* about to be described, and in *Diplactis*, as I propose to name the genus to which the form with tentacles

[1] *A. Andres.* Le Attinie. Fauna und Flora des Golfes von Neapel Monographie ix. 1883.

replacing the fronds will be referred, a sphincter of the diffuse type is present, but instead of being situated upon the column wall below the margin, it occurs internal to the margin, between the inner tentacles and the peripheral fronds or tentacles. In *O. flosculifera* from the Bahamas this sphincter was not observed, but was probably overlooked in the single specimen I obtained for study, and none of the preparations which I still possess include the region in which the sphincter should occur. Secondly in the two species of *Oulactis* which I have studied, and in the *Diplactis*, the gonidial grooves are very deep and are prolonged a considerable distance below the inner margin of the stomatodæum; the histological structure also of the ectoderm lining the grooves differs slightly from that of the general surface of the stomatodæum, it is not thrown into folds as it is elsewhere, and the mesoglœa of the grooves is thickened.

I would define the family Phyllactidæ as follows:—Actininæ in which the disc is furnished with simple tentacles towards the center and with a cycle of short digitiform tentacles or more or less foliaceous fronds towards the periphery; a sphincter of the diffuse type occurs upon the inner surface of the disc between the inner tentacles and the outer tentacles or fronds: and the stomatodæum is provided with two deep gonidial grooves which are prolonged some distance below the inner extremity of the stomatodæum.

The family Phyllactidæ was placed by Andres in the suborder (family) Stichodactylinæ, the fronds being considered homologous with tentacles. I have here ventured to remove the family to the suborder Actininæ, and it will be necessary to furnish my reasons for such a change. The tentacles must necessarily be considered outgrowths of the disc, since structurally they resemble it closely while differing greatly from the column. Are the fronds also disc structures?

The question turns upon what we shall consider to be the limit between the disc and the column. The majority of authors have taken a more or less distinct fold of the body wall, the margin, frequently furnished with conspicuous acrorhagi, to be the boundary, and certainly in many cases there seems to be a marked difference on either side of this fold. Thus the column may, as in *Bunodes* and *Phymactis*, be tuberculated as far as the margin, but beyond this the tubercles cease, and there is apparently a decided difference between the region below and that above the limiting fold.

In the Sagartidæ and Paractidæ there is imbedded in the column wall below the margin a sphincter muscle. In other forms, however, such as the Bunodidæ, which possess a circumscribed endodermal sphincter, that structure lies internal to the margin. If we assume with the Hertwigs that the sphincter is a columnar structure its situation in the Bunodidæ would indicate that the margin is not the boundary between the disc and column.

Neither the margin nor the sphincter, however, can be considered the morphological boundary of the disc, since both seem to vary somewhat in position. The true criterion is to be found in the difference of histological structure presented by the disc and column ectoderm. This layer in the disc possesses ectodermal muscle-cells and a nerve-layer, which structures are absent in the column. The tentacles resembling the disc in structure are to be considered outgrowths of that region, and passing outward from these one finds that the characteristic structures of the disc gradually fade out and are lost. It is impossible to say just where the change is completed, but the region in which it occurs must be considered the boundary between the disc and column. In *Bunodes tæniatus* and *Aulactinia stelloides* I find that the sphincter muscles lie beneath the outer border of this indifferent region, and are consequently to be regarded as columnar structures.

In the Phyllactidæ the sphincter muscle lies between the tentacles and the fronds, and although the ectoderm in the region in which it occurred, and in the area between the fronds or their representatives and the margin was completely macerated away in the forms studied, yet reasoning from the relations of the sphincter in other forms we must conclude that the region between the margin and the base of the tentacles is columnar, and that the fronds and outer digitiform tentacles are column structures perhaps comparable to acrorhagi, and cannot be considered homologous with tentacles. Accordingly only one tentacle belongs to each intra-mesenterial space, and the Phyllactidæ must be referred to the sub-order Actininæ.

Andres in the introduction to his Monograph, notes the fact that the margin does not always mark the boundary between the disc and the column. He proposes the term "collar" to denote the portion of the column internal to the margin. Gosse's term "fosse" is not applicable in all cases, as for instance in *Condylactis* where the region does not form a depression, but is horizontal.

3. **Oulactis fasciculata.** n. sp. (Pl. VI, fig. 5.)

By this name I denote three specimens in various degrees of contraction, the largest of which measured about 1 cm. in height and 1-2 cm. in breadth. The color, as ascertained from alcoholic specimens, is in the lower part of the column a grayish-brown similar to what is frequently seen in preserved Actininæ, while the upper part of the column and the fronds are of a grass-green, the tentacles resembling somewhat the lower part of the column, but having a distinctly greenish tinge.

The column is provided in its upper part with about 48 vertical series of tubercles, probably verrucæ, there being about five or six in each series, and is thrown into numerous transverse folds the result of contraction. The mesoglœa, when exposed, appears to be raised into numerous minute elevations, whereby the surface acquires a finely punctured appearance.

The tentacles are moderately long, simple and pointed at the extremity. They appear to be arranged in two cycles, and from a necessarily uncertain count I estimate their number to be about forty-eight. Their ectodermal longitudinal muscle layer is well developed, being arranged on long slender mesoglœal processes. The fronds (Pl. VI, fig. 5, fr.) are small, yet occupy the entire width of the area between the tentacles and the apparent margin. They consist of hollow evaginations of the disc, arranged in bunches. I could not determine with certainty their number in any of the specimens, but there are probably twenty-four of them in all. A well-defined margin is present.

Immediately external to the bases of the tentacles, and lying between them and the fronds there is an endodermal sphincter (sp.) fairly well developed. Immediately external to it, in the region occupied by the fronds and for a slight distance down the column-wall below the margin, there are no muscle processes, but further down they do occur, forming what might be termed a second sphincter, though it is by no means well developed. The surface of the disc between the tentacles and the mouth is deeply depressed so that a fosse is formed around the peristome. The mouth is large. Sections show that over the general surface of the stomatodæum the mesoglœa is very thin, and upon the ectodermal surface gives rise to numerous more or less regularly arranged fine processes over which the ectoderm passes so as to be thrown into numerous folds. The gonidial grooves are deep, and are prolonged some distance below the rest of the stomatodæum. Its mesoglœa is much thickened, and is devoid of processes upon its ectodermal surface, being thus strongly contrasted with that of the stomatodæum. In its histology the ectoderm of the groove also differs from that of the general stomatodæum, the glandular cells being evidently fewer in number, but the preservation of the specimens was not sufficiently perfect to permit the details to be made out.

There are altogether twenty-four pairs of mesenteries, twelve of which are perfect. The six primary pairs are united with the stomatodæum to a greater extent than are the six secondaries, and the two pairs of directives have a much more extensive union than any of the other primary mesenteries, owing to the great prolongation of the gonidial grooves. The longitudinal muscle processes form a strongly projecting though rather narrow band, the edges of which are sharply defined, the processes being of equal length throughout the muscular area and diminishing abruptly towards the sides. The mesoglœa of the portion of the mesenteries external to the muscle bands is rather thick, and there is a strong parieto-basilar muscle. Apparently only the mesenteries of the third cycle, *i. e.* the imperfect mesenteries, are gonophoric, but my preparations do not allow of certainty on this point.

A few remarks are called for concerning the relationships of this species. I was at first tempted to identify it with *O. formosa*[1] but further consideration led me to separate it as a new species. The fronds differ markedly from those of other species of *Oulactis*. In these they have been described as being "*chicoracés*," a term which cannot be applied to the fronds of *O. fasciculata*. In it they consist of bunches of finger or club-shaped hollow processes, the various processes of each bunch being united by their base but distinct above. This arrangement suggested the specific term which I have employed, and I think is of sufficient importance to warrant the formation of a new species. It was a question whether a new genus should be instituted as Verrill[2] has done in the case of *Lophactis ornata*, but there is such close agreement with the Bahaman *O. flosculifera* as regards the internal structure, the number of perfect mesenteries, and the distribution upon the mesenteries of the reproductive

1 *Duchassaing* and *Michelotti*—Mem. Reale Accademia di Torino. 2nd Ser. xix, 1860 and xxiii, 1866.

2 *Verrill A. E.*—Trans. Conn. Acad. Vol. i, 1868.

organs that such a proceeding was considered unnecessary. It seems probable that the genus *Lophactis* should be fused with *Oulactis.*

DIPLACTIS. Gen. nov.

I propose this generic name for two species, one of which is described below, which do not seem to be referable to any of the genera now recognized. The genus may be briefly defined as follows:—Phyllactidæ in which the fronds are represented by a single cycle of short digitiform tentacles and in which all the mesenteries except those of the first cycle are gonophoric. The term *Diplactis* has been chosen as indicating the tentacular appearance of the fronds, from which it seems as if there were two series of tentacles, an inner and an outer (*diplous*, double and *aktis*, a ray).

In the Supplementary Report on the Actiniaria collected by the "Challenger," R. Hertwig describes a form whose locality is unknown, which he refers to Gosse's genus *Hormathia.* It is very similar to the form about to be described from the Bermudas, and there can be no doubt that though specifically distinct the two must be referred to the same genus. Gosse's *Hormathia*[1] was described from a single specimen brought up on a deep-sea fishing line, and attached to the shell of a living *Fusus.* It was characterized by possessing slightly below the margin about ten spherical protrusions. I do not think it is possible to associate in the same genus with this either the Bermuda *Diplactis* or Hertwig's *Hormathia.* In the first place in both these forms the bodies near the margin are digitiform and not spherical; and secondly, these bodies are situated not below the margin but internal to it. In all the Bermuda specimens, of which there are quite a large number, a well-marked margin is present and Hertwig describes in his form a fold of the column-wall which must be considered equivalent to the margin of the other species. Although the margin cannot be considered of importance as marking the boundary of the disc, yet it is a structure of frequent occurrence and must be taken account of. Structures that occur on the column-wall below it, as in *Hormathia*, cannot be considered identical for systematic purposes with others which invariably lie above or internal to it, and are not quite similar in form.

It must be noticed that Haddon has recently referred to Gosse's *Hormathia* a form[2] altogether different from that assigned to it by

[1] *P. H. Gosse.* Actinologia Britannica. London. 1860.

[2] *A. C. Haddon.*—On two species of Actiniæ from the Mergui Archipelago.—Journ. Linn. Soc. Vol. XXI. 1888.

Hertwig. The correctness of Haddon's identification is quite as doubtful as Hertwig's, if not a little more so. The form is certainly a Sagartid and probably a *Phellia*, it being stated that it is very similar to Hertwig's *Phellia pectinata*.

Hertwig refers his *Diplactis* (*Hormathia*) *delicatula* to the family *Antheadæ*, on account of the diffuse endodermal nature of the sphincter. The situation of the muscle and other characters make it evident that *Diplactis* should be associated in the same family with *Oulactis*. In the Phyllactidæ as here limited we have several grades of complication of the fronds. In *Diplactis* their structure is exceedingly simple, being simply digitiform in *D. bermudensis* and club-shaped in *D. delicatula*. In *O. fasciculata* they are somewhat more complicated, and from this the passage is easy to Verrill's *O.* (*Lophactis*) *ornata*, and from this to the very complicated structure seen in *O. flosculifera*.

4. **Diplactis bermudensis**, n. sp. (Pl. VI, figs. 4 and 6, Pl. VII, figs. 1 and 2.)

A number of specimens of the form for which I propose this name were obtained. The majority were in a partially contracted condition, but apparently the power of contraction is not fully developed as in none were the tentacles completely concealed. The average height of the specimens is about 1·5 cm. and the breadth nearly the same, and thus *D. bermudensis* is decidedly smaller than *D. delicatula*. The ectoderm has been almost entirely macerated away, so that the external surface of the mesoglœa is exposed to view. This presents numerous transverse folds due to contraction, but in addition fine linear depressed striæ are present, both horizontal and longitudinal, dividing the surface into numerous rows of small quadrangular elevations visible to the unaided eye. The color throughout is a dirty-green.

The base is adherent, flat, and about the same size as the column. It is marked by radiating and concentric striæ, continuations of the longitudinal and horizontal striæ respectively of the column. No verrucæ or tubercles occur on the column, though the quadrangular areas produced by the striæ are slightly more prominent toward the margin. This is well marked and smooth, and is separated from the tentacles by a deep fosse (collar) near the bottom of which are about 12 short digitiform fronds about 1 mm. in height. (Pl. VI, fig. 4p, and Pl. VII, fig. 1.)

Between these fronds and the tentacles there is upon the endodermal surface of the collar a sphincter (Pl. VI, fig. 4, sp.) of the diffuse type, which differs markedly in detail from that of *D. delicatula*, the mesoglœal, processes being much more delicate and anastomosing somewhat in their proximal portions (Pl. VII, fig. 2). The circular muscles of the column wall external to the digitiform fronds are fairly prominent, and are continued the entire way down the column, not enlarging however to form a second sphincter.

The tentacles are simple, conical, and of moderate length, and are arranged in four cycles, their number being probably 96. By actual count they seemed to vary somewhat, usually falling below that number, but the discrepancies are probably due to the difficulty of making a correct enumeration. They possess well-developed mesoglœal processes for the support of the ectodermal muscles. The disc is deeply folded in, internal to the tentacles, so as to form a deep fosse around the peristome (Pl. VII, fig. 1), which, however, does not rise above the level of the margin. I was not able to distinguish in any of my preparations the delicate mesoglœal processes of the disc which support the ectodermal muscle cells in *D. delicatula*, but it is possible that they had been macerated away.

The mesoglœa of the stomatodæum is raised upon its ectodermal surface into prominent but rather delicate ridges, over which the ectoderm is folded. The gonidial grooves are deep, and as in *Oulactis* are prolonged below the level of the internal opening of the stomatodæum, and have the mesoglœa thickened. In *D. delicatula* Hertwig describes the gonidial grooves as being hardly marked in the stomatodæum, and if this is found to be an invariable characteristic, it will be necessary to alter slightly the definition of the Phyllactidæ given above. The depth of the grooves, and their prolongation downwards, is so marked in the other members of the group that I have examined, as to suggest that its apparent shallowness in the specimen examined by Hertwig may be due to distortion.

The primary and secondary mesenteries are perfect throughout the whole length of the stomatodæum; the tertiaries are perfect in their upper part, but lower down separate from the stomatodæum; while the fourth cycle consists entirely of imperfect mesenteries. The directives are attached throughout a greater part of their length than are any of the other mesenteries, owing to the prolongation of the gonidial grooves. The longitudinal muscles in the upper portion of the mesenteries form a low band, covering the greater portion of the non-gonophoric region of the mesentery; internally the muscle processes end rather abruptly, but externally they gradually diminish in size. In the lower part of the mesentery, below the level of the stomatodæum, the arrangement of the muscle processes is very different (Pl. VI, fig. 6). Throughout the greater portion of the non-gonophoric region of the mesentery they are very small, but as the gonophoric region is approached they suddenly increase in size, forming a strong projection, and then just as suddenly diminish again, the projection being of slight extent. The parieto-basilar muscles are well developed and form conspicuous folds. Both external and internal mesenterial stomata are present (Pl. VII, fig. 1). All the mesenteries with the exception of those of the first cycle are gonophoric.

The differences, between *D. bermudensis* and *D. delicatula* may be briefly enumerated as follows:

D. bermudensis.	*D. delicatula.*
Tentacles 96.	Tentacles 160.
Fronds digitiform, about 12 in number.	Fronds dilated at the extremity, about 42 in number.
Mesoglœal processes of sphincter muscle rather delicate, anastomosing slightly.	Mesoglœal processes of sphincter stout, not anastomosing.
Ectodermal muscle processes of disc wanting (?)	Ectodermal muscle processes of disc, long and delicate.

Sub Tribe STICHODACTYLINÆ.

Family PHYMANTHIDÆ.

5. Phymanthus crucifer. (Les.) Andres.

A single specimen of this species was obtained. I have nothing to add to the statements already made regarding it in my paper on the Bahama Actiniaria.

Tribe ZOANTHEÆ.

Family ZOANTHIDÆ.

6. Zoanthus flos-marinus. Duch. and Mich. (Pl. VII, figs. 3 and 4.)

A large number of specimens of this species were obtained, and enclosed with them was a label stating that they were collected at Shelly Bay, Tuckerstown. In general appearance they resemble *Z. sociatus* from the Bahamas, the individuals as in that species forming stolon-like prolongations from which new individuals bud; their structure, however, shows them to belong to a different species. The colonies are, according to the accompanying label, 4 to 5 cm. in breadth. The individual polyps in the preserved condition measure 1-2 cm. in height, and in breadth at the upper end 0·5, cm. the lower portion and stolons measuring about 0·25 cm. All are strongly contracted, a small depression being the only indication of where the entrance into the interior is situated. The color, according to the inclosed label, was "spinach-green," but this must be taken as applying only to the upper part of the column, the lower part and the stolons being brown or sand colored. The disc was "apple-green" and the tentacles green.

The column upon the outside is covered by a cuticle, in which are sparingly imbedded foreign bodies. The ectoderm is separated from the cuticle by a layer of mesoglœa, and consists of cells arranged in groups separated by partitions of mesoglœa, but not showing the degeneration which occurs in *Z. sociatus*. The mesoglœa is comparatively thick, and consists of a homogeneous matrix containing (1) numerous anastomosing spaces more or less filled with cells, and (2) granular cells which give rise to delicate processes which enter into connection with other granular cells, and with the spaces just mentioned, and with the ectoderm and endoderm. Some suggestions regarding the origin and function of these structures will be found in connection with the description of *M. tuberculata* which follows. The endoderm of the column is low, and consists of more or less spherical cells, usually containing zooxanthellæ. A delicate layer of muscle fibres arranged circularly occurs between the endoderm and the mesoglœa.

At the upper part of the column a well-developed double sphincter muscle occurs, imbedded in the mesoglœa. It is stronger than that found in *Z. sociatus*, and more nearly resembles that described by Erdmann[1] and Hertwig[2] in *Z. Danæ*. (?)

The tentacles, according to the brief notes taken of the living specimens, are "short, 50-60 in number, in 3 rows." My preparations, however, show that the last statement is erroneous, the tentacles being arranged in two cycles only. Their ectoderm is not imbedded in the mesoglœa, nor is there a cuticle covering it. The ectodermal muscle processes of the mesoglœa are fairly developed, and immediately below them are to be seen, imbedded in the mesoglœa, peculiar granular pale yellowish-green cells, the proto-

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[1] *A. Erdmann*. Ueber einige neue Zoantheen. Jen. Zeit. XIX. 1885.

[2] *R. Hertwig*. Supplement to Report on the Actiniaria. Zoology of the voyage of H. M. S. Challenger. Vol. XXVI. 1888.

plasm of which, with the exception of the nucleus, does not stain with carmine. Otherwise the mesoglœa is homogeneous. The endoderm is thick, and is richly supplied with zooxanthellæ. In structure the disc resembles the tentacles, possessing, like them, the peculiar yellowish-green granular cells.

The mesoglœa of the stomatodæum is homogeneous. I cannot make any statements as to the histology of the ectoderm of this region, as it had macerated into a mass of a characteristic appearance which cannot easily be described. Transverse sections show that the gonidial groove, to which the macro or ventral directives are attached, is very shallow, and indeed can hardly be said to exist.

The mesenteries are arranged on the microtypus[1]. Their mesoglœa is for the most part very thin but thickens towards the base where it contains a canal. (Pl. VII, fig. 4, bc.) A second canal, circular in section and packed with cells occurs in the thin region, the mesoglœa splitting to form its walls. The muscle layers are only slightly developed.

A very peculiar arrangement occurs in connection with the mesenterial filaments of the perfect mesenteries. Immediately below the stomatodæum the mesenterial filament is triradiate (Pl. VII, fig. 3), the central ray being short and stout, the lateral rays longer and recurved. The epithelium covering the central ray and that face of the lateral rays which looks towards it resembles in structure that of the stomatodæum. The outer surface of the lateral rays is, however, covered with cells similar to those which line the general surface of the mesentery. In a section which passes through the stomatodæum a little above its extremity, the intervals between the perfect mesenteries is occupied by macerated tissue resembling the ectoderm of the stomatodæum. Apparently it lines the surfaces of the mesenteries for a short distance outwards from their point of attachment to the stomatodæum, and also the outer surface of the latter for a short distance above its inner opening. It looks as if the ectoderm of the stomatodæum were reflected upwards, so as to cover its endodermal surface and the adjacent surfaces of the perfect mesenteries. Further down (Pl. VII, fig. 4) the two lateral processes of the mesenterial filaments disappear, the central one alone persisting. It is evidently the "glandular streak" of the filament. The cells which cover the surface of the mesentery for some distance outward from this towards the column-wall are very peculiar. (Pl. VII, fig. 4 di.)

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[1] See Erdmann *loc. cit.*

They form a layer much thicker than that formed by the ordinary endodermal cells, and are loaded with green granules, closely packed together so that to the naked eye the region occupied by this layer is of that color. Foreign bodies of organic nature are imbedded in the cells, sometimes being surrounded by a number of cells containing no granules, or occasionally imbedded in the mesoglœa.

In unstained specimens, when the animal is laid open by a longitudinal incision, this region of the mesenteries is very distinct on account of its rich green color. When the loose cells of the green area are scraped away with a scalpel and examined, they are seen to be of a very irregular shape (suggesting a power of ameboid movement), and to contain numerous green globules, much smaller than the zooxanthellæ, darker in color, and homogeneous in structure. Amongst the cells are numerous zooxanthellæ, and there are also numerous spherical refractive bodies, apparently of a fatty nature and with a slightly-greenish tinge, as well as the foreign bodies already mentioned as seen in the section, and very numerous delicate acicular silicious spicules.

The occurrence of these spicules and organic foreign bodies in the cells of this region is very strong evidence in favor of the supposition that they have a digestive function. The green globules may be the products of digestion. If this be the case it is exceedingly interesting as indicating a method of digestion in the Zoantheæ somewhat different from what is usually described as occurring in the rest of the Actiniaria.

None of the specimens examined possessed sexual organs. There were about 24–26 pairs of mesenteries in the specimens examined.

I have identified this form with Duchassaing and Michelotti's *Z. flos-marinus*, with the imperfect description of which it agrees fairly well. In many respects it comes near *Z. sociatus*, but differs markedly from it in others; such for instance as in the nature of the ectoderm and in the form of the sphincter-muscle, so that it must be regarded as distinct. From the only *Zoanthus* hitherto described from the Bermudas, *Z. Danæ* (?) of Hertwig[1] it is readily distinguished by the absence of any distinct line of demarcation between the upper and lower portions of the column.

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[1] *R. Hertwig.* Supplement to report on the Actiniaria of the Challenger Expedition. 1888.

7. **Mammillifera tuberculata** (Gray) (Pl. VII, figs. 5 and 6.)

Synon.—*Isaurus tuberculatus*—J. E. Gray. 1828.
Zoanthus tuberculatus—Duchassaing and Michelotti. 1860.
Antinedia tuberculatus—Duchassaing and Michelotti. 1866.
Zoanthus (Monanthus) tuberculatus—Andres. 1883.
Antinedia Duchassaingi—Andres. 1883.

This form was first described by J. E. Gray,[1] from specimens in the British Museum, whose locality was unknown. He adopted for the genus Savigny's name *Isaurus.* In 1860, Duchassaing and Michelotti rediscovered it, and, though apparently unacquainted with the earlier description of Gray, applied to it the same specific name, but placed it in the genus *Zoanthus* on account of the absence of sandy incrustations on the column walls. In their second paper these authors placing importance on the tuberculation of the column walls erected for its reception the genus *Antinedia.* Andres in his most useful monograph has assumed that the form described by Gray is different from that which Duchassaing and Michelotti obtained at St. Thomas and Guadeloupe, relying probably on the discrepancies between the poor figures given by the latter authors and the more correct one which Gray has given. He consequently retains the specific term *tuberculatus* for Gray's form, proposing for Duchassaing and Michelotti's the name *Duchassaingi.* There is little room for doubt, however, that the two forms are identical: my observations have shown that the species is to be referred to the genus *Mammillifera* as defined by Erdmann.

The specimens from the Bermudas were either solitary, attached to a piece of rock by a base only very slightly expanded, or else were grouped together in twos or threes in which case they were united by a slightly-developed, flat or slightly-tubular cœnenchyme. In none had the cœnenchyme any such tubular or stolon-like form as is shown in the figure given by Duchassaing and Michelotti. Judging from the specimens I studied, the tendency to form a cœnenchyme is slight.

The polyps (Pl. VII, fig. 5) vary in height from 1·3–2·7 cm.; their diameter being about 0·7–0·9 cm. The column is marked by six or eight distinct annular grooves, and by from twenty to twenty-five longitudinal ones. In the lower part of the column the ridges formed by these longitudinal grooves are entire, but higher up they begin to be divided into a series of tubercles, a row of these corresponding

[1] *J. E. Gray*—Spicilegia Zoologica. London. 1828.

to each ridge. These tubercles increase in size towards the margin and several become grouped together upon elevations of the column wall, giving rise to mulberry-like protuberances. Near the margin the tubercles suddenly cease, forming, in contracted specimens, a strong ridge bounding the dome-shaped area which forms in such specimens the summit. This dome-shaped area belongs to the column, the animal being strongly contracted, and though without tubercles shows clearly the continuation upwards upon it of the longitudinal furrows, and is, accordingly, marked by a series of radiating ridges.

In structure the tubercles of the column are solid, being elevations of the mesoglœa. This tissue throughout the column is very thick, measuring on the average 1 mm. in thickness. It presents numerous anastomosing canals filled with cells, as well as the delicate canals, which have been described by Erdmann and others, very distinctly. These canals are without doubt processes from the large canals, and the structure of the zoanthan mesoglœa may be compared to that of a bone, such as a frog's femur, the anastomosing canals being compared to the lacunæ and the delicate canals to the canaliculi. My preparations of *M. tuberculata* seem to show that the lacunæ arise from both the ectoderm and endoderm. In some of my sections deep bays can be seen running from the endoderm up into the mesoglœa, and from their ends and sides numerous canaliculi can be seen branching out. These bays can be found in various stages of enclosure by the mesoglœa, the cells which they contain being in some cases continuous with the general endoderm, in other cases almost separated from it and finally quite so. So too with the ectoderm. The lacunæ which have just been formed in this manner are much larger than the majority of those scattered through the mesoglœa, these frequently consisting of only a few or even a single cell, and further the newly-formed lacunæ usually contain zooxanthellæ, whose presence is rare in the older ones. It would seem as if many of the newly-formed lacunæ become divided into smaller portions which separate from each other, except by the delicate canaliculi, and at the same time undergo an alteration in the histological structure of their cells, the zooxanthellæ disappearing and the cells becoming filled with refractive deeply-staining granules. It seems not improbable that these altered cells are concerned in the formation of the mesoglœa, their granules being particles which will later on be added to the matrix of the mesoglœa.

Upon the outside of the column is a thin cuticle (Pl. VII, fig. 6, cu.) similar to what occurs in *Z. sociatus* and *Z. flos-marinus*. Andres[1] considers this to be merely a differentiation or hardening of the external layers of the mesoglœa, but I cannot agree with this view. It is a clearly defined layer external to the mesoglœa, and appears quite different in composition and behavior to staining fluids from that tissue. Below this cuticle comes a layer of mesoglœa for which Andres' term subcuticula may be employed. The distinction between the cuticle and this layer has been overlooked by most authors. It was recognized by Kölliker,[2] however, who believed it to be a portion of the cuticle. Andres recognized its true nature considering it simply a continuation of the mesoglœa.

Below the subcuticula is the ectoderm (Pl. VII, fig. 6, ec.) which forms a layer 0·08 mm. in thickness. It is not continuous, however, but is divided into more or less cubical masses by columns of mesoglœa extending from the general mass of that tissue to the subcuticula. A peculiar feature of the ectoderm of this species is the presence in it of zooxanthellæ. In adult actinians these structures are usually confined to the endoderm, but I have observed them in the ectoderm in free-swimming larvæ, in which layer they also occur according to H. V. Wilson[3] in the embryos of the coral *Manicina*. It is possible that their presence in the ectoderm of *M. tuberculata* is due to the thick cuticle and subcuticula preventing a rapid aeration of the ectoderm cells and so, by favoring the accumulation to a certain extent of carbon dioxide, producing favorable conditions for the growth of the parasitic algæ. The ectoderm thus buried in the mesoglœa evidently corresponds with what Kölliker, in the admirable account he has given of the zoanthan mesoglœa.[4] terms "eine zusammenhängende Schicht drüsenartiger Körper" and which he believed to correspond to the ectoderm.

The endoderm consists of low cells containing numerous zooxanthellæ. In the upper part of the column, extending from the margin to the upper row of tubercles, is a single strong sphincter

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[1] *A. Andres.* On a new genus and species of Zoanthina malacodermata (Panceria spongiosa, sp. n.)—Quart. Journ. Micros. Sci. N. S. Vol. xvii. 1887.

[2] *Kölliker.* Icones Histologicæ. Leipzig. 1865.

[3] *H. V. Wilson.* On the development of Manicina areolata. Journal of Morphology. Vol. II. 1888.

[4] *A. Kölliker*, loc. cit.

muscle imbedded in the mesoglœa, and occupying nearly its whole thickness.

All the specimens were in a state of strong contraction, and I was not able to see the tentacles. Duchassaing and Michelotti state that they are small tubercles. My sections show that they are ar-arranged in two cycles. It is also evident that they are short, but they can scarcely be termed tubercles. Their mesoglœa is thick, especially toward the base, thinning out somewhat towards the apex. Its outer surface is thrown into rather strong muscular processes.

The surface of the stomatodæum is thrown into numerous rather high folds, the ectoderm being elevated on slender processes of the mesoglœa.

The mesenteries are arranged on the microtypus and number twenty-two pairs. Towards their base the mesoglœa is very thick diminishing gradually towards the distal edge. Just at the base there is a sudden diminution of the thickness, so that they are attached to the column wall by a thin pedicle. The basal portion contains the usual canal, and in addition there are numerous lacunæ similar to those of the column wall in every respect. *M. tuberculata* is hermaphrodite, and I am able to add this particular to the definition of the genus given by Erdmann.[1] I could not make out any regularity in the arrangement of the reproductive elements on the different mesenteries, nor did there seem to be any definiteness in their position in any one mesentery. Sometimes a mesentery would possess ova only, but usually each one presented both ova and spermatozoa.

8. Corticifera ocellata (Ellis).

Synon.: *Alcyonium ocellatum.* Ellis and Solander, 1786.
Palythoa ocellata. Lamouroux, 1821.

A number of small colonies of a *Corticifera* were obtained at Shelly Bay, and were accompanied by a label referring them to the above species. The term *ocellata* was first given by Ellis and Solander to a form which, however, was very poorly characterized, so much so that certainty of identification is impossible. The only statement in the description of which use may be made is that the polyps are rust-colored. Later authors simply copied Ellis and Solander's description until Dana,[2] evidently relying on the figure which accompanies the earlier description adds the characteristic that the polyps, though imbedded in cœnenchyma throughout the

[1] *Erdman A.* loc. cit.

[2] *J. D. Dana,* Zoophytes. United States Exploring Expedition. 1849.

greatest part of their extent, are yet free above. Duchassaing and Michelotti in their paper of 1860 describe a form under this name which differs somewhat from the original type species, and is probably to be considered, as Andres has done, a distinct form. In their later paper they make this form identical with a form they name *Palythoa mammillosa*, a name taken from a second imperfectly characterized form mentioned by Ellis and Solander. In fact so much confusion is introduced by Duchassaing and Michelotti as to render it very difficult, if not impossible, to ascertain what forms they are really describing.

Under the circumstances I have thought it well to retain the name which accompanied the specimens, and trust that the following description will sufficiently characterize them to allow of the identification in the future.

The polyps are grouped together in small masses, and project decidedly above the surface of the cœnenchyme. Their height measured from the lower surface of the cœnenchyma is 1-2 cm. and their breadth, measured at the summit, about 0·7 cm. in the fully grown individuals. The polyps and cœnenchyma are densely incrusted with particles of sand and other foreign bodies, and are of a grayish sandy color, sometimes deepening to a rust color.

Upon the outside of the column is a rather thick cuticle, but I was not able to discover whether or not a layer of mesoglœa intervened between this and the ectodermal cells. The outer portion of the mesoglœa for about half its thickness has imbedded in it foreign bodies, and when decalcified is fenestrated by the numerous cavities previously occupied by them. The internal portion of the layer presents the structural features found in other Zoanthidæ, but it is to be noticed that foreign bodies occur in the so-called "nutritive canals" or lacunæ. The sphincter muscle is imbedded in the mesoglœa, is single, and consists of a single row of cavities containing muscle fibres.

The tentacles are arranged in two rows and are apparently fifty-six in number in the specimens examined. Their outer muscular layer is weak and the mesoglœa is homogeneous except upon the outer face of the tentacles where it contains a number of granular cells similar to those occurring in the column mesoglœa in this and other forms already described. Zooxanthellæ occur in the ectoderm.

The ectoderm of the disc is peculiar. It consists of high much-vacuolated cells which contain, like the ectoderm of the tentacles, zooxanthellæ. I have found this peculiar structure of the disc ectoderm in no other Zoanthids. Unfortunately the preservation of the specimens was not sufficiently good to allow of the histological details being studied. The gonidial groove of the stomatodæum is rather broad and the mesoglœa lining is thickened and truncated upon the endodermal side, the macrodirectives being inserted into each angle of the truncation.

The mesenteries are arranged on the microtypus, there being about twenty-six pairs. The basal canal is large, and contains foreign particles similar to those found in the lacunæ of the column, The mesoglœa is thickened towards the base of the mesenteries and contains in addition to the basal canal, several others nearly circular in section and completely filled with spherical granular cells. The endoderm throughout contains zooxanthellæ. No reproductive organs were present.

9. **Corticifera glareola**, Les.

Synon.: *Corticifera glareola.* Lesueur. 1817.
Palythoa glareola. Milne-Edwards. 1857.

The identification of this form depends mainly on the coloration, which Professor Heilprin informs me is sufficiently similar to Lesueur's description.

The polyps form encrusting masses, and are so deeply imbedded in the cœnenchyme, that in contraction a slight depression alone indicates the position of the various individuals, or in some cases a slight annular elevation. The species is by this peculiarity readily distinguishable from *C. ocellata*, as well as from *C. flava* of the Bahamas, which stands in an intermediate position as far as the projection of the polyps above the cœnenchyme is concerned. The form described from the Bermudas by Erdmann, and named *C. lutea* by Hertwig resembles *C. glareola* in this respect, but appears to differ from it in other points.

The mesoglœa is, with the exception of a narrow band immediately adjoining the endoderm of the polyps, richly supplied with imbedded foreign bodies, so that the entire colony is very hard, almost stony in its consistency. *C. ocellata* is much less richly provided with foreign particles, and the same is the case with Hertwig's *C. lutea.* Whether this is a characteristic of sufficient importance for specific distinction can only be ascertained by the examination of numerous specimens of some species, obtained from different localities and living under different conditions. In fact our knowledge of the histology of the zoanthidæ is not yet sufficiently advanced to enable us to ascertain what features are of systematic importance and what are liable to extensive individual variation.

The sphincter muscle resembles closely that of Hertwig's *C. lutea*. It is imbedded in the mesoglœa and is single, consisting of a single row of cavities which are entirely confined to the portion of the column which is invaginated during contraction. All the cavities contain muscle cells and there are none of the empty spaces with clearly defined walls such as occur in *C. flava*.

The mesenteries are arranged in the microtypus, and in the specimens examined there were about eighteen pairs only. The mesoglœa is delicate, and is not dilated towards the base as in *C. ocellata*, and in consequence, the basal canal is elongated. Notwithstanding that the specimens were very much macerated it was possible to perceive that a digestive area, similar to that described as occurring in *Z. flos-marinus* was present, just below the stomatodæum. No reproductive organs were present.

The stomatodæum presented the pyriform, truncated shape which has been described for other members of the genus.

It seems not improbable that the form described by Hertwig as *C. lutea* may be identical with this. Alcoholic specimens of *C. glareola* show no trace of the coloration of the living forms, but are of a universal sandy color. In the very slight prominence of the polyps above the cœnenchyme, in the structure of the sphincter muscle, and in the slenderness of the mesenteries there is agreement between the two, and these are points which will probably prove to be of systematic importance. On the other hand there is dissimilarity in the extent of the incrustation by foreign bodies, in the pigmentation of the endoderm which is wanting in *C. glareola*, and apparently in the extent of the development of the longitudinal muscles of the mesenteries, which cannot be said to be well developed in *C. glareola*. This last character is probably of importance, but the first two are probably subject to variation depending upon the conditions of life and the food.

The evidence then, seems to be in favor of the identity of the two forms, in which case the name here used has the priority. It seems to me very doubtful indeed if Hertwig's identification of the Bermuda form with Quoy and Gaimard's *C. lutea* from the Fiji islands is correct. The only point of correspondence, judging from the description and figures given by Quoy and Gaimard,[1] is the slight prominence of the polyps above the cœnenchyme when in contraction.

10. Gemmaria Rusei, Duch. and Mich. (Pl. VII, fig. 7–9.)

Synon.: *Gemmaria Rusei.* Duchassaing and Michelotti. 1860.

I was pleased to find in the Bermuda collection several specimens of a form which evidently belongs to the same genus as the form from the Bahamas which I described as *Gemmaria isolata.* Several anatomical features are common to the two, and I am now able to give other characteristics which may serve to distinguish the genus more definitely than was done in my former paper.

The polyps of *G. Rusei* (Pl. VII, fig. 7) are solitary, being attached to pebbles without the development of any cœnenchyme. The specimens were obtained at North Rock, and are five in number. The upper portion of the column is larger than the lower, so that the polyps have the shape of a short stout club; the lower portion is transversely wrinkled even in the expanded condition, as is noted in the label accompanying the specimens. The height of the column is about 2·5 cm. in the largest specimens; the diameter of the upper part is 0·65 cm. and of the lower 0·5 cm. The color is stated on the label to have been "cinereous throughout."

The column wall is rather thin, and is occupied throughout nearly its entire thickness by foreign bodies. The ectoderm is covered externally by a cuticle, but I was unable to ascertain whether a layer of mesoglœa intervened between this and the surface of the ectoderm. The structure of the thin layer of mesoglœa unoccupied by foreign bodies is as in other zoanthidæ and calls for no special comment. The sphincter is single, and imbedded in the mesoglœa; it consists for the most part of a single layer of cavities, but thickens somewhat towards its upper end. All the cavities contain muscle cells, there being none of the empty cavities described in *G. isolata.*

The tentacles are arranged in two cycles, and have only a very weak ectodermal musculature, as is also the case in *isolata.* Towards the base and upon the outer surface the mesoglœa contains peculiar granular cells, and occasionally enclosures of foreign bodies, and this likewise occurs in *isolata.*

The disc is traversed by a number of ridges which radiate from the peristome to the margin, a ridge corresponding to each tentacle of the outer cycle. The elevations are produced by thickenings of the mesoglœa (Pl. VII, fig. 9), and along each ridge the ectodermal

[1] *Quoy and Gaimard,* Zoologie du Voyage de la corvette l'Astrolabe. Paris. 1833.

muscle cells are more numerous and larger than elsewhere. *Isolata* presents similar structures. Zooxanthellæ occur in the ectoderm of the disc, and tentacles in both forms. The enclosures in the mesoglœa of the disc, which I thought might possibly be muscle cells in *isolata*, are seen in *Rusei* to be comparable to the lacunæ of the column wall.

The mesoglœa of the stomatodæum in both species of *Gemmaria* has enclosures of granular cells (Pl. VII, fig. 8), as a rule one such enclosure opposite the insertion of each mesentery, especially in the upper part of the stomatodæum, the arrangement being lost in the lower part. The gonidial groove has the same shape as that of *G. isolata.*

The mesenteries are arranged in thirty-one pairs and are on the microtypus. The mesoglœa thickens towards the base so that the basal canal is almost circular and not elongated as in *G. isolata.* No reproductive organs were present.

The description given by Duchassaing and Michelotti of *Gemmaria Rusei*, with which I identify this form, is very imperfect, but so far as it goes it applies to the Bermuda species. The form described by Gray[1] as *Triga philippinensis* is very similar in external form and is in all probability a *Gemmaria.*

Of the forms described above, no less than seven, viz: *Condylactis passiflora, Phymanthus crucifer, Zoanthus flos-marinus, Mammillifera tuberculata, Corticifera ocellata, C. glareola* and *Gemmaria Rusei*, are represented in the West Indian fauna, and of the other three, the genera *Aiptasia* and *Phyllactis* also occur in the islands to the South, leaving only the genus *Diplactis* as a characteristic form of the Bermudas. No doubt a systematic search for Actinians in the Bermudas would lead to the discovery of a greater number of West Indian forms, but the proportion of common forms given above is sufficient to show that the Actinian fauna of the Bermudas has been derived from that of the West Indies.

Explanation of Plates.

bc.=basal canal.	*en.*=endoderm.
c.=column wall.	*fr.*=fronds.
cm.=circular muscles.	*m.*=margin.
cu.=cuticle.	*p.*=tentaculiform fronds.
d.=disc.	*sp.*=sphincter.

[1] *J. E. Gray.* Notes on Zoanthinæ with descriptions of some new genera. Proc. Zool. Soc. London. 1867.

di.=digestive region of mesenterial filament.
Ec.=Ectoderm.
sp[1].=lower sphincter.
t.=tentacle.

Plate VI.

1. Transverse section through the middle region of the sphincter of *Aiptasia* sp. (?) × 350.

2. Longitudinal section through the upper half of the column wall of *Aiptasia* sp. (?) × 40.

3. Transverse section through the outer edge of the longitudinal mesenterial muscles of a specimen of *Condylactis passiflora* from the Bermudas. × 42.

4. Longitudinal section through the margin and adjacent parts of *Diplactis bermudensis.* × 24.

5. Longitudinal section through the margin and adjacent parts of *Oulactis fasciculata.* × 21.

6. Transverse section through the longitudinal mesenterial muscles below the stomatodæum in *Diplactis bermudensis.* × 40.

Plate VII.

1. Perfect mesentery of *Diplactis bermudensis.* Natural size.

2. Portion of transverse section of sphincter of *Diplactis bermudensis.* × 100.

3. Transverse section of mesenterial filament of *Zoanthus flos-marinus* just below the stomatodæum. × 120.

4. Transverse section of perfect mesentery of *Zoanthus flos-marinus* slightly below the stomatodæum. × 50.

5. *Mammillifera tuberculata.* Natural size.

6. One-fourth of a portion of a longitudinal section through the column wall of *M. tuberculata.* × 200.

7. *Gemmaria Rusei.* Natural size.

8. Transverse section through the gonidial groove of *Gemmaria Rusei.* × 65.

9. Transverse section through upper part of column of *Gemmaria Rusei.* × 24.

NOTES ON A SMALL COLLECTION OF MYRIAPODS FROM THE BERMUDA ISLANDS.

BY CHARLES H. BOLLMAN.

The following species, which were collected by Prof. Heilprin in the summer of 1888, although limited in number, show the diverse origin of the Myriapod fauna of the Bermuda Islands. Heretofore *Julus moreleti* has only been found in the Azores Islands; *Mecistocephalus guildingii* in the West Indies; *Lithobius lapidicola* in Europe; and *Spirobolus heilprini*, by having scobina, shows its West Indian and not African origin, for all found in the latter continent belong to the subgenus *Spirobolus* from which scobina are absent.

These four species, including a specimen of *Scolopendra subspinipes* which I have in my collection, are all that as yet have been reported from the Bermuda Islands.

I desire to express my thanks to Prof. Angelo Heilprin, of the Acad. Nat. Sciences of Philadelphia, for the privilege of examining this collection of Myriapods.

1. **Spirobolus heilprini**, sp. nov.

Diag.—Related to *Spirobolus flavocinctus* Karsch., but the segments very distinctly segmented, anterior part not striate; antennæ and legs reddish-brown.

Type.—Museum Acad. Nat. Sci. Phil. Greenish-black, posterior margin of segments rufous; antennæ and legs reddish-brown. Slender, anterior segments scarcely attenuated. Vertex smooth, sulcus shallow; clypeus only moderately emarginate, foveolæ 2 + 2, distant, sulcus sub-continuous with vertical. Antennæ rather slender, reaching second segment in both sexes. Ocelli arranged in a suboval or subtriangular patch, 45–55, in seven or eight series. Segments not smooth; posterior parts above with short and wavy, beneath with short and straight striæ; median part with a transverse sulcus which ends above repugnatorial pore; posteriorly above with a few striæ, beneath almost smooth or with a few weak oblique striæ. Lateral lobes of first segment rounded, a weak marginal sulcus. Anal segment with a flat, thick mucro, which passes beyond valves; anal valves weakly margined, not punctate; anal scale obtusely angled. Repugnatorial pore placed on anterior division, small and rather deep set. Legs extending slightly beyond sides of body. Male: slenderer than female; coxæ of 3, 4, 5th, pairs of legs produced into short lobes; tibia and first two tarsal joints beneath with an oval roughened lobe; joints of anterior legs short and thick, third and fourth pairs of legs strongest; tarsi without a pad; ventral plate of copulation-foot triangular as high as foot, its base not concave, its posterior surface ridged, thus making the plate of a triangular-pyramidal form; anterior part of first foot not as high as ventral plate, triangularly pointed, the ventral plate ridge separating them; posterior part of anterior foot as high as ventral plate, its apex with a short blunt lobe on its posterior surface; posterior copulation-foot bifid, projecting out of the opening, the upper branches flattened and fan-shaped at its end, which is convex; lower branch elongate-lanceolate, its upper edge serrate, basal part of foot rectangular and white, while the upper part is yellowish.

Segments male, 46; female, 44.

Length 52^{mm}, width $3{\cdot}8^{mm}$–$4{\cdot}2^{mm}$

This species is described from six broken and badly preserved specimens. In the type of copulation-foot it resembles that of *arboreus* and *dugesi*, and it is very probable that all the species belonging to this group have the same type, *i. e.* the ventral plate triangular and as high as posterior part of anterior part, while the anterior part is less, the posterior foot bifid and projecting out of the opening.

I have named this species after Prof. Angelo Heilprin, of the Academy of Natural Sciences of Philadelphia.

2. **Julus moreleti** Lucas.

In the collection are a number of female specimens, which I refer to this species. It has only been found in the Azores Islands.

These specimens have the striæ of the anterior division of the segments not so irregular as represented in Porath's figure of this species.*

Segments 42–49. Adult almost black, legs reddish-brown; young dusky, with a lateral row of black spots and a medium black dorsal line, bordered with yellowish.

3. **Mecistocephalus guildingii** Newport.

Three specimens. These are so moulded and broken that it is almost impossible to make much out; but in the characters of the head, they seem to be identical with the West Indian species.

*Am. nagra Myriopoder frau Azorerna. Öfver. Kongl. Vet. Akad. Forh., Stockh., 820, 1870.

Fig 1

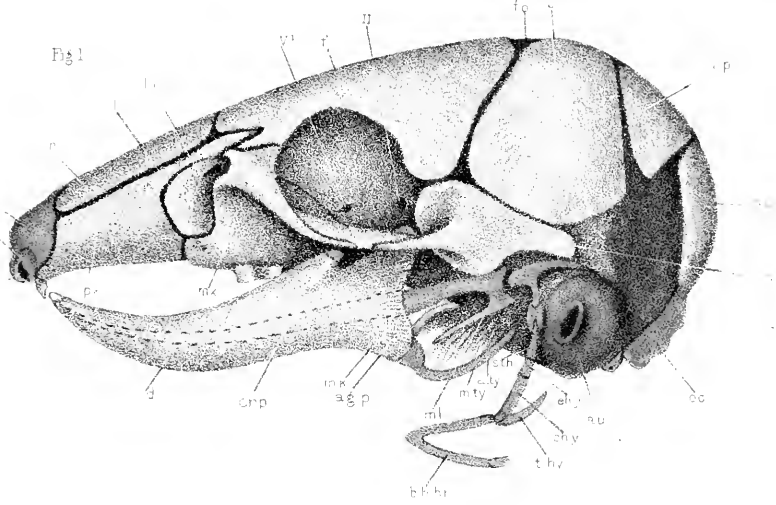


Fig 2

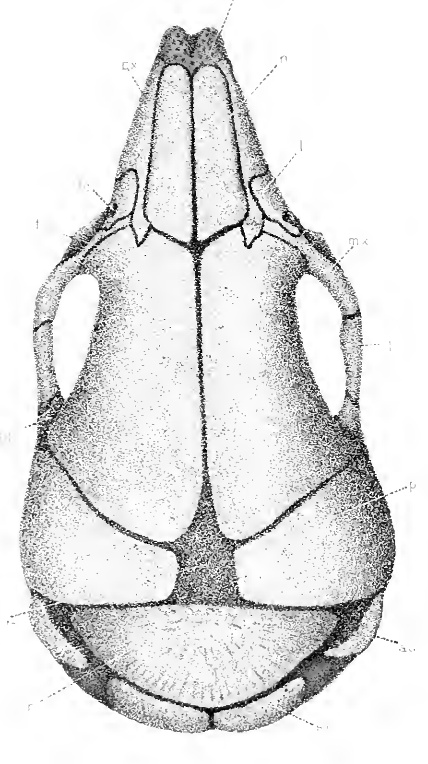
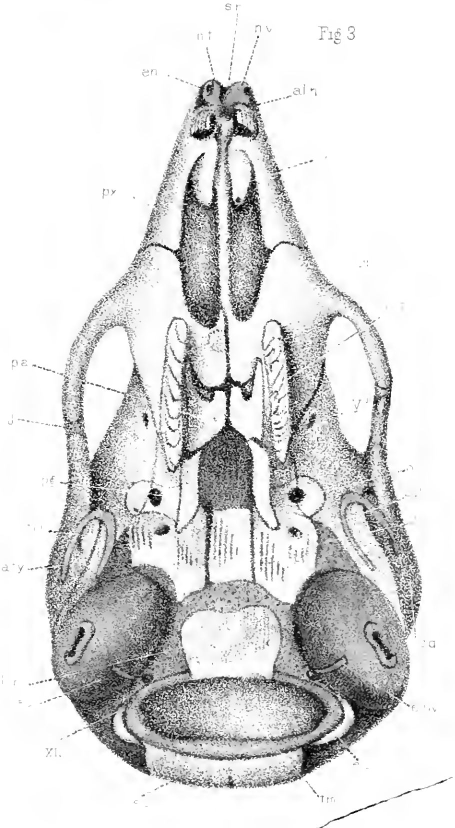


Fig 3



SHUFELDT ON NEOTOMA FUSCIPES.
(Embryo, ×6)

Fig 4

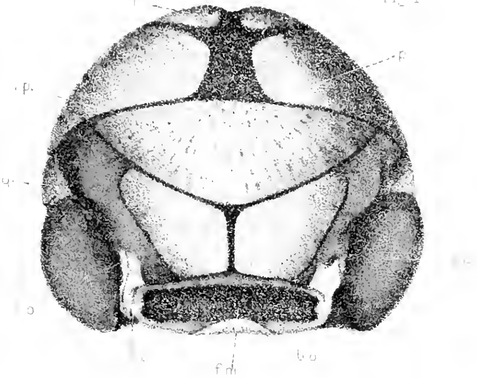


Fig 5

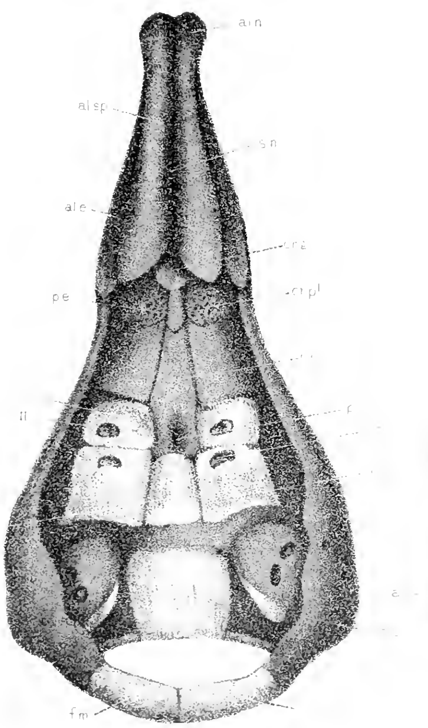
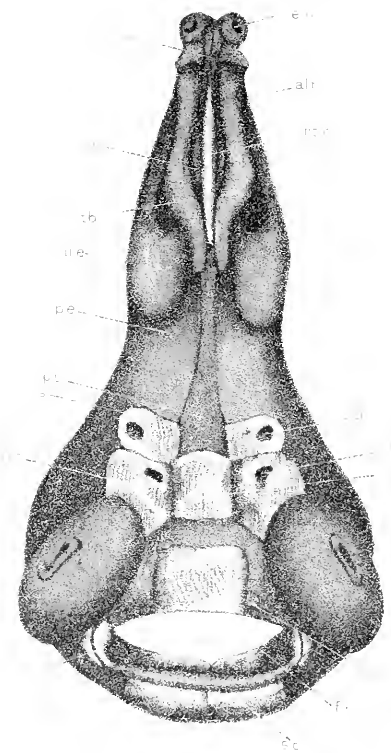
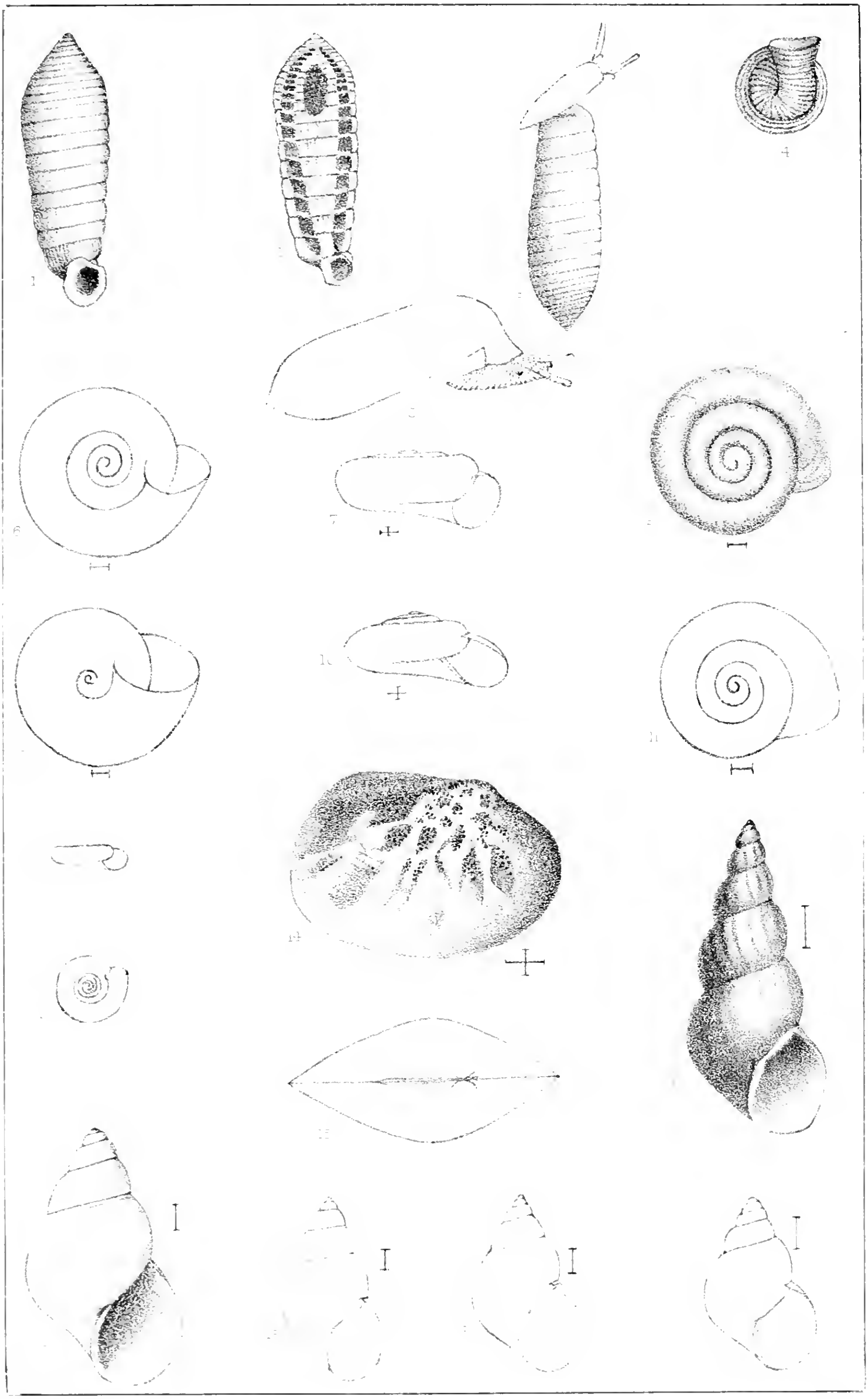


Fig 6

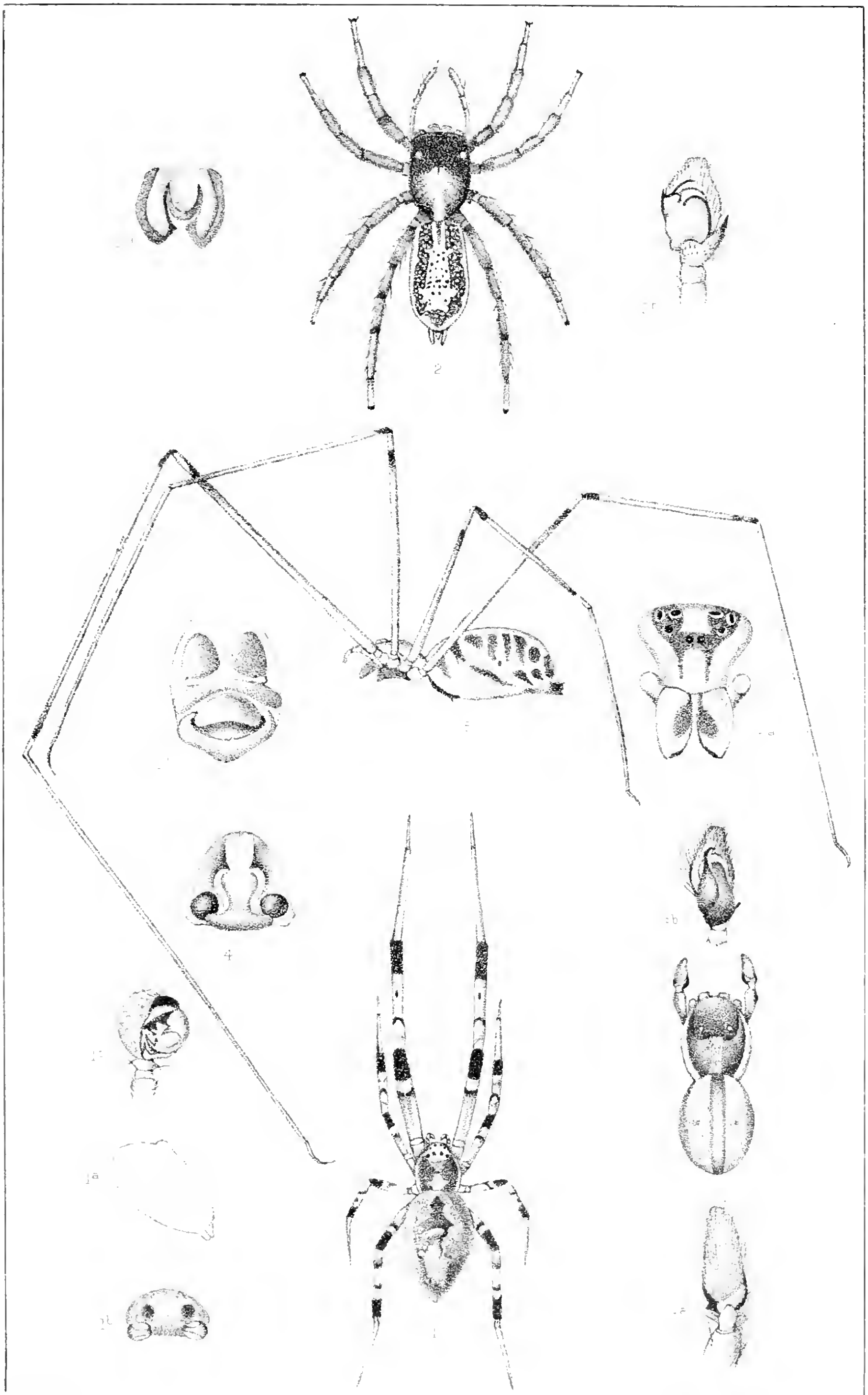


SHUFELDT ON NEOTOMA FUSCIPES.

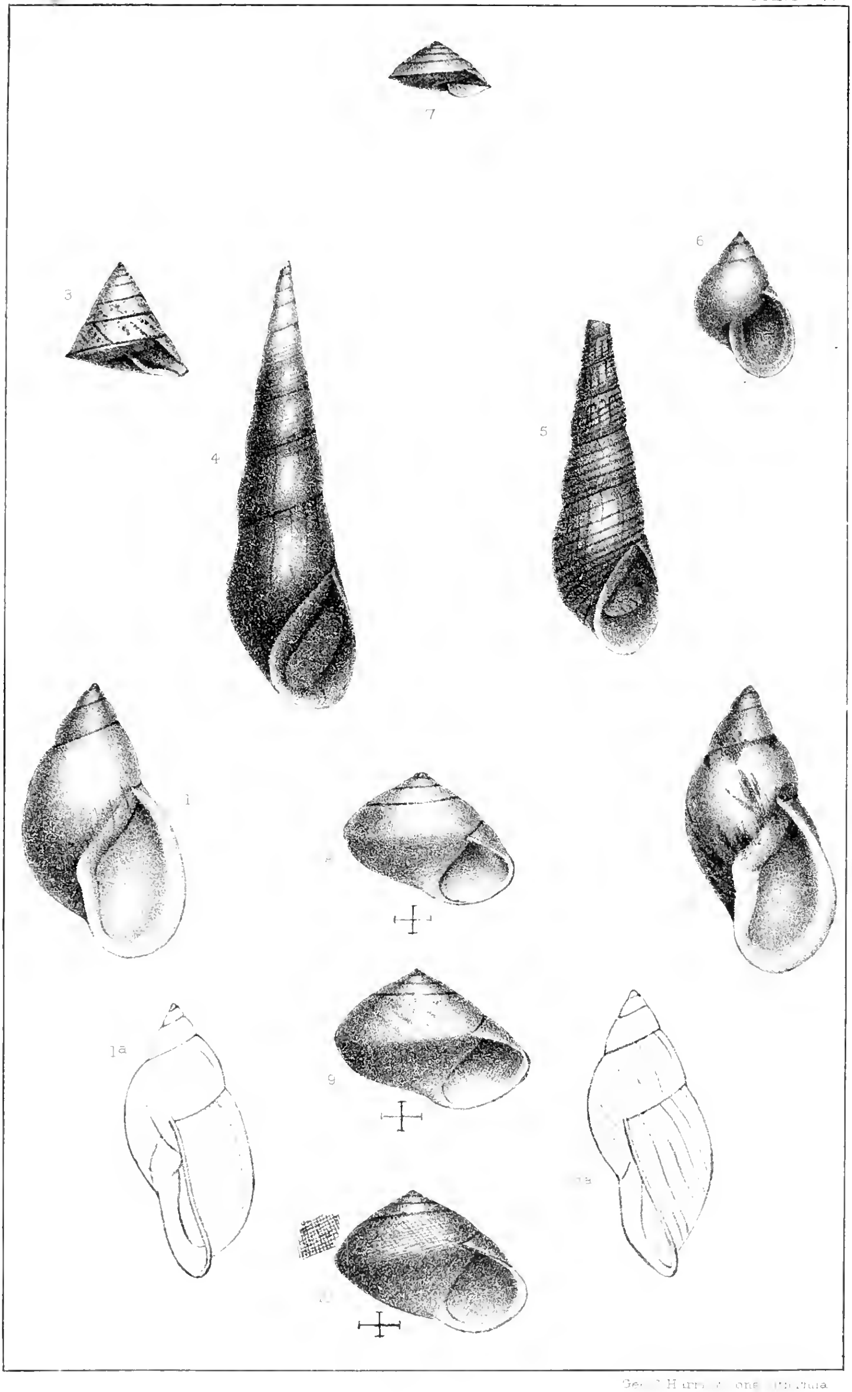
(Embryo × 6).



PILSBRY ON NEW AND LITTLE KNOWN MOLLUSKS.

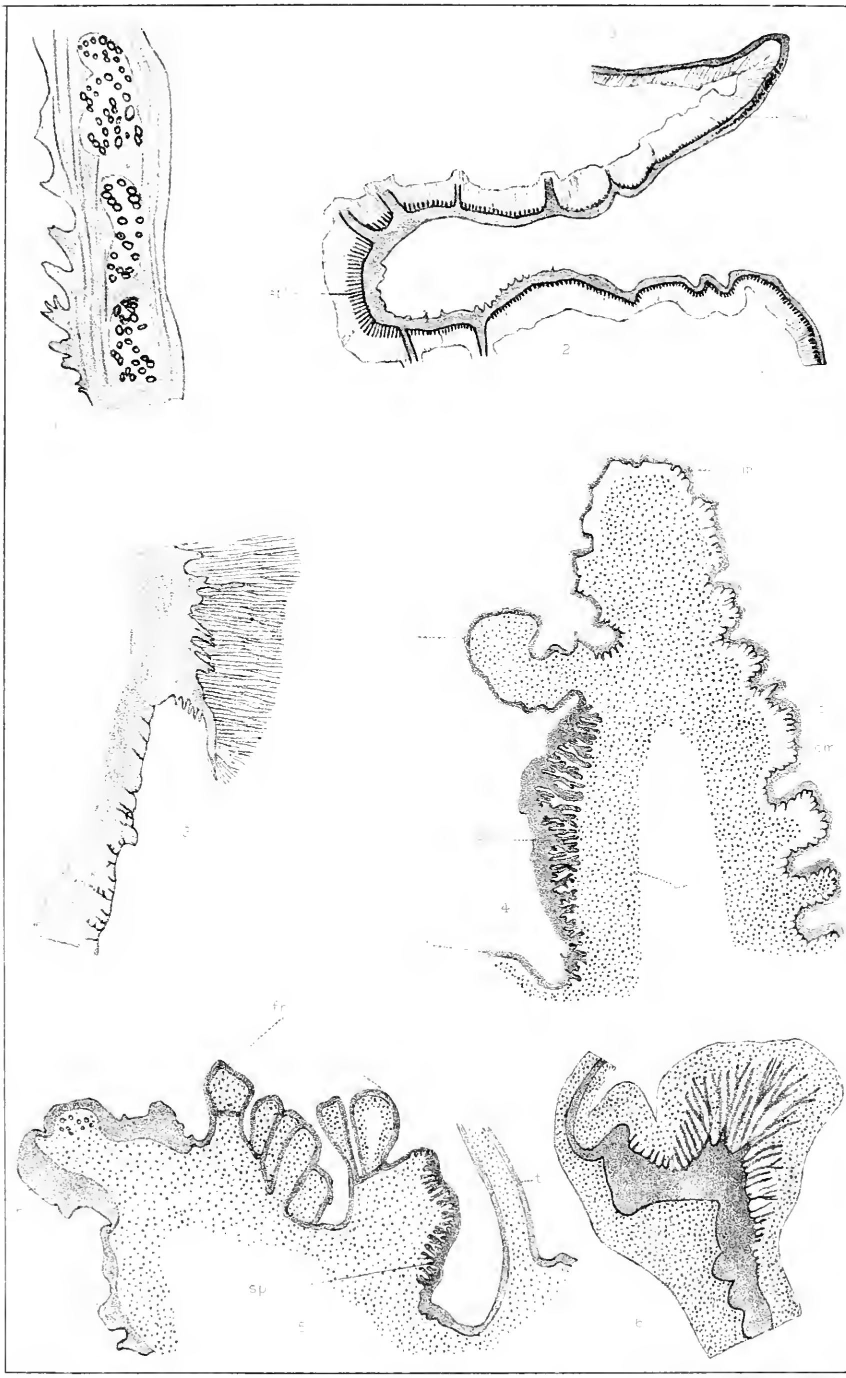


MARX ON SPIDERS OF BERMUDA.

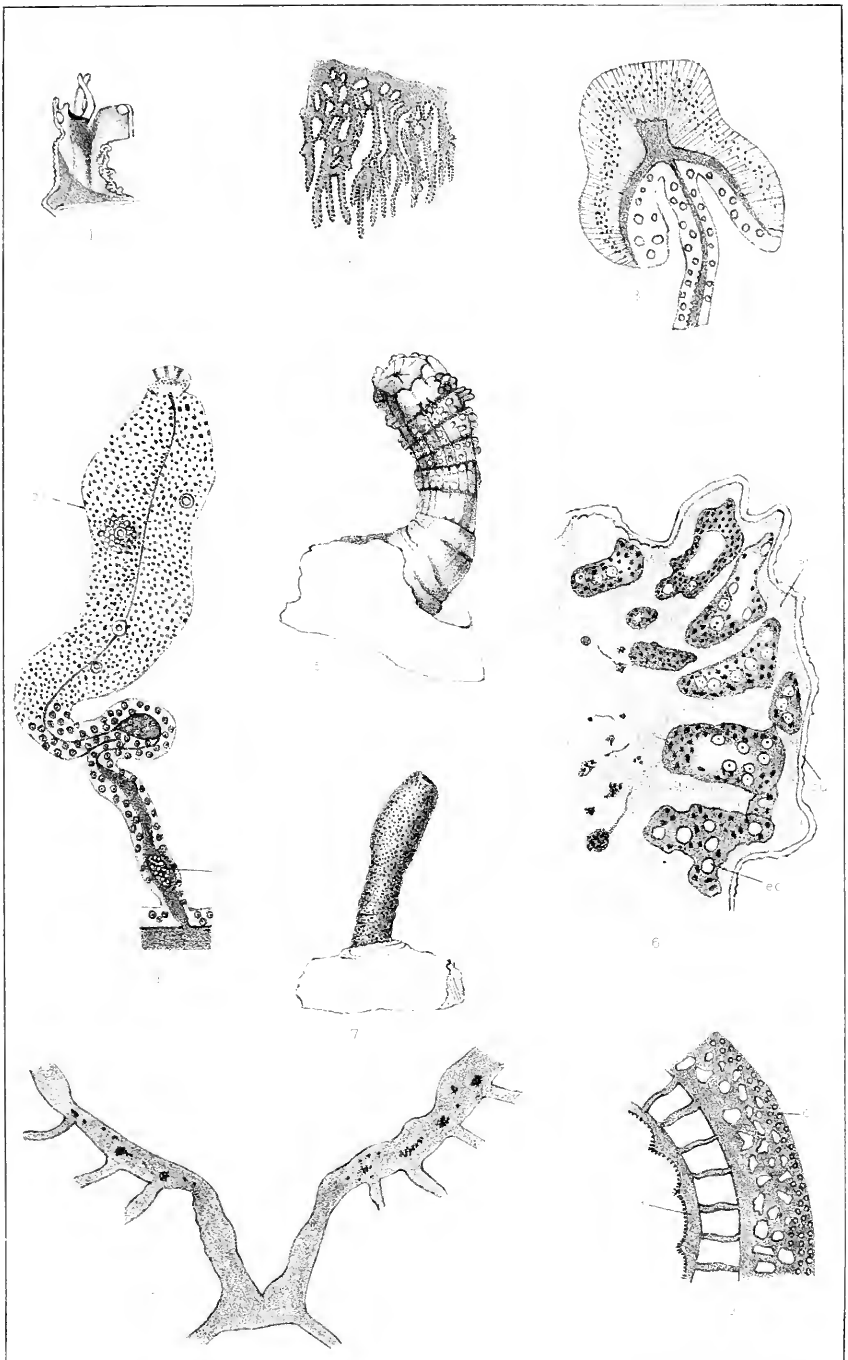


Geo. F. Harris & Sons, Lith. Phila.

HARTMAN, SHELLS FROM NEW HEBRIDES.



Mc MURRICH ON ACTINIARIA.



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McMURRICH ON ACTINIARIA.

4. **Lithobius lapidicola** Meinert.

Two specimens, male and female. Joints of antennæ 26; ocelli 8 or 9, in three series; coxal pores male 2, 3, 3, 2, female 3, 4, 4, 3; spines of first pair of legs, 0, 1, 1; of penultimate pair, 1, 3, 3, 1; of anal pair, 1, 3, 2, 0; spines of female genitalia stout, claw very distinctly tripartite, middle lobe not much longer; length male 7^{mm}; female 8^{mm}.

It is very probable that these specimens are not identical with *L. lapidicola*, a European species; but as they are rather mutilated, I have hesitated to describe them as new.

MAY 7.

The President, Dr. JOSEPH LEIDY, in the chair.

Fifty persons present.

The following papers were presented for publication:

"Catalogue of the Asteroidea and Ophiuroidea in the collection of the Academy of Natural Sciences of Philadelphia," by J. E. Ives.

"Provisional List of the Plants of the Bahama Islands," by John Gardiner and L. J. K. Brace.

The Proceedings of the Botanical Section having precedence the following communications were made:—

On the Use of the Bambusa Stem, in Incandescent Electric Lighting.—PROF. WM. P. WILSON stated that the ordinary exogenous woods are not adapted to the construction of the filament for want of a homogeneous structure. Such woods are made up of wood-cells of varying lengths and shapes in combination with a variety of ducts and vessels.

The walls of the wood-cells may be more or less thickened, the vessels and ducts may be larger or smaller, numerous or infrequent according to the kind of wood examined. There are always enough of these vessels and ducts combined with the wood-cells in any stem to render the structure exceedingly heterogeneous. Most of these cells and vessels have their longer diameter parallel with the general direction of the stem. Groups of thin walled, prismatic cells pass radially from the central portion of the stem to the circumference. These groups of cells are called medullary rays. It is impossible to cut a filament from any of these woods and so cut it that the medullary rays will not cross it many times at right angles to the ducts and long cells. The character of the cells forming these rays is so very different from the others in the filament, both as to shape, direction, and thickness of the walls, that at the crossing points resistance is greatly increased, thus causing rapid burning and destruction at such points.

Such woods as Hickory and Rock-Elm furnish the very best of our timbers. They are the toughest and most durable of our woods; but they do not make good filaments. The medullary rays are very numerous and the walls of the cells composing them greatly thickened. The long, pointed, thick-walled wood-cells do not follow a parallel course, but interlace with each other. This interlacing of the cells gives to these woods their toughness. It is the main characteristic also which renders them worthless when made into electric filaments. Upon carbonization of such filaments the tension of the interlacing cells is relieved and the tissues composing it become friable and easily fall apart.

In the adult stem of the Bambusa a combination of anatomical characters has brought about a result which makes it the most fitting material so far as now known for the electric filament.

The nearly parallel fibro-vascular bundles grow more numerous as they approach the circumference of the stem and as is usual in similar stems lose most, or sometimes all, of the woody elements, thus becoming pure bast. The parenchymatic tissue which toward the center of the stem may be composed of a layer of five or six cells between the bundles, decreases in amount near the circumference until but one layer of cells remains. The walls of the cells in this single layer often become so thickened, and at the same time compressed by the growth of the bast, that these bundles appear to make a solid zone of bast around the circumference of the stem. The bast-cells also continue to thicken their walls until they become, in the best specimens for the filament, completely filled and solid.

It is from this zone of bast at the circumference of the stem that the filament is always taken.

The following characters will be found to exist in such a filament: Bast fibers solid; very compact without inter-cellular spaces; nearly parallel; joined together by mitred ends thus appearing as continuous fibres; the presence of a minimum amount of parenchyma possible in such filament; a sufficient amount of cohesion between the separate fibres to often cause the separation of bast-cells in halves upon splitting the material.

These characters secure the least possible diversification of cells, *i.e.*, the most homogeneous structure which can be secured where long, solid fibers are sought. This filament is perhaps the nearest approach, in its continuity of structure and uniform character, to a metallic conductor of any tissue which can be found in the vegetable kingdom.

The Botany of the Bahamas.—PROF. CHARLES S. DOLLEY remarked that the list of Bahama plants which he presented for publication this evening represents one hundred and fifteen families, four hundred and ten genera, and six hundred and twenty-one species. One-third of the families (forty-seven) are represented by but one or two species each, another third by five species or less. Nearly two-thirds of the genera have but one representative.

In order of importance, or number of species, the families are *Leguminosæ*, fifty-three sp.; *Euphorbiaceæ*, thirty-five sp.; *Compositæ*, thirty-two sp.; *Gramineæ*, thirty-two sp.; *Rubiaceæ*, twenty-three sp.; *Malvaceæ*, eighteen sp. The genera having the largest number of species are *Croton*, *Epidendron*, *Euphorbia*, *Passiflora* with eight species each; *Acacia*, *Cassia*, *Citrus*, *Eugenia*, *Ipomœa*, *Solanum* and *Tillandsia*, with six species each, and *Anona*, *Cereus*, *Cyperus*, *Eupatorium*, each with five species. Nearly one-third of the total number of species are of economic value; of those possessing medicinal properties there are forty-five astringents, thirty-four tonics, twenty-five purgatives and twenty-one diuretics.

A comparison of the Bahama–phænogamic flora with that of the Bermudas shows eighty-two families and one hundred and ninety-five species common to the two groups of islands.

While a large per centage of the flora is undoubtedly common to Florida and the neighboring islands of the West Indies, fully one-third of the species listed may be considered indigenous.

Unfortunately no tract similar to the "Walsingham tract" of the Bermudas has yet been found, in which the indigenous vegetation of the group remains undisturbed in the possession of the orginal surface.

The present rocks are æolian in formation, and the contained fossils resemble present species, facts which indicate the recent character of the Bahamas.

That the older vegetation has been exterminated by wind and water erosion and by subsidence, and that it, in its turn, grew upon a surface of æolian origin is well shown by the present state of Booby Island and similar barren Cays. Here the surface is covered by grotesque excrescences produced by the wearing away of the softer portions of the rock. Among these projecting masses, many are tubular, the lumen of the tubes ranging from a fraction of an inch to over a foot in diameter. These tubes bifurcate and branch in various ways, and at first sight suggested to the speaker the idea that they might be fulgurites. Close examination shows that the rock of which they are formed consists of minute water-worn grains of calcareous material, comminuted coral and shell, cemented compactly together; in fact, they resemble in structure the rocks of the fertile islands. They are, however, very much hardened on the inner surface and a distinct zone of harder substance is apparent upon fresh transverse fracture.

This vitreous appearance, together with evidence that the tubes had been formed while the sand was in an uncompacted condition, recalled Darwin's description of fulgurites found in a similarly exposed locality near the La Plata[1] and those found at Drigg

[1] Journ. of Researches into the Nat. Hist. of countries visited during the Voyage of H. M. S. Beagle, Vol. I, p. 76.

in Cumberland.[1] Specimens brought to Philadelphia, however, and carefully examined chemically and microscopically go to prove that these tubes are not the result of lightning strokes, and that the hardened interior is not vitrification, but solidification due to partial solution of the loose grains of sand.

Evidence is thus obtained to show that these tubes represent the ramifications of plant roots of a now exterminated flora; plants which existed probably upon the first sands drifted upon the original rocky core. The juices of the roots acting upon the sand immediately surrounding them formed a compact layer. Through erosion and subsidence the vegetation was afterwards exterminated, the looser particles of the drift rock worn away and the surface left covered by myriads of tubes of all sizes formerly occupied by plant roots and rootlets. The small islands exhibiting these peculiar formations are indications, therefore, of erosion and subsidence, and in the Bahamas, the processes of land destruction and land formation may be seen actively at work. There is reason to believe that the topography of the present islands has undergone great change, and the probabilities of finding a locality in which the present flora represents an undisturbed indigenous growth are slight.

Fossil corals of recent types are found much above high water-mark; large caves with their floors above tide level exist, together with many other evidences of land elevation. Many of the islands show the formation of æolian rocks in progress, while in the great bights dividing Andros Island, and elsewhere, the deposition of foraminifera has been so great that former channels and sponging grounds have within very recent years become too shallow for approach. On the whole the Bahamas seem to be growing, but changes in the configuration of the group have also undoubtedly been going on through erosion and local subsidences probably owing to the undermining action of the waves.[2]

The role played by vegetation in determining the character of land surface is again well shown in the so-called "Banana holes," so abundant in New Providence and other islands, holes varying in size from that of a pint cup to that of a large cistern. They are suggestive of pot holes, but can have no such origin and are evidently not cut out by the waves at any previous period of subsidence. He could account for their formation in but one way, and that is through the action of decaying vegetable matter. Each of these holes contains large quantities of leaves and other vegetable substances which, being kept wet by the heavy rains and by the fresh water elevated by each rising tide (almost all wells have a regular ebb and flow in these porous islands), undergo fermentative changes, by the products of which the soft calcareous rock is dissolved and leaches away. He was interested also in examining sections of ex-

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[1] Geol. Trans., Vol. ii, p. 528.

[2] Vid. Fewkes, on the Origin of the Present Form of the Bermudas, Proc. Boston Soc. Nat. Hist., Vol. xxiv, 1888, p. 518.

posed coral rock, to find in the minute interstices, between the component grains, actively living protococci, sometimes at a depth of $\frac{1}{12}$ –$\frac{1}{6}$ of an inch. Undoubtedly these little plants have much to do with the rapid breaking down of the rock surface.

The list of plants was in its original shape placed at his service by Sir Alfred Blake then Governor of the Bahamas.

The speaker had been able to add quite a number of species from his own collections made for the University of Pennsylvania,[1] from a list of plants collected by Prof. F. H. Herrick[2] and from collections made by his friend Dr. Anna H. Searing, of Rochester, New York. While the botany of the Bermudas has been well worked up,[3] no extensive lists have before been prepared for the Bahamas, and he therefore felt justified in presenting the paper recorded by title this evening.

The celebrated botanist Andre Michaux visited these islands over one hundred years ago, and sent to France over nine hundred trees and twenty boxes of seeds. No record exists of these other than this fact, recorded in Michaux's journals. Lists and specimens of many valuable woods and textile plants were sent to the colonial exhibition,[4] together with a series of over sixty beautiful life-size, water-color paintings of many of the more interesting plants made by Mrs. Blake. From time to time notes and reports have been published on special agricultural plants[5] and references to the more striking plants occur in the various popular accounts of the Bahamas and in the various works on the history of these islands. The larger islands, such as Abaco and Andras, could supply much valuable timber, were it not for the difficulty of bringing it from the interior to the harbors. Although surface soil is very scant throughout the islands, the difficulty of cultivation does not consist so much in

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[1] Vid. Preliminary Abstract Report of the Marine Laboratory, Ann. Report of the Provost for 1887.

[2] Flora of Abaco and Adjoining Islands, Johns Hopkins Univ. Circ., Vol. vi, p. 46.

[3] The Botany of the Bermudas by Sir John Henry Lefroy, F. R. S., Bull. U. S. Nat. Mus., No. 25, Part II, 1884.

Plants of the Bermudas, or Somers Islands, by Oswald A. Reade, Royal Gazette Office, Hamilton, Bermuda, 1885.

On the Lichens of the Islands of the Atlantic Ocean (Bermuda) Journ. Linn. Soc. (Botany), Vol xiv, p. 366, by J. Stirton.

On the Lichens collected during the Challenger Expedition, ibid., xvi. by J M. Crombie.

Notes on the Vegetation of the Bermudas. On the Marine Algæ of St. Thomas and the Bermudas, by H. N Moseley, ibid , xiv, p. 311, 317.

On the Marine Algæ of St. Thomas and the Bermudas by George Dickie, ibid., Vol. xiv, p. 312.

[4] Commercial and Technical Report on West Indian and British Honduras Products at the Colonial and Indian Exhibition, 1886. Wm. Clowes and Son, London.

[5] Local Notes on Science and Agriculture, Four Series, Nassau Guardian, 1886, by John Gardiner. Report on the Agricultural condition and prospects of the Bahamas, Nassau N. P. April 17, 1886, by John Gardiner.

natural obstacles, as in the lack of enterprise shown by the people and the poor market facilities. The larger growers of pine apples, bananas, etc., are Americans, and the islands present a most inviting place for the employment of American capital and energy. Unlike the Bermudas, deciduous trees are abundant and furnish a natural contribution and aid to cultivation, while the cedar, which retards cultivation, is not of sufficient abundance to have any importance. Large quantities of sea weed are available, which, combined with cave earth and sand, would furnish a cheap and available fertilizer. Most of the West Indies have had their flora greatly enriched by the introduction of exotics through Government or individual influence; the Bahamas, on the other hand, while offering a much more favorable and uniform climate than the Bermudas or the more tropical islands, has been singularly neglected, and formerly cultivated fertile tracts have been allowed to grow up in dense bush or to become denuded of soil. The present Government is making a strong effort to develop the culture of *Agave Mexicana* or Sisal Hemp.* Botanists will find a rich and almost untouched field in the cryptogamic flora of these islands, especially in the Algae.

The Sand-Dunes of Lewes, Del.—Prof. J. T. ROTHROCK spoke briefly of the dunes at Lewes, Delaware, and illustrated his statements by some photographs, recently taken by him at that place.

It may be stated in advance that, while the conspicuous change in the surface has been most marked toward Cape Henlopen, the marshes between the Breakwater and the mouth of Lewes Creek have been slowly rising: that whereas a few years ago these marshes were a large number of times overflowed each year, that now this occurs so seldom that the flats are being built upon, and regular crops of marsh hay taken from them. South of the Breakwater, and say one fourth of a mile inland, one encounters a mass of pure shore sand, probably in its greatest depth one hundred feet deep, becoming on the north and south and west less and less deep until one reaches nearly the sea-level. On top of this ridge the dead trunks of former forests rise out of the sand. On the northern slope they become less and less abundant, disappearing when one reaches the marsh level. North of this, toward the water's edge a second growth of trees is seen appearing. On the southern slope of the ridge a forest of *Pinus rigida* stands, but this forest, by the moving of the sand toward the south, is being constantly encroached upon.

Indeed, at present one may there see trees standing on the natural level, in no wise surrounded or endangered by sand. A few yards to the north of these is the face of the advancing sand hill. There one finds the Pines in all stages of burial, from those whose roots are barely touched, to those (sixty to eighty feet high) whose

* Report of George Preston, Esq., as Special Commissioner to Yucatan to Inquire into the working of the Fibre Industry in that Country. Nassau N. P., 1888.

extreme tips alone remain above the sand. How many are absolutely covered, one can hardly even guess.

The force at work here is plain enough. The wind from the north and north-east drives the sand to the hill-top, and when it reaches the crest, gravity carries it down the southern declivity. Once the forests have been killed, and the leaves are fallen, there is nothing to arrest the force of the wind and the slow process of uncovering the tree trunks by the sand drifting away from them begins. This, however, appears to be simply shifted further south, covering up fresh forests as it advances. While, therefore, ground is being lost to the forests and to the hay makers in the south and west, there is a gain on the north, for enough of the sand remains there to raise the general level of these meadows slightly, and to make them less subject to frequent overflow. Indeed as we have seen, a second forest growth is commencing on that very spot.

To one familiar with the dunes on Cape Cod, those of Lewes are striking from the fact of the absence of the wild rose, blueberries, beach-plums, etc., which one finds so common in the Massachusetts examples. They illustrate further, that we have on our own soil, and within a few hours of this city, the same forces operating which were so destructive on the shores of the Bay of Biscay. These dunes and trees suggest further that the same remedies which restored a vast area (rescued from the sandy deluge) again to France may in time have to be appealed to here. There is, however, this difference, that whereas, in Europe, it was the *Pinus Pinaster* Soland. or Maritime Pine that was used to make seaward barrier, we here can safely depend upon the *Pinus rigida* or Pitch Pine, which is thriving now at Lewes, to accomplish this same result. Indeed from Massachusetts south to Lewes, here and there, in sight of the sea and on a most sandy soil this tree is flourishing almost as well as it does on the rocky hillsides in the interior of Pennsylvania.

MAY 14.

Mr. EDW. GOLDSMITH in the chair.

Twenty-three persons present.

A paper entitled "Catalogue of the Muscicapidæ in the Collection of the Academy," by Witmer Stone was presented for publication.

Notes on Corema Conradii.—Mr. J. H. REDFIELD stated at the meeting of the Botanical Section of the Academy held May 13th, that it had been supposed of late years that *Corema Conradii* Torr. had disappeared from the pine barrens of New Jersey, the earliest reported station for the plant. He referred to an unsuccessful search for it, made by the late Charles F. Parker and himself in April, 1869, at Cedar Bridge, Ocean Co., N. J., where Dr. Torrey had seen it in 1834 and had indicated the exact locality in the Annals of N. Y. Lyc.

Nat. Hist. IV. 85. In a notice of that search given in the Proceedings of the Academy for 1869, p. 91, Mr. Redfield had said, "If the Corema is again to be discovered in New Jersey it will probably be in the wide sandy waste a few miles west of Cedar Bridge, near the boundary between Burlington and Ocean Counties, where a succession of elevated ancient beaches offers conditions similar to those of Cape Cod." He had now the satisfaction to report that about two years ago the plant was discovered by Prof. Merrill of Columbia College, N. Y., in the precise region which had been indicated. The place was soon after visited by Prof. Britton, and in April of this year, at the invitation of the latter, Mr. Arthur Hollick, Dr. J. B. Brinton and Mr. Redfield had accompanied him in a visit to the locality which lies about three miles west of Cedar Bridge, and about eleven miles west of Barnegat. The region is most singular in its aspect and impresses one with a sense of desolate loneliness. Forming the divide or water-shed, it rises in gentle swells which command an extensive view of a sandy desert leached by the rains to a degree of barrenness such that the scattered trees of *Pinus rigida* can attain the height of only three or four feet. The party was surprised at the amazing extent of *Corema*, exceeding that of any locality yet reported in the United States, being more or less abundant over a tract nearly a square mile in extent, its scattered patches in some places becoming confluent over large spaces. Myriads of young seedlings were also springing up in the bare white sand, so that there is little prospect of the plant becoming extinct. This is now the most southern station known for *Corema*, and was probably the origin of the few patches which Dr. Torrey found at Cedar Bridge, in 1834, but which had disappeared before 1869.

The following communications were made in connection with the proceedings of the Conchological Section:

The Radula in Rhipidoglossate Mollusks.—Mr. H. A. PILSBRY spoke of the modes of specialization of the radula in rhipidoglossate mollusks illustrating his remarks by black-board diagrams. He stated that the marginal teeth undergo but slight variations throughout the group. The reduction in number of the teeth consequent upon the enlargement of the individual teeth takes place in the median portion of the membrane, where differentiation of the primitive homodont radula commenced. In the family Trochidæ the outer lateral teeth (next to the numerous undifferentiated marginal teeth) become degenerate in the more specialized forms (*Trochus, Clanculus, etc.*) which have only five perfect laterals, a sixth being represented by a small plate without cusp or cutting point. In certain other genera of Trochids, there are seven or more laterals. In Turbinidæ and Phasianellinæ, on the other hand, the reduction in number of the teeth proceeds by the obsolescence or total loss of the central tooth (as in the group of Phasianellæ which the speaker had named *Orthomesus*), or the loss of the cusp of the tooth, as in certain sections of the genus *Astralium*. This process is followed by the obsolescence of the inner lateral teeth, shown in certain species of *Astralium* in which the cusps of these teeth are absent. The same course had been followed in the Neritopsidæ, where, as Dr. Fischer has shown, the central and inner lateral teeth have been lost. Attention was called to the anomalous radula of *Phasianella virgo* Angas, a species of *Orthomesus* in which the rhachidian tooth was replaced by a false central tooth, formed by the coalescence of the two inner lateral teeth.

Remarks on Oliva inflata, Chem., O. irisans, Lam. and other species of shells.—MR. JOHN FORD exhibited a large number of specimens representing *Oliva inflata* Chem. and *Oliva irisans* Lam. In referring to the various colors and forms of the series shown he called attention to the difficulties attendant upon a correct separation of the species comprised in the genus. As evidence of thereof it may be said that fully one hundred and fifty names have been applied to the species which altogether do not number more than sixty.

Mr. Tryon reduced the number to fifty-five, and a careful examination of the Academy's collection will show no reason for questioning his judgment.

Very many of the discarded names were, by Marratt and other writers, avowedly based upon color varieties only. A larger number, however, may be safely charged to the lack of opportunity for comparing the newly-discovered specimens with others already named, and an absence of the literature referring to them.

These latter difficulties can be readily comprehended if a casual glance be given to the two species under consideration, showing as they do at least twenty varieties of color, including one perfect albino, and half as many different forms. And yet a close observation will satisfy the most skeptical student that certain characters proving their specific distinction are present in each.

These conclusions apply also to several other species belonging to the genus,—markedly so to *O. ispidula* Lam. *O. araneosa* Lam., and *O. reticularis* Lam.,—each shell in the first-named species varying in color, and often in form, from either of its otherwise closely allied fellows.

While much that has been said will apply with equal force to *O. irisans*, it has been deemed best in this instance to retain several of the names formerly held as specific, but with the understanding that they be used for varieties only.

Thus we have as the type of the species, *O. irisans*, Lam., and as varieties, *concinna* Marratt, *tremulina* Lam., *erythrostoma* Lam. and *textilina* Lam.

With the series of *O. inflata* shown, there are a dozen specimens belonging to the species, but which are distinct in two characters at least from all of the others. To these the varietal name *Ocumralli*, has been given by the speaker. Though all of the specimens are well developed, they are singularly pale in color, and have a more delicate structure than any of the species heretofore observed.

They are also ornamented with small chocolate-colored spots or mottlings, quite unusual to the species. Though secured in one lot, their habitat is still conjectural.

Reference was also made to a new species of *Helix*, found in the Island of New Guinea.

This the speaker had named *Helix Dentoni* in honor of the discoverer, Mr. Wm. Denton, who died while pursuing his researches in the wilds of the island mentioned. The type, which has been presented to the Academy, was received from Mr. Geo. W. Dean, of Kent, Ohio, to whom it was sent from New Guinea by the sons of Mr. Denton. Its habitat is therefore established.

The species belongs to the sub-genus *Trachia*, its nearest ally being *H. Tuckeri*, Pfr.; but it may readily be distinguished from the latter by the continuous peristome, more oblique aperture and deeper constriction of the whorl behind the lip.

In reference to the lasting character of the colors of shells when properly cared for, attention was called to a magnificent *Triton tritonis* belonging to the speaker. This specimen is 18 inches long, 11 inches high, and has an expanse of lip 6 by 9 inches. Though known to have been out of its native element for more than fifty years, the external colors are still perfectly patterned and brilliant, while the crimson and white sun-burst covering the inside of the lip is a bit of coloring which an artist might envy.

May 21.

The President, Dr. Joseph Leidy, in the chair.

Twenty-eight persons present.

In connection with the proceedings of the Biological and Microscopical Section the following communication was made:—

On the fore and aft poles, the axial differentiation and a possible anterior sensory apparatus of Volvox minor.—Prof. J. A. Ryder remarked that he had recently had an opportunity to study a very large colony of *Volvox minor* Stein, which appeared in the aquarium jars kept in the Conservatory of the Biological Department of the University of Pennsylvania. As some of the singular features of these algæ which he had noticed were apparently unrecorded, it was desirable that they should be described in order that others should have an opportunity to more fully investigate the facts and their bearings upon the life-history of these singular organisms.

It was noticed that there was an empty pole in every colony or cœnobium. This empty or non-spore-bearing pole was always the anterior one, or that which was directed forwards in the act of locomotion, which is effected by a rotating motion of the whole cænobium impelled by the flagella of its cells projecting through its envelope of cellulose. The direction of the rotation of the cænobia is not constant and may be either sinistral or dextral, but the direction of progress always coincides with an imaginary axis passing through the centre of the anterior empty pole and the posterior germ-bearing portion of the nearly spherical colony or cænobium. These poles are sometimes differentiated before the young Volvoces leave their parent cænobium, which they do by breaking through the wall of the latter at its hinder pole.

The diameter of a Volvox cænobium is slightly longer measured along the axis around which it revolves than in the direction transverse to it. It results from this that the cænobia are somewhat smaller equatorially than axially so that the form of the whole is that of a very slightly oblong spheroid. These characters are fairly constant and nearly always apparent while that of the production of the spore in a little more than the posterior hemisphere of the cænobium is invariable as well as the uniform direction of the axis of progressive locomotion in relation thereto.

Another very extraordinary fact which was observed was that the so-called "eye-spots" found in the flagellate cells of the anterior pole of the spherical cænobium were the largest, and invariably occupied a definite position with relation to the flagella and to the axis around which the colony rotated. The anterior cells had the brownish red "eye-spots" largest, and as one examined row after row of the cells of the cænobium in succession backward toward what one might term the *caudal pole* these "eye-spots" were seen to gradually diminish in size, until in the last cells of the hinder pole, they were barely distinguishable as minute reddish points, which elevated the protoplasm of the cells into a slight prominence, such as is more marked over the larger anterior "eye-spots." This remarkable fact of the "eye-spots" of the anterior pole being the largest, revives in a striking way the query whether these reddish bodies are not really visual organs or sense organs of some kind, after all, as originally supposed by Ehrenberg. Their gradual diminution in size toward the posterior pole where they are nearly atrophied would seem to indicate that they were in some way related to the power of the organism to move in a definite direction, the cells of the anterior end being provided with the best developed visual, sensory apparatus, or whatever it may be. If it should prove possible to show that these "eye-spots" are really sensory organs in *Volvox*, as all the facts which have been here noted would seem to indicate, it would be one of the few instances known of a plant possessed of visual or sensory organs of any kind unless we except some such plants as the Venus' fly-trap.

The speaker stated that he had been unable to find any notice of any of the features of *Volvox*, which are here described; all of the figures to which he had had access in standard works were entirely erroneous from their authors having completely overlooked these very salient and important features of this remarkable plant. This should therefore be regarded as his apology for bringing a very common organism to the notice of the Academy, and to the renewed attention of the microscopists who take pleasure in studying it. It is to be hoped that some one who is skilled in such work may be induced to take up the study of *Volvox* anew and publish a well-executed drawing of a colony in which the facts here recorded are adequately represented. This is all the more desirable in that, if *Volvox* is really a plant, its psychological history should be as much a matter of interest as its singular beauty and its intricate methods of reproduction seem to have been.

MAY 28.

Dr. W. S. W. RUSCHENBERGER in the chair.

Eighty-three persons present.

A paper entitled "A review of the American Species of Priacanthidæ" by Willard L. Morrison.

The following were elected members:—Emma Walter, Henry Bentley, Henry C. Johnson, and William W. Meigs.

George H. French of Carbondale, Ohio, was elected a correspondent.

The following were ordered to be printed:—

ON SOME NEW SPECIES OF MOLLUSCA FROM THE BERMUDA ISLANDS.

BY PROFESSOR ANGELO HEILPRIN.

The following species were obtained in the summer of 1888, during a brief sojourn with a class of students from the Academy of Natural Sciences.

Chama Bermudensis. Pl. VIII, fig. 1.

Shell thick, ponderous, sub-cordiform; the right valve considerably smaller than the left, but yet thicker and deeper than in most Chamas; beak of left valve prominent, spirally incurved; ligamental furrow in left valve deep, arciform; dental sulcus broad, moderately deep, and supported inferiorly by a prominent plate tooth.

Muscular impressions elongated, not deep. External surface roughly corrugated by the lines of growth.

Height of shell (left valve), measured to top of beak about three inches; length, measured along the antero–posterior axis 2·3 inches; thickness of single valve 1·2–1·5 inch.

Dredged in large quantities in Harrington Sound.

Macoma eborea. Pl. VIII, fig. 2.

Shell moderately inequilateral, truncated in the lower half of the posterior slope; anterior slope regularly declivous, the posterior flattened. Right valve with widely diverging cardinal teeth, the space between which receives the double-tooth (grooved medially) of the left valve; lateral teeth in right valve.

Pallial sinus large, extending more than half across the shell; external surface (white) concentrically and delicately lined by the lines of growth.

Length of shell three-quarters of an inch; height, two-thirds of an inch.

Mysia pellucida. Pl. VIII, fig. 3.

Shell thin, convex, ovally orbicular; the umbones moderately prominent; no lunule; hinge-line linear, a single medially-grooved cardinal tooth in the left valve (resembling *Felania*).

Adductor impressions oval, not much elongated. Shell white, nearly smooth. Length of single specimen somewhat over a half-inch; height the same.

Cytherea Penistoni. Pl. VIII, fig. 4.

Shell sub-trigonal, the beaks prominently elevated; lunule cordiform; the dental characters normally those of the genus; anterior lateral tooth (left valve) triangular, lamellar.

Margin of shell even; pallial sinus broad, directed upwards, and not quite reaching the centre of the shell. Lines of growth closely set, and even. Shell covered with a chestnut epidermis; interior purplish.

Length ·6 inch; height ·5 inch.

It gives me pleasure to name this delicate, and abundantly represented, Cytherea after my friend Miss A. Peniston, of Peniston's, from whom I have received much valuable assistance in the preparation of my material illustrating the Bermudian fauna.

Emarginula dentigera. Pl. VIII, fig. 7.

Shell flattened, scutiform, broadened posteriorly, and with the apex slightly sub-central; surface with radiating ribs, which alternate in size—sometimes two smaller ones between each pair of large ribs—and project (the larger ones) prominently beyond the general margin. The impressed concentric lines give to the ribs a knobbed appearance. Fissure fairly long, narrow.

Length nearly ·25 inch; height ·1 inch.

Emarginula pileum. Pl. VIII fig. 6.

Shell elevated, with the form of a Phrygian cap; apex largely posterior, well beaked; radiating lines alternate, deeply impressed by the concentric lines of growth, and appearing knobbed. Fissure moderately long, parallel-sided, and occupying the position of one of the larger ribs.

Length slightly exceeding a quarter of an inch; height ·2 inch.

Cæcum termes. Pl. VIII, fig. 5.

Shell arcuate, gradually increasing in size anteriorly, where it is somewhat swollen; surface longitudinally-costated, the costæ appearing slightly rugose near the swollen base through the passing of the lines of growth. Mucro distinct, well excentric.

Color of shell yellowish; surface glossy.

Length about ·1 inch.

This form appears to be fairly abundant. It may be readily distinguished from most of the other longitudinally-costated species by the very nearly equal diameter of the shell, being only slightly swollen basally.

ON A NEW GENUS AND TWO NEW SPECIES OF OPHIURANS.

BY J. E. IVES.

In a collection of Ophiurans principally from the west coast of North America, but also from localities in the North and South Pacific, recently received by the Academy from Mr. W. N. Lockington, there are two apparently undescribed forms, representing a new genus and a new species respectively.

They unfortunately have no locality attached to them. They are described below. The figures representing the upper and lower surfaces of the disk and of an arm, and the views of the side arm plates near the base of an arm are enlarged two diameters. The views of the outer and inner faces of an arm-bone of *Ophioncus granulosus* have been magnified considerably (Figs. 4, 5).

OPHIONCUS, n. g.

Upper surface of disk covered with swollen plates and granulated; no notch in the disk over the base of the arms; teeth few; no tooth papillæ; mouth papillæ small, even, numerous; side mouth shields long, not meeting within; arm spines, few, short, arranged on the outer edge of the side arm plate; upper and lower arm plates entire; four genital openings in each interbrachial space. The genital openings nearest to the mouth are long and narrow, and widest at their inner ends; the openings farthest from the mouth are small and nearly circular. These four genital openings appear to have been formed from the two usually found by the edges of each of the two original slits meeting near their outer ends. I believe that *Ophiura* is the only other genus of *Ophiuridæ* possessing four genital openings. In *Ophiura*, however, the inner opening is smaller than the outer one. *Ophioncus* in general characters somewhat resembles *Ophiozona*, but differs markedly in the swollen granulated plates of the disk and in the presence of four genital openings and two tentacle scales. The arm bones (figs. 4, 5) appear to have more resemblance to those of *Ophiozona* than to those of any other genus.

Ophioncus granulosus, n. sp. (Figs. 1–5.)

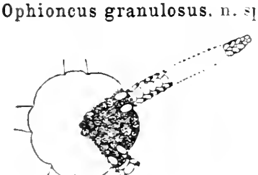


Fig. 1

Upper surface of disk covered with irregular swollen plates, granulated; small irregularly oval, naked radial shields. Lower surface of the disk covered with smooth scales, granulated; mouth shields, ovate with the smaller end directed towards the mouth, partially granulated; side mouth shields longer than broad, inner ends not meeting within; teeth two or three, conical, pointed, flattened from above downwards; mouth papillæ about eighteen to each mouth angle, small, closely placed, touching one another, the inner ones bluntly conical and becoming squarer as they pass outwards. Edge of the disk between the arms slightly swollen. Arms, length not much greater than the diameter of the disk, short, flat; outer edges of the upper arm plates convex, about twice as wide as the inner edge; the lateral edges straight; side arm plates projecting forwards and outwards, meeting above and below only towards the tip of the arm, bearing five short stout spines, the lowest rather longer than the others and the base covered by the outer tentacle scale; sometimes near the base of the arm there are one or two supplementary spines within and between the others; under arm plates four-sided with the inner angles truncated, longer than broad, outer edge convex, wider than the inner edge; lateral edges concave; two tentacle scales, the inner one the larger of the two. Diameter of the disk about 7 mm.; length of arms about 9 mm.


Fig. 2.


Fig. 3.


Fig. 4.


Fig. 5.

Color of single dried specimen, a very light brownish tint.

Ophioglypha Lockingtoni, n. sp. (Figs. 6–8.)

Disk stout, flat; dorsal surface with central rosette of primary plates; a similar plate in each interbrachial space, and in each of the interbrachial spaces of the edge of the disk; radial shields rounded pentagonal, about the same size as the primary plates; between the larger plates there are smaller ones. Mouth shields covering the greater part of the interbrachial spaces of the under surface of the disk, ovate with the narrower end turned inwards; side mouth shields oblong; outer pair meeting along their whole length, and their outer ends resting upon the inner end of the mouth shield; the inner pair meeting along the greater part of their length, and their outer ends resting upon the inner ends of the outer pair. The rest of the lower surface of the disk is covered with a few smaller scales. Arms, short, strongly keeled; upper arm

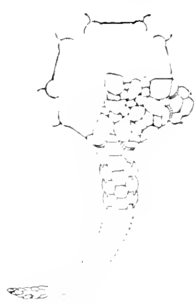


Fig. 6.

plates convex, rounded hexagonal; side arm plates convex, about three times as high as broad, not meeting above or below, bearing a single small arm spine rather more than half way up the side of the arm; on some of the arm plates there are one or more extremely rudimentary papillæ; mouth tentacle pores opening into the mouth slit, and having six tentacle scales on the inner side and five on the outer; five tentacle scales on the inner side of the sixth arm plate and one

Fig. 7.

tentacle scale on the outer side; farther out the tentacle scales on the outer side of the tentacle pores disappear altogether; papillæ of an arm comb about seventeen in number, squarish flat and touching each other and borne by a semicircular plate about four times as long as broad; under arm plates rather convex, irregularly hexagonal, longer than broad; about nine mouth papillæ in each mouth angle, those at the side of the angle small flattened, three rather larger pointed ones at the apex. Diameter of disk 9 mm.; length of arms 17 mm.

Fig. 8.

Color of the two dried specimens, dull straw.

This form approximates more or less to many of the species of this prolific genus but may be distinguished by its large ovate mouth shields, and the following combination of characters:—the possession of a single arm spine, the shape of the upper and lower arm plates, and the arrangement of the plates covering the disk.

CATALOGUE OF THE MUSCICAPIDAE IN THE COLLECTION OF THE ACADEMY OF NATURAL SCIENCES OF PHILADELPHIA.

BY WITMER STONE.

The arrangement of the present list is based upon Sharpe's Catalogue of the Birds in the British Museum. The number of species of Flycatchers there recognized is 391, and the addition of the species since described will swell the number to somewhat over 400; but a considerable number of these will, I think, eventually be reduced to mere varieties or geographical races.

The Academy's collection contains 156 species of Muscicapidae represented by 592 specimens and includes the types of 34 species.

The principal individual collections included in the Academy collection are as follows:—

The collections of Gen. Massena, Duke of Rivoli and his son, the Prince d'Esling, including specimens from all over the world.

The Gould collection of Australian birds comprising the types of the great work "The Birds of Australia."

A collection of Indian birds made by Capt. Boys of the British Army.

Du Chaillu's collections in Western Africa containing the types of many of Mr. Cassin's species.

In the following list the localities given after each species are those from which the Academy possesses specimens:

HEMICHELIDON SIBIRICA (Gm.), India.

MICROECA FASCINANS (Lath.), Australia. Gould collection.

MICROECA ASSIMILIS Gould, W. Australia. Types of the species.

MICROECA FLAVIGASTER Gould, Pt. Essington, Australia. Types.

ALSEONAX LATIROSTRIS (Raffl.), India and Japan.

ALSEONAX ADUSTA (Boie), Cape of Good Hope.

ALSEONAX COMITATA (Cassin). Types of the species, from Muni River, W. Africa. Collected by Du Chaillu.

ALSEONAX EPULATA (Cassin). Three specimens from W. Africa. Collected by Du Chaillu, including the type.

BATIS CAPENSIS (Linn.), Cape of Good Hope.

BATIS SENEGALENSIS (Linn.), Africa.

BATIS MOLITOR (Halm.), Africa,

BATIS PRIRIT (Vieill.), Elephant's Bay, W. Africa.

DIAPHOROPHYIA CASTANEA (Fraser.), Gaboon district.

BIAS MUSICUS (Vieill.), Gaboon. Collected by Du Chaillu.

ARTOMYIAS FULIGINOSA (Verr.), Gaboon. Du Chaillu.

ARTOMYIAS USSHERI Sharpe.

One specimen collected by McDowell on St. Paul River, Siberia, is referred to this species. The under parts are nearly uniform ashy brown.

PLATYSTIRA CYANEA (Müll.), West Africa.

PLATYSTIRA PELTATA Sundev., Zanzibar.

MUSCICAPA GRIZOLA Linn., Europe and Africa.

They include one from Cape of Good Hope and several from Du Chaillu's collection on Camma River.

MUSCICAPA GRISEISTICTA (Swinh.), Luzon.

MUSCICAPA LUGENS (Hartl.)

Two specimens, male and young, types of *M. Cassini* Heine collected by Du Chaillu on the Camma River, W. Africa. These birds evidently belong to *M. lugens* as suggested by Mr. Sharpe (Catalogue of Birds, vol. IX, p. 156). The under wing coverts are cinereous, some of them more or less tipped with white. The young bird is spotted above with rufous and has the tail feathers all tipped with white.

MUSCICAPA ATRICAPILLA Linn., Europe Algiers, Morocco, etc.

MUSCICAPA COLLARIS Bechst., Europe.

MUSCICAPA PARVA Bechst.

A series from Europe and also two collected by Capt. Boys in India which seem to belong here and not to the following species; indeed it seems probable that the two forms shade into one another where their limits approach.

MUSCICAPA ALBICILLA Pall., India.

PETROICA LEGGII Sharpe (= *P. multicolor* of Gould's Birds of Australia). A fine series from S. and W. Australia, Tasmania and Kangaroo Island from the Gould collection.

PETROICA PHOENICEA Gould, Types of the species. S. Australia and Tasmania.

PETROICA MULTICOLOR (Gm.), (= *P. erythrogaster* of Gould's work), Norfolk Island. Gould col.

PETROICA RHODINOGASTRA (Drap.). Tasmania and S. Australia. Gould col.

PETROICA ROSEA Gould. Types of the species. New South Wales.

PETROICA GOODENOVII (Vig. and Horsf.), S. and W. Australia. Gould collection. I think it is doubtful whether *P. ramsayi*

Sharpe is specifically distinct from this species, it is the western form and is distinguished from *P. goodenorii* by having the center of the throat red. In Gould's collection a Southern bird has considerable red on the throat and among those from W. Australia is a typical *P. goodenorii.*

PETROICA BICOLOR (Vig. and Horsf.), New South Wales. Gould collection.

PETROICA TOITOI (Garnot), New Zealand.

PETROICA MACROCEPHALA (Gm.), New Zealand.

PETROICA VITTATA (Quoy and Gaim.), Tasmania. Types of *P. fusca* Gould.

PRATINCOLA RUBETRA (Linn.), Europe and N. Africa.

PRATINCOLA RUBICOLA (Linn.), Europe.

PRATINCOLA MAURA (Pall.), India.

PRATINCOLA TORQUATA (Linn.)

A series from Cape of Good Hope including one albino.

PRATINCOLA SYBILLA (Linn.)

Several from Madagascar and one from Gaboon (the type of *P. salax* Verr.) which seems identical with this species. (Proc. Phila. Acad. 1889, p. 78.)

PRATINCOLA LEUCURA Blyth, Paree.

PRATINCOLA CAPRATA (Linn.), Luzon.

ERYTHROMYIAS PYRRHONOTA (Müll. and Schl.), Timor.

POLIOMYIAS LUTEOLA (Pall.), Java.

MUSCICAPULA HYPERYTHRA (Blyth), Java.

MUSCICAPULA MACULATA (Tickell), Borneo and Timor.

SMICRORNIS BREVIROSTRIS Gould, Australia.

SMICRORNIS FLAVESCENS Gould. Type of the species, Pt. Essington, Australia. Gould collection.

GERYGONE ALBIGULARIS Gould, New South Wales. Types.

PSEUDOGERYGONE CULICIVORA (Gould), W. Australia. Types.

PSEUDOGERYGONE MAGNIROSTRIS (Gould), Pt. Essington, Australia. Types.

PSEUDOGERYGONE FUSCA (Gould), New South Wales. Types.

PSEUDOGERYGONE LAEVIGASTRA (Gould), Pt. Essington, Australia. Types.

PSEUDOGERYGONE CHLORONOTA (Gould), Pt. Essington. Types.

CHASIEMPIS SANDWICHENSIS (Gm.), Sandwich Islands.

MIRO AUSTRALIS (Sparrm.), New Zealand.

METABOLUS RUGENSIS (Hombr.), Adult male; Ruk Island.

Poecilodryas superciliosus Gould, Central Australia. Types.
Hyliota flavigastra Swains., Senegambia.
Hyliota violacea Verreaux.

Type of species obtained from Verreaux by Dr. Wilson and also one collected by Du Chaillu, both from Gaboon.

Xanthopygia narcissina (Temm.), Japan.
Xanthopygia tricolor (Hartl.), Java.
Xanthopygia cyanomelaena (Temm.), Japan.

One specimen has the back quite green.

Tarsiger cyanurus (Pall.), Japan.
Tarsiger rufilatus (Hodgs.), Himalayas.
Tarsiger stellatus (Vieill.), Cape of Good Hope.
Lioptilus olivascens (Cassin). Type of species.

This unique specimen was described as a Parisoma (Proc. Phil. Acad. 1859, p. 52) and has been placed in the present genus by Sharpe. The specimen was collected by Du Chaillu on the Camma River, West Africa; it seems quite distinct from any other form in the Academy's collection.

Stenostira scita (Vieill.), Cape of Good Hope.
Parisoma plumbeum (Hartl.)

Several specimens from the Camma River being types of Cassin's *P. melanurum*, collected by Du Chaillu. One specimen, probably a young bird, differs somewhat from the others: it is browner above and has the under surface uniform brownish-ash, except the middle of the abdomen which is white. The feathers of the wings and rump are edged with fulvous, and the under tail coverts are rufous as is the case in all the Gaboon specimens.

Parisoma layardi Hartl., Cape of Good Hope.
Hypothymis azurea (Bodd.), Bengal.
Hypothymis occipitalis (Vig.), Philippines and Java.

This species is certainly very close to the preceding.

Chelidornix hypoxantha (Blyth), India.
Malurus cyaneus (Gm.), New South Wales. Gould collection.
Malurus gouldi Sharpe. (= *M. longicauda* of Gould's Birds of Australia.) S. Australia and Tasmania, Gould collection.
Malurus melanotus Gould. Types of the species. S. Australia.
Malurus splendens (Quoy and Gaim.), W. Australia. Gould collection.
Malurus leucopterus (Q. and G.), N. S. Wales. Gould collection.

MALURUS ELEGANS Gould, types of the species. W. Australia.

MALURUS LAMBERTI Vig. and Horsf., N. S. Wales and N. W. Australia. Gould collection.

MALURUS AMABILIS Gould. One specimen doubtfully referred to this species.

MALURUS PULCHERRIMUS Gould, W. Australia. Types.

MALURUS MELANOCEPHALUS Vig. and Horsf., N. S. Wales. Gould collection.

MALURUS DORSALIS (Lewin), (= *M. brownii* of the Birds of Australia), Pt. Essington. Gould collection.

ERYTHROCERCUS MACCALLII (Cass.). Two specimens from W. Africa collected by Du Chaillu. One is the type of the species.

TROCHOCERCUS CYANOMELAS (Vieill.), Cape of Good Hope.

TROCHOCERCUS NITENS Cassin.

Types of the species from Camma River, W. Africa, collected by Du Chaillu. I can not find any of the specimens referred to by Cassin as indicating another species. (Proc. Phila. Acad. 1859, p. 51.)

TROCHOCERCUS BORBONICUS (Gm.), Reunion and Mauritius.

RHIPIDURA FLABELLIFERA (Gm.), New Zealand.

RHIPIDURA ALBISCAPA Gould, S. Australia, also from the North and East Coast. Types of the species.

RHIPIDURA SATURATA Sharpe.

One specimen of this species from Tasmania in Gould's collection is labelled "*R. albiscapa*, Type;" the same as his other specimens, so he evidently did not think the Tasmanian form worthy of specific distinction.

RHIPIDURA FULIGINOSA (Sparrm.), New Zealand.

RHIPIDURA ALBICOLLIS (Vieill.), Java.

RHIPIDURA RUFIFRONS (Lath.), N. S. Wales, also one from Pt. Essington which is identical with the southern form.

RHIPIDURA SEMICOLLARIS Mull. and Schl., Timor.

RHIPIDURA SP.

One specimen from the Massena collection does not appear to agree with any of the described species. Below it is very much like *R. rufifrons*, the entire throat and neck are uniform black, the feathers edged with white as they join the breast, and those of the chin slightly tipped with white. Above the rufous color is confined to the tail coverts and basal portion of the tail. The locality has not been recorded and I think it hardly worth while to name the specimen without further data as it may be a stage of some other species.

RHIPIDURA DRYAS Gould.

Two specimens from Pt. Essington in the Gould collection labelled "*R. rufifrons*, type" Mr. Gould did not recognize the two forms as distinct until his supplement was published. It would be much better if this and a number of other forms recognized as species, in the British Museum Catalogue were considered as subspecies as they are, I think, nothing more than geographical races.

RHIPIDURA PHOENICURA Müll. and Schleg., Timor.

RHIPIDURA PERLATA Müll., Borneo and Sumatra.

RHIPIDURA SETOSA (Quoy and Gaim.), Two specimens from the Gould collection, types of *R. isura* Gould.

RHIPIDURA RUFIVENTRIS (Vieill.), Timor.

RHIPIDURA JAVANICA (Sparrm.), Java.

There are also several specimens of the form described as *R.longicauda* by Wallace, from the Indian Archipelago.

RHIPIDURA NIGRITORQUIS Vig., Luzon.

RHIPIDURA ALBIFRONTATA Frankl., Ceylon and Bengal.

RHIPIDURA TRICOLOR (Vieill.), Ceram, S. and W. Australia.

NEOMYIAS EURYURA (Müll.), Java.

ZEOCEPHUS RUFUS (Gray), Philippines.

TERPSIPHONE PARADISI (Linn.), Ceylon and India.

The collection contains short-tailed birds in the reddish plumage which are, I think, correctly referred to the adult female; also pure white adult males and several rufous-colored males apparently in full breeding plumage. These latter show two varieties of coloring, one uniform bay above including the wings and tail, breast gray, the center tail feathers very long. The other differs in having several of the secondaries and the outer tail feathers white, and the breast pure white instead of gray.

TERPSIPHONE AFFINIS (Blyth), Borneo and Java.

This is certainly very close to the preceding. A specimen of the Ceylon bird exhibits traces of black shaft lines and a specimen labelled "Java" is typical *T. paradisi.*

TERPSIPHONE MUTATA (Linn.), Madagascar.

Besides adult males and females which resemble the corresponding stages of *T. paradisi*, there is a fine series of young males exhibiting great variety of plumage the following being the most interesting:

No. 981 resembles the female but is rather brighter chestnut; tail feathers only slightly elongated, coverts and primaries edged with white.

No. 979 similar but with long central tail feathers.

No. 978 similar but with one of the long feathers white and one chestnut; the latter is the shorter, and the white one is spotted with rufous and has the outer web black for half its length.

No. 977 has both the long feathers white, the barbs and outer webs marked with black.

TERPSIPHONE CRISTATA (Gm.), Gaboon and also N. E. Africa.

This is probably the most perplexing species of this difficult genus, and after examining the types of Cassin's several species I think Mr. Sharpe was perfectly justified in uniting them all under *T. cristata*. The series collected by Du Chaillu in Gaboon contains connecting links between all the more distinct phases of coloration, and I think it is rather remarkable that Mr. Cassin did not notice the identity of some of the forms at least. Very young males are reddish above and gray beneath with the head and neck steel-green and the under tail coverts rufous.

No 991 is similar with white edgings to some of the wing feathers and with the central tail feathers longer than the others.

No. 988 apparently in breeding plumage is similar but has the secondaries, with the exception of the innermost, white on the outer webs, and the coverts pure white.

No. 990 has the under tail coverts gray, and the tail black and rufous; some of the secondaries are bordered with rufous and some with white. This is the type of *T. speciosa* of Cassin. Various other specimens are in about the same stage; some have the tail feathers red, some white, and others red, white and black on the same feathers. There are also adult males (types of *T. duchaillui* Cassin) and intermediate forms between these and the red-backed stages mentioned above.

TERPSIPHONE PERSPICILLATA (Swains.), Cape of Good Hope.

TERPSIPHONE TRICOLOR (Fraser).

A number of specimens from Gaboon collected by Du Chaillu, exhibiting various stages of plumage. The bird which I take to be the adult male is blue-gray above and bright orange-chestnut below, head glossy steel-black. The female is similar but duller, while the young birds are dull orange above and below.

There are other stages in the collection which perhaps represent the male in the first year. One is pure gray beneath, and gray above strongly tinged with orange, tail orange bordered with gray on the edges of the feathers; wings gray, with the secondaries and coverts bordered with rufous. Another differs in having the under tail coverts and rump dull orange; tail and wings uniform gray, the latter slightly tinged with rufous on the greater coverts.

TERPSIPHONE RUFIVENTRIS (Swains.), St. Paul River and Senegal, W. Africa.

TERPSIPHONE PRINCEPS (Temm.), India and Japan.

ELMINIA LONGICAUDA (Swains.), Senegal.

PHILENTOMA VELATUM (Temm.), Java and Borneo.

PHILENTOMA PYRRHOPTERUM (Temm.), Borneo and Sumatra.

CULICICAPA CEYLONENSIS (Swains.), Java.

MYIAGRA RUBECULA (Lath.) (= *M. plumbea* of the Birds of Australia). N. S. Wales.

MYIAGRA CONCINNA Gould, Pt. Essington, Australia. Types.

MYIAGRA NITIDA Gould, Tasmania and N. S. Wales. Types.

MYIAGRA VANIKŎRENSIS (Quoy and Gaim.).

A female from the Fiji Islands collected by the U. S. Exploring Expedition.

MYIAGRA LATIROSTRIS Gould, Pt. Essington, Australia. Types.

MYIAGRA RUFIGULA Wallace, Timor.

SMITHORNIS CAPENSIS (Smith), Natal.

CRYPTOLOPHA BURKII (Burton), India.

CRYPTOLOPHA ARIVIRGATA (Strickl.), Java.

SEISURA INQUIETA (Lath.), N. S. Wales, S. and W. Australia. Gould collection.

ARSES KAUPI Gould.

Two males from Cape York, Australia. Mr. Sharpe in his key to the species and in his description gives the chin as pure white, whereas it is black as is distinctly shown in Gould's plate.

PIEZORHYNCHUS ALECTO (Temm.), N. W. Coast of Australia.

PIEZORHYNCHUS NITIDUS Gould, Pt. Essington. Types of species.

PIEZORHYNCHUS NIGRIMENTUM Gray, Moluccas.

PIEZORHYNCHUS GOULDI (Gray), Moreton Bay, Torres Strait and Pt. Essington, Australia. Gould collection. This bird I think is not specifically distinct from *P. trivirgatus*. It is described as "only to be distinguished by the absence of white on the fourth outer tail feather, the three outermost only tipped with white." One of

Gould's specimens has the fourth tail feather tipped with white showing that this character does not always hold.

Piezorhynchus leucotis (Gould), Rockingham Bay, Australia.

Piezorhynchus chrysomelas (Gm.), New Ireland.

Mornarcha melanopsis (Vieill.), N. S. Wales and Pt. Essington. Gould collection.

Monarcha inornatus (Gaim.), Amboina, Moluccas.

Pomarea nigra (Sparrm.), Tahiti. Society Islands.

A fine series, representing the supposed adult sexes and young in various plumages. As the sex has not been marked on the labels I cannot say whether Mr. Sharpe was correct in considering the white-backed bird as the adult female.

Stoparola indigo (Horsf.), Java and Timor.

Stoparola albicaudata (Jerd.), India.

Stoparola melanops (Vig.), India.

One female specimen exhibits the black marks which characterized Mr. Gray's *N. spilonota.*

Stoparola thalassinoides (Cab.).

Specimens from Sumatra which apparently belong to this species have no black before the eye.

Stoparola panayensis (Sharpe) ?

A female collected by Capt. Boys comes very close to this species. It has a black line in front of the eye but otherwise agrees very well with the description. I can not be certain of its identity without comparison of specimens.

Siphia hyacintha (Temm.), Timor.

Siphia rubeculoides (Vig.), India.

Siphia elegans (Temm.), Borneo and Sumatra.

Siphia tickelliae (Blyth) ?

One specimen referred doubtfully to this species.

Siphia banyumas (Horsf.), Java.

Siphia philippinensis (Sharpe), Luzon.

Siphia turcosa (Brügg.). One specimen without locality, appears to be this species.

Digenia solitaria (Müll.), Sumatra.

Niltava sundara Hodgs., India.

Niltava grandis (Blyth), Himalayas.

Cassinia fraseri (Strickl.), Muni River, W. Africa. Du Chaillu.

Cassinia semipartita. (Rüpp.), N. E. Africa.

June 4.

Mr. Theo. D. Rand in the chair.

Twenty-nine persons present.

June 11.

Rev. H. C. McCook, D. D., Vice President, in the chair.

Twenty-seven persons present.

A paper entitled "Description of new species of fossil Crustacea from the Lower Silurian of Tennessee with remarks on others not well known," by J. M. Safford and A. W. Vogdes was presented for publication.

June 18.

Mr. Harold Wingate in the chair.

Twenty-six persons present.

The death of Mr. Geo. Y. Shoemaker, a member, was announced.

The proceedings of the Biological and Microscopical Section having precedence the following communications were made in connection therewith:—

Heterocercy in Batrachia.—Prof. Ryder remarked that in some larvæ of *Amblystoma*, species not determined, the tip of the tails of individuals from one to two weeks old were drawn out into an acute point; this acute point was invariably flexed upward. This fact is of interest since it may be a transitory or evanescent exhibition of traces of the heterocercal condition seen in the tails of fishes. If it is to be so interpreted, it would seem that somewhere in the remote past the Urodelous Batrachians had a heterocercal fish-like ancestor.

The Hypertrophied Hairs on Ampelopsis.—Prof. Ryder remarked that he had lately noticed that some of the hairs on the leaves, petioles and tendrils of *Ampelopsis tricuspidata* or *Veitchii*, hort. were very greatly enlarged. These hypertrophied hairs as they proved to be, have no uniform distribution. Their development is anomalous and some young leaves and tendrils are without them. They are found only on the young growing shoots of the plant. These hairs are covered with an epidermis inclosing a few very large, thin-walled cells. They are colorless and contain little or no chlorophyll. They vary greatly in form. What their function is was not made out.

Notes on Enteridium Rozeanum—Mr. HAROLD WINGATE presented verbally the following description of the species:—

ENTERIDIUM ROZEANUM (Rki.), *Reticularia (?) Rozeana* Rki., Monogr. Sup., No. 179.—Aethalium of irregular shape, globose, ovoid or rounded-pyramidal, attached to the substratum by a wide base. Variable in size from 5 to 30 M. in diameter. Cortex and mass of spores ferruginous-brown; occasionally the cortex shining; sometimes membranaceous, pellucid. Interior structure very variable, the walls of the individual sporangia (which form a capillitium), membranaceous, pellucid, band-like, combined into an all-sided network attached uniformly to all sides of the cortex. The bands have triangular or polygonal expansions at the angles where they join each other. Spores globose, about two-thirds of the surface covered with a delicate, regular, fine-meshed network, the remainder with simple warts or elongated ridges. The warted portion has the outline of a wide spindle, the points of the spindle lying at the poles of the little sphere. Spores measure 7·5-9 mk. Found frequently in Fairmount Park, Philadelphia, Pa.

The spaces in the capillitium, which represent the individual sporangia of the aethalium, have about the same dimensions in the same plant, but vary considerably, comparing one specimen with another. The extremes of variation may be expressed by the proportion 1 to 10. Sometimes the bands of the capillitium are very much lacerated longitudinally, and form a filamentous mass, where the characteristic structure of the genus is entirely lost after the dispersal of the spores. Capillitium yellowish under the microscope.

This plant has a rather interesting history. Mr. Ernest Roze, of Paris, studied the development of the myxomycetes quite a number of years ago by a method of culture which consisted of using earthenware dishes filled with sphagnum and water, into which he thrust dead branches of trees, pieces of rotting stumps, etc., which he brought from the woods in the neighborhood of Paris. He obtained by this method various plasmodia, studied them up to their fructification, and in the "Bulletin de la Société Botanique de France" (Tomes xix and xx), he gave the results of his experiments and his ideas upon the group.

In the spring of 1875 Mr. Roze obtained by culture a plasmodium, which, if his memory does not deceive him, was white. This produced aethalia which he was unable to identify, so he placed them aside for future study. Towards the end of the year, Dr. Rostafinski, who had in preparation his monograph, visited Paris, and examined among other collections there, that of Mr. Roze. Among numerous plants offered him for inspection, were the above mentioned aethalia which struck his attention immediately. He expressed his surprise to Mr. Roze, who told him to take the plants with him. This he did, but no description of this myxomycete appeared in the monograph, owing, probably, to the limited quantity of the material, and, as Mr. Roze suggested, the possibility of the plant being abnormal from the manner of its production.

In the supplement to the monograph, No. 179, however, Dr. Rostafinski described the plant as follows:—

"*Reticularia* (?) *Rozeana* Rki.—Aethalia of irregular shape, rounded, attached to the substratum by a wide base. Cortex, columella, capillitium and mass of spores uniformly ferruginous-brown. Cortex thin, membranaceous, irregularly perforated. Capillitium composed of thin threads with flat membranaceous expansions, joined into an all-sided net. Spores irregularly globose, very much warted, 8·3 mk. wide.

Note.—The aethalia run about 1½ cm. wide, a few about the size of a pea. Surface slightly shining, under the magnifying glass uneven, with point-like depressions. Examined under the microscope it is a delicate membrane, slightly colored, with numerous small, irregular perforations. Over the bottom of the aethalium are raised, very numerous, small, membranaceous, flattened, short, dark-brown columellas, running further into the net of the capillitium. The latter is composed of filaments with a not entirely smooth outline, running very often into triangular or quadrangular, membranaceous expansions, the last arms attached to the external cortex, sometimes running into the wall. The species is included temporarily in the genus *Reticularia*, as its individual history which might throw some light upon the organization of the curious aethalium, remains uninvestigated. In the meanwhile, we may work upon the hypothesis, which is highly probable, that *Reticularia Rozeana* is an aethalium composed of degenerate sporangia.

It differs from *R. lycoperdon* particularly in its cortex, which is not deposited in layers, but is a delicate membrane. Besides its weakly developed columellas and the spores with the entire surface uniformly warted, make it a good distinct species."

In his correspondence with Mr. Roze the speaker asked him if he could furnish a specimen of this species, suspecting that he (the speaker) had the plant already in his herbarium. As Dr. Rostafinski had gotten all the material Mr. Roze had obtained, the question had to remain unsettled. By watching the locality from which the wood came that produced the original specimens, Mr. Roze was rewarded by finding in 1887 under natural conditions, an example of the plant, and was kind enough to send a portion of it. The plant as was suspected, proved to be one of our quite frequent species in the neighborhood of Philadelphia, probably found in North American collections as a variety of *Reticularia lycoperdon*, Bull.* The external appearance of the two plants is very similar, and the spores, unless very carefully examined, nearly alike in structure. In *R. lycoperdon* the warted portion of the spore has a circular outline, while in *E. Rozeanum* it has a spindle-shaped outline, the remainder of the spore in each case being covered with a fine-meshed, delicate network.

*The plant may also be found in the Schweinitz Collection in the Acad. Nat'l. Sc., Philada. under the name of *Licea fallax*, Pers.

In the meanwhile, Dr. Geo. A. Rex, in studying the variations of this myxomycete was the first to recognize the true genus of the plant, and was prepared to make a new species of it under the name of *Enteridium umbrinum*, Rex. As Dr. Rostafinski left the question of the genus to be decided as opportunity might determine, the plant can now find its place in our systematic botany under the name of *Enteridium Rozeanum*, with its description amended as above given.

June 25.

Rev. H. C. McCook, D. D., Vice-President, in the chair.

Thirty-two persons present.

The following papers were presented for publication :—

"The Phylogeny of the Sweat Glands," by Prof. John Ryder.

"Notes on the osteology and systematic position of Dinictis Felina Leidy," by W. B. Scott.

Mr. Uselma C. Smith was elected a member of the Council for the unexpired term of the late Mr. Geo. Y. Shoemaker.

Messrs. A. Sydney Biddle and William Gerlach were elected members.

The following were ordered to be printed :—

A REVIEW OF THE AMERICAN SPECIES OF PRIACANTHIDÆ.

BY WILLARD L. MORRISON.

In the present paper I have attempted to give the synonymy of the genera and species of fishes of the family of Priacanthidæ (Big-Eyes or Catalufas) found in American waters, with analytical keys by which the species can be recognized.

The specimens examined by me are all in the Museum of the Indiana University, duplicate series having been sent to the U. S. National Museum.

I recognize the Priacanthidæ as a family distinct from the Serranidæ, from which it is apparently an off-shoot.

I am indebted to Dr. D. S. Jordan for the use of his library and other invaluable aid in the preparation of this paper.

The family may be thus defined:

Perciform fishes with the body oblong or ovate, covered with small, firm, rough scales; all parts of the body and head, and even snout and maxillaries being densely scaly. Head deep; mouth large, very oblique, lower jaw prominent. Bands of villiform teeth on jaws, vomer and palatine, none on tongue. Premaxillaries protractile; maxillaries broad, without supplemental bone, not slipping under the very narrow preorbital. Eye very large, its diameter nearly half the head. Posterior nostrils slit-like, vertical, near the eye. Preopercle more or less serrated, with one or more spines at the angle. Operculum very short, ending in two or three points behind. Gill membranes separate, free from the isthmus; pseudobranchiæ large; gills four, a slit behind the fourth; gill-rakers long, slender, toothed. Branchiostegals 6. Lateral line continuous, high, forming an angle below spinous dorsal. Dorsal fin continuous, with about 10 spines, depressible in a groove. Anal spines 3; soft part of anal long, similar to soft dorsal, and terminating opposite to the termination of dorsal. Vertebræ (*cruentatus*) 9+13. Ventrals large, thoracic, I, 5, attached to body by membrane; pectorals small, rounded, with 16 to 19, rays; caudal fin truncate or lunate, of about 18 rays. Skull almost flat between the eyes, with a long, thin and high occipital crest.

These fishes inhabit deep waters in the tropics. They are of moderate size and most of them are rose-colored in life. The species, about 20 in number, seem to be referable to two genera; distinguished by the following characters:—

Analysis of Genera of Priacanthidæ.

a. Scales very small, 80 to 100 in the lateral line; body oblong, more than twice as long as deep; preopercle with a spine at angle; interorbital area externally transversely convex, the cranium itself transversely concave, the elevation being formed of flesh; a conspicuous foramen in the interorbital area; lateral line extending upward and backward from upper angle of gill opening toward second dorsal spine, below which it changes its course, following outline of back to end of dorsal fin, thence direct to middle of caudal; anal fin rather long, its rays about III, 14; dorsal rays about X, 13.

PRIACANTHUS. 1.

aa. Scales large, very rough, 35 to 50 in the lateral line; body ovate, not twice as long as deep; preopercle with 2 small spines at angle. Interorbital space broad and flat, there bring no flesh between skin and skull; no foramen in interorbital area; lateral line changing its course below the fourth dorsal spine; anal short, its rays III, 9; dorsal X, 11. PSEUDOPRIACANTHUS. 2.

PRIACANTHUS.

Priacanthus Cuvier, Règne Animal Ed. II, 1829. (*Macrophthalmus.*)

Type: *Anthias macrophthalmus* Bloch.

Etymology, *prion*, saw; *ákantha*, spine; from the serrature of the spines.

Analysis of American species of Priacanthus.

a. Ventrals moderate, not extending beyond second anal spine: dorsal and ventrals pale.

b. [First spine only of dorsal and anal finely serrated, the others smooth; preopercle with its angle terminating in an oblique point; smaller than the spine in the next species; depth 3⅘ in total length (male) or about 2⅗ in length to base of caudal; length of head equal to depth; eye 2½ in head; opercle with a flat pointed spine which does not project; supraclavicle with prominent edge; caudal slightly lunate, the upper lobe the longer; scales smaller near the back; D. X, 14; A. III, 15; lateral line 95. "Base of skull pierced with a large hole between the great wing and the base of the superior sphenoid."] (*Poey.*) CATALUFA. 1.

bb. Body deep, the depth 3 in total length (with caudal; $2\frac{3}{5}$ to base of caudal); dorsal and anal spines all finely serrated in front; preopercle with a flat, triangular spine; length of head nearly equal to distance from lateral line to edge of belly; eye 2 in head; opercular spine very small; last dorsal spine $1\frac{2}{3}$ the length of second; pectorals small, little longer than eye. Mouth large, oblique; maxillaries reaching nearly to middle of the eye, 2 in head; caudal slightly notched; roof of mouth with longitudinal ridges: upper limb of preopercle almost vertical; dorsal X, 13 to 14; anal III, 14 to 15. Lateral line 84. Skull without foramen below; color rose, the back brownish, the dark color of the back sometimes forming rounded blotches on sides; dorsal fin with small dark spots. CRUENTATUS. 2.

aa. [Ventrals very long, extending to third soft ray of anal; dorsal and ventral fins almost entirely black. All the rays and spines of dorsal and anal fins with striated or roughened surface; preopercle with a cylindrical spine; depth of body $2\frac{3}{4}$ in total length; head $3\frac{2}{3}$; diameter of eye 3 in head; operculum with two short spines; a larger one above belonging to scapular bone; length of second dorsal spine nearly three times in that of the last; pectorals yellowish; D. X, 13; A. III, 13; lateral line 80.] (*Günther.*) BONARIENSIS. 3.

1. **Priacanthus catalufa.**

Catalufa Parra, Dif. Piezas Hist. Nat., 1787, plate 20 (Havana).

Priacanthus catalufa Poey, Proc. Acad. Nat. Sci. Phil., 1863, 182 (Havana); Poey, Repertorio I, 1867, 274; Poey, Synopsis, 1868, 302; Poey, Enumeratio 1875, 38.

Priacanthus macrophthalmus Gill. Rept. U. S. F. C. for 1871–2, 807. ("Occasional northwards.") (Not of C. & V.)

Habitat. West Indies, occasional northwards in the Gulf Stream.

Etymology, *Catalufa*, common name of the species at Havana.

This species is unknown to me. From the accounts given by Parra and Poey, it would seem to be more elongate than the next species, and Poey has indicated a differential character in the structure of the skull. Not having seen the skull I find it difficult to understand the character in question.

Since writing the above, Dr. Jordan has examined, at my request, small specimens in the U. S. National Museum, from Wood's Holl and Newport. These seem to belong to *P. catalufa* rather than to *P. cruentatus.* Compared with the latter, these are more slender, depth $2\frac{4}{5}$ in length; eye smaller, $2\frac{1}{2}$ in head, and the preopercular spine much smaller. In these specimens, the dorsal is unspotted, having only a dark shade across it; along the lateral line are eight small black spots, which probably disappear with age.

2. **Priacanthus cruentatus.**

Big Eye; Catalufa.

Labrus cruentatus Lacépède, Hist. Nat. Poiss. III, 1800, 522 (from a copy by Aubriet of a plate made by Plumier at Martinique). *Priacanthus cruentatus*, Cuv. & Val., III, 1829, 102; Poey, Syn. Pisc. Cub., 1868, 302; Poey, Enum. Pisc. Cub. 1875, 40.

Priacanthus cepedianus Desmarest, Prém. Dec. Ichthy. 1823, 9, plate 1 (Havana); Poey, Syn. Pisc. Cub. 1868, 302; Poey, Repertorio I, 1867, 273; Poey, Enum. Pisc. Cub. 1875, 39.

Priacanthus macrophthalmus Cuv. & Val. III, 1829, 97; Günther I, 1859, 215 (Cuba, Jamaica, Madeira) (not *Anthias macrophthalmus* Bloch, an East Indian species); Jordan & Gilbert, Syn. Fishes N. A. 1883, 544.

Priacanthus arenatus Cuv. & Val. III, 1829, 101 (Brazil) (description very brief).

Priacanthus fulgens Lowe, Trans. Zool. Soc. III, 1838, 174.

Habitat.

Etymology, *cruentatus*, bloody.

I identify the specimens collected by Dr. Jordan at Havana with the *Pr. cepedianus* of Poey, rather than with his *Priacanthus catalufa.* They agree most closely with the description of *Pr. cepedianus* of Desmarest. The description and figure of *Labrus cruentatus* Lacépède are very far from accurate, but it seems almost certain that it was drawn from a specimen of this species in which the dark markings on the side were more distinct than usual.

Poey recognizes *cruentatus* and *cepedianus* as distinct species but he says that they differ only in color.

Since writing the above, two mounted specimens have been received by the museum of the Indiana University. These were sent by Poey from Havana under the name of *Priacanthus cepedianus.*

3. **Priacanthus bonariensis.**

Priacanthus bonariensis Cuv. & Val. III, 1829, 105 (Buenos Ayres); Günther, I, 1859, 216. (South America.)

Habitat. Atlantic Coast of South America.

Etymology, from Buenos Ayres.

This species is known to me from descriptions only.

PSEUDOPRIACANTHUS.

Pseudopriacanthus Bleeker, Versl. Ak. Wet. Amsterd., 1869, 241 (*niphonius*).

Type *Priacanthus niphonius* C. & V., from Japan.

Etymology, *pseudos*, false; *Priacanthus*.

This genus is distinguished from *Priacanthus* by its deeper form, its larger and rougher scales, its shorter anal fin, and by several peculiarities of form. Two species are known, the one West Indian, the other from Japan.

Analysis of the American species of Pseudopriacanthus.

a. Head, 3 in length to base of caudal; $1\frac{1}{2}$ in depth; depth 2 in length to base of caudal; eye 2 in head, placed very high; chin very rough; profile from first dorsal spine to chin straight; snout extremely short and blunt; mouth large and very oblique. Maxillaries reaching almost to the middle of eye, $1\frac{3}{4}$ in head; spines striated, not serrated; preopercle serrated; an embedded spine at angle of opercle; preorbital roughly serrated; scales large and very rough; base of dorsal $2\frac{1}{2}$ times base of anal; tips of soft dorsal reaching beyond base of caudal; soft rays of dorsal, anal and ventrals rough or serrated throughout; caudal truncate; ventrals large, extending to first ray of anal; pectorals small, about as long as eye; fourth and last dorsal spines of equal length, second $1\frac{1}{2}$ times the first, sixth the longest. Color scarlet red; ventrals tipped with black; D. X, 12; A. III, 9; lateral line 40 to 50. ALTUS. 4.

4. **Pseudopriacanthus altus.**

Priacanthus altus Gill, Proc. Acad. Nat. Sci. Phil., 1862, 132 (very young specimen from Narragansett Bay); Jordan & Gilbert, Syn. Fishes N. A., 1883, 545 (from original type).

Pseudopriacanthus altus, Jordan & Eigenmann, Proc. U. S. Nat. Mus. 1887, 269 (Charleston).

Pseydopriacanthus? Poey, Enumeratio, 1875, 40 (Havana).

Habitat. Atlantic Coast of U. S. and West Indies, in deep water (Rhode Island, Charleston, Pensacola, Havana).

Of this rare species I have examined two adult examples 8 and 10 inches in length from Charleston and Pensacola.

GADOLINITE FROM LLANO CO., TEXAS.

BY E. GOLDSMITH.

The specimen so called which came from the above locality is in the Wm. M. Vaux Collection of the Academy and is of unusual size. It appears as a rough orthorhombic crystal. A piece broken off at one end revealed the fact that the crystal was not homogeneous throughout. Within, a glassy material surrounded by a rather thick layer of perfectly dull appearance indicated that it was made up of at least two different minerals. I procured from the mineral dealer fragments of these two substances for investigation. The inner or vitrous substance proved to be Gadolinite. In mass the color is deep black and opaque but, when a thin plate is prepared by grinding, it appears green. Beneath the microscope apparently all is homogeneous, only a few minute black spots are noticed. Between the two nicol prisms it was not at all affected, even when the ray passed through it parallel or convergent. The field of the crossed nicols became darker when the plate was placed between them. The apparent form is therefore misleading. Supposing the optical laws of crystallized bodies to be correct, I arrive at the conclusion that the crystal found is either isometric or pseudomorphous.

Fracture conchoidal and uneven. Hardness = 6. Sp. Gr. = 4·276. It affords no streak on unglazed porcelain and it is brittle: the powder is grayish-green.

For analysis the substance was selected with care and was easily decomposed by hydrochloric acid, the silica gelatinizing.

The result was as follows:

Silica	25·70	per cent. O	= 13·7
Ittria	58·30	" "	= 12
Iron monoxide	15·52	" "	= 3·44
Glucina	2·10	" "	= 1·32

The oxygene ratios of the silica to the monoxyds is as 1 : 1·2, therefore nearly 1 : 1 which corresponds fairly with one of Berlin's analysis of material from Ytterby, except that he found in all his investigations cerium, small quantities of alkalies and alkaline earths. I took special pains to trace the presence of cerium but could not detect it. The ittria found was dissolved as nitrate and the concentrated solution examined spectroscopically for erbia, but none was found. I confess to not knowing a reliable process for separating either erbia or terbia, hence the results obtained can only be considered approximate.

The material enveloping the Gadolinite seems to be amorphous; dull, with an uneven fracture and brittle; its color is grayish brown; streak red, when powdered bright red.

It was found necessary the float off the suspended part in water from another portion which was not decomposable by hydrochloric acid, and this was repeated until a sample was wholly decomposable by that acid. The silica did not gelatinize.

Hardness = 3. Sp. Gr. = 3·494.

Not fusible before the blow-pipe. The fluxes indicated iron; heated in a tube it gave water. Heated with carb. soda upon charcoal it afforded a dark brown slag.

The analysis indicated great complexity of mixture:—

SiO_2	18·145	per cent.	O = 9·676
Ce_3O_4	20·662	"	O = 16·773
Fe_2O_3	26·026	"	O = 7·807
YO	21·854	"	O = 4·500
CaO	3·642	"	O = 1·040
MgO	0.214	"	O = 0·085
HO	9·761	"	O = 8·676

The approximate O ratios of the sum of the monoxyds are equal to the tetraoxyds, or about two, whilst the O ratio of the dioxyds and the sesquioxyds are each nearly one, hence this general expression is proposed.:—

$$2\ (RO+R_3O_4)\ SiO_2\ (R_2O_3)$$

The question whether this substance is a mixture or not, I endeavored to solve by this consideration: sesquioxydes of iron as goethite, limonite, etc., are respectively soluble to some extent in a strong solution of citric acid; if any of these oxyds should be mixed or occur as such in the mineral a test with that acid would indicate the fact. The test was made; for several hours the fine red mineral powder was kept in contact with a strong solution of citric acid at ordinary temperature, about 70° F. and agitated occasionally with no effect. If heated on steam bath the effect was very slight. It seems, therefore, that the substance is not a mixture, but a hydrated tribasic silicate in which the water is conceived to be substitutable for any other monoxyde.

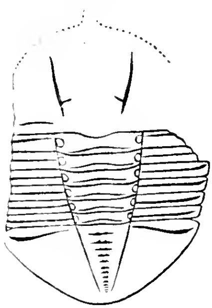
The ittria was also tested optically for erbia with negative result.

I am not aware that this material over the Gadolinite has been named. I propose for it the name METAGADOLINITE.

DESCRIPTION OF NEW SPECIES OF FOSSIL CRUSTACEA FROM THE LOWER SILURIAN OF TENNESSEE, WITH REMARKS ON OTHERS NOT WELL KNOWN.

BY J. M. SAFFORD AND A. W. VOGDES.

Ampyx Americanus, n. s.



General outline broadly oval, glabella somewhat claviform, slightly convex, narrowing behind the middle and widening out slightly at its junction with the occipital ring; it is marked at each side by one or more oblique furrows, the condition of the three specimens before us do not clearly indicate more than one pair. Projecting spine broken off. The cheeks are broad and rounded towards the margins. Genal spines broken off. Facial sutures not observed.

The axis is broad anteriorly and gradually diminishes, being well defined by its broadly convex form; the rings are deeply furrowed centrally. The pleuræ are six in number, straight and deeply grooved, terminating in obtusely pointed points, similar to those of *Ampyx nudus.* [Barrande Syst. Sil. Boheme, Vol. 1, Pl. 5, fig. 14.]

The pygidium is triangular in form, the axis being prominent, gently tapering to an obtuse point on the posterior border. It is marked with 13 or more rings, with a central row of nodes. The sides have only one pair of side ribs, which are deeply furrowed outwards cutting off the posterior portion of the tail.

Geological position and locality, Trenton group, near Bulls Gap on the road to Russelville, Tenn. Cabinet of J. M. Safford.

Affinities: We have compared the Tennessee species with the 17 described species of the genus *Ampyx* and find that it differs in detail from all of them. It has affinities with *Ampyx nasutus,* Dalm. which has the same number of thoracic segments, its pygidium being marked with only one lateral side furrow on each side. From this *A. Americanus* can be readily distinguished by its glabella, broader pygidium and its central row of nodes along the axis of the pygidium.

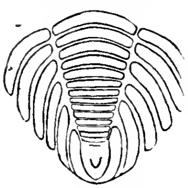
Mr. Edward Forbes, [Mem. Geol. Survey United Kingdom, Dec. 2, 1849, pl. X] has suggested the new generic name of *Brachampyx* for species like the above, with six thoracic segments and short and rounded heads, to separate them from species of the genus *Ampyx* with five thoracic segments and longheads. Length of largest specimen 27½ mm., head 11 mm., thorax 8½ mm., pygidium 8 mm., greatest width of tail 20 mm., length of pygidium, small specimen, 6 mm.

Encrinus varicostatus, Walcott.

Encrinurus varicostatus, Walcott, 1877, Adv. Sheets 31st. Rept. N. Y. State Cab. Nat. Hist. p. 16; 31st. Rept. N. Y. State Cab. Nat. Hist. p. 69.

Cryptonymus varicostatus, Vodges, 1878, Mon. genera Zethus, Encrinurus and Cryptonymus, p. 27.

Encrinurus excedrinus, Safford, 1869, Geology Tennessee, p. 290.



The only known part of this species is the pygidium, it is subtriangular in outline, width slightly greater than its length, convex, axis tapering to a blunt point and marked with 13 or more rings extending entirely across it as far as the last pleuræ, with possibly 6 or 8 more. The sides are marked with 6 ribs, decreasing in length gradually, the last pair coalescing with the axis, and separated from it by a shallow groove. Surface granular, without nodes. Length of largest specimen 7 mm., width 7½ mm. Geological positions and locality, Trenton limestone, Lebanon, Tenn., Cedar Glades.

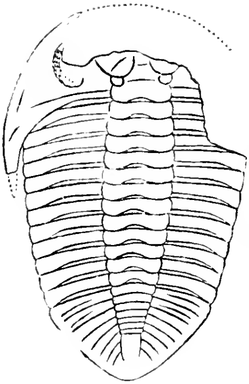
Mr. C. D. Walcott says that his specimens have about 16 smooth rings; the anchylosing of the posterior rings renders it difficult to determine the exact number.

Trenton limestone, Mineral Point, Beloit, &c., Wisconsin.

Chasmops Troosti, Safford.

Dalmanites Troosti, Safford, 1869, Geol. Tennessee, p. 290.

Description: General form narrowly ovate, convex, head semicircular, genal angles produced into spines extending to the fifth thoracic segment. Eyes prominent, faceted glabella large, clavate. The specimem is not in condition to record the minor details of the head. Thorax with 11 segments, axis prominent, convex, tapering



posteriorly. Pleuræ grooved about half their length. Pygidium triangular, axis prominent and tapering to a blunt obtuse point, marked with about 9 axial rings; lateral lobes with seven ribs, the first two pair are grooved.

Geol. position, Trenton group. Murfreesboro, Tennessee, also Stone River 6 miles north of Murfreesboro.

This species has some affinities with *Dalmanites intermedius*, Walcott, from the Trenton group of Wisconsin, but in minor details it can readily be distinguished from it.

CATALOGUE OF THE ASTEROIDEA AND OPHIUROIDEA IN THE COLLECTION OF THE ACADEMY OF NATURAL SCIENCES OF PHILADELPHIA.

BY J. E. IVES.

The following catalogue will be found to contain a number of localities that are new for various species.

Two new forms of Star-fishes and two new forms of Ophiurans from the collection have recently been described in the Proceedings of the Academy.

A large proportion of the Pacific forms are contained in a collection given to the Academy by Mr. W. N. Lockington. Many of his specimens unfortunately have no locality indicated. The majority of them, however, were collected on the west coast of North and Central America, but there are also forms from Alaska, Japan, New Zealand and the Pacific Islands.

ASTEROIDEA.

ASTERIIDÆ.

ASTERIAS ÆQUALIS, Stimpson. 5 San Francisco, Cal., 4 Seal Rock, San Francisco, Cal. and 50 locality undetermined, W. N. Lockington.

ASTERIAS ARENICOLA, Stimpson. 4 Atlantic City, F. M. Beamer; 5 dried and 50 alcoholic, H. A. Pilsbry; 1 U. C. Smith; 1 Fort Macon, N. C., Dr. H. C. Yarrow; 1 (alcoholic) Gloucester, Mass. and 1 Vineyard Sound, Mass., U. S. Fish Commission; 1 Massachusetts Bay, Museum of Comparative Zoology; 1 Point Judith, R. I., Dr. Jos. Leidy.

ASTERIAS ATLANTICA, Verrill. 13 (alcoholic) Bermuda, Heilprin coll. July 1888.

ASTERIAS CAMTSCHATICA, Brandt (?). 1 locality undetermined, W. N. Lockington.

ASTERIAS CAPITATA, Stimpson. 3 San Diego, Cal., Joseph Jeanes; 1 Santa Barbara, Cal., and 1 locality undetermined, W. N. Lockington.

ASTERIAS (LEPTASTERIAS) COMPTA, Verrill. 6 Noank, Conn., Dr. Jos. Leidy; 2 (alcoholic) off Watch Hill, R. I. (22 fath.) U. S. Fish Commission.

Asterias epichlora, Brandt (?). 1 locality undetermined, W. N. Lockington.

Asterias fabricii, Agassiz. 3 Greenland, Museum of Comparative Zoology; 1 Newport, R. I., S. Powel.

Asterias forbesii, Verrill. 15 (alcoholic) Holmes' Holl, Mass., Dr. J. H. Slack; 3 Newport, R. I., S. Powel; 5 (alcoholic) Vineyard Sound, Mass., U. S. Fish Commission; 8 specimens undetermined (4 alcoholic).

Asterias gigantea, Stimpson. 4 locality undetermined, W. N. Lockington.

Asterias glacialis, Linck. 1 "British," E. Wilson.

Asterias lurida, Philippi (?). 3 San Diego, Cal., Joseph Jeanes (H. Hemphill); 3 locality undetermined, W. N. Lockington.

Asterias ochracea, Brandt. 1 (alcoholic) Oregon, Smithsonian Inst.; 1 San Francisco, Cal., Museum of Comparative Zoology; 2 T. G. Watson; 2 Santa Cruz, Cal., John Ford; 6 locality undetermined, W. N. Lockington.

Asterias rubens, L. 2 Belfast Bay, Wm. Thompson; 25 England, Dr. T. B. Wilson.

Asterias sertulifera, Xantus (?). 1 locality undetermined.

Asterias vulgaris, Stimpson. 30 (alcoholic) Gay Head, Martha's Vineyard, Mass., Heilprin coll. 1886; 3 Grand Menan, and 2 Massachusetts, Museum of Comparative Zoology; 1 (alcoholic) Halifax, N. S., U. S. Fish Commission; 8 Maine, Dr. J. H. Slack; 1 (alcoholic) Mt. Desert, Me., Dr. H. C. Chapman; 2 Long Branch, N. J., Dr. J. L. LeConte.

Asterias, species undetermined. 2 Guaymas, J. W. Wilson, U. S. N.; 1 New Zealand, Messrs. Warwick and Argent; 2 Sandwich Islands, J. K. Townsend; 2 dissimilar forms, localities undetermined, W. N. Lockington.

Heliaster helianthus, Lam. 1 Chili, W. W. Drinker.

Heliaster microbrachia, Xantus. 1 Chili, W. W. Drinker; 1 Magdalena Bay, Low. Cal., W. N. Lockington. (Fischer coll.)

Heliaster multiradiata, Gray (= H. Kubinijii, Xantus). 1 Lower California and 1 (young) locality undetermined, W. N. Lockington; 1 (alcoholic) Machuoha, Nicaragua, Dr. Bransford; 2 dried and 3 alcoholic, Pacific Coast of Mexico, Dr. W. H. Jones; 2 locality undetermined.

BRISINGIDÆ.

Coronaster bispinosus, Ives. A single specimen. Type, Proc. Acad. 1888, p. 422. Locality undetermined.

ECHINASTERIDÆ.

Echinaster echinophorus, Lam. 6 New Providence, Bahamas, Dr. H. C. Wood.

Echinaster fallax, M. and T. (?). 1 Pacific Islands, W. N. Lockington.

Echinaster sentus, Say. 2 Key West, Florida, Lieut. Gandtt (Proc. Acad. 1825. p. 143).

Echinaster spinulosus, Verrill. 4 (alcoholic) Anclote Bay, Florida, and 2 (alcoholic) (12 ft.) Sarasota Bay, Florida, Heilprin coll. 1886.

Ehinaster tenuispina, Verrill. 2 (alcoholic) Bay of Pichilinque, W. Coast of America, Dr. W. H. Jones; 1 Monterey, Cal., and 12 locality undetermined, W. N. Lockington.

Cribrella leviuscula, Stimpson. 6 (alcoholic) Marmot Island, Northwest Coast of America, Dr. W. H. Jones; 1 locality undetermined, W. N. Lockington.

Cribrella sanguinolenta, Mülier. 2 Belfast Bay, Wm. Thompson; 2 "British," E. Wilson; 2 Manchester, Mass., S. Tufts, Jr.; 3 (alcoholic) Massachusetts Bay, U. S. Fish Commission; 12 Maine and 7 (alcoholic) Nahant, Mass., Dr. J. H. Slack; 3 Noank, Conn., Dr. Jos. Leidy; locality undetermined.

Mithrodia clavigera, Lam. 1 (alcoholic) Oahu, Sandwich Islands, Dr. W. H. Jones.

Solaster decemradiata, Brandt. 1 California, W. N. Lockington.

Solaster endeca, Gmel. 1 dried and 5 alcoholic, Mt. Desert, Me., Dr. H. C. Chapman.

Solaster papposa, L. 1 (alcoholic) Mediterranean, Dr. Howel; 3 (alcoholic) Mt. Desert, Me., Dr. H. C. Chapman.

Acanthaster ellisii, Gray. 1 Gulf of California, W. N. Lockington (Fisher coll.).

LINCKIIDÆ.

Linckia guildingii, Gray. 1 Bermuda, Mr. Janney; 1 San Diego, Cal., Jos. Jeanes (H. Hemphill); 5 locality undetermined, W. N. Lockington; 1 locality undetermined.

The specimens received from Mr. Lockington resemble the single specimen presented by Mr. Joseph Jeanes from San Diego, Cal. They are small, the largest not exceeding 8 mm. in diameter, but otherwise thoroughly agree with descriptions of Linkia Guildingii. This species has not been recorded before from the West Coast of North America.

LINCKIA LÆVIGATA, Lam. (= L. Pacifica, Gray). 3 Navigator's Isles, Dr. Eckstein; 1 Navigator's Isles and 3 Arica, Peru, Dr. W. S. W. Ruschenberger.

LINCKIA NODOSA, Perrier. 2 locality undetermined.

LINCKIA UNIFASCIALIS, Gray. 1 Central America, Dr. LeConte; 2 Honduras, Capt. J. M. Dow; 1 Lower California, Wm. M. Gabb; 2 Magdalena Bay, Low. Cal., W. N. Lockington; 2 Pacific Coast of Mexico, Dr. W. H. Braden; 2 (alcoholic) Panama, McNeil Expedition; 7 (alcoholic) Pichilinque Bay, West Coast of America, Dr. W. H. Jones; 3 localities undetermined, W. N. Lockington.

LINCKIA, species undetermined. 1 Christmas Island, W. N. Lockington.

This specimen does not appear to be *Linckia lævigata* Lam. (*L Pacifica*, Gray), the only species of *Linckia* recorded from Christmas Island by Prof. F. Jeffrey Bell.

LINCKIA, species undetermined. 1 Lower California, W. M. Gabb.

OPHIDIASTER GRACILIS, Gray. 1 locality undetermined, W. N. Lockington.

OPHIDIASTER PUSILLUS, M. and T. 5 (alcoholic) Oahu, Sandwich Islands, Dr. W. H. Jones.

OPHIDIASTER PYRAMIDATUS, Gray. 1 Honduras, Capt. J. M. Dow; 1 La Paz, Low. Cal., and 1 Magdalena Bay, Low. Cal., W. N. Lockington; 6 (alcoholic) Panama Bay, McNeil Expedition; 1 (alcoholic) Pichilinque Bay, West Coast of America, Dr. W. H. Jones.

OPHIDIASTER, species undetermined. 1 West Coast of Honduras, Capt. J. M. Dow; 3 locality undetermined.

GONIASTERIDÆ.

PENTAGONASTER DILATATUS, Perrier. 1 New Zealand, Messrs. Warwick and Argent.

PENTAGONASTER (STELLASTER) EQUESTRIS, Retzius. 1 New Zealand, Messrs. Warwick and Argent.

Pentagonaster granularis, O. F. Müller. (Alcoholic) Marmot Island, Alaska, Dr. W. H. Jones; 1 Monterey, Cal., W. N. Lockington (W. G. W. Harford).

Pentagonaster pulchellus, Gray. 1 New Zealand, Messrs. Warwick and Argent.

Pentagonaster semilunatus, Linck. 1 New Zealand, Messrs. Warwick and Argent.

Pentagonaster, species undetermined. 1 locality undetermined, W. N. Lockington.

Anthenea acuta, Perrier (?). 2 (alcoholic) locality undetermined.

Anthenea tuberculosa, Gray (?). 1 New Zealand, Messrs. Warwick and Argent.

Oreaster (Nidorellia) armata, Gray. 1 Guaymas, J. W. Wilson; 1 La Paz, Low. Cal., W. N. Lockington (W. J. Fisher coll.); 1 Panama Bay, Dr. W. S. W. Ruschenberger; 1 (alcoholic) Panama, McNeil Expedition; 1 locality undetermined, W. N. Lockington.

Oreaster dorsatus, L. 1 New Zealand, Messrs. Warwick and Argent; 1 Senegal, Dr. Isaac Lea.

Oreaster (Amphiaster) insignis, Verrill. 1 locality undetermined, W. N. Lockington.

Oreaster lütkeni, Bell. 1 locality undetermined.

Oreaster occidentalis, Verrill. 1 Honduras, Capt. J. M. Dow; 1 Lower California, W. N. Lockington (Fisher coll.); 1 dried and 1 alcoholic, Pacific Coast of Mexico, Dr. W. H. Jones.

Oreaster reticulatus, L. 1 Maracaibo, C. D. Meigs; 1 Nassau, New Providence, Chas. P. Perot; 1 St. Bartholomew, West Indies, Dr. Gaës; 2 West Indies, E. Wilson; 1 locality undetermined, J. C. Fisher; 4 specimens, locality undetermined.

Culcita discoidea, Schmidt. 1 Zanzibar, Museum of Comparative Zoology.

ASTERINIDÆ.

Asterina folium, Lütken. 2 alcoholic, locality undetermined.

Asterina gibbosa, Penn. 2 Belfast Bay, W. Thompson; 1 Mediterranean, Dr. S. B. Howel; 1 locality undetermined, W. N. Lockington.

Asterina granulosa, Perrier. 1 (alcoholic) Oahu, Sandwich Islands, Dr. W. H. Jones.

ASTERINA MINIATA, Brandt. 2 Monterey, Cal., W. M. Gabb; 2 San Diego, Cal., Jos. Jeanes; 2 locality undetermined, W. N. Lockington.

ASTERINA OBTUSA, Gray. 1 locality undetermined, W. N. Lockington.

ASTERINA REGULARIS, Verrill. 3 New Zealand, Messrs. Warwick and Argent.

ASTERINA, species undetermined. 1 locality undetermined, W. N. Lockington.

PALMIPES MEMBRANACEUS, Linck. 1 "Europe."

ASTEROPSIS IMBRICATA, Grube. 1 Gulf of Georgia, Northwest Coast of America, Museum of Comparative Zoology; 1 Monterey, Cal., W. N. Lockington.

ASTROPECTINIDÆ.

ASTROPECTEN ARTICULATUS, Say. 1 (alcoholic) 9–12 ft. off Manatee, Tampa Bay, Fla., Heilprin coll. 1886; 1 South Carolina, F. S. Holmes; 1 dried and 4 alcoholic, localities undetermined.

ASTROPECTEN AURANTIACA, Lam. 2 Mediterranean, Dr. T. B. Wilson.

ASTROPECTEN OERSTEDII, Lütken. 2 San Diego, Cal., Jos. Jeanes (H. Hemphill); 4 locality undetermined, W. N. Lockington.

ASTROPECTEN SUBINERMIS, M. and T. 1 (alcoholic) Mediterranean, Dr. Howel; 2 locality undetermined.

ASTROPECTEN, species undetermined. 6 Gulf of Mexico, C. S. Westcott; 1 (alcoholic) Oahu, Sandwich Islands, Dr. W. H. Jones; 6 Sandwich Islands; 1 West Coast of Africa, Dr. Henderson, U. S. N.; 8 Yokohama, Japan, W. N. Lockington.

LUIDIA CLATHRATA, Say. 4 Charleston, S. C.; 1 Cuba, W. M. Gabb; 3 (alcoholic) Stumps' Pass, West Coast of Florida, Heilprin coll. 1886; 2 locality undetermined.

LUIDIA TESSELLATA, Lütken (?). 3 Lower California, W. N. Lockington; 2 Gulf of California, W. N. Lockington. These two last specimens are very large, measuring from 200 to 225 mm. from the center of the disk to the tips of the rays.

CTENODISCUS CRISPATUS, Retzius. 11 (alcoholic) (40–50 fath.) and 5 dried Massachusetts Bay, U. S. Fish Commission; 1 Salem, Mass., W. N. Lockington (J. S. Kingsley); 1 locality undetermined, S. B. Howel.

Archaster typicus, M. and T. 1 California, 4 Lower California and 1 Mulege Bay, Low. Cal. (Fisher coll.), W. N. Lockington; 1 Sandwich Islands, W. H. Pease.

The specimen from the Sandwich Islands differs from the others by its narrower arms and greater number of arm plates, having about 40 on each side of an arm, whereas the others have only about 35. It differs also in color, being of a very light cream color instead of light or dark umber. This however may be due to the fading of the original tint. This species has not before been recorded either from the Pacific Coast of North America or from the Sandwich Islands.

PTERASTERIDÆ.

Pteraster tessellatus, Ives. A single type specimen in alcohol. Proc. Acad, 1888, p. 421. Kodiak, Alaska. Dr. W. H. Jones.

OPHIUROIDEA.

OPHIURIDÆ.

Ophiura appressa, Say. 1 Callao, Peru, Dr. W. S. W. Ruschenberger; 3 Florida; 14 (alcoholic) locality undetermined.

Ophiura brevispina, Say. 1 Rhode Island, A. D. Bache.

Ophiura cinerea, M. and T. 5 Aspinwall, W. M. Gabb; 16 (alcoholic,) locality undetermined.

Ophiura panamensis, Lütk. 1 California, W. M. Gabb; 2 (alcoholic) Panama (?), NcNeil Expedition; 1 San Bartolomé Bay, Low. Cal., W. N. Lockington; 3 (alcoholic) San Diego, Cal., Jos. Jeanes; 1 alcoholic, West Coast of Mexico, Dr. W. H. Jones.

Ophiura teres, Lyman. 1 Cape Tortola, Low. Cal., and 1 locality undetermined, W. N. Lockington; 1 alcoholic, Nicaragua, Dr. Bransford; 3 dried and 7 alcoholic, West Coast of Mexico, Dr. W. H. Jones.

Ophiolepis elegans, Lütken. 1 (alcoholic) Sarasota Bay, Fla. (12 feet), Heilprin coll. 1886.

Ophioplocus esmarki, Lyman. 3 (alcoholic) San Diego, Cal., Jos. Jeanes; 1 (alcoholic) West Coast of America, George Davidson; 6 locality unknown, W. N. Lockington.

The number of arm spines to each side arm-plate in this species appears to be somewhat variable. In the specimen from the West

Coast presented by Mr. Geo. Davidson there are only two such spines, and in one of the specimens received from Mr. Lockington, some of the plates have two, and some three arm spines.

Ophioplocus imbricatus, M. and T. 1 Bay of Islands, New Zealand, W. N. Lockington.

Ophioncus granulosus, Ives. Type specimen (Proc. Acad. 1889, p. 143), locality undetermined, W. N. Lockington.

Ophioglypha albida, Forbes. 3 Belfast Bay, W. Thompson.

Ophioglypha ciliata Retzius. 3 Belfast Bay, W. Thompson; 27 "British," E. Wilson.

Ophioglypha lockingtoni, Ives. 2 type specimens (Proc. Acad. 1889, p. 143), locality undetermined, W. N. Lockington.

Ophioglypha lütkeni, Lyman. 4 dried and 2 alcoholic, locality undetermined, W. N. Lockington.

Ophioglypha nodosa, Lütken. 1 locality undetermined, W. N. Lockington.

Ophioglypha robusta, Lyman. 3 Bay of Fundy, U. S. Fish Commission.

Ophioglypha sarsi, Lyman. 3 dried and 7 alcoholic (20–125 fath.) U. S. Fish Commission.

Ophiopholis aculeata, Retzius. 1 Belfast Bay, W. Thompson; 1 "British"; 9 dried and 6 alcoholic, Maine, and 2 alcoholic, Nahant, Dr. J. H. Slack; 12 (alcoholic) Massachusetts Bay and Gulf of Maine (10–100 fath.) U. S. Fish Commission; 15 (alcoholic) Mt. Desert, Me., Dr. H. C. Chapman; 6 locality undetermined.

Ophiopholis caryi, Lyman. 1 (alcoholic), W. N. Lockington.

Ophiopholis japonica, Lyman. 1 (alcoholic) Dr. S. B. Howel.

This specimen agrees closely with Mr. Lyman's description of *O. Japonica*. The arm spines, however, are slightly longer and also more slender, and there are on the upper surface of the disk a few scattered spines of about the size of the smallest arm spines.

Ophiopholis kennerlyi, Lyman. 4 (alcoholic), West Coast of Mexico, and 11 (alcoholic) Alaska and California, Dr. W. H. Jones.

Ophiactis mülleri, Lütken. 2 (alcoholic) Bermuda, Heilprin coll. July 1888.

These specimens which were identified as *Ophiactis Krebsii* in Professor Heilprin's "Contributions to the Natural History of the

Bermuda Islands" (Proc. Acad. 1888, p. 316), on further examination I am inclined to regard as *O. Mülleri.*

OPHIACTIS SAVIGNYI (= *O. virescens*, Lütk.) 3 (alcoholic), one of them parasitic in sponge, La Paz, Low. Cal., W. N. Lockington; 18 (alcoholic) Oahu, Sandwich Islands, Dr. W. H. Jones.

AMPHIURA GEMINATA, Lyman. 2 alcoholic, La Paz, Low. Cal., W. N. Lockington (Fisher).

AMPHIURA SQUAMATA, Chiaje. 4 Belfast Bay, W. Thompson; 2 England, E. Wilson.

OPHIOCNIDA BRACHIATA, Montagu. 1 England, Dr. T. B. Wilson.

HEMIPHOLIS ELONGATA, Say. 1 Florida.

OPHIONEREIS RETICULATA, Lütk. 20 (alcoholic) Bermuda, Heilprin coll. July 1888; 1 Florida, T. R. Peale.

OPHIOSTIGMA ISACANTHUM, Say. 2 (alcoholic) Harrington Sound, Bermuda, Heilprin coll. July 1888.

OPHIOCOMA ÆTHIOPS, Lütk. 2 (alcoholic) Nicaragua, Dr. Bransford; Panama, 8 (alcoholic) McNeil Expedition and 1 dried, Capt. J. M. Dow; 1 West Coast of Honduras, Capt. J. M. Dow; 7 (alcoholic) West Coast of Mexico, Dr. W. H. Jones.

OPHIOCOMA ALEXANDRI, Lyman. 8 (alcoholic) Pichilinque Bay, Dr. W. H. Jones.

OPHIOCOMA CRASSISPINA, Say. 2 Aspinwall Bay, W. M. Gabb; 1 (alcoholic) New Providence, Bahamas, Dr. H. C. Wood; 1 (alcoholic) North Rock, Bermuda, Heilprin coll. July 1888; 1 (alcoholic) locality undetermined.

OPHIOCOMA ECHINATA, Lam. (Lyman). 3 East Coast of Florida; 1 Gulf of Mexico, C. S. Westcott; 4 (alcoholic) Panama, McNeil Expedition; 21 (alcoholic) locality undetermined.

OPHIOCOMA ERINACEUS, M. and T. 4 (alcoholic) locality undetermined.

OPHIOCOMA NIGRA, M. and T. 1 Belfast Bay, W. Thompson; 1 "British," E. Wilson.

OPHIOCOMA PICA, M. and T. 1 (alcoholic) locality undetermined.

OPHIOCOMA PUMILA, Lütken. 1 (alcoholic) Bermuda, Heilprin coll. July 1888; 1 (alcoholic) locality undetermined, W. M. Gabb.

OPHIOCOMA RIISEI, Lütk. 1 Aspinwall Reef, W. M. Gabb; 1 (alcoholic) New Providence, Bahamas, Dr. H. C. Wood; 7 (alcoholic) locality undetermined.

OPHIOCOMA SCOLOPENDRINA, Lam. 4 Enderbury Island, Phœnix Group, Dr. H. C. Eckstein.

OPHIOPTERIS ANTIPODUM, E. A. Smith. 1 New Zealand, Messrs. Warwick and Argent; 2 locality undetermined, W. N. Lockington.

OPHIOTHRIX ANGULATA, Say. 8 Florida.

OPHIOTHRIX LINEATA, Lyman. 7 Key West, Fla., S. Ashmead.

OPHIOTHRIX OERSTEDII, Lütk. 2 Key West, Fla., S. Ashmead; 6 (alcoholic) New Providence, Bahamas, Dr. H. C. Wood; 50 (alcoholic) locality undetermined.

OPHIOTHRIX PENTAPHYLLUM, Pennant. 3 Belfast Bay, W. Thompson; 15 "British," Dr. Wilson.

OPHIOTHRIX RUDIS, Lyman. 2 (alcoholic) West Coast of America, Geo Davidson; 3 locality undetermined, W. N. Lockington.

The specimens of this species received from Mr. Lockington agree with Mr. Lyman's description, but the dorsal surface of the arms and disk is of a light bluish-gray and the upper arm plates are marked each by a central transverse darker band, with a lighter band on either side of it. The specimens received from Mr. Geo. Davidson answer to Mr. Lyman's description as to color, but have a light band on the outer edge of each upper arm plate. This light band is bordered on the inside by a faint line of darker.

OPHIOTHRIX SPICULATA, Le Conte. 2 (alcoholic) Magdalena Bay, Low. Cal., W. N. Lockington; 4 (alcoholic) San Diego, Cal., Jos. Jeanes; 6 dried, West Coast of Low. Cal., and Gulf of California and 2 alcoholic locality undetermined, W. N. Lockington.

I have found it so difficult to determine whether the above forms belong to *O. spiculata*, Le Conte or *O. dumosa*, Lyman that I think it probable that these two species represent varieties of one form. The color appears to be very variable.

OPHIOTHRIX SUENSONII, Lütk. 1 (alcoholic) Nassau, New Providence, Dr. H. C. Wood.

OPHIOMYXA FLACCIDA, Lütk. 1 (alcoholic) New Providence, Bahamas, Dr. H. C. Wood; 1 (alcoholic) Bailey's Bay, Bermuda, Heilprin July 1888; 7 (alcoholic) locality undetermined.

ASTROPHYTIDÆ.

ASTROPHYTON COSTATUM, Seba. 1 South Carolina, F. S. Holmes; 1 Cuba, J. G. Howard; young specimen on Pterogorgia, West

Indies, I. Lea; 1 (alcoholic) Santa Cruz, West Indies, T. Davidson, Jr.; 1 (alcoholic) West Indies, R. Swift.

ASTROPHYTON PANAMENSIS, Verrill. 5 (alcoholic) locality undetermined, McNeil Expedition.

GORGONOCEPHALUS AGASSIZII, Stimpson. 1 dried and 2 alcoholic off Cape Cod (25–35 fath.), U. S. Fish Commission; 3 Maine, Dr. J. H. Slack; 4 (alcoholic) Mt. Desert, Me., Dr. H. C. Chapman; 1 (alcoholic) locality undetermined, Smithsonian Institution.

GORGONOCEPHALUS ARBORESCENS, Agassiz. 1 Palermo, Italy, John Ford.

GORGONOCEPHALUS CARYI, Lyman. 1 Monterey, Cal., and 1 locality undetermined, W. N. Lockington.

GORGONOCEPHALUS STIMPSONI, Verrill. 1 (alcoholic) Arctic Ocean, Smithsonian Institute, North Pacific Expedition; 1 (alcoholic) Marmot Island, Alaska, Dr. W. H. Jones; 1 locality undetermined, W. N. Lockington.

ASTROSCHEMA LÆVE, Lyman (?). 1 locality undetermined.

ASTROSCHEMA OLIGACTES, Pallas. 1 locality undetermined.

July 2.

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

Nine persons present.

The following papers were presented for publication:—

"Nomenclature and Check-List of North American Land Mollusks." By H. A. Pilsbry.

"The Origin and Meaning of Sex." By John A. Ryder.

"A review of the American Species of Sturgeons (Accipenseridae)." By Philip H. Kirsch and Morton W. Fordice.

July 9.

Rev. H. C. McCook, D. D., Vice-President, in the chair.

Twenty persons present.

Note on the true Systematic Position of the Ray Spider.—Dr. Henry C. McCook remarked that he had been recently led to reinvestigate the character of the web of the Ray spider and its proper systematic place.

When the snare of this aranead was first discovered by him in 1881, and described in the Proceedings of this Academy[1] he considered the spider new to science, and gave it the name of *Epeira radiosa* in a paper containing a careful and detailed description of its spinningwork and habits. He then indicated that it would probably be assigned to a new genus, and subsequently in a verbal communication to this Academy, proposed for it the name of *Actis radiosa*. Emerton, in his monograph of the New England Epeiradæ, created for it the genus *Microepeira*.[2] Subsequent investigation had led Dr. McCook to believe that the spider belongs to Cambridge's genus *Theridiosoma*,[3] and probably is identical with the European species *Theridiosoma gemmosum* of Dr. L. Koch.[4] This genus has a marked resemblance to *Epeira*, as Cambridge himself allows, and certainly on the ground of structure appears to be at least equally related to the Epeiroids.

[1] Proc. Acad. Natural Sciences. Phila., 1881, pp. 163–75.

[2] New England Spider of the Family Epeiradæ. Transactions Connecticut Academy, Volume VI., 1884, p. 320.

[3] Rev. O. Pickard-Cambridge, Annals and Magazine of Natural History, 1879, p. 193.

[4] Theridium gemmosum: Verzeichniss der bei Nurnberg beob. Arten. p. 69.

Count Keyserling, however, in his extended and admirable monograph[1] retains the species among the Retitelariæ where it had previously been placed. But the spinningwork of the spider, which appears to have been unknown to the above named arachnologists, shows conclusively that it must be placed with the Orbitelariæ. To that position, therefore, Dr. McCook assigned it, and it became necessary to transfer the genus *Theridiosoma* from the Retitelariæ to the Orbitelariæ, and to make for it a new family, for which he proposed the name *Actinæ*.

In the paper above alluded to, in which the habits and spinningwork of this spider were originally described, the statement was made that the spiral lines of its web were covered with viscid beads. Upon this point turned very largely the decision as to the true systematic place of the spider, for it has never yet been observed that any other spiders than those belonging to the Orbitelariæ make geometric webs that are habitually covered with viscid beads as the ordinary armature for capturing prey. In correspondence with arachnologists upon the subject, the speaker was not able to say that he had made such tests of this point as to enable him to speak with absolute assurance. He had made a somewhat careful investigation with a good hand lens, which seemed to indicate with reasonable certainty the presence of viscid spirals. But as the webs are habitually located within cavities and shaded positions, where they are extremely difficult to study, there remained the possibility that he might have been mistaken. This appeared to be the more likely because when such webs as those of the Triangle spider, *Hyptiotes cavatus*, are examined, the spiral lines often appear to be beaded, although it is well known that they have no viscid armature. The lack of beads is supplied by a thin flocculent thread, which is teased or hackled by a special instrument known as the calamistrum. Yet, when one looks at the spiral thread of *Hyptiotes*, or of *Uloborus*, which has the same peculiarity, he finds that it presents to a careless glance the appearance of being beaded. More closely examined, however, these seeming beads prove to be nothing but globular grains of pollen or particles of dust which have been drifted upon and entangled with the flocculent lines. The speaker had himself more than once been deceived by the strong resemblance of these drifted minutiæ, and been led to look again with the wonder whether after all there might not be beads upon these webs which were so well known to be unbeaded? When, therefore, the question was raised and became of such special importance, he resolved to make a careful and thorough re-examination and test of this point.

No opportunity occurred to do this successfully until July 8th (1889), near Wallingford, Delaware County, Pennsylvania. The Ray spider was found in sufficient abundance for desired study, located along the banks of a little run or stream of spring water. Its posi-

[1] Die Spinnen Amerikas. Theridiidae, I Hälfte, von Graf. E. Keyserling, Zweiter Band, p. 218.

tion was there precisely like that in which it has always been discovered, in cool, shaded retreats overhanging or close to running water. He had provided himself with all the apparatus necessary to make a satisfactory microscopic examination of the webs. Many of his previous investigations were repeated and confirmed. The viscid globules were found to be visible along the spiral lines with a common hand lens. Not satisfied with this, portions of the web were removed and microscopically examined, and thus displayed beyond doubt the presence of the viscid beads.

The behavior of the web was precisely like similar portions of the orb of *Epeira*. The beads would melt upon the glass, leaving the thread visible as a straight line. Within the cups or frames, upon which the lines were taken for examination, the beads being undisturbed were readily examined and their character easily determined. Drawings were made of these beads, and the number counted on single strings, amounting in one case to sixty-four. A number of insects entangled upon several snares were also observed and drawings made. They showed in every instance the same method of entanglement as that so frequently observed upon the web of *Epeira*. The feet, wings and antennæ of a fly were caught in the viscid lines from which, at certain parts, the gummy material had been absorbed into the pubescence of the insect's limbs, and at other parts remained in the globular form of beads.

Dr. McCook not only satisfied himself beyond question of this fact, but submitted the various tests, independently, to his private secretary, Mr. Edwin S. Gault, who had been requested to carefully note and accurately report precisely what he saw. His report confirmed in every particular as to the beaded nature of the spirals, that which is here submitted. Thus the one point which remained at least open to question concerning the spinning habit of this interesting spider, has been placed beyond doubt. Thus also, the position of *Theridiosoma radiosum*[1] is placed beyond doubt among the Orbweavers. The special interest of this decision rests upon the fact that the spinningwork of the Ray spider forms a remarkable connecting link between that of the Triangle spider *Hyptiotes*, and the ordinary geometric Orbweaver. The Triangle spider spins a snare composed of four converging lines and uniting finally in a common supporting thread known as the trap-line. They are joined by cross lines after the manner of the spiral concentrics of an orbicular web, but without any viscid armature as has been stated.

This web is used for the capture of insects by a method of trapping or springing the snare, which has been fully described by various observers, particularly by Professor Burt Wilder. The

[1] Dr. McCook preferred for the present thus to characterize the spider, awaiting until its actual identity with Dr. Koch's species shall be determined. He had no species of the European *Theridiosoma gemmosum* with which to compare his own specimens and had sent specimens to Europe for such comparison.

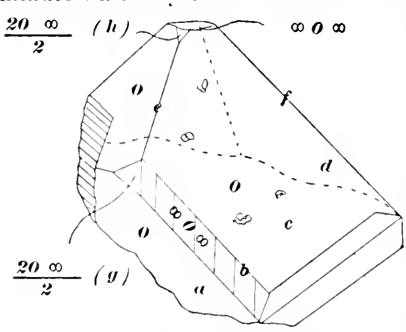
spider takes its position upon the handle or trapline of its little ray-formed web, holding between its fore feet and the third pair of feet a coil of slack line. When an insect strikes its snare it quickly unlooses its fore feet, and the web shoots forward the distance of the coil of slack line. It is then rapidly gathered up again and successively snapped in this wise until the insect is thoroughly entangled.

Now, this same method of springing its net and trapping its prey is habitual with *Theridiosoma radiosum.* Its web may be said to be composed of a series of rays somewhat resembling the orb sector of the Triangle spider. The handles or traplines of these rays are, however, all centered upon a common thread or trapline, which the little weaver holds within her feet. She has the power of springing or snapping off all these combined concentrics at once; or, if she so choose, to spring one or more of them at a time. She thus in this remarkable and essential particular resembles the Triangle spider in her habit. Had the spiral lines of her web proved to be of the same character as those of the Triangle spider, this peculiarity of combining the rays upon a central point might not have seemed so remarkable; but when it is found that the spiral lines are covered with beads entirely after the manner of true Orbweaving spiders, the combination becomes very striking and remarkable indeed.

Many Orbweavers do use a trapline in connection with their webs. This is almost invariably the custom with those which make an orb having in the upper part an open segment, as is the case with *Epeira triaranea*, *Epeira thaddeus* and generally with the species of the genus *Zilla.* But this trapline, while it is attached to the center of the orb, and assists to hold the various converging lines taut, has simply these two uses: first, it is used as a telegraphic line along which pass the vibrations of the entangled insect, and which are thus communicated to the owner of the snare who occupies a position in a little den just above and beyond her domain. Second, the trapline serves as a gangway along which the spider runs first to the center of her orb and then to the point where her prey happens to be entangled. None of these Orbweavers, however, make any such use of their traplines as that which has been described as habitual to the Triangle and Ray spiders. Perhaps one may not be able to suggest a method by which these variations have been originated, but at all events, it must be conceded that the fact, which is in this communication placed beyond question, as to the viscid character of the spiral lines of the Ray spider's snare, certainly reveals a connecting link between two forms of spinningwork, namely that of the Triangle spider and that of the typical geometric Orbweaver, which had heretofore been supposed to stand at the opposite extremes of the spinningwork of a great family, without any known connection between the two.

Chloanthite, Nicolite, De Saulesite, Annabergite, Tephrowillemite, Fluorite and Aquatite from Franklin, N. J.—PROFESSOR GEORGE A. KOENIG stated that on a recent visit to Franklin he obtained from Major de Saules, the manager of the Trotter mine, material of a recent find of nickel ore, in which he identified the above species, of which two are new and the others have not been observed heretofore at this locality. At a depth of 340 feet the shaft passed through a stratum of yellow garnet. Under this a considerable nest of sphalerite and fluorite was met with and with these the bunch of nickel ore was associated, probably 30 pounds. The first and only observation that nickel and cobalt are found at Franklin, dates from 1876, when the speaker described the product of alteration of Jeffersonite under the name of Anomalite (Amer. Inst. of Mining Engineers, 1876). From this substance the reaction of manganese in borax and salt of phosphorus could not be obtained, although it contains over 30% of this metal. The cause of this lies in the presence of nickel and cobalt (about 3%) which together give a green color to the glass and this being complementary to the red of the manganese, extinction results. The present find of nickel minerals is, then, not unexpected, but very interesting.

1. *Chloanthite.*—Forms the main bulk. It is chiefly massive, in thin layers, having a very thin interposition of calcite. The color of the massive portion is light steel-gray. On one specimen, the mineral is bordered by cleavable calcite. All along the border minute white crystals of metallic lustre are imbedded in the calcite. Their habitus is generally prismatic. Fortunately the speaker observed one crystal, $\frac{1}{12}$ inch length of edge, which could be chiseled out from the matrix and was large enough to afford goniometric measurements. The figure shows this crystal in linear enlargement of 1: 18. The crystal is broken off at the left and at the back. On the right front a small crystal appears.



The right front face O and all others of the same position show small protuberances and do not reflect the light completely. However, the reflections obtained were in the main satisfactory.

Edge (e) = 70° 24′

Edge (f) = 70° 35′ (theoretically 70° 33′)

The face (b) is very narrow, striated, and it reflects a drawn image.

$a : b$ = 55° (54° 44′) $b : c$ = 54° 30′ (54° 44′)

$a : c$ = 109° 30′ (109° 28′)

$a : d$ = 180°

From these measurements it follows that the crystal belongs to the *isometric* system; the combination being O, ∞ O ∞. The faces (g and h) belong to a pentagonal dodecahedron, whose symbol is $\frac{20\infty}{2}$ because $g : b = 24° 30'$ (uncertain owing to the strongly blurred condition of the weak reflection; 20 ∞ requires 26° 30′). This form should occur, however, in symmetrical pairs of faces. It is observed here only in single faces. The upper apex is quite perfect and so is the front apex, yet there is no indication in either case of a companion face. A tetartohedral development must therefore be assumed in this instance.

Specific gravity = 6.8334 at 24° C. B. B. In closed tube it yields a sublimate of metallic arsenic. On charcoal it does not fuse until a large quantity of arsenic has been volatilized. Heated with a borax head in the O. H. on charcoal, a blue glass is obtained for some time, then a brown glass. (Cobalt and Nickel.)

The analysis gave:

Arsenic	=	70·66	0·9421	0·9902
Sulphur	=	1·54	0·0481	
Nickel	=	18·63	0·3185	0·4685
Cobalt	=	6·37	0·1087	
Iron	=	2·31	0·0413	
Zinc	=	trace		
Ca CO^3	=	0·89		
		100·40		

The atomic ratio therefore:

(As, S) : (Ni, Co, Fe) = 2· 11 : 1

It is further notable that

Fe : Co : Ni = 1 : 3 : 9 very nearly.

2. *Nicolite.*—This species has been observed only in a few small grains in connection with the following species. It is recognized by the peculiar color.

3. *De Saulesite*, a zinciferous variety of Garnierite.—This species occurs as a crust and as the filling of the cavities in a deeply purple fluorite. It is associated with Chloanthite in such a manner, that the most probable inference to be drawn is, that the arsenide is not the original, but was crystallized either at the same time or later than the silicate. Chloanthite is disseminated in very minute prismatic crystals all through the green silicate. This latter is built up loosely in grate-like forms, assuming the texture of certain sponges. The linear, intersecting, cylindroid rods are covered with roughly polyhedral excrescences which seem to be crystalloid bodies. Besides this form, which has been reported for the Algerian Garnierite, the green mineral appears less frequently in massive, compact, bluish-green bands, bordered by Chloanthite. It resembles in this form certain serpentines, from which, however, its softness readily distinguishes it. The color varies from yellowish-green to bright

apple and emerald-green. The material for the analysis was picked with the utmost care, especially to exclude the minutest crystals of chloanthite. The quantity analyzed was 0·2805 gram. In closed tube it yields water and turns brown. It is infusible even in the Bunsen blowpipe, but the green color returns at this high temperature, and the specimen looks as if it had not changed. It gives with the fluxes only nickel reaction. It is easily decomposed by hydrochloric acid, a little less after ignition, and separates flocculent silica. Owing to the scantiness of material, the substance was first ignited then digested with concentr. hydrochloric acid over night. The silica was then fused with sodic carbonate, when it was observed that it had lost 10%, showing that 90% of the ignited silicate had been decomposed by the acid. The analysis gave:—

$Si\,O^2$	= 31·62	
$Ni\,O$	= 38·22	
$Zn\,O$	= 4·00	
$Fe\,O$	= 2·03	
$Ca\,O$	= 0·70	
$Mg\,O$	= 0·42	
$As^2\,O^5$	= 4·77	
$H^2\,O$	= 16·58	9·44 at 100° C.
	97·71	7·14 at 600° C.

The arsenic oxide is undoubtedly contained as such in the mineral. Let it be assumed then that it is admixed in the form of Annabergite, there will be:

$Si\,O^2$	= 31·02	Coeffic:	0·5017	
$Ni\,O$	= 33·62		0·4508	
$Tn\,O$	= 4·00		0·0490	
$Fe\,O$	= 2·03		0·0290	
$Ca\,O$	= 0·71		0·0120	0·5408
$Mg\,O$	= 0·42			
$H^2\,O$	= 13·58		0·7500	
$As^2\,O^5$	= 4·77	Annabergite.		
$Ni\,O$	= 4·60			
$H^2\,O$	= 3·00			

For the silicate the ratio will be

$$\begin{array}{ccccc} (Ni, Zn, Fe)\,O & : & Si\,O^2 & : & H^2\,O \\ 0{\cdot}5408 & : & 0{\cdot}5017 & : & 0{\cdot}75 \\ 1{\cdot}08 & : & 1 & : & 1{\cdot}5 \end{array}$$

This is the ratio exactly, given by Groth for Garnierite. (Tabell. Uebersicht, 2 Aufl.) The question remains, however, is Garnierite an Ortho-or a Metasilicate? Groth takes the latter alternative, writing the formula

$$H^2\,(Ni, Mg,)\,Si\,O^4.\ \ \tfrac{1}{2}\,aq.$$

To the speaker this view does not seem confirmed by the present results. The water is expelled too readily, over one-half at 100° C., and he would write the formula

$$(Ni, Tu, Fe)\,Si\,O^3.\ \ 1\tfrac{1}{2}\,aq.$$

as a metasilicate.

Experimenting with some Garnierite from Africa, the speaker observed that the mineral behaves like the present one. It turns *brown* and in a strong heat again green, not *black* as Damour states: (Zeitschr. f. Crystallogr. Mineralogie, vol. iii, p. 636.) The speaker thinks it proper to distinguish this zinciferous Garnierite by a new name and proposes *De Saulesite* in honor of Major A. B. de Saules, E. M., the present manager of the Trotter mine, to whose kindness in furnishing the material, the author is much indebted and herewith expresses his thanks.

4. *Tephrowillemite*, an intermediate species. The speaker received from Master Percy de Saules a broken crystal, found at the same depth as the preceding minerals in the Trotter mine. The crystal fragment shows two faces which intersect in an edge 1,5 inch long, conforming to 120° measured with a hand goniometer. The crystal is imbedded in well cleaving gray calcite. Its substance is very homogeneous, showing under the microscope but a few very small black grains, most probably Franklinite.

The color is brownish-gray. Lustre resinous, unctuous. B. B. Is infusible; yields no water: furnishes on charcoal a zinc incrustation and with the fluxes a strong manganese reaction. It gelatinizes completely with cold, concentrated hydrochloric acid.

The mean of two analyses gives:—

$Si\,O^2$ = 27·75		0·4925	
$Zn\,O$ = 60·61		0·7302	
$Mn\,O$ = 10·04		0·1360	
$Fe^2\,O^3$ = 2·00	= 1·80 Fe O	0·0250	.8912
$Ca\,O$ = trace			
100·40			

Under the supposition that the iron is all ferrous, the ratio obtains:—

$$\begin{array}{ccc} Si\,O^2 & : (Tn, Mn, Fe) & = \\ 0{\cdot}4925 : & 0{\cdot}8912 & \\ 1 \quad : & 1{\cdot}85 & = 1 : 2 \end{array}$$

The formula is, therefore:—

$$(Zn, Mn, Fe)^2\,[Si\,O^4]$$

5. *Fluorite.*—Whilst the species had been found in the mass of the white marble in the quarries south-west of the furnace, it had not previously been noticed within the ore body. The speaker observed it in very light pink octohedrons, and in deeply purplish masses, compact, small granular and large granular cleavage pieces. It is chiefly notable as the supporting substance of the De Saulesite. It is largely associated with the beautiful yellow sphalerite.

6. *Apatite.*—The speaker noticed this species on a small specimen showing an intimate mixture of the purple fluorite with yellow garnet. The apatite occurs in small prismatic crystals of bluish-green color. The combination is P ∞. 0 P. 2 P 2.

The spores of the Myxomycetes.—Mr. HAROLD WINGATE, referring to the work done by Dr. Rostafinski some years ago upon the spores of the Myxomycetes, and also to the recent paper by Mr. Geo. Massee on the Trichiaceae, made a communication upon some of the results he had obtained from the study of these reproductive bodies.

The speaker observed that for many years the mycologist had been satisfied with the results obtained from the use of lenses from $\frac{1}{4}$ to $\frac{1}{8}$ inch focus in arriving at the morphology of the spores of the fungi, but of late years, in the study of the structural details of the Myxomycetes, the results from the use of a good, high-power immersion lens ($\frac{1}{12}$ to $\frac{1}{18}$ inch focus), have been so astonishing that the careful investigation of this group is now impossible without such a lens.

The speaker for some years had spent considerable time in making accurate drawings of the spores of this group, using a Zeiss water-immersion lens equivalent to $\frac{1}{18}$ inch focus. It was interesting to note that some of the drawings showed a tendency to fall into an artificial series based upon the thickenings of the epispore, commencing with simple structure and by gradual steps ending with a rather complex one.

The drawings were exhibited and the following types might be selected as a series showing this progression:—

1.—The series should begin with a spore absolutely without thickenings, but, with the exception of the spore of an undescribed species, no spore has yet been found in the speaker's collection which would accurately fit this type from the hypercritical standpoint of the present.

2.—Thickenings of the epispore in the shape of isolated faint warts, *Arcyria punicea*, Pers.

3.—Thickenings in the shape of faint, sparsely scattered warts, *Comatricha pulchella*, Bab.

4.—Thickenings in the shape of faint warts somewhat thickly scattered over the surface, *Didymium squamulosum*, A. & S.

5.—Thickenings in the shape of faint warts densely scattered over the surface, *Trichia fragilis*, Sow.

6.—Thickenings in the shape of warts arranged to form a pattern having a reticulate appearance, *Stemonitis fusca*, Roth.

7.—Thickenings in the shape of warts arranged to form a reticulate pattern, the warts confluent at their bases, *Stemonitis dictyospora*, Rki.

8.—Thickenings in the shape of warts which very frequently coalesce to form a delicate fine-meshed net-work over the greater portion of the epispore, the remaining surface with warts and ridges; the outline of the warted portion very irregular, *Trichia scabra*, Rki.

9.—Thickenings in the shape of a delicate fine-meshed net-work covering the greater portion of the epispore.

A.—The portion without the fine net-work having scattered warts and ridges and with an irregular outline, *Tubulina* *cylindrica*, Bull., *Lycogala epidendrum*, Buxb., *Dermodium conicum*, Pers.

B.—The portion without the fine net-work having a very wide-meshed net-work and with an irregular outline, *Siphoptychium Casparyi*, Rki., *Tubulina stipitata*, B. & Rav.

10.—Thickenings in the shape of a delicate, fine-meshed net-work covering about two-thirds of the surface, the remaining portion with scattered warts and ridges; the warted portion having the sharp, regular outline of a wide spindle, the ends of the spindle lying at the poles of the sphere, *Enteridium Rozeanum*, Rki.

11.—Thickenings in the shape of a delicate fine-meshed net-work covering about one-half of the surface, the remaining portion with scattered warts and ridges; the warted portion having a sharp, regular, circular outline, *Reticularia Lycoperdon*, Bull.

It will be seen from this series how readily the rather complex sculpturing of numbers 9, 10 and 11 might have had its origin from a simple warted type by the gradual coalescence of the warts in certain directions.

Note on Orthotricha.—Mr. Harold Wingate also remarked that in the Journal of Mycology for November, 1886, he had described a new genus of Myxomycetes under the name of *Orthotricha*. In some of the journals which noticed the article the genus was mentioned as *Orthotrichia*, and in Saccardo's Sylloge Fungorum, vol. vii, part i, this error was repeated. It is inferred that it was done in error as no mention is made of any intention to correct the original name. As the original name conflicted with that of a genus of mosses, the speaker had concluded to adopt the orthography as given in Saccardo:—*Orthotrichia* instead of *Orthotricha*.

July 16.

Mr. Charles Morris in the chair.

Thirteen persons present.

The following papers were presented for publication:—

"Notes on the food of birds." By Frank C. Baker.

"A review of the European and American Uranoscopidae or Star-Gazers." By Philip H. Kirsch.

July 23.

Mr. Charles Morris in the chair.

Seven persons present.

The following papers were presented for publication:—

"Remarks on the Round-tailed Muskrat, Neofiber Alleni, True." By Frank C. Baker.

"Notes on the Anatomy of Pholas (Barnea) Costata and Zirphæa Crispata, Lin." By W. H. Dall.

"On the Anatomy of Aerope and Zingis." By H. A. Pilsbry.

JULY 30.

Mr. THOMAS MEEHAN, Vice-president, in the chair.

A paper entitled "Description of New Shells from the Island of Segon, New Hebrides." By Wm. D. Hartman, was presented for publication.

The death of Charlemagne Tower, a member, on the 24th inst., was announced.

On report of the Publication Committee the request of the author for the withdrawal of the following papers was granted:—

"The Phylogeny of the Sweat-Glands." By John A. Ryder.

"On the Origin and Meaning of Sex." By John A. Ryder.

The following were ord red to be printed:—

NOMENCLATURE AND CHECK-LIST OF NORTH AMERICAN LAND SHELLS.

BY H. A. PILSBRY.

The following list includes all of the species of land Pulmonata known to me to inhabit America north of the Mexican Boundary. I have taken this occasion to examine nearly every species (except the *Succinea*) and also to somewhat critically review the generic and subgeneric nomenclature with a view to attaining greater stability. The departures made from the ordinary usage of American malacologists have been only such as seemed to me to be absolutely necessary. The principal innovations are the following:

PRISTILOMA Ancey.

Mr. Ancey proposed in 1887 the subgenus *Pristina* for *Z. lansingi* and *Z. stearnsi* Bld., two tiny Oregon species resembling *Conulus* in the shell. Later, the writer changed the name to *Anceyia* (*Pristina* being preoccupied), and redefined the group, pointing out the true generic characters (which Mr. Ancey had overlooked). This name also having been used for an African genus, Mr. Ancey replaced it by *Pristiloma*. The genus is quite distinct from other American modifications of the *Zonites* stock; and in the combination of aculeate or thorn-shaped marginal teeth of the radula with a strongly ribbed jaw, can only be compared with the New Zealand genus *Phacussa* of Hutton. I can see no reason for uniting this group to either *Zonites* or *Microphysa*.

PATULA Held.

This division of the Helices seems to have sufficient individuality to stand as a genus. It is composed of a large number of subdivisions founded on minor modifications of the shell, which varies from large and strongly ribbed to minute, thin, subtranslucent; and whilst usually broadly umbilicated, is often more compactly convoluted, with only a minute perforation. The lip is always acute and thin. The jaw is either striate or ribbed. Like *Helix*, the genus is world-wide in distribution. In many of the sections I have grouped here, the species, or part of them, are viviparous.

PTYCHOPATULA Pilsbry.

This name is proposed for a section of the genus *Patula* including Neotropical Helices with minute, conical, thin shells, a *narrow um-*

bilical perforation, rounded or rounded-lunar aperture. the lip fragile, simple, columellar margin expanded; surface nearly smooth or delicately, very obliquely ribbed. The color is brownish or greenish. The species have heretofore been scattered through two families and many subgenera (*Acanthinula*, *Conulus*, *Pyramidula*, etc.) by Pfeiffer and other authors. The species are as follows: *H. dioscoricola* C. B. Ad., *H. punctum* Morelet, *H. cæca* Guppy, *H. plagioptycha* Shutt., *H. cæcoides* Tate, *H. ierensis* Guppy, *H. granum* Strebel et Pfeffer. This number will require some reduction, as the first three forms are very closely allied, and the last four equally so.

MICROPHYSA Albers.

The note in Proc. Acad. Nat. Sci. Phila. 1889, p. 82, contains the writer's views on this little group, which is allied to *Microconus* and the smaller forms of *Patula*. The name *Microphysa* is preoccupied, and may have to be replaced, in which event *Thysanophora* Strebel may be used, as it seems to be practically synonymous. The section is essentially West Indian.

PUNCTUM Morse.

This genus was perfectly defined by Morse, and should, I am convinced, be restricted to species agreeing with the original diagnosis in characters of animal. I am unable to follow Mr. Binney in uniting it to *Microphysa*, or Dr. Fischer in including *Glyptostoma* with it.

HELIX Linn.

The genus *Helix*, restricted, after the elimination of those groups possessing distinct structural characters, is capable of division into a moderate number (about twenty) of groups which may be ranked as subgenera. Most of these consisting of a number of minor groups, the characters of which usually merge more or less completely into one another in some species. For the primary divisions of the genus, the characters of the shell, genitalia and dentition have about equal value; and the consideration of either one of these characters to the exclusion of the others is almost certain to result in a false grouping.* The older writers on land shells, especially Férussac, defined a large number of subgenera founded on characters of the shell alone; but most of these groups have proved to be so heterogeneous that we are

* Semper's classification founded principally on the genitalia is a notable example of this. The characters of the jaw are of comparatively slight value in the Helices.

compelled to reject them entirely. The same objection applies to many of the divisions made by H. and A. Adams. Albers, in 1850, inaugurated what may be called the modern period in Helicology; and von Martens and Pfeiffer have successively (and generally successfully) elaborated the structure of Albers.

LYSINOE H. and A. Ad.

Consists of Helices of Old World affinities, confined to Mexico and the West Coast. The species are excessively variable and plastic, and their inter-relations can be understood only by one acquainted with the conditions under which they exist. This knowledge of their environment I do not possess; and in the specific distinctions I follow mainly Binney, with, however, a different grouping, and a number of other departures from his arrangement. I cannot admit that "*Aglaia*" (as distinct from "*Arionta*") has any claims to the slightest systematic rank; nor do *Helminthoglypta* or *Micrarionta*, or "*Euparypha*" have any characters worth the time it takes to write them down. Several species of "*Helminthoglypta*" have varieties which are not "helminthoglyptous;" *Micrarionta* is united to the other species by *H. rufocincta* and other species; and as to "*Euparypha*," its species (*H. tryoni*, *areolata*, etc.) are merely arid-country forms of the *kelletti* and *intercisa* group of *Lysinoe*. The *true Euparypha* is a European section closely allied to *Xerophila*, *Fruticicola*, etc., and belonging to a different phylum of Helices.

POLYGYRA Say.

Equals, in part, *Anchistoma* Ads., Tryon, Fischer and others. Includes as sections, *Polygyra*, *Mesodon*, *Triodopsis*, etc.

I have adopted *Polygyra* as the name for that group of American Helices characterized by a horn-colored striate shell, with reflected white peristome, usually toothed within; ribbed jaw; genitalia simple, without dart-sack or appendages other than the essential organs, penis without flagellum, duct of the spermatheca short. The subgenus thus defined is very homogeneous. Numbers of species would go equally as well in *Mesodon* as in *Triodopsis* or *Stenotrema*. *H. levettei* Bld., is as nearly related to *Polygyra helictomphala* Pfr., as to *Triodopsis*, etc., etc. *Atopa*, *Plectopylis*, and a number of other sections referred to "*Anchistoma*" by Tryon, Fischer, and others, should be widely sundered from this subgenus. There are several striking and important anatomical differences. On account of the heterogeneous composition of *Anchistoma* I have dropped that name altogether, and have substituted *Polygyra*, the oldest name proposed for a member of the subgenus as restricted here. The species are nearly all American.

PUPA.

In this difficult genus I have had the advantage of the experience of Dr. V. Sterki of New Philadelphia, Ohio, who has kindly criticised my mss., pointing out to me the distinctions between *V. pentodon* and *V. curvidens;* the identity of *P. simplex* with *P. edentula* of Europe, and the generic position of this species, which had heretofore been classed in *Vertigo;** and also for information regarding the curious little group *Angustula*, lately proposed by him. The balance of the species I have left as in my original mss. I have not been able to make certain other changes recommended by Dr. Sterki. *P. sterri* Voith, a European species, has been identified by him from Colorado, but I am disposed to refer the form to some variety of *P. muscorum.*

SUCCINEA Drap.

I have made no special study of this genus. The species are arranged alphabetically.

VAGINULUS Blainv.

The reasons for adopting the name *Vaginulus* instead of *Veronicella* given by Fischer (Manual, p. 493, and Moll. Mex. et l'Amer. Cent.) seem to me conclusive.

Origin. In regard to origin of the snail fauna of the United States, we may roughly divide the species into six categories, as follows:

(1.) Species introduced by human agency, such as *Helix hortensis, Limax agrestis* and *maximus, Rumina decollata*, etc. These are principally European forms, and are as yet only locally distributed. In the list they are indicated by having their numbers in brackets.

(2.) Species inhabiting both Palæarctic and Nearctic regions. Mostly minute boreal forms. *Pupa muscorum, Helix pulchella, Zonites radiatulus, Punctum pygmæum*, etc., are examples.

(3.) Pacific slope or Californian fauna. This fauna occupies the region lying west of the Sierra Nevada,—a range which divides America into two primary faunal provinces. This division was commenced with the upheaval of the Sierras in Jurassic times, constitut-

* Dr. Sterki calls the subgenus containing *P. edentula*, "*Edentulina*" but this name is preoccupied in *Streptaxidæ* and elsewhere.

ing a barrier which was insurmountable to most land snails. From the gradually receding Pacific, California, a narrow, long strip, emerged. Sometime in the early tertiary (probably) there was an infusion of Palæarctic types into this region, from the Northwest.[1] To this influence we owe the Arionta-like shells, *Gonostoma*, *Ariolimax* (most nearly related to the Old World genus *Arion*), etc., which are closely allied to characteristic Palæarctic types, but are quite different from the snails of Eastern North America.

(4.) American fauna, embracing the whole country lying East of the Sierra Nevada range. This is the autochthonous American fauna, developed with very little trace of Old World influence, or none at all, from an early, probably Cretaceous, period. Characteristic groups are *Mesodon*, *Stenotrema*, *Triodopsis*, *Polygyra*, *Strepomatidæ*, *Campeloma*, *Amnicola*, *Somatogyrus*, etc.

In the South this fauna has received species from two sources: (5) Mexican species, such as *Bulimulus alternatus* and *schiedeanus*, *Holospira*, etc., and (6) West Indian and Central and South American forms which have passed into Florida, such as *Orthalicus*, *Liguus*, *Bulimulus Cylindrella*, *Microphysa*, *Ptychopatula*, etc. The number of these makes it probable that there has been land connection with South America by way of the Antilles and Caribees; a theory which derives no slight support from the finding in Florida of quaternary fossil *Glyptodon* and other South American forms.[2]

Family i. TESTACELLIDÆ.

Genus i. GLANDINA Schumacher, 1817.

1. Glandina truncata Gmel. Coast Region from Ga. and Fla., to Texas.

1a. Glandina truncata bullata Gld. Louisiana.

1b. Glandina truncata parallela W. G. Binney. Florida.

2. Glandina texasiana Pfr. Brownsville, Texas.

3. Glandina decussata Desh. Central Southern Texas.

4. Glandina vanuxemensis Lea. Southern Texas.

Family ii. SELENITIDÆ Fischer.

Genus ii. SELENITES Fischer, 1878.

5. Selenites concava Say. Eastern U. S.

6. Selenites vancouverensis Lea. Washington Ter., to Alaska; Western Idaho.

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1 Siberia and Alaska are now united by a ridge covered by less than 50 fms. depth. This was probably dry land during the Eocene, as it is also said to have been during part of the Quaternary.

2 See Proc. Acad. N. S. Phila. 1889, p. 96.

7. Selenites hemphilli W. G. Binn. Eastern Oregon and Washington Ter.
8. Selenites sportella Gld. San Diego to Puget Sound.
9. Selenites voyana Newc. San Diego to Trinity Co., Cal.
9a. Selenites voyana simplicilabris Ancey. Cal.
10. Selenites duranti Newc. San Francisco, Cal., southward.
10a. Selenites duranti cælata Mazyck. Southern California.

Family iii. LIMACIDÆ.

Genus iii. LIMAX Linn.

[11.] Limax maximus Linn. New Bedford and Cambridge, Mass.; Philadelphia, Pa.; New Braunfels, Texas.
[12.] Limax flavus Linn. Most large cities of Atlantic Coast.
[13.] Limax agrestis Müll. Most large cities of Atlantic Coast.
14. Limax campestris Binn. U. S. east of Rocky Mts.
15. Limax montanus Ingersoll. Utah; Colorado.
16. Limax hyperboreus Westerlund. Labrabor.
17. Limax hewstoni Cooper. San Francisco, Cal.

Genus iv. VITRINA Drap., 1801.

18. Vitrina limpida Gld. Northern U. S.
19. Vitrina pfeifferi Newc. Mts. of Utah, Nevada, Idaho, Cal., etc.
20. Vitrina angelicæ Beck. Greenland.
21. Vitrina exilis Morel. Alaska; Labrador.

Genus v. VITRINOZONITES W. G. Binn., 1879.

22. Vitrinozonites latissimus Lewis. Mts. of E. Tennessee and Western N. Carolina.

Genus vi. ZONITES Montf., 1810.

(Section Mesomphix Rafinesque, 1819.)

23. Zonites capnodes W. G. Binn. E. Tennessee; Northern Alabama; Western N. Carolina.
24. Zonites fuliginosus Griff. Eastern U. S.
25. Zonites friabilis W. G. Binn. Eastern U. S.
26. Zonites caducus Pfr. New Washington, Texas (?)
27. Zonites lævigatus Pfr. Western Pennsylvania to Arkansas and Florida.

28. Zonites demissus Binn. Western Pennsylvania to Texas and Georgia.
29. Zonites acerrus Lewis. Mts. of E. Tennessee and Western N. Carolina.
30. Zonites ligerus Say. Eastern U. S.
31. Zonites intertextus Binn. Eastern U. S.
32. Zonites cerinoideus Anth. Virginia to Florida.
33. Zonites inornatus Say. Appalachian Mts., Penna., Southward
34. Zonites subplanus Binn. Mts. of Eastern Tenn., and Ky.; Western Penna. and N. C.
35. Zonites rugeli W. G. Binn. Western N. C.
36. Zonites sculptilis Bld. Western N. C.; Eastern Tenn.: Northern Ala.; Northern Texas.
37. Zonites elliotti Redf. Mts. of Ga., Tenn., Western N. C. and Va.

(**Section Hyalina Fer., 1819.**)

[38.] Zonites cellarius Müll. Principal cities of Eastern States; Portland, Oregon.
39. Zonites whitneyi Newc. Sierra Nevada Mts., Cal.; Utah.
40. Zonites nitidus Müll. Northern U. S. and British America.
41. Zonites arboreus Say. Entire U. S.
42. Zonites radiatulus Alder. ("viridulus Mke.;" electrinus Gld.)
43. Zonites dallianus Simpson. Western Fla.
44. Zonites indentatus Say. Dakota to Texas and eastward.
45. Zonites subrupicolus Dall. Cave in Utah.
46. Zonites wheatleyi Bld. Knoxville, Tenn.; (Tiverton, R. I.?)
47. Zonites petrophilus Bld. Knoxville, Tenn.; Habersham Co., Ga.; Clarkesville, N. C.
48. Zonites limatulus Ward. New York to Cal. and northward.
49. Zonites minusculus Binn. Entire U. S.
49a. Zonites minusculus alachuanus Dall. Alachua Co., Fla.
50. Zonites singleyanus Pilsbry. Central Texas.
51. Zonites milium Morse. Entire U. S.

52. Zonites binneyanus Morse. North-eastern U. S.; Canada.
53. Zonites ferreus Morse. Maine.
54. Zonites exiguus Stimpson. North-eastern U. S.; Canada.
55. Zonites chersinellus Dall. Calaveras Co., Cal.
56. Zonites lawi W. G. Binn. Eastern Tenn.
57. Zonites capsella Gld. Mts. of Eastern Tenn., and W. Va.
58. Zonites placentulus Shutt. Eastern Tenn., and Ky; W. Va., Ark.
59. Zonites sterkii Dall. Ohio.
60. Zonites selenitoides Pilsbry. California.

(Section Conulus Fitzinger, 1833.)

61. Zonites fulvus Drap. Entire U. S.
61a. Zonites fulvus egenus Say.

(Section Gastrodonta Albers, 1850.)

62. Zonites gularis Say, Western Pa. to Ga. and Ala.
63. Zonites suppressus Say. Eastern U. S.
64. Zonites cuspidatus Lewis. Monroe Co., E. Tenn.; Roan Mt., N. C.
65. Zonites andrewsi W. G. Binn. Roan Mt., N. C.
66. Zonites macilentus Shutt. Mts of Eastern Tenn.; Western N. C.
67. Zonites lasmodon Phillips. Eastern Tenn.: Northern Ala.
68. Zonites significans Bld. Tenn.; Indian Ter.
69. Zonites internus Say. Ohio and Missouri to Ga.
70. Zonites multidentatus Binn. North-eastern U. S.; Canada.

Subgenus vii. **GUPPYA** Mörch.

71. Guppya? gundlachi Pfr. Western and Southern Fla.;

Genus viii. **PRISTILOMA** Ancey, 1887.

72. Pristiloma lansingi Bld. Astoria, Oregon.
73. Pristiloma stearnsi Bld. Oregon; Washington Ter., Alaska.

Family iv. TEBENNOPHORIDÆ.

Genus ix. TEBENNOPHORUS Binn., 1842.

(Section Tebennophorus.)

74. Tebennophorus carolinensis Bosc. Eastern U. S.

(Section Pallifera Morse.)

75. Tebennophorus dorsalis Binn. North-eastern U. S.

76. Tebennophorus wetherbyi W. G. Binn. Whitley Co., Ky.

77. Tebennophorus hemphilli W. G. Binn. Hall Co., Ga.

Family v. HELICIDÆ.

Genus x. ARION Fer., 1819.

[78.] Arion fuscus Müll. Boston and New Bedford, Mass.

Genus xi. ARIOLIMAX Mörch, 1860.

79. Ariolimax columbianus Gld. Washington Ter. to Cal.

80. Ariolimax californicus J. G. Coop. Cal., near San Francisco.

81. Ariolimax niger J. G. Coop. Central California.

82. Ariolimax hemphilli W. G. Binn. Alameda Co., Cal.

83. Ariolimax andersoni W. G. Binn. Alameda Co., Cal.

84. Ariolimax heconi Wetherby. Santa Cruz, Cal.

Genus xii. PROPHYSAON Bld. and Binn., 1873.

85. Prophysaon hemphilli B. and B. Oregon; California.

86. Prophysaon andersoni J. G. Coop. Mendocino Co., Cal.

Genus xiii. HEMPHILLIA Bld. and Binn., 1872.

87. Hemphillia glandulosa Bld., and Binn. Washington Ter. and Oregon.

Genus xiv. BINNEYA J. G. Cooper, 1863.

88. Binneya notabilis J. G. Coop. Santa Barbara Id., Cal.

Genus xv. PATULA Held, 1837.

(Section Anguispira Morse, 1864.)

89. Patula alternata Say. Eastern U. S.

89a. Patula alternata fergusoni Bld. New York; Ohio.

89b. Patula alternata mordax Shutt. Mts. of Tenn. and Va.

90. Patula cumberlandiana Lea. Mts. of Eastern Tenn.

91. Patula solitaria Say. Mississippi and Ohio Valleys; Northern Idaho; Eastern Oregon, etc.

92. Patula strigosa Gld. Nevada to Idaho and Colorado.

92. Patula strigosa strigosa Gld. (Including *cooperi* W. G. B. and *utahensis* Hemphill.)

92a. PATULA STRIGOSA HAYDENI Gabb. (Including *Hemphilli* Newc., *gabbiana* Hemphill, *bruneri* Ancey, *wasatchensis* Hemphill.) Nevada, Idaho, Colorado, Utah.

92b. PATULA STRIGOSA IDAHOENSIS Newc. (Including *binneyi*, *newcombi*, *castaneus*, *albofasciata*, *gouldi* and *multicostata* of Hemphill.) Idaho; Utah.

(Section **Discus** Fitzinger.)

93. PATULA PERSPECTIVA Say. Eastern U. S.

94. PATULA BRYANTI Harper. Mitchell Co., N. Carolina.

95. PATULA STRIATELLA Anthony.

95a. PATULA STRIATELLA CRONKHITEI Newc. Klamath Valley, Oregon.

96. PATULA RUDERATA PAUPER Gould. Alaska.

97. PATULA HORNII Gabb. Arizona.

(Section **Ptychopatula** Pilsbry, 1889.)

98. PATULA CÆCA Guppy. St. Augustine to Hillsborough River, Florida; Hidalgo, Texas.

99. PATULA GRANUM Strebel and Pfeffer. Alachua Co.: Evans' Plantation, Rogers River; and near Lake Worth, Florida.

(Section **Planogyra** Morse, 1864.)

100. PATULA ASTERISCUS Morse. Maine to Washington Ter. and Northward.

(Section **Microphysa** Albers-Martens, 1860.)

101. PATULA INCRUSTATA Poey. Galveston, Corpus Christi, and Hidalgo, Texas.

102. PATULA VORTEX Pfr. Southern Florida.

103. PATULA INGERSOLLI Bld. Lawrence, Kansas; Colorado; Utah; Umatilla Co., Oregon.

Subgenus **HELICODISCUS** Morse, 1864.

104. PATULA LINEATA Say. Entire U. S.

105. PATULA FIMBRIATA Wetherby. Mts. of Eastern Tennessee;

Subgenus **ACANTHINULA** Beck, 1837.

106. PATULA HARPA Say. Maine to Minnesota and Northward.

Genus xvi. PUNCTUM Morse, 1864.

107. PUNCTUM PYGMÆUM MINUTISSIMUM Lea. Entire U. S.

108. PUNCTUM CONSPECTUM Bld. Monterey, Cal., to Alaska; Colorado.

Genus xvii. HELIX Linne, 1758.

Subgenus **HELIX** (restricted).

(Group Pentatænia A. Schm.)

(Section Pomatia Beck. 1837.)

[109.] HELIX ASPERSA Müll. Charleston S. C., New Orleans: Santa Barbara, Cal., etc.

(Section Tachea Leach, 1840.)

[110.] HELIX NEMORALIS Müll. Lexington, Va.; Burlington, N. J.

[110a.] HELIX NEMORALIS HORTENSIS Linn. Newfoundland to Cape Cod, along the Coast.

(Group Arianta Leach, 1840.)

(Section Lysinoe H. and A. Ad., 1855.)

111. HELIX FIDELIS Gray. Northern Cal. to Vancouver Id.

111a. HELIX FIDELIS INFUMATA Gould. Coast of Cal., from Marin Co. to Mendocino Co.

112. HELIX TOWNSENDIANA Lea. Oregon.

113. HELIX ARROSA Gould. Santa Cruz to Mendocino Co., Cal.

114. HELIX EXARATA Pfr. Santa Cruz to Marin Co., Cal.

115. HELIX CALIFORNIENSIS Lea. Monterey, Cal.

115a. HELIX CALIFORNIENSIS NICKLINIANA Lea. Santa Cruz to Mendocino Co., Cal.

115b. HELIX CALIFORNIENSIS ANACHORETA W. G. B. California.

115c. HELIX CALIFORNIENSIS RAMENTOSA Gould. Napa Co. to Santa Clara Co., Cal.

115d. HELIX CALIFORNIENSIS BRIDGESI Newc. San Pablo, Cal.

115e. HELIX CALIFORNIENSIS DIABLOENSIS J. G. Coop. Near San Francisco, Cal.

116. HELIX TUDICULATA Binney. San Diego to Ventura Co., and Merced, Tuolumne and Calaveras Cos., Cal.

117. HELIX DUPETITHOUARSI Desh. Monterey, Cal.

118. HELIX TRASKI Newcomb. Los Angeles to Ft. Téjon and to San Luis Obispo.

119. HELIX SEQUOICOLA Cooper. Santa Cruz Co., Cal.

120. HELIX MORMONUM Pfr. Fresno Co. to Klamath Lake, Cal.

120a. HELIX MORMONUM CIRCUMCARINATA Stearns. Stanislaus Co., near Turlock, Cal.

120b. HELIX MORMONUM HILLEBRANDI Newc. Calaveras and Tuolumne Cos., Cal.

121. HELIX CARPENTERI Newc. San Diego, Cal.

122. HELIX ROWELLI Newc. Salt River Mts., 7 miles north of Phœnix, Arizona.

123. HELIX RUFOCINCTA Newc. Catalina Id., Cal.

124. HELIX GABBI Newc. Is. of San Clemente, Santa Barbara and San Nicolas, Cal.

124a. HELIX GABBI FACTA Newc. Santa Barbara Id., Cal.

125. HELIX KELLETII Forbes. San Diego and Catalina Id., Cal.

126. HELIX STEARNSIANA Gabb. San Diego, Cal.

127. HELIX AYRESIANA Newc. Is. of Santa Cruz, San Miguel, Santa Rosa, Cal.

128. HELIX INTERCISA W. G. Binney. San Clemente Id., and Santa Cruz Id., Cal.

129. HELIX INTERCISA REDIMITA W. G. Binney. San Clemente Id., Cal.

130. HELIX TRYONI Newc. Santa Barbara and San Nicolas Is., Cal.

(**Section Praticola Strebel et Pfeffer.**)

131. HELIX BERLANDIERIANA Moricand. Texas.

132. HELIX GRISEOLA Pfeiffer. Southern Texas.

Subgenus **HEMITROCHUS** (Swains.) Pilsbry.

(**Section Hemitrochus Swainson, 1840.**)

133. HELIX VARIANS Menke. Florida Keys.

Subgenus **FRUTICICOLA** Held.

(**Section Fruticicola Held, 1837.**)

[134.] HELIX HISPIDA Linné. Martha's Vineyard, Mass.

[135.] HELIX RUFESCENS Pennant. Quebec, Canada.

[136.] HELIX CANTIANA Montagu. Quebec, Canada.

(**Section Turricula Beck. 1837.**)

[137.] HELIX ELEGANS Gmel. (*T. terrestris* Chemn., Binney) Charleston, S. Carolina.

Subgenus **GLYPTOSTOMA** Binney and Bland.

138. HELIX NEWBERRYANA W. G. Binney. Los Angeles, Cal. to Todos Santos Bay, L. Cal.

Subgenus **POLYGYRA** Say, 1818.

(**Section Mesodon Rafinesque, 1831.**)

139. Helix jejuna Say. Georgia; Florida.
139a. Helix jejuna mobiliana Lea. Southern Alabama.
140. Helix lawi Lewis. Northwestern Ga., Western N. C. East Tenn.
141. Helix downieana Bld. Eastern Tenn. and Kentucky.
142. Helix mitchelliana Lea. N. C. to Kentucky and Ohio.
143. Helix clausa Say. Ohio to Dakota, Mississippi and Carolina.
144. Helix multilineata Say. New York to Dakota.
145. Helix thyroides Say. Eastern U. S.
145a. Helix thyroides bucculenta Gld. Southern U. S.
146. Helix andrewsi W. G. Binn. Western N. C.; Northwestern Ga.
147. Helix albolabris Say. Eastern U. S.
147a. Helix albolabris major Binney. S. Carolina to Fla.
148. Helix exoleta Binn. Western N. Y. to Missouri and Ga.
149. Helix dentifera Binn. Maine to Ohio and Ga.
150. Helix roemeri Pfr. Central and Northern Texas.
151. Helix divesta Gould. Mississippi, Ark., Indian Ter.
152. Helix wetherbyi Bld. Eastern Tenn. and Ky.; Western N. C.
153. Helix christyi Bld. Western North Carolina.
154. Helix wheatleyi Bld. Western N. C. and Ga.
155. Helix pennsylvanica Green. Western Penna. to Va. and Ill.
156. Helix elevata Say. N. Y. to Wis., south to Missouri and Ga.
157. Helix clarki Lea. Eastern Tenn.; Western N. C.
158. Helix columbiana Lea. Sitka to Santa Cruz, Cal.
159. Helix armigera Ancey. California.
160. Helix ptychophora A. D. Brown. Idaho.
161. Helix devius Gould. Oregon.
162. Helix profunda Say. Western N. Y. to Minn. and Kansas; South to Virginia.
163. Helix kiowaensis Simpson. Indian Ter.
164. Helix sayii Binney. Canada to Mich. and Ill.; South to Md. and Tenn.

164a. Helix sayii chilhoweensis Lewis. East Tenn.; Western N. C.

(Section Stenotrema Raf., 1819.)

165. Helix hirsuta Say. Eastern U. S.
166. Helix stenotrema Fér. Kentucky Southward.
167. Helix labrosa Bld. Eastern Tennessee; Northern Alabama; Arkansas.
168. Helix maxillata Gld. Mts. of Tennessee, Alabama and Georgia.
169. Helix edgariana Lea. Mts. of Tennesee, Northern Alabama and Georgia.
170. Helix spinosa Lea. East Tennessee; Northern Alabama.
171. Helix edvardsi Bld. Eastern Tennessee; West Virginia.
172. Helix barbigera Redf. Eastern Tennessee; Northern Alabama.
173. Helix monodon Rack. Eastern U. S.
173a. Helix monodon fraterna Say. Eastern U. S.
173b. Helix monodon cincta Lewis. Hayesville, N. C.
174. Helix leaii Ward. Ohio to Iowa.
175. Helix germana Gld. Oregon.

(Section Triodopsis Rafinesque, 1819.)

176. Helix tridentata Say. Eastern U. S.
177. Helix fallax Say. Eastern U. S.
178. Helix introferens Bld. Penna. to Ga., Tenn. and Kentucky.
179. Helix vannostrandi Bld. South Carolina; Georgia.
180. Helix hopetonensis Shutt. North Carolina to Fla.
181. Helix vultuosa Gld. Ark. to Texas; Florida.
182. Helix henriettæ Mazyck. Eastern Texas.
183. Helix copei Wetherby. Eastern Texas; Western La.
184. Helix cragini Call. Kansas.
185. Helix inflecta Say. Eastern U. S.
186. Helix rugeli Shutt. Eastern Tenn. and Ky.; Western N. C.
187. Helix appressa Say. Eastern U. S.
188. Helix palliata Say. Eastern U. S.
189. Helix obstricta Say. Indiana to Georgia.
190. Helix mullani Bld. Northern Idaho.

191. Helix binominata Tryon. (*Trio. hemphilli* W. G. B. preoc.) Northern Idaho.
192. Helix sanburni W. G. Binn. Northern Idaho.
193. Helix salmonensis Tryon. (*Trio. harfordiana* W. G. B. preoc.) Idaho.
194. Helix loricata Gld. California.
195. Helix roperi Pilsbry. Redding, California.
196. Helix levettei Bld. New Mexico; Arizona.

(Section Polygyra Say, 1818.)

197. Helix auriculata Say. Florida.
197a. Helix auriculata microforis Dall. Alachua Co., Fla.
198. Helix uvulifera Shutt. Gulf Coast, Florida to Texas.
199. Helix postelliana Bld. South Carolina to Florida.
200. Helix auriformis Bld. Florida to Texas; Indian Ter.
201. Helix espiloca Rav. South Carolina to Texas.
202. Helix avara Say. Florida.

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203. Helix leporina Gld. Illinois to Texas and Georgia.
204. Helix pustuloides Bld. Georgia; Alabama; Tennessee.
205. Helix pustula Fér. South Carolina to Florida; Texas?

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206. Helix fastigans L. W. Say. Tennessee; Kentucky.
207. Helix troostiana Lea. Tennessee; Kentucky.
208. Helix jacksoni Bld. Indian Ter.; Southern Missouri; Arkansas (Florida ?).
208a. Helix jacksoni deltoidea Simpson. Indian Territory.
209. Helix dorfeuilliana Lea. Kentucky to Alabama, Missouri to Indian Ter. and Texas.
209a. Helix dorfeuilliana sampsoni Wetherby. Arkansas.
210. Helix hazardi Bld. Tenn. and Ala. to Ark.
211. ? Helix oppilata Moric. Florida Keys.

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212. Helix mooreana W. G. Binn. Texas.
212a. Helix mooreana tholus W. G. Binn. Texas.
213. Helix texasiana Moric. Texas; Indian Ter.
214. Helix triodontoides Bld. Indian Ter.; Texas.
215. Helix ventrosula Pfr. Southern Texas.
216. Helix hindsi Pfr. Southern Texas.
217. Helix ariadnæ Pfr. Southern Texas.

218. HELIX HIPPOCREPIS Pfr. Comal Co., Texas.

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219. HELIX CEREOLUS Mühlf. Georgia; Florida; Alabama.
219a. HELIX CEREOLUS LAMINIFERA Binn. (*P. cereolus* W. G. B.) Florida.
219b. HELIX CEREOLUS MICRODONTA Desh. (*carpenteriana* Bld., *febigeri* Bld.) Florida to Texas.
219c. HELIX CEREOLUS SEPTENVOLVA Say. Florida.

(**Section Polygyrella Bland, 1878.**)

220. HELIX POLYGYRELLA Bld. and Coop. Idaho; Montana.
221. HELIX HARFORDIANA J. G. Cooper. Fresno Co., Cal.

(**Section Gonostoma Held, 1837.**)

222. HELIX YATESI J. G. Coop. Calaveras Co., Cal.

(**Section Vallonia Risso, 1826.**)

223. HELIX PULCHELLA Müll. Entire U. S.
224. HELIX PULCHELLA COSTATA Müll.

Subgenus **STROBILA** Morse, 1864.

225. HELIX LABYRINTHICA Say. Eastern U. S.
226. HELIX HUBBARDI A. D. Brown. Texas; Florida; Georgia.

Family vi. PUPIDÆ.

Genus xviii. PUPA Drap., 1801.

Subgenus **PUPA** (restricted).

(**Section Pupilla Leach, = typical Pupa.**)

227. PUPA MUSCORUM Linné. Northern U. S.
227a. PUPA MUSCORUM BLANDI Morse. Colorado; Utah: Montana.
228. PUPA DECORA Gould. British America; New York.
229. PUPA CORPULENTA Morse. Colorado; Utah; Nevada.
230. PUPA ROWELLII Newcomb. California; Colorado.
231. PUPA CALIFORNICA Rowell. California.
232. PUPA. Colorado.
233. PUPA CALAMITOSA Pilsbry. San Diego and Lower Cal.

(**Section Leucocheila Albers-Martens, 1860.**)

234. PUPA FALLAX Say. Entire U. S.
234a. PUPA FALLAX ARIZONENSIS Gabb. Arizona.
235. PUPA MODICA Gould. S. Carolina to Alabama.
236. PUPA CORTICARIA Say. Dakota to Mississippi and Eastward.

237. Pupa rupicola Say. Southern and Middle States.
238. Pupa hordeacea Gabb. Arizona.
239. Pupa pellucida Pfeiffer. Texas; Florida.
240. Pupa armifera Say. Dakota and Kansas Eastward; Mexico?
241. Pupa contracta Say. Minnesota to Texas and Eastward.
242. Pupa holzingeri Sterki. Illinois; Iowa; Minnesota.

(Section .)

243. Pupa edentula simplex Gould. New England to Ohio; Canada.
243a. Pupa edentula alticola Ingersoll. Colorado; Utah; fossil in Mississippi Valley Loess.

Subgenus **ANGUSTULA** Sterki, 1889.

244. Pupa milium Gould. Colorado to Maine.

Genus xix. VERTIGO Müller.

245. Vertigo ovata Say. Entire U. S.
246. Vertigo gouldii Binney. Northeastern U. S.
247. Vertigo bollesiana Morse. Northeastern States.
248. Vertigo ventricosa Morse. Maine; New York.
249. Vertigo tridentata Wolf. New York to Illinois.
250. Vertigo pentodon Say. Minnesota to Texas and Eastward.
250a. Vertigo pentodon cincinnatiensis Judge. Ohio.
251. Vertigo curvidens Gould. Eastern States.
251a. Vertigo curvidens floridana Dall. Florida.
252. Vertigo (?) variolosa Gould. Southern Florida.

Genus xx. STROPHIA Albers.

253. Strophia incana Binney. S. Florida.

Genus xxi. HOLOSPIRA Albers-Martens.

254. Holospira roemeri Pfeiffer. New Braunfels and Howard Springs, Texas.
255. Holospira goldfussi Menke. Southern Texas.

Family vii. STENOGYRIDÆ.

Genus xxii. RUMINA Risso. 1826.

Subgenus **RUMINA** (restricted).

[256.] Rumina decollata Linné. Charleston, S. C.

(Section Opeas Albers. 1850.)

257. Rumina octonoides d'Orbigny. Florida.
258. Rumina subula Pfr. Mobile, Ala.; Florida.

(Section Melanieila Pfr.)

259. Rumina gracillima Pfeiffer. S. Florida.

Genus xxiii. FERUSSACIA Risso, 1826.

Subgenus CIONELLA Jeffreys.

260. Ferussacia subcylindrica Linn. Northern U. S.

Genus xxiv. CŒCILIANELLA Bourg.

[261.] Cœcilianella acicula Müller. Florida.

Family viii. ORTHALICIDÆ.

Genus xxv. LIGUUS Montfort, 1810.

262. Liguus fasciatus Müller. S. Florida.

Subgenus ORTHALICUS Beck, 1837.

263. Liguus undatus Brug. S. Florida.

Family ix. BULIMULIDÆ.

Genus xxvi. BULIMULUS Auctorum.

264. Bulimulus dealbatus Say. South Carolina to Indian Ter. and Texas.

265. Bulimulus schiedeanus Pfr. Texas.

266. Bulimulus alternatus Say. Louisiana; Texas.

267. Bulimulus patriarcha W. G. Binney. Southern Texas.

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268. Bulimulus serperastrus Say. Southern Texas.

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269. Bulimulus multilineatus Say. Southern Florida.

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270. Bulimulus dormani W. G. Binney.

271. Bulimulus marielinus Poey. S. Florida and Keys.

271a. Bulimulus marielinus hemphilli Wright. Florida.

Family x. CYLINDRELLIDÆ.

Genus xxvii. CYLINDRELLA Pfeiffer, 1840.

272. Cylindrella poeyana Pfeiffer. S. Florida.

273. Cylindrella jejuna Gould. S. Florida.

Genus xxviii. MACROCERAMUS Guilding, 1828.

274. Macroceramus pontificus Gould. S. Florida.

275. Macroceramus gossei New Braunfels, Texas; Little Sarasota Bay, Fla.

Family xi. SUCCINEIDÆ.

Genus xxix. SUCCINEA Drap., 1801.

276. Succinea aurea Lea. Ohio; Western N. Y.
277. Succinea avara Say. Northern States.
278. Succinea campestris Say. Georgia; Florida.
279. Succinea chrysis Westerl. Alaska.
280. Succinea concordialis Gould. Texas.
281. Succinea effusa Shutt. Florida to Louisiana.
282. Succinea grœnlandica Beck. Greenland.
283. Succinea grosvenori Lea. Alexandria, La.
284. Succinea hawkinsi Baird. Lake Osoyoos, Brit. Columbia.
285. Succinea lineata W. G. B. Dakota and Idaho to New Mexico.
286. Succinea luteola Gould. Florida: Texas.
287. Succinea mooresiana Lea. Nebraska.
288. Succinea nuttalliana Lea. Oregon; California.
289. Succinea obliqua Say. Arkansas to Georgia Northward.
289a. Succinea obliqua totteniana Lea. New England to Penna.
290. Succinea oregonensis Lea. Oregon; California.
291. Succinea ovalis Gould. Northern and Middle U. S.
292. Succinea ovalis decampi Tryon. Michigan.
292a. Succinea ovalis haydeni W. G. B. Utah; Nebraska.
292b. Succinea ovalis higginsi Bland. Put-in-Bay, Lake Erie: Iowa City, Iowa.
292c. Succinea ovalis retusa Lea. Ohio.
293. Succinea rusticana Gld. Oregon; California; Nevada.
294. Succinea salleana Pfeiffer. Louisiana.
295. Succinea sillimani Bld. Nevada; California.
296. Succinea stretchiana Bld. Colorado; Nevada; California.
297. Succinea verrilli Bland. Anticosti Id., Gulf of St. Lawrence.

Family xii. VAGINULIDÆ

Genus xxx. VAGINULUS Fér., 1821.

298. Vaginulus floridanus Binney. Florida.
299. Vaginulus olivaceus Stearns (?). Lobitos, California.

Family xiii. ONCHIDIIDÆ.

Genus xxxi. ONCHIDIUM Buchanan, 1800.

300. Onchidium carpenteri W. G. Binney. Sts. of Fuca to Gulf of Cal.

301. Onchidium floridanum Dall. Knight's Key, Florida.

Genus xxxii. ONCHIDELLA Gray, 1850.

302. Onchidella borealis Dall. Alaska to Vancouver Id.

NOTES ON THE OSTEOLOGY AND SYSTEMATIC POSITION OF DINICTIS FELINA, LEIDY.

BY W. B. SCOTT.

The problem of the origin of the *Felidæ* and of their relations to the other families of Carnivora is one of such obscurity, that any information upon the subject, however slight, cannot fail to be of importance. Of all the American felines (or Pseudailuroids, as the case may be) the genus *Dinictis* is probably the most primitive and therefore the one best adapted to throw light upon the line of descent through which the group has passed. A considerable amount of undescribed material of this curious genus has come into my hands, among which there is an almost complete hind leg and foot belonging to the Princeton Museum (No. 10,035), which has led to the preparation of these notes.

The Skull.

The skull has already been described by Dr. Leidy (No. 8[1], pp. 64–65), but additional material enables me to supplement his account. The most important of the specimens to be described is a fine skull in the Academy's Museum, the base of which exhibits some most interesting characters.

As in the primitive carnivores generally, the cranium is very long and narrow and is sharply constricted some distance behind the orbits, which marks the anterior limits of the cerebral hemispheres. Posteriorly the cranium is broadest and tapers forwards more regularly and more rapidly than in the *Viverridæ* and the constriction above mentioned is further back of the orbits than in that family, occupying the same relative position as in *Daphænus*[2] and other primitive cynoids. Another factor which is of importance in the construction of the cranium is the elongation of the posterior portion of it, that part lying behind the mastoid processes. This region in *Dinictis*, as in the viverrines, *Cynodictis*,[2] and in most creodonts, is very

[1] See list of Authors at end of paper.

[2] The American cynoids of the White River and John Day epochs, which Cope has called *Galecynus* and Leidy has referred to *Amphicyon*, are for the most part more nearly like the European *Cynodictis*, under which name they are referred to here, though a careful comparison would not improbably show them to be distinct. The White River dogs with 3 upper molars are quite different from the true *Amphicyons*, and for these the name originally given them by Leidy, *Daphænus*, should be revived.

long. In spite, therefore, of the greatly elongated cranium, including in that term the region behind the anterior rim of the orbit; the space allotted to the cerebral hemispheres is comparatively short, while the cavities for the hind-brain and the olfactory lobes are long. The face in advance of the orbits is much contracted.

The upper contour of the cranium slopes sharply downwards and backwards from the highest point of the skull just behind the orbits, while that of the face slopes downwards and forwards from the same point, the two meeting in an open V. Of course at the point of meeting the skull is disproportionately deep, while the muzzle, and especially the occiput, is low. This gives the skull of *Dinictis felina* a very characteristic physiognomy and is an exaggeration of the arrangement found in *Hoplophoneus* and others of the *Nimravidæ*, but in the John Day species, *D. cyclops*, the contour is very different.

The premaxillaries have well developed alveolar portions, which, however, form a nearly straight transverse line and project but little in advance of the canines; the ascending ramus is very long and nearly vertical, its upper portion sloping backwards less than in the viverrines and further removed from the frontals than in that family. The maxilla has a high and short (antero-posteriorly) preorbital portion which joins the frontal by a short straight suture. The suborbital part of the maxilla exceeds the preorbital in length more than in the cats and very much more than in *Viverra*, as the orbit is placed far forward. The frontals are strongly inclined upwards and backwards and appear to be very decidedly shorter than in the cats; anteriorly they together form a notch to receive the ends of the nasals, but the fronto-nasal process is very short and more obtuse than in the cats, its maxillary and nasal edges forming a right angle. The nasals are longer than in the cats, but otherwise very much like them. The lachrymal is small and does not extend at all upon the face, as it does in the creodonts, and just within the edge of the orbit it is pierced by two foramina.

The parietals, so far as the great fissuring of the specimens will allow of a determination, seem to be much longer than in the cats and to exclude the frontals from all share in roofing the cerebral hemispheres. At all events the very long sagittal crest runs to a point in advance of the post-orbital constriction, from which point the supraciliary ridges diverge rapidly and pass outwards in bold curves to the short post-orbital processes of the frontals. Besides being long the parietals are deep vertically, extending far down on the sides of the cranium.

The squamosal is rather low, but long from before backwards; the root of the zygomatic process projects downwards below the basi-cranial axis much more strongly than in the cats and civets, but not to the same degree as in *Hoplophoneus*, where it forms a peculiar and

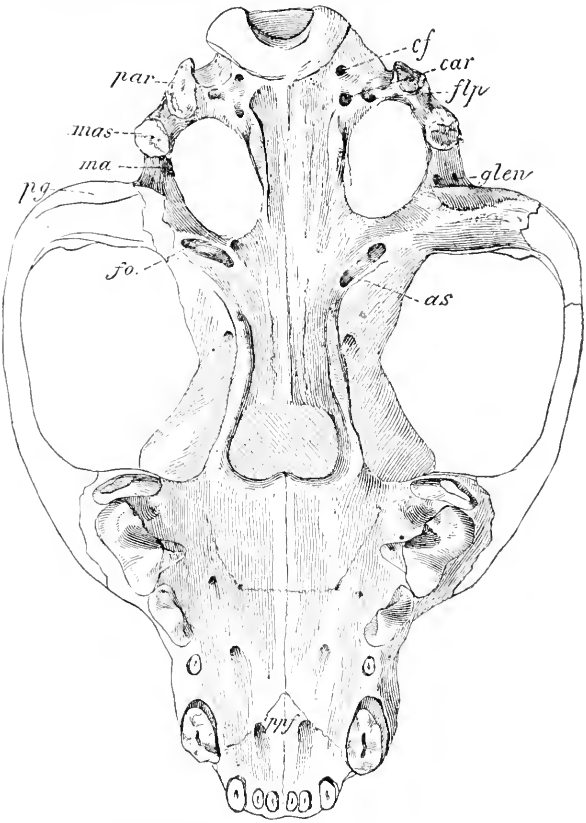


FIG. 1. *Dinictis felina*; base of skull; *car.* carotid canal; *c.f.* condylar foramen; *f. l. p.* foramen lacerum posterius; *glen.* glenoid foramen; *f. o.* foramen ovale; *as.* hinder opening of alisphenoid canal; *p. p. f.* posterior palatine foramina; *p. g.* post-glenoid process; *mas.* mastoid process; *par.* paroccipital process; *m. a.* external auditory meatus.

conspicuous, pedicel. The glenoid cavity is thoroughly feline in appearance, owing to the strong development of the preglenoid ridge. The zygomatic arches are very long, compressed and quite heavy, though they do not arch out from the sides of the skull so strongly as in the true cats. The post-orbital process of the jugal is but feebly developed. Owing to the strong downward projection of the mastoid processes and their anterior position, the distance between these and the post-glenoid processes is very short and forms a deep narrow notch, which lends to this region of the skull an appearance very different from the corresponding part in the cats and civets.

The occiput is low, and very broad at the base, but narrowing rapidly upwards; it is exceedingly convex, in correspondence with the very advanced position of the mastoids, and consequently much of the occipital surface is visible in the side view of the skull. Above the foramen magnum there is a strong convexity which covers the prominent vermis of the cerebellum. The paroccipital processes are short, almost rudimentary in fact; they project backwards and are separated by a considerable interval from the auditory bullæ, as in the mustelines. The mastoid processes are heavy, prominent and not in contact with the bullæ.

Notwithstanding the angle made by the upper contour of the face and cranium, the cranio-facial axis is straight. The base of the cranium is broad and the glenoid cavities of the two sides widely separated from each other, which results in a somewhat unusual arrangement of the foramina. The basi-occipital is not so broad as in the *Viverridæ*, and has sharp prominent edges which abut against the sides of the tympanic bullæ and so give the bone a deeply concave shape from side to side. The bullæ are very large and were almost certainly divided by an internal septum into two chambers, though whether the chambers are situated one behind the other, as in the *Viverridæ*, or one internal to the other, as in the *Felidæ*, cannot be determined from the material at command, though the external shape is rather feline. Though the opening into the bulla is quite far removed from the surface, there is no tubular meatus auditorius other than that formed by the notch between the mastoid and post-glenoid processes. The relation of the bullæ to the mastoid and paroccipital processes recalls that which is found in the bears, save that in *Dinictis* the latter processes are so small.

The posterior nares are very long, owing to the fact that the bony palate is not carried back of the molars. In front the opening is broad and its anterior edge is formed by two emarginations of the palatines, separated by a short median spine or angle; in the hinder part of their course the walls of the nares are constricted, giving them a characteristic appearance. The hamular processes of the pterygoids are decidedly more feline than viverrine both in shape and position, being much further in advance of the glenoid cavity than in the latter animals. The palatines are short and broad, the maxillo-palatine suture being opposite the interval between the 3rd and 4th premolars, and in general shape they resemble those of the cats. The hard palate is very broad behind, and following the oblique position of the molar series, it narrows rapidly forward, though it never becomes very narrow on account of the abruptly truncated muzzle. The palatine processes of the premaxillaries are well developed. The whole palatine region has a decidedly feline appearance, though *Cryptoprocta* exhibits an approach to it, as it does in so many other respects as well.

The mandible is peculiar and is in most respects very closely like that of *Hoplophoneus*, but the condyle is more elevated above the line of the molars and the coronoid process is much higher; the latter has a less antero-posterior extent, is straight and less recurved than is usual in the felines. The masseteric fossa is very deep and extends forward beneath $\overline{\text{m. 2}}$. The horizontal ramus is compressed and rather slender and shallow; its lower border is nearly straight until the front end is nearly reached, when it dips downwards to form the flanges for the protection of the great upper canines, though these flanges are not so long as in *Hoplophoneus*, in correspondence with the less development of the tusks. The chin is slightly concave and abruptly truncate, as in the sabre-tooths generally, and forms a right angle with the side of the ramus; the symphysis is short and nearly vertical.

Foramina. These present a curious assemblage, being anything but "ailuroid" in arrangement. The incisive foramina call for no description, being much like those of the cats in size and position. The posterior palatine foramina resemble those of the civets in so far that they are in the maxillaries and not in the palatines, but they are placed much further back than in that group, being opposite the anterior edge of pm. 3. There is an alisphenoid canal, the posterior opening of which is nearer to the very large foramen ovale than in the viverrines and indeed is enclosed in a common groove with it. The latter is placed unusually far from the median line and is separated by a prominent ridge from the eustachian canal and the foramen lacerum medium, which occupy the ordinary position close to the antero-internal angle of the bulla. There is a large and distinct carotid foramen which is well separated from the foramen lacerum posterius. The condylar foramen is also entirely separated from the latter, and there is no ridge running inwards from the paroccipital process. There are also very large glenoid foramina. There is a single large post-parietal foramen on each side of the sagittal crest. The infra-orbital foramen is placed very close to the orbit, from which it is separated only by a narrow bridge of bone; it lies above pm. 3.

The arrangement of foramina in *Dinictis* is thus seen to be very much the same as that described by Cope in *Archælurus* and others of the *Nimravidæ* (No. 2. p. 955), but no living carnivore presents such an assemblage of characters in the *basis cranii*. These primitive cats seem to show conclusively that the construction of the base of the cranium has not the taxonomic value attributed to it by Flower (No. 5) an opinion which Schlosser (No. 14, p. 233) has reached on quite different grounds. The *basis cranii* of *Dinictis* is perhaps on the whole more cynoid than anything else, though ailuroid and even arctoid features occur. We shall return later to a discussion of this question.

The *brain* of *Dinictis* is unknown, but that of *Hoplophoneus*, a nearly allied genus, has been described and figured by Bruce (No. 1, p. 42, Pl. vii, fig. 8). This is distinctly feline in character, though as would naturally be expected, the convolutions are simpler and less winding; it bears obvious resemblance to the brain of *Pseudælurus* which Gervais has figured (No. 7, Pl. 6, fig. 6) and which, as that writer has pointed out, has certain affinities with the brain of *Cryptoprocta* and the viverrines.

The Dentition.

The dental formula of *Dinictis* is I $\frac{3}{3}$ C $\frac{1}{1}$ Pm. $\frac{3}{3}$ M $\frac{1}{2}$, which, as Leidy has observed, is the same as that of most mustelines, and also occurs in *Ælurogale*.

Upper Jaw. The incisors are in general cat-like and form a straight, transversely directed row, separated by considerable diastemata from the canines. The external incisor is the largest of the series and has a long, acute, conical and somewhat recurved crown, except for its smaller size, very similar to that of *Hoplophoneus*. As in that genus, there is no cingulum, such as occurs in the external incisor of the cats. The median incisor is much smaller than the outer one and has a simple pointed crown without cingulum. Only the fang of the inner incisor is preserved, but this shows that the tooth was still smaller and more compressed than the median one. In *Hoplophoneus* the incisors are all much larger, all have similar crowns, and are separated by wider spaces from each other and from the canines.

The upper canines of *Dinictis* are compressed and elongated tusks of narrow oval section; they are, however, shorter and less compressed than in *Hoplophoneus*.

The most anterior premolar (pm. 2) is exceedingly small, much more reduced than in *Cryptoprocta;* it has a compressed conical crown with a sharp posterior cutting edge which is finely serrate, and a very minute posterior basal cusp; it is implanted by two fangs. Pm. 3 is a large and well developed tooth; it is much higher and more compressed than in the *Felidæ*, and the large posterior cusp is single, not double as in that family. This tooth resembles much the corresponding one in *Cryptoprocta*, but the principal cusp is more compressed and has a greater antero-posterior extent. The sectorial (pm. 4) is more canine than either feline or viverrine and differs from pm. 3, only in its greater size, the greater proportional development of the heel and the presence of the inner cusp. This tooth is very like the sectorial of *Cynodictis*, exhibiting only the following differences: (1) the anterior cusp is more flattened; (2) the heel is longer and higher; (3) where the two come together there is a deeper fossa, such as is found in cats; (4) the inner cusp is less reduced, though smaller than in *Cryptoprocta* and very much smaller than in the *Viverridæ* generally. Of the anterior basal cusp which is so characteristic of the cats and which appears in *Cryptoprocta* and to a certain extent in other viverrines, there is not a trace. The sectorial of *Hoplophoneus* is decidedly more cat-like than that of *Dinictis*, as is shown in the better development of the sectorial blade and in the appearance of a small antero-external cusp.

The single upper molar of *Dinictis* is very much better developed than in the cats, or *Cryptoprocta*, or even than in *Hoplophoneus*, but is much more reduced than in the *Viverridæ* generally; it is not at all overlapped or concealed by the sectorial, being plainly visible from the side. The construction shows clearly its derivation from the trituberculaar pattern of *Cynodictis*, but the length of the tooth from before backwards has been greatly reduced, so that the two outer tubercles have come to stand in nearly the same transverse line, while the inner cusp has extended far internally. The tooth is implanted by three fangs. In *Hoplophoneus* the separation into three cusps is very obscure.

Lower Jaw. The crowns of the lower incisors are broken away in all the specimens I have had the opportunity of examining, but the fangs show that, as in the upper jaw, the outer teeth are the largest of the series, and that, as in the cats, the lower incisors form a straight row, the second one not being pushed back as is so commonly the case among the Carnivora.

In correspondence with the lesser development of the upper tusks, the lower canine is larger than in *Hoplophoneus.* The crown is high, conical and somewhat recurved. The most anterior premolar (pm. 2) is very small and more reduced than in *Cryptoprocta;* it consists of a simple compressed cone implanted by two fangs. Pm. 3 is proportionally larger, higher, more acute and more compressed than in the cats; it is composed of a principal conical cusp, with small anterior and posterior cingular cusps. Pm. 4 is almost exactly like pm. 3 except that it is somewhat larger, and that the accessory cusps are more conspicuous. Both of these teeth differ from the corresponding ones of *Felis* not only in their relatively larger size and smaller transverse diameter, but also in the absence of the posterior cingulum. In *Cryptoprocta* the principal cusp is more slender and pointed and the cingulum is better developed, especially on pm. 4, than in *Dinictis.* In *Proailurus* these teeth are much like those of *Cryptoprocta.*

The first or sectorial molar is very feline in appearance, though with very obvious signs of its derivation from the tuberculo-sectorial type. The anterior cusp is formed just as in the cats, but the posterior cusp is higher and less flattened and more distinctly angulate between the lateral and posterior surfaces. In many specimens there is a small but perfectly distinct postero-internal cusp, which thus completes the primitive triangle of the tuberculo-sectorial molar, and in these specimens the tooth is almost a reproduc. tion of the lower sectorial of *Proailurus*, as figured by Filhol (No. 4, Pl. 2, fig. 2). But in *Dinictis* this cusp is evidently on the point of disappearing, as in some specimens it is present only on one side, in others hardly visible at all. The talon is also very small and has a sharp cutting edge, with no trace of accessory tubercles. The second molar is very much reduced and has a small oval crown; the fang, though single, is elongate and obviously formed by the coalescence of two, as is shown by the median groove which runs down the inner face and by a partial division of the alveolus. The tooth is much less reduced than in *Proailurus.*

The dentition of *Dinictis*, like the skull, irresistibly suggests relationship with the cats, and yet it still exhibits many important primitive characters, of which may be mentioned the number of the teeth, the large size of the upper molar and the presence of the inferior tubercular; the presence of a heel and of the posterior-internal cusp on the lower sectorial and the absence of the anterior basal cusp from the upper sectorial. In these respects *Dinictis* departs from the feline type and approximates the canine-viverrine group.

Measurements.

	M.
Total length of skull (condyles to premaxillaries),	·154
Length of cranium (to anterior rim of orbit),	·108
Length of face,	·046
Distance from anterior rim of orbit to post-orbital constriction,	·050
Length of bony palate,	·069
Breadth of bony palate (posterior edge),	·072
Breadth of bony palate between canines,	·026
Distance between foramen magnum and line of post-glenoid processes,	·033
Distance between foramen magnum and line of mastoid processes,	·0195
Length first four cervical vertebræ,	·075
Length of mandible, from the condyle,	·119
(Second Specimen, Princeton Mus., No. 10,012.)	
Upper incisor series, transverse breadth,	·029
Third upper incisor, transverse diameter,	·0045
Third upper incisor, fore and aft diameter,	·005
Second upper incisor, transverse diameter,	·003
Second upper incisor, fore and aft diameter,	·003
Upper canine, transverse diameter,	·008
Upper canine, fore and aft diameter,	·012
Length upper molar series,	·049
Length pm. 2,	·0055
Length pm. 3,	·014
Length pm. 4,	·019
Length m. 1,	·006
Transverse diameter m. 1,	·015
Lower incisor series, transverse breadth,	·016
Third lower incisor, fore and aft diameter,	·005

Third lower incisor, transverse diameter,	·0035
Lower canine, fore and aft diameter,	·008
Lower canine, transverse diameter,	·006
Length lower molar series,	·052
Length pm. 2,	·006
Length pm. 3,	·012
Length pm. 4,	·0145
Length m. 1,	·0185
Length m. 2,	.006

VERTEBRÆ.

Attached to the Academy's specimen of the skull of *Dinictis*, which has been described above, are the four anterior cervical vertebræ, which are decidedly feline in character, and resemble those of the John Day *Nimravidæ* described and figured by Cope. The atlas is badly broken and only the slender inferior arch and deep anterior cotyli can be certainly made out. The parts preserved, however, agree closely with the atlas of *Hoplophoneus*, which in its turn is most like that of *Cryptoprocta*. The transverse processes are much more widely extended than in the *Viverridæ* generally, and there is, as in that family, a foramen in the anterior edge of the transverse process (centroido-diapophysial, Albrecht) which in the cats is represented by a deep notch. The axis, so far as preserved, agrees rather better with that of *Cryptoprocta* than that of *Hoplophoneus;* the odontoid process is a very long and slender peg, while in *Hoplophoneus* it is broader and more depressed than is usual in the carnivores. The centrum is depressed, slightly opisthocœlous and provided with a small hypapophysial keel; the atlanteal facets are extended transversely, but have a small vertical diameter and are not emarginated by the neural canal. The posterior face of the centrum is set obliquely to the long axis, as are the faces of the succeeding vertebræ, though not to the same extent as in the large cats. The transverse processes are slender and shorter than in *Cryptoprocta* and the anterior opening of the vertebrarterial canal is placed much further forward than in that genus. The neural arch is high and narrow and not obstructed behind by opisthapophyses, as in the recent felines. The third and fourth cervicals have rather short and quite broad centra, with hardly any indications of hypapophysial keels. They are slightly opisthocœlous and the articular faces are somewhat oblique. The third has the neural spine represented by a very low ridge, and as in the felines there are opisthapophyses; the transverse processes are slender and the pleurapophysial plates but little developed. The hind part of the neural arch of the fourth is broken away so that nothing can be determined as to the character of the spine and the opisthapophyses; the pleurapophysial plate is much better developed than on the third vertebra.

Fore-Limb.

This member is but very scantily represented in the collections, the only portions of it which I have seen being fragments of the humerus and radius. Fortunately there can be no doubt as to the reference of these specimens, as they were found associated with a skull (No. 10,012 of the Princeton Museum). The humerus is too much mutilated for description, further than to say that this bone is much stouter than the femur would lead one to expect; the supinator ridge is very prominent and runs far up the shaft.

The radius is distinctly feline in character. The proximal end is formed by a small disc-like head with a concave facet for the capitellum of the humerus; the concavity is not quite so deep and its margin not so even as in the cats, being notched in the middle of the front edge, which edge is thus given a sigmoid curve. The head does not project inwardly beyond the line of the shaft, as is so markedly the case in the lion. The articular surface for the ulna forms a narrow band which extends around two-thirds of the circumference of the head, considerably more than in the lion and indicating very complete powers of pronation and supination. Distal to the head the shaft gradually contracts and becomes irregularly oval in section. The lower part of the shaft is quite broad, thickened on the outer side and tapering to a thin edge on the inner; the distal end is somewhat rugose and narrower than the lower part of the shaft, the rugosities are much less prominent than in the recent forms. The facet for the scapho-lunar is broad towards the ulnar side and slightly concave in both directions, but suddenly becomes much narrower internally. There is a small facet on the external side for the distal end of the ulna.

It is interesting to note that the distal end of the radius in the Bridger creodont, *Miacis bathygnathus*, is very similar to that of *Dinictis*, but the carpal surface is somewhat differently shaped, and the styloid process less prominent.

The *pelvis* is rather more viverrine than feline in character, though with some points of resemblance to that of the ? *Cynodictis* (*Galecynus*) *geismarianus* of Cope (No. 2, Pl. lxx*a*, fig. 10). The anterior end of the ilium is broken away, so that its length cannot be determined, but judging from the position of the sacral facet, it would seem to be somewhat shorter than the ischium. The neck is short, deep and thick and the anterior expansion does not greatly exceed the neck in breadth. The gluteal surface is not simply concave, as in *Felis*, but is divided by a sharp ridge into upper and lower concavities, of which the upper is the broader; this ridge also occurs in the ? *Cynodictis* above mentioned and is faintly marked in *Viverra*. The acetabular border is short, but broad, rugose and prominent, and beneath it is a small antero-inferior tuberosity or spine, giving to this region a decided similarity to the pelvis of *Cryptoprocta*. Mivart says with regard to the pelvis of the viverrines: "There may be two prominences (each like an ilio-pectineal prominence)—one just preaxial to the acetabulum, and the other placed a little more ventrally on the pelvic brim. These may both be found (at least sometimes) in *Cryptoprocta*, *Viverra*, *Crossarchus* and especially in *Suricata*." (No. 13, p. 473.) Very much the same statement will apply to *Dinictis*.

Fig. 2. *Dinictis felina*; left os innominatum.

The ischium is long, straight, slender and of trihedral section; the posterior portion is hardly at all everted, a striking difference from the condition seen in both *Felis* and *Canis*; the tuberosity is a mere thickening of the border and not at all projecting. The spine is represented by a slight convexity of the superior border, which ends abruptly behind, forming thus the lesser sacro-ischiadic notch. This notch is placed somewhat further behind the acetabulum than in ? *Cynodictis* and occupies about the same position as in *Cryptoprocta*. The portion of the ischium which descends to form the symphysis is broken away, but was obviously slender and much compressed; the same may be said of the pubis.

The *femur* is long and slender and resembles that of many of the more primitive carnivores, such as *Amphicyon*, *Cynodictis*, *Crypto-*

procta, *Proailurus*, etc. The head, as in *Cryptoprocta* is presented more obliquely inwards and upwards than in the cats; it is very sharply constricted off from the neck and is evenly rounded, forming something more than a hemisphere, and shows a distinct pit for the round ligament. The great trochanter is massive and much extended from before backwards, but rising only slightly above the level of the head, and its upper edge is more regularly rounded than in the cats; the digital fossa is deep but of limited extent. The ridge connecting the head with the great trochanter is, as in *Proailurus*, more compressed than in *Cryptoprocta*. The second trochanter is quite prominent: a short curved rugose line runs from this point towards the lower end of the great trochanter. Of especial interest is the presence of a well developed third trochanter, which runs some distance down the shaft and is continued as an external linea aspera. The third trochanter appears to be universally present in the creodonts, it is also found in *Amphicyon* (Filhol, No. 4*a*, Pl. xiv, fig. 4, Pl. xv, fig. 5), *Cynodictis* (Schlosser, No. 14, p. 265), *Proailurus* (Filhol, No. 4, Pl. 5, fig. 3), and the figure given by Milne-Edwards and Grandidier (No. 11, Pl. 9, fig. 7) would seem to indicate its presence in *Cryptoprocta*, though the specimens which I have had the opportunity of examining did not possess it. It is further faintly indicated in certain of the *Procyonidæ* and *Viverridæ*, but no living carnivore exhibits it in any such degree of development, as is seen in *Dinictis*. In the latter the shaft is rather long and slender and quite strongly arched forward; the posterior surface is flattened, the anterior regularly curved from side to side. The lower portion of the shaft expands gradually to the condyles; the popliteal region is nearly smooth, showing no such rugosities for muscular attachment as occur in the larger cats; it is even less rugose than in *Cryptoprocta*. The condyles are of nearly equal size and are quite widely separated; above and to the side of each one is a small articular facet, apparently for sesamoid ossicles. The rotular trochlea is broad, shallow and symmetrical, giving to this region of the bone a very feline appearance.

The femur of *Nimravus* is quite different from that of *Dinictis*: the shaft is more slender and more decidedly curved; the condyles project more strongly backward, due, no doubt, to the digitigrade gait of this animal, while *Dinictis* was plantigrade, and the condyles

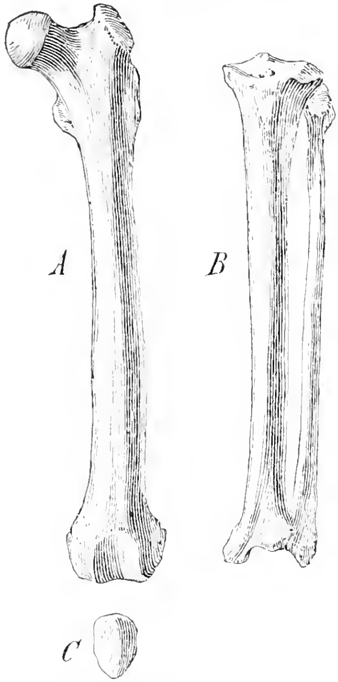


Fig. 3. *Dinictis felina*; A, left femur; B, left tibia and fibula; C, left patella.

are less equal in size; the trochlea is longer and more curved and the pits for the attachment of the crucial ligaments much more marked.

The *patella* of *Dinictis* is broad but quite thin from before backwards; its upper margin is abruptly rounded and the lower end pointed, giving it the shape of a flattened almond. The articular surface is somewhat concave from above downwards and even more slightly convex from side to side. The anterior surface and the sides are but little roughened, or rather faintly striate.

The *tibia* is considerably shorter than the femur; if we designate the length of the latter as 10, that of the tibia would be 8·4. In *Proailurus lemanensis* the length of the tibia on the same scale is 9·3, in *Cryptoprocta* 8·6, in *Paradoxurus* 10·4, in *Cynogale* 9·1, in *Viverra civetta* 9·2; it thus appears that in *Dinictis* the disproportion is unusually great. Seen from in front the tibia in this genus appears to be straight, as in *Cryptoprocta* and *Proailurus*, not having the lateral curvature which occurs in many viverrines, seen from the side, however, the tibia is strongly arched forward. The proximal end differs in some not unimportant respects from that of both *Cryptoprocta* and *Proailurus;* the condyles are more flattened and are almost in contact, instead of being separated by a considerable interval; the spine is very low; the cnemial crest is somewhat less prominent and does not descend so far upon the shaft; the posterior portion of the condyles is also less deflected than in *Cryptoprocta*. On the postero-external angle of the outer condyle there is a large, flat oval facet for the head of the fibula. In *Archælurus* the upper portion of the tibia is very similar to that of *Dinictis*, but the cnemial crest is more massive and the shaft deeper from before backwards, while the spine is higher. In *Dinictis*, as in *Archælurus*, there is a deep concavity in the posterior side, just below the head. The upper two-thirds of the shaft is trihedral, the lower portion is compressed and oval in section. The distal end is quite peculiar; it is less expanded transversely than in *Cryptoprocta;* the internal malleolus is long and very heavy and projects somewhat inward as well as downward, and the lower end is abruptly truncate. The sulcus for the tibial tendons is double, as in the felines, and the bounding ridges are continued to the end of the malleolus. The astragalar surface is much flattened and the intercondylar ridge is hardly indicated, being formed merely by the angle at which the two facets meet. This region of the tibia is strikingly different from the corresponding part in *Proailurus* (see Filhol, No. 4, Pl. 5, fig. 6) in which the groove for the astragalus is much more complete. On the other hand, it is very similar to the distal end of the tibia in *Archælurus* (Cope, No. 2, Pl. lxxia, fig. 15*a*).

The *fibula* is comparatively well developed and very cat-like; the proximal end is considerably expanded from before backwards and at the same time thickened; it bears a large, oval and obliquely placed facet for the head of the tibia. The shape of this part of the bone is much like that seen in many viverrines. The shaft, though slender, is quite as strong proportionately as in the existing cats and civets, and is of an irregular trihedral shape, with a sharp *crista interossea.* The distal end is more expanded in both directions than the proximal and in shape resembles that of the cats; on its posterior border is a deep tendinal sulcus, and on the inner side is a large facet for the external face of the astragalus. The fibula is in contact with the tibia only at the proximal and distal ends, the shafts of the two bones being quite widely separated throughout their entire length.

The Pes.

The hind-foot is relatively long and slender and has many points of resemblance to that of *Cryptoprocta*, as well as important differences from that animal. The calcaneum is very like that of *Proailurus* and has considerable resemblance to the calcaneum of *Procyon.* The tuber is short and stout, with a moderately expanded free end, which is grooved by a tendinal sulcus; the posterior astragalar facet is large, regularly arched from before backwards and presenting decidedly more internally than superiorly, in this respect resembling *Proailurus* rather than *Procyon.* The sustentaculum is heavy and prominent and the articular facet is reflected over upon the posterior side; the cuboidal facet is oval and concave, and slopes from within outwards and downwards. The outer side of the distal end of the calcaneum shows a prominent process, which is as strongly developed in *Prouilurus* and *Procyon*, and to a less degree in *Cryptoprocta* and *Amphicyon*. This process is most conspicuous in the plantigrade forms, though it is also present in such forms as the tiger.

Fig. 4. *Dinictis felina;* left hind foot.

The astragalus of *Dinictis* is remarkable for its flatness, the intercondylar groove being hardly more than indicated; the outer condyle is much broader and somewhat higher than the inner and forms nearly a right angle with the very large and slightly concave external fibular surface; at its posterior (or superior) end the trochlea becomes exceedingly narrow and somewhat more deeply grooved; anteriorly it ends abruptly and is not continued down over the neck, as is the case in *Archælurus* and the tiger. The internal face of the astragalus is placed very obliquely and passes into the inner condyle by a gentle curve, quite different from the sharp ridge found in most recent carnivores, but very similar to the shape in *Archælurus*. The neck is very short and much less strongly deflected towards the tibial side than is usual in recent forms; the distal end is formed by the large convex head for the navicular, but upon the outer side there is a small, though distinct facet for the cuboid, a connection which rarely occurs in the recent carnivora, the bears and certain mustelines having it, however. Cope's figure of the astragalus of *Archælurus* (No. 2, Pl. lxxia, fig. 16b) seems to indicate its occurrence in that genus, and in all probability it will also be found in the White River species of *Cynodictis*, though in the *C. geismarianus* from the John Day horizon (Cope, No. 2, Pl. lxxa, fig. 9) it is not apparent. The facet for the sustentaculum is long and rather narrow, convex in front and concave behind, as it embraces the hinder edge of the sustentaculum; the external calcaneal facet is deeply concave from before backwards, and has an unusually oblique position in accordance with that of the corresponding surface on the calcaneum. The resemblance in the structure of the astragalus between *Dinictis* and *Archælurus* have been mentioned, but there are important differences, chief among which are that in the latter genus the inner condyle is continued almost to the navicular facet; the external side is curved outwardly very much more strongly and the facet for the sustentaculum is much smaller and further removed from the head.

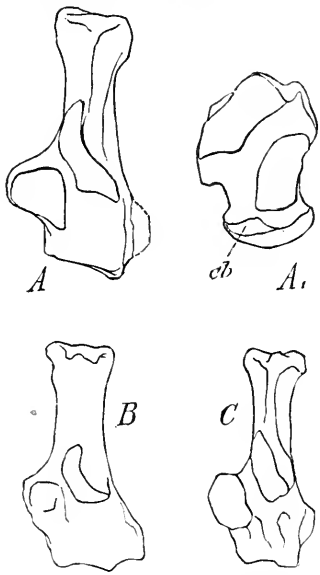


Fig. 5. A dorsal view of left calcaneum; A1, plantar view of left astragalus of *Dinictis felina*. In A1, *cb.* marks the facet for the cuboid. B, left calcaneum of *Proailurus*; C, of *Cryptoprocta*. B and C, after Filhol.

The *navicular* is rather unusually broad and of very simple construction; the proximal surface is taken up entirely by the deeply concave astragalar facet; on the external side there is a single narrow facet for the cuboid, and the distal side shows three facets for the cuneiforms, that for the ectocuneiform being much the largest, that for the entocuneiform is very obliquely placed, causing a great reduction of the height of the navicular upon the inner side.

The *cuboid* is a stout bone with large diameters in all three directions: the proximal surface, forming the facet for the calcaneum, is somewhat convex and slopes downwards and outwards from the internal side; internally to the calcaneal surface is a narrow and obliquely placed facet for the astragalus. The internal face of the cuboid shows a single small and nearly flat facet for the ectocuneiform. On the distal end there is a very large and slightly concave surface for the fourth metatarsal, and external to this very much narrower facet for the fifth metatarsal, which has an oblique position presenting outwards as well as downwards. The sulcus for the peroneal tendons upon the external side of the cuboid is very distinctly marked, though not nearly so deep as in *Procyon*.

The ectocuneiform is large, very broad on the dorsal side, especially distally and rapidly becoming narrower towards the plantar side, where from the proximal end is given off a stout knob-shaped process; on the internal side is a pair of small facets for the second metatarsal. The mesocuneiform resembles that of *Paradoxurus* in shape, having a very oblique facet for the navicular; the tibial side of the bone is much higher than the fibular and consequently the proximal edge slopes strongly downward and outward.

The entocuneiform is high and narrow, though of considerable depth; the proximal end rises sharply toward the plantar side, so that this diameter much exceeds that on the dorsal side. The facet for Mt. I is narrow and concave from before backwards. The entocuneiform descends considerably below the level of the mesocuneiform and abuts against the side of the second metatarsal.

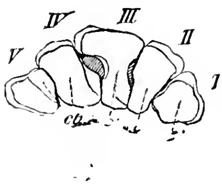


FIG 6. *Dinictis felina;* proximal ends of metatarsals, facets for the tarsals represented by c,' c,'' c,''' cb.

As compared with those of most of the existing *Felidæ*, the *metatarsals* of *Dinictis* are weak and slender and have a viverrine appearance. Only the proximal end of Mt. I is preserved and so its length cannot be determined, but the diameter of the shaft is relatively less reduced than in *Cryptoprocta*, and apparently the hallux bore about the same proportion to the other digits as in *Paradoxurus*. The head is convex from before backwards, concave from side to side, extending upwards and inwards, with a prominent rugose surface on the tibial side. Metatarsal II is rather short and quite slender; the head is wedge-shaped, becoming very narrow on the plantar side; the shaft is obscurely trihedral, flattened on the tibial and rounded on the other sides. Owing to the shortness of the mesocuneiform. Mt. II rises above the level of both I and III and is thus wedged in between the ecto- and entocuneiforms, an arrangement which is nearly universal among the fissipede carnivores. On the fibular side there is a slight depression for Mt. III, but this digit is not interlocked with its neighbors so firmly as the three external ones.

The third metatarsal is decidedly the heaviest, though not the longest of the series, and the proximal portion is especially broad; on the fibular side of this end is a very deep depression, into which fits a corresponding projection from Mt. IV. The facet for the ectocuneiform is very obliquely placed with reference to the long axis, rising strongly towards the fibular side, and has the ordinary feline arrangement, the two facets for Mt. IV being separated by a deep emargination, and the plantar side of the proximal end very much constricted. The shaft is very nearly straight. This bone articulates only with the ectocuneiform, being excluded from both the cuboid and the mesocuneiform, as both II and IV rise above it.

The fourth metatarsal is somewhat longer than No. III and decidedly more slender, though heavier than any of the others; it has a narrow convex head for the cuboid and is closely interlocked with III and V; on the tibial side is a prominence which fits into the pit on No. III and on the fibular side is a pit for the projection from No. V. The three outer digits are thus firmly interlocked by means of the metatarsals, No. II is less closely connected, but is securely held in place by being wedged between the ecto- and entocuneiforms. The shaft of Mt. IV is curved so that the distal end is deflected outwards, and is slightly twisted upon itself; seen from the dorsal side it seems to be attached only to the cuboid, but posteriorly has a small facet for the side of the ectocuneiform.

The fifth metatarsal is a little more slender than No. II and of about the same length, though it descends lower, owing to the lower level of its attachment to the cuboid as compared with that between the mesocuneiform and Mt. II; the cuboidal facet is very narrow and convex from before backwards, and above it rises the large, thickened and rugose external process; the shaft is curved both forward and inward, like that of No. IV. The distal ends of all the metatarsals show rounded hemispherical heads for the phalanges which are sharply constricted off from the shafts, and on the plantar side are sharp and prominent keels; just above these articular heads the shafts are expanded and have rugose processes for ligamentous attachment.

The metatarsals of *Dinictis* are not unlike those of *Cynodictis*, to the viverrine character of which Schlosser has called attention (No. 14, Taf. vi, fig. 18, 29), but in the former Mt. III is proportionately heaver and its proximal end overlaps No. IV more extensively, and the cuboidal facet of Mt. V is smaller. In *Ælurogale* (Schlosser, loc. cit. figs. 15 and 23) the metatarsals are very much heavier than in *Dinictis;* the head of Mt. II is less distinctly wedge-shaped, the head of No. IV is broader and shows an excavation on the tibal side which is not seen in *Dinictis*, while the projection from the head of Mt. V is much longer and more compressed. The shape of the fifth metatarsal is decidedly more feline in *Dinictis* than in *Ælurogale;* the shafts in the latter genus are also much straighter than in the former. The metatarsals of *Proailurus* seem

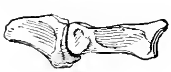


FIG. 7 *Dinictis felina;* median and ungual phalanges of IV digit seen from the fibular side.

to be considerably longer and more slender than those of *Dinictis* (Filhol No. 4, Pl. 4, figs. 1 and 5).

The *phalanges* of *Dinictis* are in general very much like those of *Cryptoprocta* but are proportionately stouter. Those of the proximal row are quite long, broad and strongly arched towards the dorsal side of the foot. Those of the second row are flatter and quite deeply excavated upon the fibular side of the distal end, in order to allow the retraction of the claws. This excavation is much more marked than in *Cryptoprocta* or in any of the *Viverridæ* which I have been able to examine. According to Mivart (No. 12, p. 157) the claws of *Prionodon* are almost as completely retractile as in the cats, as certainly seems to have been the case in *Dinictis.* The ungual phalanges are less strongly arched than in *Cryptoprocta;* they are short, very much compressed and not far from straight. In shape they are quite like the unguals of *Paradoxurus*, but the articular surface is of a different shape and the backwardly projecting process beneath this surface is much better developed, though not to the same degree as in the true cats. There is no trace of the bony lamina or hood which in the last-mentioned family is reflected over the base of the horny claw. This hood occurs in *Hoplophoneus* and probably also in the later *Nimravidæ* from the John Day, though we may infer that in this respect *Archælurus* agrees with *Dinictis.*

It will be seen from the foregoing description that the hind-leg and foot of *Dinictis* presents a very curious assemblage of characters. In some respects these characters are very primitive, as for example the large third trochanter on the femur, the greatly flattened ankle-joint, the articulation of the astragalus with the cuboid and the shape of the calcaneum. Indeed, I was at first misled into the belief that this specimen belonged to a creodont and accordingly referred it to *Hyænodon* (quoted in Cope, No. 3, p. 344) until material subsequently brought to light showed its true nature. Such a creodont-like tarsus associated with the highly differentiated dentition of *Dinictis* is certainly very remarkable. In general, the specimen before us has much resemblance to the corresponding parts of *Cryptoprocta* and other viverrines, as well as to *Cynodictis*, but at the same time there are points of approximation to the felines, of which the most important is perhaps the degree of retractility shown in the ungual phalanges, which seems to be equalled among the *Viverridæ* only by *Prionodon.*

Measurements.

	M.
Femur, length,	·190
Femur, breadth, proximal end (head and great trochanter),	·038
Femur, breadth, distal end (greatest width of condyles),	·034
Tibia, length (including malleolus),	·168
Tibia, breadth, proximal end,	·034
Tibia, breadth, distal end,	·020
Calcaneum, length,	·043
Astragalus, length,	·027
Metatarsal I, breadth, proximal end,	·006
Metatarsal II, length,	·046
Metatarsal II, breadth, proximal end,	·006
Metatarsal III, length (?),	·051
Metatarsal III, breadth, proximal end,	·012
Metatarsal IV, length,	·053
Metatarsal IV, breadth, proximal end,	·006
Metatarsal V, length,	·0485
Metatarsal V, breadth, proximal end,	·008
First phalanx, fourth digit, length,	·022
Second phalanx, fourth digit, length,	·017
Third phalanx, fourth digit, length,	·015

The Systematic Position of Dinictis.

Before any systematic arrangement of the Carnivora can be accepted as final, it will be necessary to show the steps by which the various groups have diverged from the common stock. We are as yet by no means in a position to do this, and hence any classification of them at present can only be tentative. However, recent investigations throw some light upon the problem. It is obvious, in the first place, that the retention of primitive characters in any two groups of a series is no proof of any relationship nearer than that through the common ancestor of the entire series. Thus the presence of the alisphenoid canal, or the epicondylar foramen, cannot be employed as an indication of direct connection between two groups otherwise differing. Secondly, the *loss* of characters present in the ancestral form is no better indication of affinity, since we have abundant evidence that these suppressions take place independently. Examples of this are the reduction in the number of the teeth and digits, loss of the alisphenoid canal, the loss of the septum in the auditory bulla in the hyenas and mustelines, which no one supposes to be closely related. Although characters which belong to these two categories are by no means valueless, those which are derived from differentiations of a similar kind are much more important; that is to say, positive characters are of more value than negative ones. With these principles before us, we may proceed to the consideration of the question.

The arrangement of the fissipede Carnivora into Arctoidea, Cynoidea, and Aeluroidea proposed by Flower (No. 5), founded chiefly upon the characters of the basis cranii, has been very generally accepted among English speaking zoölogists, but as Schlosser (No. 14) remarks, it receives little support from paleontology, as in the various early fossil forms the characteristics are mingled in a very confusing way, and in a way not intelligible if Flower's arrangement be accepted. Schlosser regards the dogs and bears as being very closely related, while the mustelines, civets and hyenas are placed together as another series. The *Procyonidæ* (*Subursidæ*) "endlich stellen einen Formenkreis dar, der sich von den primitivsten Typen der Carnivoren, ausser im Zahnbau, fast gar nicht entfernt hat" (No. 14, p. 237). The cats, on the other hand, Schlosser believes to be widely separated from all others groups of Carnivora and to have been independently derived from creodonts, though admitting that as yet we know nothing of their history.

In most respects I regard these views as justified by paleontological evidence. Thus Gaudry (No. 6, ch. IX) and Lydekker (No. 9, p. 202; No. 10, p. 106) have satisfactorily shown the derivation of the bears from *Amphicyon* through *Dinocyon* and *Hyænarctos*. The connection between the viverrines and mustelines, though not so clear, is at all events very probable, as is shown by such forms as *Stenoplesictis*. Through the kindness of M. Filhol, I had an opportunity of examining a fine skull of *S. cayluxi* in his collection and found that it exhibited a remarkable combination of viverrine and musteline characters. The skull is like that of the civets in shape; the auditory bulla is divided by a septum and the separation into two chambers is plainly indicated by an external constriction; the bulla is in contact with the paroccipital process, though the latter is small and does not enclose the former as in a capsule, a striking difference from the viverrines. The condylar foramen is entir ly free from the foramen lacerum posterius and perforates a ridge passing from the paroccipital process to the condyle. The alisphenoid canal, if present at all, is very minute, but the glenoid foramen is large and conspicuous. The combined viverrine and musteline features in the dentition of this and other genera have been fully described by Schlosser, and such forms certainly seem to indicate a close connection between the two families, while the relationship between the civets and hyenas is very generally admitted and need not be dwelt upon here.

Schlosser's scheme (No. 14, p. 238) does not indicate any near connection between the dogs and viverrines, which however, seems to be equally clear. The skull of the White River species, ? *Cynodictis gracilis*, is interesting in this connection. In general character the skull is distinctly cynoid, but the long, narrow and sharply constricted cranium, the short, pointed face, and the slender mandible are very suggestive of the *Viverridæ*. The auditory bulla is marked by an external constriction as in most of the latter family, though I could not determine certainly the existence of a septum ; the bulla is not in contact at all with the paroccipital. The condylar foramen is much nearer to the foramen lacerum posterius than in *Canis* and occupies the same position as in *Viverra antiqua* from St. Gerand-le-Puy. The carotid canal is not enclosed in the foramen lacerum posterius. The upper true molars are more viverrine than canine in construction. The skeleton of this species is unfortunately not known at present, but Cope has called attention to the exceedingly viverrine character of the skeleton of the John Day species, *C.* (*Galecynus*) *geismarianus*. Schlosser likewise points out many viverrine features in the structure of the European *Cynodictis*, and it seems clear that, while *Cynodictis* should most probably be placed in the cynoid series, it stands very near to the point of division where the *Canidæ* and the *Viverridæ* diverged.

All of the carnivorous groups mentioned thus seem to come to a common point of origin and their early representatives agree quite closely in the characters of the skull and dentition. This primitive carnivorous skull may be thus described. The cranium is much elongated and very narrow ; the elongation affecting chiefly the posterior part and the region between the orbits and the post-orbital constriction ; the parietal zone is very long and excludes the frontals from contact with the cerebral hemispheres and there is a very long and single sagittal crest ; the face is comparatively short and the orbit is placed far forward ; the mandible is slender and tapers rapidly forward, and the teeth are relatively small. As to the base of the cranium, this exhibits a combination of characters which are now found separately in the various groups of carnivores, though among the recent families the nearest approach to the primitive condition is found in the dogs. The auditory bulla is almost certainly divided by a septum, as is still to some degree the case in *Canis*, where the mode of development of the bulla is very like that which occurs in the cats; the alisphenoid canal and the post-glenoid foramen are present; the foramen lacerum posterius, carotid canal and condylar foramen are all distinct from each other; the mastoid and paroccipital processes are free from the bullæ and are placed far in front of the occipital condyles. It is usually taken for granted that a short face is always a secondary modification, but the history of several groups of mammals shows that this assumption is untenable in many cases. The primitive forms both of ungulates and carnivores from the Puerco and Wasatch all have short faces, very long and narrow crania, the orbits are placed far forward in the face, and the zygomatic arches are in consequence greatly elongated. The two factors which chiefly determine the modifications of the skull are the teeth and brain, and the principles which Rütimeyer has laid down with reference to the modifications of the ungulate skull apply equally well to the carnivores. In the later forms the orbit is shifted backwards and the zygomatic arches shortened, the parietal zone reduced, the frontal zone extended, the teeth are much enlarged and if their number is unreduced, the face becomes correspondingly elongated, as in the dogs, or it may become greatly shortened, accompanying the much reduced dentition, as in the cats. Comparing the dogs of the White River, John Day and Loup Fork epochs, the gradual elongation of the face becomes plain.

The derivation of the *Felidæ* offers problems of much greater difficulty than that of the other groups, and as we have already seen, Schlosser altogether rejects the view that they have any connection with the *Viverridæ*, and derives them independently from creodonts. According to Mivart the following characters are common to both families and the hyenas. (No. 12, pp. 137–8).

"1. Bulla greatly dilated, rounded, smooth, thin-walled, with one exception, osseous, and almost always divided by a septum into two distinct portions.

2. Bony meatus short or with its inferior wall imperfectly ossified.

3. Paroccipital process applied to and, as it were, spread over the hinder part of the bulla.

4. Mastoid process never very salient, often obsolete.

5. Carotid canal small, sometimes very inconspicuous.
6. Condyloid fissure concealed.
7. Glenoid fissure extremely minute or absent.
8. Bone of penis generally small and irregularly shaped."

The same authority (pp. 144–5) gives the following skeletal and dental characters of the *Felidæ*:—

1. The muzzle is short as compared with the cranium.
2. The auditory bulla is much inflated, smooth and rounded, but hardly shows any external sign of division.
3. The bulla is more prominent towards its inner than towards its hinder border.
4. There is an almost complete bony septum between the two chambers of the bulla, which are one behind the other.
5. The bony meatus auditorius is short and neither produced anteriorly nor inferiorly, neither is it imperfectly ossified below.
6. There is no carotid foramen anywhere visible on the *basis cranii*.
7. There is no alisphenoid canal.
8. The palatine foramina are situated in the hinder half of the palate.
9. The post-orbital processes are more or less strongly developed, sometimes enclosing the orbits completely.
10. The paroccipital process projects only slightly as a rough tubercle beyond the bulla.
11. The mastoid is rather prominent.
12. The palate is very little or but moderately produced beyond the last molars.
13. The pterygoid fossa is very small.
14. Angle of mandible not greatly flattened beneath, and coronoid process high and inclined backwards.
15. There is a short pollex with a claw not, or hardly, reaching to distal end of metacarpal II.
16. The hallux is represented only by a rudimentary metatarsal bone.
17. The ungual phalanges are greatly arched with a wide lamina to shelter the base of the claw, and except in *Cynælurus* completely retractile.
18. Humerus with an epicondylar foramen.
19. Dorsal vertebræ 13 in number.
20. Bone of penis small.
21. $\frac{\text{P. 1}}{\quad}$ and $\frac{\quad}{\text{P. 2}}$ not developed.

22. There is no lower tubercular molar, no. $\frac{\text{M. 2}}{}$ and no. $\frac{}{\text{M. 2}}$.
23. $\frac{\text{M. 1}}{}$ is always very small and transversely extended.
24. The antero-external cusp of $\frac{\text{P. 4}}{}$ is fairly developed, but much smaller than the two others.
25. $\frac{}{\text{M. 1}}$ has hardly any talon.
26. Proportionate length of limbs considerable.

To these characters should be added the following:

27. The postero-internal cusp of $\frac{}{\text{M. 1}}$ has disappeared.
28. The lower incisors form a straight row, the second one not being pushed backward out of line.
29. The front of the jaw is not tapered and the chin is abruptly rounded.
30. The metacarpals are very closely interlocked.
31. There are considerable remnants of the clavicles.

The *Viverridæ* are distinguished by the following characters, including *Cryptoprocta* in that family (Mivart. pp. 196–8):—

1. The auditory bulla (except in *Nandinia*) is ossified, much inflated and shows externally that it consists of two chambers, which may or may not be one behind the other.
2. The bony meatus auditorius is almost always short, and may have its anterior, posterior, or inferior margin most projecting; and it may be imperfectly ossified below.
3. The bulla is not more prominent towards its inner than towards its hinder border.
4. There are one or two carotid foramina on each side of the *basis cranii.*
5. There is an alisphenoid canal (except often in *Viverricula*).
6. The palatine foramina are situated in the anterior half of the palate.
7. The muzzle is large in proportion to the cranium.
8. The post-orbital processes are generally developed but rarely enclose the orbit.
9. Paroccipital process depending or not.
10. Mastoid prominent or not.
11. Palate not much, moderately, or much prolonged behind the molars.
12. Pterygoid fossa present or absent.
13. The coronoid process of the mandible is almost, if not quite always, less lofty relatively, and less backwardly produced than in the *Felidæ*.

14. There may or may not be a pollex; but in the large majority of species there is one.
15. There may or may not be a hallux; but in the large majority of species there is one.
16. The ungual phalanges may or may not be strongly arched, but there is not so wide a lamina of bone to shelter the base of the claw as in the *Felidæ*. They are hardly ever (except perhaps in *Poiana* and *Prionodon*) completely retractile, and often not at all so.
17. The humerus may be without epicondylar foramen.
18. The dorsal vertebræ never number more than fourteen.
19. The bone of the penis is small (except in *Cryptoprocta*).
20. $\frac{\text{P. 1}}{\quad}$ is generally and $\frac{\quad}{\text{P. 2}}$ constantly developed.
21. There is always an $\frac{\quad}{\text{M. 2}}$ and generally an $\frac{\text{M. 2}}{\quad}$.
22. $\frac{\text{M. 1}}{\quad}$ is always present and generally large.
23. The antero-external cusp of $\frac{\text{P. 4}}{\quad}$ is generally very small.
24. $\frac{\quad}{\text{M. 1}}$ has almost always a considerable talon.
25. The limbs are short in proportion to the body.

To these we may add:—

26. Except in *Cryptoprocta*, the lower sectorial has a well developed postero-internal cusp.
27. The second lower incisor is pushed backwards out of the line of the others.
28. The mandibular rami are tapering.
29. The metacarpals are less complexly interlocked than in the cats.
30. There are no clavicles.

On comparing the description already given of *Dinictis* with the characteristic features of the cats and viverrines here set forth, it appears that, so far as the base of the cranium is concerned, these two groups agree together much more nearly than *Dinictis* does with either of them, the latter corresponding rather to the cynoids and very closely approximating the condition stated above as characteristic of the primitive stock of the Carnivora. In other respects the skull of *Dinictis* may fairly be said to be intermediate between the cats and viverrines in structure, but the shape of the mandible is peculiarly feline. The dentition exhibits the same intermediate characters, and though it approximates that of the cats in several important respects, it is distinctly less feline than is the dentition of *Cryptoprocta*. One very characteristic feature of the *Felidæ* is however shown in the dentition of *Dinictis*, namely, the fact that the crowns of the lower incisors form a continuous row and the second one is not forced out of line. The vertebræ of the genus before us are also rather feline, but with certain resemblances to the civets and especially to *Cryptoprocta*. The hind-limb has very little about it that reminds one of the cats, the most important resemblance being the degree of retractility shown by the claws, though this is shared by some civets. On the other hand both in its proportions and in its individual members the hind-limb and foot of *Dinictis* approximates closely the corresponding parts of many of the *Viverridæ*, though with certain features which are more primitive than occur in any living member of that family, for example, the well developed third trochanter of the femur, the very flat ankle joint and the articulation of the cuboid with the astragalus. And it further seems clear that the numerous viverrine characters are not the result of independent development, or "convergence."

In a former publication (No. 16, p. 153), I referred *Dinictis* to the *Cryptoproctidæ*; but since that account was written, I have had an opportunity to study specimens of the Madagascar genus, which have led me to agree with Mivart in referring this genus to the *Viverridæ*, to which *Dinictis* manifestly does not belong. The *Nimravidæ*, alone remain, and the characters of the base of the skull are so exactly like those of *Dinictis*, that in spite of differences in the feet, I feel constrained to follow Cope's example and place the White River genus in that family, of which it, probably, together with *Archælurus*, will form the more primitive section.

Comparing the *Nimravidæ* with the *Felidæ* and *Viverridæ*, we reach the following results:—

1. The muzzle is short as compared with the cranium.
2. The auditory bulla is inflated, but (in the genera in which this region is known) shows no external sign of division.
3. The bulla is more prominent towards its inner than towards its hinder border.
4. There is, probably, an almost complete bony septum between the chambers.
5. The bony meatus is not produced nor imperfectly ossified below.
6. There is a distinct carotid foramen.
7. There is an alisphenoid canal.
8. The palatine foramina are situated about midway in the palate.

9. The post-orbital processes are generally very small, and never enclose the orbit behind.
10. The paroccipital processes project backwards, and do not touch the bullæ.
11. The mastoid is very prominent.
12. The palate is not at all prolonged behind the molars.
13. The pterygoid fossa is small.
14. The coronoid process of the mandible is high and inclined backwards.
15. There is a short pollex (in *Hoplophoneus* at least.)
16. The hallux is well developed.
17. The ungual phalanges are retractile, and in *Hoplophoneus* are strongly arched and have wide bony laminæ at their bases.
18. The humerus has an epicondylar foramen.
19 and 20. Unknown.
21. $\frac{\text{P. 1}}{\quad}$ and $\frac{\quad}{\text{P. 2}}$ often developed.
22. There is often an $\frac{\quad}{\text{M. 2}}$; but no $\frac{\text{M. 2}}{\quad}$.
23. $\frac{\text{M. 1}}{\quad}$ is transversely extended.
24. The antero-external cusp of $\frac{\text{P. 4}}{\quad}$ is rudimentary or absent.
25. The talon of $\frac{\quad}{\text{M. 1}}$ is much better developed than in the *Felidæ*.
26. The limbs are relatively short and the feet weak.
27. The postero-internal cusp of $\frac{\quad}{\text{M. 1}}$ is often present.
28. The lower incisors form a straight row; the second in a line with the others.
29. The front of the jaw is not tapered, and the chin abruptly truncate.
31. Unknown.

The *Nimravidæ* differ from both *Viverridæ* and *Felidæ* in the following respects:—

(1.) The paroccipital process is not applied to the bulla.
(2.) The mastoid process is quite prominent.
(3.) The carotid canal is conspicuous.
4. The condylar foramen is not enclosed in the foramen lacerum posterius (as is also the case in *Viverra antiqua* and some of the lynxes).
5. Glenoid foramen large.
6. There is usually a large third trochanter on the femur.
7. The astragalus in some genera much flattened, and articulates with the cuboid.

These comparisons show that in the *Nimravidæ*, and more especially in *Dinictis*, there is a strange association of both feline and viverrine features, together with others, which are more primitive than those which occur in the living representatives of either of these families. In order, therefore, to understand the systematic relations of the extinct family, we must assume either that these animals are not related to the felines at all, but resemble them merely as the result of an independent and parallel development, or that the *Felidæ* and *Viverridæ* are related. In view of the numerous and extraordinary resemblances between the cats and the higher *Nimravidæ*, which no one has ever called in question, the weight of probability is strongly in favor of the second view—namely, that the cats are a highly specialized branch of the primitive group which also gave rise to the *Viverridæ*. If we admit the connection between the *Nimravidæ* and the *Felidæ*, that between the latter and the *Viverridæ* seems necessarily to follow.

With regard to the White River genera of this family, Schlosser has remarked as follows (No. 15, pp. 589–90): "Unter den Fleischfressern treffen wir hier zum ersten mal katzenähnliche Formen, *Drepanodon*, *Dinictis*, *Bunælurus* und *Hoplophoneus*, doch soll nur das Gebiss und der Schädel mit jenen der Katzen nähere Uebereinstimmung zeigen, das Skelet jedoch vielmehr an jenes von Hunden erinnern. Höchst wahrscheinlich handelt es sich hier um einen völlig erloschenen Formenkreis." These statements are due to a misunderstanding of my account. The skeleton of *Dinictis* and *Hoplophoneus* is not like that of the dogs, but it does resemble in many important respects, as does also the skull, that of the primitive dog-viverrine group, of which *Cynodictis* may be taken as a typical example. So numerous and important are the correspondences between the dentition, skull and skeleton of *Dinictis*, the lower viverrines and the ancestral dogs, that it seems impossible to avoid the conclusion that they are all very closely related.

Schlosser has not as yet discussed fully his reasons for separating the *Felidæ* so widely from the other Carnivora, and deriving them independently from the creodonts, not having reached that portion of his great work. Some hint of the grounds for his views may be gained from a recent short paper (No. 15, p. 596), where criticising Filhol's opinion that *Stenoplesictis*, *Proailurus*, etc., form the transition from *Cynodictis* to the cats, he says: "Dies ist jedoch wenig wahrscheinlich, da eine so weitgehende Umgestaltung unmöglich sehr rasch erfolgen konnte, d. h. innerhalb des Zeitraums, welcher durch die Fauna der Phosphorite begrenzt erscheint; ausserdem sprechen auch anatomische Gründe gegen diese Annahme. Bei allen diesen Formen ist nämlich der zweite untere Schneidezahn wie bei der Gattung *Cynodictis* und den Hunden, Mardern und Zibethkatzen schon hinter den ersten und dritten gerückt, während die Schneidezähne bei den Katzen mit dem Kronenteil eine Reihe bilden, ferner erscheint der vordere Teil des Unterkiefers nicht abgestutzt wie bei den Katzen, sondern läuft spitz nach vorn zu, und ausserdem sind auch hier die Schlüsselbeine ganz wie bei allen Hunden, Mardern und Zibethkatzen verloren gegangen, während die Katzen noch deutliche Rudimente derselben aufzuweisen haben. Da aber die Nachkommen unmöglich in der einen oder andern Beziehung dem ursprünglichen Zustand näher stehen können, als ihre Ahnen, so wird die Filhol'sche Ansicht wenig haltbar erscheinen."

Though not wishing to defend Filhol's views, it seems to me that the anatomical objections which Schlosser urges against them are of no great weight. It seems quite clear that the slender, tapering, mandibular ramus is the original, primitive one; at least, it is well nigh universal among the creodonts, and it is difficult to see why the form which characterizes the feline lower jaw should not have been derived from the slender ramus. At all events, the hyenas, which Schlosser admits to be closely connected with the civets, have developed a mandible, which, in its anterior portion, is very like that of the cats, and in this respect *Cryptoprocta* is just intermediate between *Proailurus* and *Felis*—a slight change further in the same direction would reproduce the mandible of the cats.

Necessarily correlated with the shape of the mandible is the arrangement of the lower incisor series—here, again, it would appear that the *Felidæ* present, so far as the Carnivora are concerned—not the primary, but a modified condition, for in all of the creodonts in which the condition of the lower incisor series is known to me, the second one is either wanting, or has been pushed back of the first and third, just as in the dogs and civets. In this respect, also, *Hyæna* agrees with the cats, as do some, at least, of the bears, and it would appear to be a necessary consequence of the widening of the muzzle in the groups mentioned.

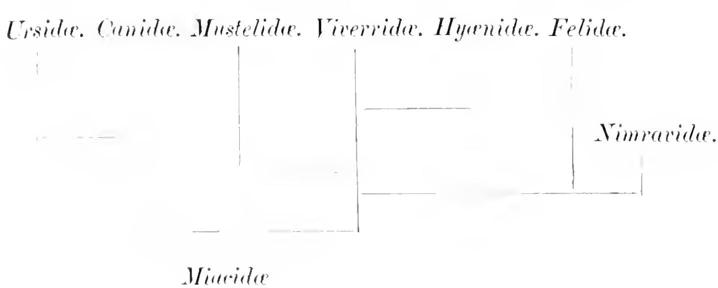
As regards the presence of clavicles in the cats, it need only be said that nothing is as yet certainly known as to their presence or absence in the early members of the various groups which now do not possess them.

It may not be fair to assume that these are Schlosser's chief reasons for excluding the *Felidæ* from the æluroids, as they are employed only against the derivation of that family from *Proailurus*, etc., but apparently they imply as much, especially when read in connection with other passages. Nor do his attempts to explain away the correspondences in the structure of the skull between the cats and the viverrines, appear to me much more successful, though lack of space forbids a discussion of them here.

No known group of creodonts can be selected as having any close relations to the cats. The *Oxyænas*, it is true, do exhibit certain surprising analogies with the recent family, but the analogy is confined to the teeth, and is only superficial, as the teeth which in the two groups look so much alike, are not homologous, and are developed in quite a different way. The lower sectorials of *Protopsalis*, for example, are very cat-like, but not so much so as those of *Cryptoprocta;* and the feet of the former genus, as well as those of *Oxyæna* itself, and *Hyænodon*, are curiously specialized in an entirely opposite sense from that which characterizes the cats.

Unless, therefore, we are prepared to regard the resemblances between the *Nimravidæ* and the *Felidæ* as merely analogical, which, to say the least, seems highly improbable, we must admit a connection between the latter family and the viverrines, since the *Nimravidæ* clearly show that they are not far removed from the primitive series, of which *Cynodictis* may be taken as a representative.

The following table will show the modifications in Schlosser's scheme, which seem to me to be necessary. The *Procyonidæ* are omitted, as we have as yet no information upon their history :—



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A REVIEW OF THE AMERICAN SPECIES OF STURGEONS (ACIPENSERIDAE.)

BY PHILIP H. KIRSCH AND MORTON W. FORDICE.

In the following paper we have given the synonymy of the Sturgeons or Acipenseridae found in American waters, an analytic key by which the species may be distinguished, and a list of nominal species with identifications. All the species examined by us belong to the Museum of the University of Indiana. Most of them were collected by Dr. D. S. Jordan, to whom we are indebted for aid in various ways. The variations due to age are extremely great in this group, and some of the characters given here as distinctions may prove to be of little value when a larger amount of material is examined. There can, however, be little doubt of the distinctions of the six species here recognized. We feel also very certain that no other species exist within our limits, and that all of the many nominal species should be referred to these six. This paper must be regarded as provisional only, as helping to clear the way to a better knowledge of the members of the group.

Characters of the Acipenseridae.

The order of Glaniostomi contains among recent fishes but a single family, *Acipenseridae* which may be thus characterized:

Body elongate, subcylindrical, with five rows of bony plates, a median dorsal, and a lateral and ventral on each side. Each plate has a median carina which terminates in a more or less developed spine, which becomes blunt with age, while the ventral plates are sometimes deciduous. The skin, between the bony plates is rough with smaller, irregular plates and spicules of varying sizes. Head covered with bony plates connected by sutures; snout produced, depressed, subcylindrical, conical or subspatulate; mouth small, inferior, round or transverse, protractile, with thickened lips, and toothless: nostrils large, double, in front of the eye, which is small, lateral; four barbels in a transverse series on the lower side of the snout: maxillary distinct from premaxillary. Gills 4. An accessory opercular gill. Pseudobranchiae small or obsolete. No branchiostegals. Gill-membranes united to the isthmus. Pectoral fins placed low; dorsal posteriorly; anal somewhat behind it and similar; ventrals many rayed, behind the middle of body. Tail heterocereal, the lower caudal lobe developed, the upper lobe covered with rhomboid scales. The vertical fins with fulcra, and all the fin-rays slender and articulated.

Air-bladder large, simple, attached to the dorsal wall of the abdominal cavity, and in free communication with the esophagus. Stomach without blind sac. Rectum with a spiral valve. Pancreas divided into pyloric appendages.

Large fishes found in the seas and fresh-waters of northern regions. Most of the species are migratory, inhabiting the same waters as the salmon. About 20 species are known, of which 6 are found in American waters. The species fall into two very natural genera.

Analysis of Genera of Acipenseridae.

a. Spiracles obsolete; snout broad, shovel-shaped, much depressed above; rows of bony shields confluent behind the dorsal, so that the depressed tail is completely mailed; gill-rakers small, fan-shaped, ending in 3 or 4 points. SCAPHIRHYNCHUS, 1.

aa. Spiracles present; snout sub-conic; rows of bony shields nowhere confluent; the tail not depressed or mailed; gill-rakers lanceolate. ACIPENSER, 2.

SCAPHIRHYNCHUS.

Acipenser Rafinesque, Ichth. Ohiensis, 80, 1820 (platorhynchus).
Scaphirhynchus Heckel, Ann. Wiener Mus. Naturgesch. I. 71, 1835 (*rafinesquii*). (Not *Scaphorhynchus* of *Prince Maximilian*, 1838, a genus of birds.)
Scaphirhynchops (Gill MSS.) Jordan and Copeland, Bull. Buff. Soc. Nat. Hist. 161, 1876 (*platyrhynchus*). (Substitute for *Scaphirhynchus* regarded as preoccupied).
Type: *Scaphirhynchus rafinesquii* Heckel=*Acipenser platorhynchus* Rafinesque.

Etymology. *skáphe*, a skiff; *rhynchos*, snout.

Analysis of Species of Scaphirhynchus.

a. Plates between ventrals and anal large, in two rows of three in each row, and one median row of one plate. Space between dorsal and lateral shields of small bony plates in 4 or 5 series. Last dorsal shield of moderate size, less than half length of one before it. Dorsal shields 18 (15–20); lateral shields 46 (41–46); ventral shields 13 (11–13). D. 32; A. 20. Shields sharply keeled and spines well developed. Body elongate, tapering into the slender depressed tail, which extends in the young beyond the caudal as a slender filament. Anal little more than half the length of the dorsal and placed entirely behind it. Color, yellowish-brown above, lighter below. PLATYRHYNCHUS, 1.

1. **Scaphirhynchus platyrhynchus.** Shovel-nosed sturgeon; white sturgeon.

Acipenser platorhynchus Rafinesque, Ichth. Ohiensis, 80, 1820 (Ohio river); Kirtland, "Rept. Zool. Ohio, 196, 1838;" Kirtland, Bost. Jour. Nat. Hist. V. 25, 1841 (Cincinnati); Storer, Synop. Fish. N. Amer. 501, 1846 (Ohio river).

Scaphirhynchus platyrhynchus Baird, "Iconogr. Encycl. II. 238, 1850;" Girard, U. S. and Pacif. R. R. Survey, 337, 1858 (Missouri river; Poteau river); Duméril, Hist. Poiss. II. 269, 1870 (New Orleans; Wabash river); Jordan, Man. Vert. Ed. V. 34, 1888.

Scaphirhynchops platyrhynchus (Gill MSS.) Jordan and Copeland, Bull. Buff. Soc. Nat. Hist. 161, 1876; Cope and Yarrow, Zool. Lieut. Wheeler's Expl. W. 100th Merid. V. 639, 1876 (Rio Grande); Nelson, Bull. Ill. Mus. Nat. Hist. 51, 1876 (Ohio river); Bean, Proc. U. S. Nat. Mus. 114, 1880 (Ohio river; Republican river, Kan.; Yellowstone river); Hobbs, Bull. U. S. Fish. Com. 125, 1881 (Ohio river); Jordan and Gilbert, Synop. Fish. N. Amer. 88, 1882; Jordan, Proc. U. S. Nat. Mus. 318, 1884 (New Orleans); Jordan, Cat. Fish. N. Amer. 13, 1885.

Acipenser cataphractus Gray, "Proc. Zool. Soc. London, 122, 1834;" Günther, Cat. Fish. Brit. Mus. VIII. 345, 1870 (Ohio; New Orleans).

Scaphirhynchus rafinesquii Heckel, "Ann. Wiener Mus. Naturgesch. I. 71, pl. 8, f. 1, 1835;" Brutzer, "Dessert. Dorpat. 1860."

Habitat.—Mississippi valley and southern and western streams.

Etymology. *Platys*, flat; *rhynchos*, snout.

This well-known species is found in abundance in all the large rivers of the west and south. Early in May it ascends the streams for the purpose of sprawning. In the Ohio river it is taken in considerably large numbers and used for food, though it does not seem to be highly valued. Its habits are much like those of *A. rubicundus.*

ACIPENSER.

Acipenser Artedi, Genera Piscium, 68, 1738; Linnæus, Systema Naturæ, 237, 1758 (*sturio*).

Sturio Rafinesque, Indice d'Ittiologia Siciliana, 41 et 58, 1810 (*sturio*).

Sterletus Rafinesque, Ichth. Ohiensis, 79, 1820 (*serotinus*).

Dinectus Rafinesque, lc. 82 (*truncatus*).

Huso Brandt and Ratzeburg, "Medizin. Zool. II. 3, 1833" (*huso*).

Sterletus Brandt and Ratzeburg, Medizin. Zool. II. 3, 1833 (*ruthenus*).

Helops Brandt and Ratzeburg, Medizin. Zool. II. 352, 1883 (*stellatus*).

Antaceus Brandt, Bull. Acad. Sc. St. Petersbourg, V. 138–141 et 179–185, 1865 (*schypa*).

Lioniscus Fitzinger and Heckel, Ann. Wien. Mus. 370, tab. XXV. f. 3, et XXVIII. f. 5 et 6, 1836 (*glaber*).

Type: *Acipenser sturio* Linnæus.

Etymology. Lat. *acipenser*, a sturgeon; from *akis*, point; *pente*, five.

The species of this genus have been multiplied to more than one hundred, those in American waters have in particular been unduly increased by Auguste Duméril, who has described about forty from specimens in the museum at Paris. All of these nominal species are a burden to systematic science. The changes with age in these fishes is considerable, the snout becomes shorter and less acute, the spines become blunter, the roughness of the plates is generally diminished, and the ventral plates often disappear altogether. The number of plates is also subject to considerable variation.

Analysis of Species of Acipenser.

a. Plates between ventrals and anal large, in one row, or two rows anteriorly and one median row posteriorly of 1 to 4 plates.

b. Space between dorsal and lateral shields with stellate plates of rather large or medium size, in 5 to 10 series; last dorsal shield of moderate size, more than half length of one before it.

c. Shields, stellate plates and bony plates on head roughly striated and ridged, and shield-spines strongly developed, presenting a general rough and angular appearance; stellate plates rather large, in about 5 series, densely interspersed with smaller ones. Dorsal shields 11 (9–11); lateral shields 26 (26–30); ventral shields 8 (7–10). D. 33; A. 22. Snout sharp in the young, becoming blunt with age, usually rather shorter than the rest of head. Anal nearly as long as dorsal and placed almost entirely posterior to it. Color olive-green, with an olive stripe on the median line of the belly and one each side above the ventral plates, these stripes ceasing opposite the vent. MEDIROSTRIS, 2.

cc. Shields feebly striated; stellate plates rather small, in about 10 rows, with numerous smaller ones interspersed. Dorsal shields 10 (10–14); lateral shields 29 (27–36); ventral shields 9 (8–11). D. 38; A. 27. Snout rather sharp, nearly as long as the rest of the head, becoming comparatively shorter and blunter with age. Anal a little more than half length of dorsal, and placed almost entirely under it. Color, sides, back, olive-brown, belly, whitish. STURIO, 3.

bb. Space between dorsal and lateral shields with minute spicules in very many series.

d. Last dorsal shield of moderate size, more than half length of one before it. Dorsal shields 15 (11–16); lateral shields 38 (30–39); ventral shields 10 (9–11). D. 35; A. 27. Shields large, rough, with strongly hooked spines, becoming later comparatively smooth: Ventral shields growing smaller with age, and finally deciduous. Snout slender and long in the young, becoming quite blunt with age, when it is considerably shorter than the head. Anal 1½ in dorsal and beginning about its middle. Color blackish above, sides paler or reddish with irregularly distributed black spots. RUBICUNDUS, 4.

dd. Last dorsal shield very small, less than half length of one before it. Dorsal shields 11 (8–11); lateral shields 32 (22–33); ventral shields 9 (6–9); D. 41; A. 22. Shields large and flat; their spines not well developed. Snout short and blunt, about one-fourth length of head. Anal 2 in dorsal and placed entirely under it. Color blackish above, whitish below. BREVIROSTRUM, 5.

aa. Plates between ventrals and anal small, in two rows of 4 to 8 in a row; space between dorsal and lateral shields with stellate plates of moderate size in about 5 series interspersed with many smaller ones; last dorsal shield less than half length of one before it. Dorsal shields 11–12; lateral shields 40–50; ventral shields 10–12. D. 44–49; A. 28–30. Dorsal shields large and flat; shield-spines but moderately developed; snout sharp in the young, becoming rather blunt and short in the adult, when it is considerably shorter than the rest of the head. Base of anal fin 2 in dorsal and placed wholly under it. Color dark grayish, scarcely olive-tinged, and without stripes. TRANSMONTANUS, 6.

2. Acipenser medirostris. Green Sturgeon.

Acipenser medirostris Ayres, Proc. Cal. Acad. Nat. Sci. 15, 1854 (San Francisco); Girard, Pacif. R. R. Survey, 356, 1859 (San Francisco); Duméril, "Nouv. Arch. Mus. III. 167, pl. 13, f. 2, 1867;" Duméril, Hist. Poiss. II. 222, 1870 (San Francisco); Günther, Cat. Fish. Brit. Mus. VIII. 342, 1870 (California); Jordan and Jouy, Proc. U. S. Nat. Mus. 16, 1881 (San Francisco); Jordan and Gilbert, Proc. U. S. Nat. Mus. 36, 1881 (Sacramento, Columbia and Frazer's rivers); Bean. Proc. U. S. Nat. Mus. 160, 1881 (copied); Jordan and Gilbert, Synop. Fish. N. Amer. 86, 1882; Jordan, Cat. Fish. N. Amer. 13, 1885.

Antaceus medirostris Gill, Proc. Phila. Acad. Nat. Sci. 331, 1862 (name only).

Acipenser agassizii Duméril, "Nouv. Arch. Mus. III. 181, pl. 11, f. 2, 1867;" Duméril, Hist. Poiss. II. 237, 1870 (San Francisco).

Acipenser alexandri Duméril, "Nouv. Arch. Mus. III. 183, pl. 15, f. 1, 1867;" Duméril, Hist. Poiss. 239, 1870 (California).

Acipenser oligopeltis Duméril, "Nouv. Arch. Mus. III. 184, pl. 15, f. 2, 1867;" Duméril, Hist. Poiss. II. 241, 1870 (San Francisco).

Acipenser acutirostris Ayres, Proc. Cal. Ac. Nat. Sc. 15, 1854; Günther, Cat. Fish. Brit. Mus. VIII. 344, 1870 (California).

Habitat.—Pacific Coast of North America ascending the Frazer's, Columbia and Sacramento rivers.

Etymology. Lat. *medium*, moderate; *rostrum*, snout.

This species is found on the Pacific Coast of North America and ascending all the larger rivers. It attains a length of 8 to 10 feet and a weight of 400 to 500 pounds. It is not used for food, said to be poisonous. The specimen examined by us was taken by Jordan and Gilbert at San Francisco.

3. Acipenser sturio. Common sturgeon.

Acipenser corpore tuberculis spinosis aspero Artedi, Genera Piscium 65, 1738 (seas of Europe).

Acipenser sturio Linnæus, Syst. Nat. Ed. X. 237, 1758 (After Artedi and of the copyists and of European writers generally); Mitchill, Trans. Lit. and Phil. Soc. N. Y. 461, 1814 (New York); Günther, Cat. Fish. Brit. Mus. VIII. 342, 1870 (German ocean; Thames river; Holland; Rhine river; New York); Duméril, Hist. Poiss. II. 184, 1870 (Bordeaux; mouth of the Seine; Rome); Day, Fish. Gt. Brit. III. 280, 1885; Goode, Fish and Fisheries of U. S. 660, pl. 243, 1884.

Sturio vulgaris Rafinesque, Indice d'Ittiol. Sicil. 41 and 58, 1810 (Palermo).

Acipenser lichtensteini Bloch and Schneider, Syst. Ichthyol. 348, 1801 (German ocean).

Acipenser oxyrhynchus Mitchill, Trans. Lit. and Phil. Soc. N. Y. 462, 1814 (New York); Le Sueur, "Trans. Amer. Phil. Soc. 394, 1818;" Storer, Rept. Fish. Mass. 178, 1839 (Massachusetts); DeKay, N. Y. Fauna Fish. 346, pl. 58, f. 189, 1842 (New York); Ayres, Boston Jour. Nat. Hist. 287, 1842 (Long Island Sound); Storer, Synop. Fish. N. Amer. 499, 1845. Gill, Cat. Fish. East coast N. Amer. 58, 1861; Duméril, Hist. Poiss. II. 106, 1870 (Philadelphia); Bean, Proc. U. S. Nat. Mus. 114, 1880 (Potomac river); Bean, Proc. U. S. Nat. Mus. 367, 1883 (Chesapeake Bay).

Acipenser sturio oxyrhynchus Mitchill, Trans. Lit. and Phil. Soc. N. Y. 462, 1814; Jordan and Gilbert, Synop. Fish. N. Amer. 85, 1882; Jordan, Cat. Fish. N. Amer. 13, 1885.

Acipenser latirostris Parnell, "Wien. Mem. VII. 405, 1838" (Frith of Forth).

Acipenser hospitus Kräyer, Skand. Fauna, III. 780, 1840.

Acipenser thompsonsi "Bull. Proc. Roy. Irish. Acad. 21;" "Bull. Thompson's Nat. Hist. Ireland, IV. 245, 1856" (Ireland).

Acipenser attilus Gray, Hand-Book Chondropterigean Fish. 13, 1831 (England).

Acipenser yarrellii Duméril, "Nouv. Arch. Mus. III. 164, 1867."

Acipenser mitchillii Duméril, Hist. Poiss. II. 116, 1870 (New York).

Acipenser kennicottii Duméril, Hist. Poiss. II. 130, 1870 (James river).

Acipenser girardi Duméril, Hist. Poiss. II. 132, 1870 (Maryland).

Acipenser macrorhinus Duméril, Hist. Poiss. II. 133, 1870 (New York).

Acipenser megalaspis Duméril, Hist. Poiss. II. 135, 1870 (Lake Champlain).

Acipenser milberti Duméril, Hist. Poiss. II. 137, 1870 (New York).

Acipenser bairdii Duméril, Hist. Poiss. II. 145, 1870 (Maryland).

Acipenser storeri Duméril, Hist. Poiss. II. 147, 1870 (Boston).

Acipenser holbrookii Duméril, Hist. Poiss. II. 149. 1870 (Charleston).

Acipenser lecontei Duméril, Hist. Poiss. II. 232, 1870 (New York).

Habitat.—Atlantic ocean, ascending the principal rivers of Europe and North America.

Etymology. Lat. *sturgeon.*

This widely distributed species reaches a length of five to twelve feet and a weight of one to five hundred pounds. In Europe they have been secured of a length of eighteen feet. They spawn in spring and early summer in the lower stretches of rivers. Within the last few years the capture of the sturgeon for smoking and for the manufacture of caviare from its eggs has attained considerable importance on the Atlantic coast.

We have examined three specimens about 12 inches in length from the Potomac river, and one stuffed skin four feet long from Boston.

A. sturio oxyrhynchus Mitchill, is undoubtedly identical with the European species *A. sturio.* It differs from it only in having generally fewer lateral plates and somewhat rougher stellate ossifications. But as these characteristics are subject to great variation among all the sturgeons, especially with age, they are not of sufficient importance to be made the basis of classification.

4. Acipenser rubicundus. Lake sturgeon; Rock sturgeon.

Acipenser rubicundus Le Sueur, "Trans. Amer. Phil. Soc. 388, 1818;" Richardson, "Fauna Bor. Amer. 284, 1836;" Fitzinger and Heckel, Ann. Wien. Mus. I. 316, 1836; Kirtland, Rept. Zool. Ohio, 170, 1838 (Ohio); Kirtland, Boston Journal Nat. Hist. 303, 1841 (Cincinnati); DeKay, N. Y. Fauna Fish. 344, pl. 58, f. 191, 1842 (Great Lakes); Günther, Cat. Fish. Brit. Mus. VIII. 338, 1870 (copied); Milner, "Rept. U. S. Fish. Com. 67 and 73, 1872;" Jordan, Zool. Ohio, IV. 768, 1882; Jordan and Gilbert, Synop. Fish. N. Amer. 87, 1882; Jordan, Cat. Fish. N. Amer. 13, 1885.

Acipenser maculosus Le Sueur, Trans. Amer. Phil. Soc. 393, 1818; Fitzinger and Heckel, "Ann. Wien. Mus. I. 285, 1836;" Kirtland, Rept. Zoology Ohio, 170, 1838; Günther, Cat. Fish. Brit. Mus. VIII. 339, 1870 (Ohio; Montreal); Duméril, Hist. Poiss. II. 113, 1870 (name only); Bean, Proc. U. S. Nat. Mus. 127, 1881 (Hudson's Bay); Jordan, Zool. of Ohio, IV. 768, 1882.

Acipenser serotinus Rafinesque, Ichthyol. Ohiensis, 80, 1820 (Ohio R.); Duméril, Hist. Poiss. II. 158, 1870 (Ohio river).

Acipenser ohiensis Rafinesque, Ichthyol. Ohiensis, 81, 1820 (Ohio river); Duméril, Hist. Poiss. II. 156, 1870 (Wabash river).

Acipenser macrostomus Rafinesque, Ichth. Ohiensis, 81, 1820 (Ohio river).

Dinectus truncatus Rafinesque, lc. 81 (on a drawing).

Acipenser rupertianus Richardson, Fauna, Bor. Amer. 311, 1836; Duméril, Hist. Poiss. II. 128, 1870 (Mississippi river).

Acipenser lævis Agassiz, Lake Superior, 267, 1850 (Lake Superior).

Acipenser carbonarius Agassiz, Lake Superior, 271, 1850 (Lake Superior).

Acipenser rhynchaeus Agassiz, Lake Superior, 276, 1850 (Lake Superior); Duméril, Hist. Poiss. II. 111, 1870 (Lake Superior).

Acipenser liopeltis Günther, Cat. Fish. Brit. Mus. VIII. 34, 1870.

Acipenser copei Duméril, Hist. Poiss. II. 108, 1870. (Upper Missouri?)

Acipenser rauchii Duméril, Hist. Poiss. II. 118, 1870 (Osage river).

Acipenser richardsonii Duméril, Hist. Poiss. II. 120, 1870 (Missouri river).

Acipenser anasimos Duméril, Hist. Poiss. II. 122, 1870 (Missouri river).

Acipenser paranasimos Duméril, Hist. Poiss. II. 124, 1870 (Huntsville, Ala.)

Acipenser anthracinus Duméril, Hist. Poiss. II. 126, 1870 (Lake Erie).

Acipenser lamarii Duméril, Hist. Poiss. II. 139, 1870 (Mississippi river).

Acipenser atelaspis Duméril, Hist. Poiss. II. 141, 1870 (Saskatchawan river).

Acipenser rafinesquii Duméril, Hist. Poiss. II. 143, 1870 (Ohio river).

Acipenser rosarium Duméril, Hist. Poiss. II. 152, 1870 (Upper Mississippi or Lake Erie).

Acipenser platyrhinus Duméril, Hist. Poiss. II. 154, 1870 (Upper Mississippi or Lake Erie).

Acipenser kirtlandii Duméril, Hist. Poiss. II. 161, 1870 (Lake Erie).

Acipenser nertinianus Duméril, Hist. Poiss. II. 162, 1870 (Michigan).

Acipenser honneymani Duméril, Hist. Poiss. II. 177, 1870.

Acipenser cincinnati Duméril, Hist. Poiss. II. 229, 1870 (Ohio river at Cincinnati).

Acipenser buffalo Duméril, Hist. Poiss. II. 231, 1870 (Lake Erie).

Habitat.—Mississippi valley, Great Lakes, rivers and lakes of Northern North America.

Etymology. Lat. *rubicundus*, ruddy.

This species is found in great numbers in the Great Lakes and waters to the northward, and the rivers of the Mississippi valley, especially very abundant in the upper lakes. It is a smaller species than those of the Atlantic and has a greater number of lateral plates. They spawn early in June, in the southern end of Lake Michigan near the shore and the mouths of rivers where they remain about two weeks. These are the largest fish of the Lakes. They are taken only within comparatively shoal waters and in some of the bays, and among the islands they are very abundant. Their average length is about five feet, though it is said they have been taken of a length of 9 feet. Their food consists almost entirely of shell-fish. As an article of food they are not generally popular as their meat is too rich in the peculiar flavor of the oil of the fish. Smoking is the common way of preparing it.

The specimen examined by us was taken by H. S. Bates at Michigan City, Indiana.

5. **Acipenser brevirostrum.** Short-nosed sturgeon.

Acipenser brevirostrum Le Sueur, "Trans. Amer. Phil. Soc. 390, 1818"; Fitzinger and Heckel, Ann. Wien. Mus. 316, 1836; DeKay, New York Fauna Fish. 345, 1842. (Norfolk, Va.)

Acipenser brevirostris Storer, Synop. Fish. N. Amer. 500, 1846; Günther, Cat. Fish. Brit. Mus. VIII. 341, 1870; Jordan and Gilbert, Synop. Fish. N. Amer. 87, 1883 (copied); Jordan. Cat. Fish. N. Amer. 13, 1885.

Acipenser obtusirostris Lovetzky, "Nouv. Mém. Soc. Nat. Mus. III. 257, 1533."

Acipenser microrhynchus Duméril, Hist. Poiss. II. 164, 1870 (New York).

Acipenser lesueurii Duméril, Hist. Poiss. II. 166, 1870 (New York).

Acipenser dekayii Duméril, Hist. Poiss. II. 168, 1870 (New York).

Acipenser rostellum Duméril, Hist. Poiss. II. 173, 1870 (Probably New York).

Habitat.—Atlantic Coast United States from Cape Cod to Florida.

Etymology. Lat. *brevis*, short ; *rostrum*, snout.

The specimen examined by us was taken by Dr. Gilbert at Charleston, S. C.

6. **Acipenser transmontanus.** White sturgeon ; Oregon sturgeon.

?*Acipenser* sp. Pallas, Zoogr. Rosso-Asiat. 1811 (Aleutian Islands ; on notes).

Acipenser transmontanus Richardson, Fauna Bor. Amer. III. 278, 1836 (Columbia river) ; Girard, Pacif. R. R. Survey, 355, 1859 (Columbia river) ; Günther, Cat. Fish. Brit. Mus. VIII. 336, 1870 (California) ; Duméril, Hist. Poiss. II. 236, 1870 (copied) ; Jordan and Gilbert, Proc. U. S. Nat. Mus. 457, 1880 (Puget Sound ; Columbia river ; San Francisco) ; Jordan and Jouy, Proc. U. S. Nat. Mus. 16, 1881 (Sacramento river ; Frazer's river) ; Jordan and Gilbert, Proc. U. S. Nat. Mus. 36, 1881 (Sacramento river ; Columbia river ; Frazer's river) ; Jordan and Gilbert, Synop. Fish. N. Amer. 86, 1882 ; Jordan, Cat. Fish. N. Amer. 13, 1885.

Antaceus transmontanus Gill, Proc. Phila. Acad. Nat. Sci. 331, 1862 (name only).

?*Acipenser aleutensis* Fitzinger and Heckel, Ann. Wiener Museum, 1836 (after Pallas).

Acipenser acutirostris Ayres, Proc. Cal. Acad. Nat. Sci. 14, 1854 (San Francisco) ; Girard, Pacif. R. R. Survey, 335, 1859 (San Francisco) ; Duméril, "Nouv. Arch. Mus. III. 186, 1867 ; Duméril, Hist. Poiss. II. 243, 1870" (copied).

Antaceus acutirostris Gill, Proc. Phila. Acad. Nat. Sci. 331, 1862 (name only).

Acipenser brachyrhynchus Ayres, Proc. Cal. Acad. Nat. Sci. 15, 1854 (San Francisco) ; Duméril, "Nouv. Arch. Mus. III. 166, pl. 11, f. 1, 1867 ;" Duméril, Hist. Poiss. II. 221, 1870 (San Francisco) ; Günther, Cat. Fish. Brit. Mus. VIII. 337, 1870 (San Francisco).

Antaceus brachyrhynchus Gill, Proc. Phila. Acad. Nat. Sci. 331, 1862 (name only).

Acipenser caryi Duméril, "Nouv. Arch. Mus. III. 169, pl. 12, f. 2, 1867;" Duméril, Hist. Poiss. II. 224, 1870 (California).

Acipenser ayresii Duméril, "Nouv. Arch. Mus. III, 171, pl. 12, f. 1, 1867 ;" Duméril, Hist. Poiss. II. 226, 1870 (California).

Acipenser putnami Duméril, "Nouv. Arch. Mus. III. 178, pl. 13, f. 1, 1867 ;" Duméril, Hist. Poiss. II. 234, 1870 (San Francisco).

Habitat.—Pacific Coast of North America from British Columbia south to Monterey, ascending the Frazer's, Columbia and Sacramento rivers.

Etymology. Lat. *trans*. beyond; *montanus*, mountain.

This species is the common sturgeon on the Pacific Coast of North America. Its size and distribution are the same as that of *A. medirostris*; it is however much more abundant. They run up the larger rivers in great numbers in the spring for the purpose of spawning. It is one of the most common food fishes in the San Francisco markets, always abundant and cheap. The meat is usually smoked, and caviare is made from the eggs.

The specimens examined by us were taken by Jordan and Gilbert at San Francisco.

List of Nominal Species with Identification.

Tenable names are in Italics.

Nominal species.	*Date.*	*Identification.*
Acipenser *sturio* Linnæus	1758	A. sturio
Acipenser lichtensteini Bloch & Schneider	1801	A. sturio.
Sturio vulgaris Rafinesque	1810	A. sturio.
Acipenser sturio oxyrhynchus Mitchill	1814	A. sturio.
Acipenser oxyrhynchus Mitchill	1814	A. sturio.
Acipenser *rubicundus* Le Sueur	1818	A. rubicundus.
Acipenser *brevirostrum* Le Sueur	1818	A. brevirostrum.
Acipenser maculosus Le Sueur	1818	A. rubicundus.
Acipenser platorhynchus Rafinesque	1820	S. platyrhyn- [chus.
Acipenser serotinus Rafinesque	1820	A. rubicundus.
Acipenser ohiensis Rafinesque	1820	A. rubicundus.
Acipenser macrostomus Rafinesque	1820	A. rubicundus.
Dinectus truncatus Rafinesque	1820	A. rubicundus.
Acipenser attilus Gray	1831	A. sturio.
Acipenser cataphractus Gray	1834	S. platyrhyn- [chus.
Scaphirhynchus rafinesquii Heckel	1835	S. platyrhyn- [chus.
Acipenser alutensis Fitz. and Heck.	1836	A. transmon- [tanus.
Acipenser *transmontanus* Richardson	1836	A. transmon- [tanus.
Acipenser rupertianus Richardson	1836	A. rubicundus.
Acipenser latirostris Parnell	1838	A. sturio.
Acipenser hospitus Kröyer	1840	A. sturio.

Acipenser brevirostris Storer	1846	A. brevirostrum.
Acipenser lævis Agassiz	1850	A. rubicundus.
Acipenser carbonarius Agassiz	1850	A. rubicundus.
Acipenser rhynchæus Agassiz	1850	A. rubicundus.
Acipenser acutirostris Ayres	1854	A. transmontanus.
Acipenser *medirostris* Ayres	1854	A. medirostris.
Acipenser brachyrhynchus Ayres	1854	A. transmontanus.
Acipenser thompsoni Duméril	1856	A. sturio.
Scaphirhynchus *platyrhynchus* Baird	1858	S. platyrhynchus.
Antaceus *transmontanus* Gill	1862	A. transmontanus.
Antaceus *medirostris* Gill	1862	A. medirostris
Antaceus acutirostris Gill	1862	A. transmontanus.
Antaceus brachyrhynchus Gill	1862	A. transmontanus.
Acipenser yarrellii Duméril	1867	A. sturio.
Acipenser caryi Duméril	1867	A. transmontanus.
Acipenser ayresii Duméril	1867	A. transmontanus.
Acipenser putnami Duméril	1867	A. transmontanus.
Acipenser agassizii Duméril	1867	A. medirostris.
Acipenser alexandri Duméril	1867	A. medirostris.
Acipenser oligopeltis Duméril	1867	A. medirostris.
Acipenser copei Duméril	1870	A. rubicundus.
Acipenser liopeltis Günther	1870	A. rubicundus.
Acipenser mitchillii Duméril	1870	A. sturio.
Acipenser rauchii Duméril	1870	A. rubicundus.
Acipenser richardsonii Duméril	1870	A. rubicundus.
Acipenser anasimos Duméril	1870	A. rubicundus.
Acipenser paranasimos Duméril	1870	A. rubicundus.
Acipenser anthracinus Duméril	1870	A. rubicundus.
Acipenser kennicottii Duméril	1870	A. sturio.
Acipenser girardi Duméril	1870	A. sturio.
Acipenser macrorhynus Duméril	1870	A. sturio.

Acipenser megalaspis Duméril	1870	A. sturio.
Acipenser milberti Duméril	1870	A. sturio.
Acipenser lamarii Duméril	1870	A. rubicundus.
Acipenser atelaspis Duméril	1870	A. rubicundus.
Acipenser rafinesquii Duméril	1870	A. rubicundus.
Acipenser bairdii Duméril	1870	A. sturio.
Acipenser storeri Duméril	1870	A. sturio.
Acipenser holbrookii Duméril	1870	A. sturio.
Acipenser lecontei Duméril	1870	A. sturio.
Acipenser rosarium Duméril	1870	A. rubicundus.
Acipenser platyrhinus Duméril	1870	A. rubicundus.
Acipenser kirtlandii Duméril	1870	A. rubicundus.
Acipenser nertinianus Duméril	1870	A. rubicundus.
Acipenser microrhynchus Duméril	1870	A. brevirostrum.
Acipenser lesueurii Duméril	1870	A. brevirostrum
Acipenser dekayii Duméril	1870	A. brevirostrum.
Acipenser rostellum Duméril	1870	A. brevirostrum.
Acipenser honneymani Duméril	1870	A. rubicundus.
Acipenser cincinnati Duméril	1870	A. rubicundus
Acipenser buffalo Duméril	1870	A. rubicundus.
Acipenser anthracinus Duméril	1870	A. rubicundus.
Scaphirynchops *platyrhynchus* Gill	1876	S. platyrhyn- [chus.

A REVIEW OF THE EUROPEAN AND AMERICAN URANOSCOPIDÆ OR STAR-GAZERS.

BY PHILIP H. KIRSCH.

In the following paper, I give the synonymy of the species of *Uranoscopidæ* or Star-Gazers found in European and American waters, with an analytical key by which the genera and species may be distinguished. The specimens examined mostly belong to the Museum of the University of Indiana, nearly all of them having been collected by Dr. Jordan.

The family of *Uranoscopidæ* is here accepted as limited by Dr. Gill and by Jordan and Gilbert. It may be thus defined:

Head large, broad, partly covered with bony plates. Body elongate, conic, subcompressed, widest and usually deepest at the occiput. Body either naked or covered with very small, smooth, adherent scales, which are arranged in very oblique series running downward and backward; the scales on the belly inconspicuous or obsolete. Lateral line little developed, running high. Eyes small, on anterior and upper portion of head with vertical range. Mouth vertical, with strong and prominent mandible; teeth moderate, on jaws, vomer and palatines.

Premaxillaries freely protractile; maxillary broad, without supplemental bones, not slipping under the preorbital. Gill-openings wide, continued forwards; gill-membranes nearly separate, free from the isthmus. Pseudobranchiæ present; 6 branchiostegals; 3½ gills, a slit behind the last; no anal papilla. Spinous dorsal very short or wanting; second dorsal long. Anal and pectorals large, the latter with broad oblique bases, the lower rays rapidly shortened, most of them branched; ventrals jugular, close together, I, 5, the spine very short, innermost ray longest; caudal not forked. Air-bladder generally absent; pyloric cœca in moderate number. Carnivorous fishes living on the bottom of the shores of most warm regions.

Analysis of European and American Genera of Uranoscopidæ.

a. Spinous dorsal obsolete; no scales; head above covered with bone, except the groove of the premaxillary spine; the bony occipital plate coalescing with the orbital rims; humeral spine well developed; no distinct protuberances on top of head; no spine in front of humeral spine; two small forward directed spines in front of eye;

three small spines on lower margin of preopercle; upper lip scarcely fringed; no retractile tentacle in mouth. KATHETOSTOMA, 1.

aa. Spinous dorsal of four well developed spines; scales present.

c. Head covered above with bone except a small region between and in front of the eyes, the bony occipital plate coalescing with the orbital rims.

d. Head with spines; humeral spine well developed; one strong spine on subopercle, four smaller ones on preopercle, all directed downward; one small spine directly above and in front of humeral spine; four low, stout protuberances on top of head pointing backward; naked space between eyes extending back to posterior part of orbits; upper lip and nostrils not fringed; retractile tentacle in mouth more or less developed. URANOSCOPUS, 2.

dd. Head without spines; humeral spine obsolete; occipital region with bluntish projections; naked space between eyes extending back to near middle of orbits; lips and nostrils fringed; no retractile tentacle in mouth. ASTROSCOPUS, 3.

cc. Head above not entirely covered with bone, the occipital plate ceasing much behind the orbits; from the middle line anteriorly a Y-shaped bony process extends forward, the tips of the fork between the eyes; a trapezoidal space on either side of the Y, covered by naked skin, bounded by the Y, the eyes, the suborbitals and the occipital plate. A covered furrow behind and on the inner side of each eye terminating near front of orbits, its edges fringed. Head without spines; humeral spine obsolete; lips and nostrils fringed; no retractile tentacle in mouth. EPSILONPHORUS, 4.

KATHETOSTOMA.

Kathetostoma Günther, Cat. Fish. Brit. Mus. II. 231, 1860 (*læve*).

Type. *Uranoscopus lævis* Bloch and Schneider.

Etymology. *Káthetos*, vertical; *stóma*, mouth.

This genus includes two or three species, all but one belonging to the East Indian fauna.

Analysis of American species of Kathetostoma.

a. Head very large, its upper surface covered with coarsely granular striate bones; eye 3 in interorbital space; front of dorsal nearer tip of caudal than to snout, its base equal to distance from its anterior insertion to occipital bone, its longest ray (3d) 2 in its base; front of anal opposite front of dorsal, its base somewhat longer, its height equal to that of dorsal, its longest rays reaching to base of caudal; width of caudal base 3 in base of dorsal, its longest rays $1\frac{1}{2}$ in base of anal and but little shorter than those of pectorals; ventrals narrow, long, reaching to lower insertion of pectorals; which are broad, width of base $1\frac{1}{2}$ in longest rays, which reach to the vertical front of dorsal. Color blackish above, sides chocolate, belly yellowish covered with very small brown specks; throat white; chin and naked space on top of head black; ventrals white; pectorals black; dorsal brown, with irregularly mottled base and tipped with white; anal white anteriorly with brown specks, posteriorly darker from the greater number of specks, black blotch between 9th and 10th rays; caudal white, irregularly blotched with black. Head $2\frac{2}{3}$ in length; depth 4; D. 13; A. 13; length $4\frac{1}{2}$ inches

AVERRUNCUS, 1.

1. **Kathetostoma averruncus.**

Kathetostoma averruncus Jordan and Bollman, Proc. U. S. Nat. Mus. 1889 (Pacific Coast of U. S. of Colombia).

Habitat.—Pacific Coast of Northern South America. (8° 57′ N. 79° 31′ 30″ W.)

Etymology. Latin, a protecting deity, from a word meaning to keep off, in allusion to the defensive armature of the head. The single specimen, the type of this species, was dredged by the steamer Albatross, between Panama and the Galapagos.

URANOSCOPUS.

Uranoscopus Linnæus, Syst. Nat. I. 250, 1758 (*scaber*).
Callionymus Gronow, Syst. ed. Gray, 43, 1854 (*araneus*) (not of Linnæus).

Type. *Uranoscopus scaber* Linnæus.

Etymology. *Ouranos*, the sky; *skopós*, looking.

This genus includes some 11 species, all of them, so far as certainly known, confined to the Old World, although but one is found in Europe.

Analysis of European species of Uranoscopus.

a. Pectorals large, base two in their longest ray, which is equal in length to caudal and extends to beyond front of second dorsal; ventrals small, their length $1\frac{1}{2}$ in that of pectoral, and extending to lower insertion of that fin; spinous dorsal small, first spine four in length of base, which is four in length of second dorsal; membrane of first dorsal extending beyond and concealing the spines; second dorsal and anal equal and opposite each other, the latter reaching to base of caudal; vent midway between snout and base of caudal.

Color dark brown above, whitish below; all the darker portions of head, body and fins densely covered with minute black specks. Head 3 in length; depth about 4; D. IV–I, 13; A. 13; length 8 inches.

SCABER, 2.

2. Uranoscopus scaber. Star-gazer; Bocca in capo.

Uranoscopus scaber Linnæus, Syst. Nat. I. 250, 1758 (Mediterranean); Cuv. and Val. III. 287, 1829.

Uranoscopus mus Lacèpede, Hist. Nat. Poiss. II. 349, 1799 (Mediterranean).

Callionymus araneus Gronow, Syst. ed. Gray, 44, 1854 (Mediterranean).

Uranoscopus occidentalis Agassiz, Spix, Pisc. Brazil, 123, 1829 (Atlantic Ocean); Günther, Cat. Fish. Brit. Mus. II. 229, 1860 (West Indies).

Habitat.—Mediterranean Sea and neighboring waters.

Etymology. Lat. *scaber*, rough.

This species is generally found in shallow waters in the Mediterranean. The specimens examined by me were taken by Dr. Jordan at Venice.

The brief description given of *Uranoscopus occidentalis* by Dr. Günther agrees fully with *Uranoscopus scaber*. Agassiz's specimens were from "the Atlantic," no locality being given. As most of the collections of Spix and Martius were made in Brazil, it has been assumed that this species came from Brazil also. But the habitat needs confirmation.

ASTROSCOPUS.

Astroscopus (Brevoort MS.) Gill, Proc. Acad. Nat. Sci. Phila. 20, 1860 (*anoplus*).

Agnus Günther, Cat. Fish. Brit. Mus. II. 229, 1860 (*anoplus*).

Type. *Uranoscopus anoplus* Cuv. and Val.

Etymology. *Astron*, star; *skopéō*, to look.

This genus is close to *Uranoscopus*, differing mainly in the lack of armature to the head. But one species is known.

Analysis of species of Astroscopus.

a. Pectorals rather large, their longest ray equal in length to base of second dorsal and extending to front of that fin; ventrals equal in length to pectorals, and extending to front of that fin; the second dorsal equal to anal but its anterior insertion slightly posterior to that; anal rays reach to base of caudal; vent much nearer base of caudal than to tip of snout. Color dark brown above, yellowish below; lighter portions of body covered with small white specks; chin jet black; all the fins whitish. Head 2½ in body; depth 3¼; D. IV–I, 13; A. 13; length 2 inches. ANOPLOS, 3.

3. **Astroscopus anoplos.**

Uranoscopus anoplos Cuv. and Val., Hist. Nat. Poiss. VIII. 493, 1831 (Atlantic coast N. A., probably from Charleston); Storer, Syn. Fish. North America, 298, 1846 (copied).

Agnus anoplus Günther, Cat. Fish. Brit. Mus. II. 229, 1860 (copied).

Astroscopus anoplus Gill, Proc. Acad. Nat. Sci. Phila. 20, 1860 (no description); Gill, Cat. Fish. Eastern coast North America, 20, 1873 (name only); Jordan, Cat. Fish. North America, 118, 1885; Jordan, Proc. U. S. Nat. Mus. 608, 1886; Jordan, Manual Vertebrates of U. S., ed. V. 156, 1888.

Habitat.—South Atlantic coast of the United States from Long Island to Key West.

Etymology. *Anoplos*, unarmed.

This species seems to be rather rare on our coast, but few specimens having been taken, and these of small size, 2 to 5 inches long. The specimen examined by me is 1¼ inches long. It was taken by Dr. Jordan at Key West.

UPSILONPHORUS.

Upsilonphorus Gill, Proc. Acad. Nat. Sci. Phila. 113, 1861 (*Y-graecum*).

Type. *Uranoscopus Y-graecum* Cuv. and Val.

Etymology. y, *psilon*; *phorós*, Y-bearing.

This genus is well distinguished from *Astroscopus* by the peculiar armature of the top of the head. Two species are known, both of the New World.

Naked space between forks of the Y on top of head long and narrow, shorter than the vertical limb of the Y; no distinct spines before eye; white spots on body distinct, each surrounded by a dark ring; eye 3–3½ in interorbital space; base of the two dorsals greater in length than distance from front of first dorsal to tip of snout; base of first dorsal twice length of its first spine; first spine equals in length the third, and half that of the second, and slightly exceeds the fourth; base of second dorsal equals twice length of its longest ray; caudal equal in length to ventrals; pectorals longer than ventrals and extending to middle of second dorsal. Color dark brown above, white below; upper parts covered with small roundish white spots, each surrounded by a dark ring; lower jaw and labial fringes similarly spotted; spinous dorsal black, white posteriorly;

anterior portion of second dorsal brown; central portion with a horizontal white and black band, and tipped with white; posterior portion with two vertical black stripes and a white one between them; caudal black, tipped with white, with two longitudinal white stripes, its upper and lower edges narrowly white; anal white at base and tip, with a black median band half the depth of fin, darkest posteriorly, with last ray white; pectorals brown with a black band below, and the lower edge white; ventrals white, with a black longitudinal streak near tip and center of fin. Head $2\frac{3}{4}$ in body; depth $3\frac{1}{3}$; D. IV–I, 13; A. 13; length 12 inches.

Y-GRAECUM.

4. **Upsilonphorus Y-graecum.**

Uranoscopus Y-graecum Cuv. and Val., Hist. Nat. Poiss. III. 308, 1829 (origin unknown); Günther, Cat. Fish. Brit. Mus. II. 229, 1860 (Caribbean Sea).

Upsilonphorus Y-graecum Gill, Proc. Ac. Nat. Sci. Phila. 113, 1861 (Caribbean Sea); Jordan, Cat. Fish. North America, 118, 1885; Jordan, Proc. U. S. Nat. Mus. 28, 1886 (Beaufort, N. C.); Jordan, Manual Vertebrates U. S. Ed. V. 156, 1888.

Astroscopus Y-graecum Bean, Proc. U. S. Nat. Mus. 58, 1879 (Saint John's River, Fla., and Matanzas River Inlet, Fla.); Gill, Proc. Ac. Nat. Sci. Phila. 21, 1860 (name only); Jordan and Gilbert, Synop. Fish. North America, 628, 1883.

Habitat.—Atlantic Coast of North America in sandy bays, from Cape Hatteras to Surinam.

Etymology. Lat. *Y-graecum*, the letter Y.

Specimens are in the National Museum from Matanzas River Inlet, Fla., and Saint John's River Fla.

This species is rather common along the coasts of the South Atlantic and especially the Gulf States, in sandy bays, mostly in shallow water. The specimens examined by me are from Pensacola, and Beaufort, N. C.

Naked space between forks of Y on top of head short and broad, but longer than the vertical limb of the Y, which is very short; two distinct spinules directed forward before eye; white spots on body very small and irregular without dark rings; eye $5\frac{1}{2}$ in interorbital space; base of the dorsals equal in length to the distance from front of first dorsal to tip of snout; base of first dorsal twice length of its longest spine; first spine equal to the second in length, and three times the length of the last; length of middle caudal rays a little less than that of ventrals; pectorals slightly longer than ventrals, 3½ in total length and extend to 5th anal ray. Color of upper parts of body and lower jaw bright chocolate; belly and throat white; darker portions covered with numerous circular spots much lighter than ground color; membrane of first dorsal black; second dorsal white with three irregular bands of dull black obliquely across it; the caudal with three parallel bands of blackish brown. the middle of which appears to be the continuation of a variable longitudinal band on the center of each side; the anal has a variable band of dull brown, darker upon the posterior termination. Depth 4 in. length in young and 3¼ times in adult; D. IV or V—13 or 14; V. 6. GUTTATUS.

5. Upsilonphorus guttatus.

Astroscopus guttatus Abbott, Proc. Ac. Nat. Sci. Phila. 365, 1860 (Cape May, N. J.)

Upsilonphorus guttatus Bean, Proc. U. S. Nat. Mus. 60, 1879 (Tompkinsville, N. Y., and Norfolk, Va., and other localities).

Astroscopus anoplus Bean, Proc. U. S. Nat. Mus. 58, 1879 (Tompkinsville, N. Y., and Norfolk, Va.); Jordan, Cat. Fish. North America, 118, 1885 (Young); Bean, Bull. U. S. Fish. Com. 130, 131 and 136, 1888. (Somers Point, N. J.)

Upsilonphorus guttatus Gill, Proc. Ac. Nat. Sci. Phila. 113, 1861.

Habitat.—Atlantic Coast of United States from Long Island to Norfolk, Va.

Specimens are in the National Museum from Tompkinsville, N. Y., and Norfolk, Va.

This species reaches the same size as the preceding. The distinctive characters pointed out by Dr. Jordan in Synopsis Fishes N. A. 941, 1883, hold good for the adult as well as for the young. That the two species are distinct is evident from comparison of specimens in the National Museum, which Dr. Jordan made at my request. In the National Museum specimens of the two species equally large in size are preserved. The localities recorded for *U. guttatus* are all to the north of Cape Hatteras; those for *U. y-graecum* all to the south.

Dr. Jordan says: "In *U. guttatus* the pale spots are much smaller, less sharply defined, and occupy a smaller area than in *U. y-graecum*; the lower part of the head has two black blotches in both species; the second dorsal, anal, and ventrals are nearly or quite plain. The naked area behind each eye is [in *U. guttatus*] lunate, its length barely twice that of the snout; the bony V-shaped plate is short and broad, concave on the median line, and forked for about half its length, the posterior undivided portion broader than long; the bony bridge across the occiput but little shorter than the part of the head which precedes it. In *U. y-graecum* the naked area is trapezoidal, longer than broad, and about 4 times the length of the snout; the Y is forked for more than half its length, its undivided part more than twice as long as broad, and not concave; the occipital plate is not half as long as the part of the head which precedes it."

According to Dr. J. A. Henshall, the naked area on top of the head is the seat of electric power in life. This interesting statement needs verification.

Recapitulation.

The following is the list of the genera and species of the family of star-gazers (*Uranoscopidae*) recognized in this paper as occurring in European and American waters:

1. **Kathetostoma** Günther.
   1. *Kathetostoma averruncus* Jordan and Bollman.
2. **Uranoscopus** Linnæus.
   2. *Uranoscopus scaber* Linnæus.
3. **Astroscopus** Brevoort.
   3. *Astroscopus anoplus.* (Cuv. and Val.)
4. **Upsilonphorus** Gill.
   4. *Upsilonphorus Y-graecum.* (Cuv. and Val.)
   5. *Upsilonphorus guttatus.* (Abbott.)

NOTES ON THE FOOD OF BIRDS.

BY F. C. BAKER.

The lack of satisfactory information upon the food of the birds of the United States, abundantly justifies additional investigation. The value of exact knowledge of food in the development of the law of natural selection, as well as to the agriculturist, is obvious. The facts contained in the following article are the result of observations made in the field during a period of four months (Jan., Feb., March and April, 1889), at Micco, Brevard Co., Florida, together with careful examinations in the laboratory. Upwards of three hundred birds have been dissected and the contents of their stomachs carefully noted. It will be seen that a number of birds subsist mainly upon mollusks, while others feed entirely upon seeds and berries, or the vegetables of the farmer's garden; while all are to some extent insectivorous. A discovery of interest was the presence of several specimens of *Pupa rupicola* Say, in the stomach of the catbird, *Galeoscoptes carolinensis*. My observations upon the Brown Pelican, *Pelecanus fuscus*, bring to light some obscure points in regard to the food of that bird.

Larus argentatus Brünn.

The four specimens dissected all contained fish.

Sterna maxima Bodd.

Fifteen specimens dissected contained small specimens of *Squalius gibbosus*. A single individual contained forty fishes of an average length of three inches.

Anhinga anhinga Linn.

Five specimens dissected. Three males contained each one *Squalius gibbosus*, fourteen inches in length. Two females contained a full crop of small fishes. Before the young of the species leave the nest, a parasitic worm is found in their stomachs, which works its way to the brain and thrives there in clusters of ten or more. Nine-tenths of both old and young are thus infested, and yet are in apparently good health.

Phalacrocorax dilophus floridanus, Aud.

Six specimens dissected all contained *Squalius gibbosus*.

Pelecanus fuscus Linn.

A large number of these birds were dissected and all contained the remains of *Squalius gibbosus*. It has been stated by certain ornithologists that the Pelican will not select for food a fish over eight inches in length. The contents of the crops of four Pelicans were as follows:—No. 1, contained three fishes of 14, 16 and 12 inches respectively. No. 2, contained five fishes of 8, 10, 7, 6, and 3 inches respectively. No. 3, contained seventy-five fishes of an average length of three inches. No. 4, contained two fishes 12 and 10 inches in length.

It will therefore be seen that the Pelican uses for food fishes from three to sixteen inches in length, ten to fourteen inches being an ordinary size for them. That these birds carry in their pouches a number of fishes for a considerable distance is certain, the writer having seen several instances of the kind.

Anas fulvigula Ridgw.

Two specimens dissected contained mollusks, the shells of *Truncatella subcylindrica* Gray, and *Odostomia impressa* Say, being quite distinguishable.

Anas discors Linn.

Twenty specimens dissected contained shells of *Amnicola floridana* Frau. and *Truncatella subcylindrica* Gray.

Spatula clypeata Linn.

Ten specimens dissected all contained mollusks, shells of *Rissoina pulchra* Ad. being the most prominent.

Dafila acuta Linn.

A large number dissected all contained mollusks.

Aythya affinis Eyt.

Eight specimens dissected all contained mollusks, the most important of which was *Rissoina cancellata* Phil.

Botaurus lentiginosus Montag.

The food of this bird consists principally of *Rana pipiens*, and *Hyla viridis*.

Ardea herodias Linn.

The food of the Ardeidæ as represented by this species and *A egretta* Gml., *A. candidissima* Gml., *A. tricolorruficollis* Gosse, *A. caerulea Linn* and *A. virescens* Linn., seems to be as follows:—*Rana* *pipiens*, *Coluber quadrivittatus*, *Squalius gibbosus* and *Bufo lentiginosus*.

Grus mexicana Mull.

The bill of fare of this bird is quite voluminous, consisting of *Rana pipiens* , *Leptophus aestivus*, *Bufo lentiginosus* and *Lygosoma lateralis*.

Calidris arenaria Linn.

Contained mollusks, *Odostomia impressa* Say seeming to be the principal article of food.

Symphemia semipalmata Gmelin.

Shells of *Odostomia impressa* Say and *Gemma gemma* Totten were found in the crops of these birds.

Columbigallina passerina Linn.

These birds all contained seed and other vegetable remains.

Cathartes aura Linn.

Contained carrion.

Rostramus sociabilis Vieill.

The food of this bird consists entirely of the animal of *Pomus depressus* Say.

Buteo lineatus alleni Ridgw.

The bill of fare of this bird is unusually varied, consisting of the following:—*Sciurus carolinensis*, *Sturnella magna mexicana*, *Rana pipiens*, also the remains of coleopterous and neuropterous insects.

Falco sparverius Linn.

Two specimens dissected contained the following:—*Dendroica coronata*, *Sayornis phoebe*, *Hyla viridis* and a number of coleopterous insects.

Syrnium nebulosum alleni Ridgw.

It would be useless to give a list of the many animals found in the stomach of this bird. The remains of birds, mammals, reptiles and insects were present in the various stomachs examined.

Dryobates pubescens Linn.

The following coleopterous insects were found in the stomachs examined:—*Derobranchus brevicollis* and *Bostrichus longicornis*, together with the caterpillars of *Papilio asterias*, *P. troilus* and *Callidryas sennae*.

Sphyrapicus varius Linn.

The food of this bird consists of coleopterous and lepidopterous insects, together with various seeds and other vegetable matter. The following Coleoptera were dissected from their stomachs:—*Zaplous hubbardi*, *Achrysones surinamum* and *Hypotrichia spissipes*.

Ceophloeus pileatus Linn.

The food of this bird consists of the larvæ of beetles. Examinations brought to light several species of insects among which were *Derobranchus brevicollis* and *Hypotrichia spissipes*. A few small spiders which live under the bark of trees were also noticed.

Melanerpes carolinensis Linn.

The food of this woodpecker consists of insects. The larvæ of coleopterous insects, the small spiders and beetles constituting the chief part of its diet. These birds were frequently observed picking at oranges.

Colaptes auratus Linn.

This bird appears to be almost entirely insectivorous, the following species having been found in its stomach; Caterpillars of *Papilio asterias*, *P. palamedes* and *Apatura celtis*. The berries of *Chamærops palmetto* and seed of *C. serrulata* were also found.

Tyrannus tyrannus Linn.

Dissections of this bird brought to light evidences of insectivorous food. The Honey Bee is also eaten by it.

Aphelocoma floridana Bartr.

Remains of *Papilio asterias* and *P. troilus* among Lepidoptera, and *Derobranchus brevicollis* and *Zaplous hubbardi* among Coleoptera were found in the stomach of this bird.

Corvus americanus floridanus Aud.

The remains of *Rana pipiens*, *Hyla viridis*, *Hypotrichia spissipes* and *Zagymnus clerinus* were found in the crop of this bird.

Agelaius phoeniceus Linn.

The remains of coleopterous and lepidopterous insects together with seeds was dissected from its crop.

Sturnella magna mexicana Scl.

From the crop of this bird were dissected the remains of both insects and seed. Only one of the many specimens of insects dissected from its stomach was in a perfect enough condition to identify. This was the larvæ of *Papilio troilus*.

Quiscalus quiscula aglæus Baird.

The food of this bird consists wholly of the berries of *Chamærops palmetto.*

Quiscalus major Vieill.

The remains of a few coleopterous insects together with the berries of *Chamærops palmetto* were dissected from the stomach of this bird.

Mimus polyglottus Linn.

These birds are exceedingly fond of the vegetables in the farmer's garden, and they were often noticed in the act of pecking at the ripe fruit. They also devour numbers of insects.

Cardinalis cardinalis Linn.

Berries of *Chamærops palmetto* and *C. serrulata*, together with a few spiders, were dissected from this bird.

Mnio tilta varia Linn.

Compsothlypis americana Linn.

Dendroica coronata Linn.

Geothlypis trichus Linn.

The food of these birds appears from dissections to be principally of an insectivorous character. Caterpillars of *Papilio asterias*, *Pieris ilariæ*, and *larvæ* of *Derobranchus brevicollis* were found in their stomachs.

Galcoscoptes carolinensis Linn.

Specimens of the following were found in the stomach of this bird: *Pupa rupicola*, *P. modica*, *Derobranchus brevicollis*, *Zaphous*, *Hubbardi*, and *Hypotrichia spissipes*. The seed of *Chamærops serrulata* were also detected.

REMARKS UPON THE ROUND-TAILED MUSKRAT, NEOFIBER ALLENI, TRUE.

BY FRANK C. BAKER.

The original description of this animal appeared in Science, IV, No. 75, 1884, p. 34. This was followed by one of a more detailed character in the Proceedings of the United States National Museum, VII, 1884, p. 170. The habits and distribution of this mammal have been, until recently, matters of conjecture; but, thanks to Mr. Frank M. Chapman, we now have a number of interesting facts regarding both its habits and distribution.

The original place of capture by Dr. Whittfield, was at Georgiana, which is situated near the southern extremity of Merritts Island in Eastern Florida. Its present known locality is thirty miles south on the peninsula, opposite Micco, at "Oak Lodge," the residence of Mr. C. F. Latham. At this point the peninsula is about three-quarters of a mile wide, with a fringe of mangrove-bordered islands on the west shore. Upon the river side there are large savannas, caused by the water of the river making frequent inroads into the land, and it is upon these savannas that *Neofiber alleni* may be found in large numbers. The vegetation of the savannas consists largely of *Rhizophora mangle* and *Avicennia nitida* (red and black mangrove) and "sedge," *Borrichia frutescens*, with occasionally black or "yellow mangroves" scattered irregularly over the entire surface of the savanna. The latter are also covered with grass to a height of two or three feet. It is of this grass that *Neofiber* constructs its nest, placing it in hollow stumps, around the trunks of the "yellow mangrove," or in the open savannas. The nests when placed in a hollow are of no particular shape, seeming almost as if thrown together to fill up the depression, but when placed in the open, or about the foot of the yellow mangrove, they are then elegant pieces of animal architecture, being of a pyriform shape, from ten to twenty inches in height and nearly as large in their greatest diameter. It was not at all unusual to see from ten to fifteen nests from one point, but it is not probable that all of these were inhabited. The nests are provided with two openings, situated invariably at opposite sides leading from the single chamber within and connecting with two under-ground passageways leading in opposite directions. These runways are constructed just beneath the thick, matted grass and they not infrequently extend for a considerable distance before emerging from the ground. The runways as a rule, have their exits upon the edge of some neighboring pond. Here the animal finds the succulent grass upon which it feeds, and which grows to a height of three or four feet in water half as deep. To procure the best portions of the grass the Neofiber constructs a platform of large sticks, upon which it sits and feeds at its leisure. The largest platform observed measured ten by seven inches. In all my many trips upon the water, by night, both with and without a light, I never saw *Neofiber* swimming. It is probably, therefore, not much given to nocturnal ramblings.

Mr. Chapman says of the habits of this animal:—"It is probable that *Neofiber* is much less aquatic than the last-named species (the common muskrat, *Fiber zebethicus*), a fact which would largely account for the differences observed in their habits. That *Neofiber* is quite at home in the water, however, was clearly shown by the actions of a captured individual, which, placed in a tub of water, swam and dived readily; in swimming using the tail in a peculiar gyratory manner, the tip describing circles."

After the departure of Mr. Chapman from "Oak Lodge," I spent four weeks in trapping this animal, and succeeded in catching two specimens, one of which left me nothing but his foot as a remembrance of the occasion; but the other was obtained alive and is now in my private collection. This animal when caught and placed in the bottom of my boat, made frequent attempts to escape by crawling over the side. That he is not cowardly when in captivity was shown by the ferocious manner in which he attacked my bare feet when I chanced to come in his way. Mr. Chapman's statements regarding the action of the tail in swimming were corroborated. I spent an entire morning in studying the nests and in following out numerous runways. One of these I found to extend for a distance of fifty feet and to have its exit in a pond near by. The course of this runway somewhat resembled the curves of a snake when in motion.

The description and measurements of the animal in my possession are as follows:

Neofiber alleni True.

Above seal-brown; below silvery-white, with a mixture of rufous; sides seal-brown, shading to a rufescent tinge, with here and there a few silvery hairs scattered about; forehead and tip of nose black; tail of a rufescent tinge mixed with black. Adult male.

Measurement of skin (in millimeters).

Total length,	325
Tail,	126
Hind foot (without claws),	36
Middle toe of fore foot (without claw),	7
Middle toe of hind foot (without claw),	9
Longest claw of fore foot,	5
Longest claw of hind foot,	6

Measurements of skull (in millimeters).

Total length,	47
Greatest width,	28
Length of nasals,	9
Length of tooth row,	10
Front edge of first molar to posterior margin of incisor,	15
Greatest width of muzzle,	7
Width of interorbital bridge,	5
Center of occipital crest to line of hinder margin of orbits,	18

NOTES ON THE ANATOMY OF PHOLAS (BARNEA) COSTATA LINNE, AND ZIRPHÆA CRISPATA LINNE.

BY W. H. DALL.

In *P. costata* the mantle is entirely closed, except for the passage of the foot. The siphons of the specimen (contracted in alcohol) combined in a single envelope with distinct terminal orifices, are little shorter than the whole of the rest of the body; their surface is finely circularly wrinkled, they have no epidermidal coat and no terminal coriaceous appendages. The papillæ around the two orifices are small and inconspicuous. The mantle margin is simple; the median line of the connective tissue joining its edges is marked off by a pair of not very prominent raphes. The aperture for the foot is oval, about one quarter as long as the shell. About it is a smooth, thick membrane extending laterally to a raised papillose ridge, the anterior prolongation of either raphe, which separates it by a narrow space from the much thinner simple margin of the mantle, which is continuous with the epidermis. The tissue of which this encircling membrane is composed is thick; within the aperture, extending a little behind it, on each side is a sort of curtain whose office apparently might be to close around the foot and prevent the influx of sand or mud. The anterior ends of these curtains do not reach as far forward (by a distance about equal to a third of their whole length) as the anterior commissure of the pedal opening. On opening the mantle-cavity we are first struck by the immense size of the labial palps: the anterior or external palpus is adnate throughout the greater part of its extent upon the inner surface of the mantle; only a small anterior border and its lateral tips being free. It is radiately striate, with transverse close-set lamellæ on its free margin. The lower or posterior palpus is very thick and cellular, with a lamellar gill-like surface internally, but smooth on its outer face. It is produced laterally into long slender points which extend backward further than the pedal opening. It is not muscular, at least to any great extent, and is supported by the apophyses proceeding from under the beaks of the shell; these processes are buried in its substance, though their distal margins also penetrate the visceral mass internally for a short distance beyond the palpi. The foot may be said to form the ventral face of the whole visceral mass; it is flattened, laterally carinated and terminates behind in an acute free tip near the siphonal opening. Its margins are smooth and simple. Opposite the pedal opening a part of the foot is produced and thickened, anteriorly sharp edged, rounded behind, and having a spongy sole with a small deep (glandular?) sinus near its anterior end; this portion some observers would probably regard as constituting the whole foot, but to me the view that it represents something analogous to the pedal disk of *Pecten*, seems more natural. In the sinus above the posterior end of the foot (as above defined) and in the median line, is a slender subcylindrical process (about 5·0 mm. long as contracted in spirits) probably a sensory organ like that of *Yoldia*. Directly behind this is the atrium of the incurrent siphon, a small chamber hermetically roofed by the branchia which are united by a thin membrane so as to entirely cut off the branchial from the anal chamber. This membrane is continuous with, or firmly attached to, the siphonal septum. Directly behind the chamber the passage-way or tube of the siphon contracts, though there seems to be no curtain valve. The branchia terminate at the anterior end of the siphonal septum. The gills fall in two double lamellæ on each side. The inner gill is a simple elongated flattened sac, the outer one has its inner wall dependent, then, at the distal edge, folded back upon itself and continued upward, dorsally, beyond the point of starting, so that the free edge forms a narrow "appendix." The viscera present no special points of interest. There is a large "hyaline stylet" which is contained in a larger chamber extending nearly to the front end of the foot. The other end of the stylet is attenuated, sharply bent, and projects into the cavity of the stomach. The visceral mass is large, the intestine much convoluted, the anus projecting, large, involute and cupshaped, constricted behind the "cup." The anterior adductor is normal but feeble; the muscle passes from the reflected shell margin in one side straight across to the other. The posterior adductor is oval in section and considerably stronger. In the right valve is a slender, prominent, compressed fossette carrying a small thin, internal cartilage, which is attached to the opposite valve upon a small sharp not-excavated shelly process. This remnant of the original cartilage may assist in keeping the valves attached to one another, though it is very feeble, but it has wholly lost its original function of an elastic cushion to prevent the too sudden or rude closing of the valves. It is doubtful if the thin shred of horny epidermis behind the beaks in this species is a remnant of the original ligament or a mere epidermal extension

The length of the contracted specimen examined was 270·0 mm. It was obtained on the Florida coast.

Very different in some particulars is the macroscopic anatomy of *Zirphæa crispata* of which a specimen, measuring in its contracted state 260.0 mm., is before me. It was obtained by Dr. R. E. C. Stearns, in Puget Sound, Washington Territory. In this species the siphonal tube is covered with a dehiscent thin papery epidermis, as in *Mya*. and is about three times as long as the rest of the animal, proportionally thicker, more cylindrical and consequently more bluntly pointed than in *P. costata*. There are no important differences in the pedal opening where the curtain is close to, if not coalescent with, the margin of the mantle. The ventral portion of the visceral mass is not flattened and marginated, as in *P. costatus*, but is produced into a point behind. Above this point there is no sensory appendicle. The palpi are much as in *P. costatus* and similarly supported by the umbonal apophysis on each side, but the lower or inner palpus is much less fleshy. The gills join behind the body but the junction is not floored across and hence there is no separation of the anal and branchial chambers, nor does the siphonal septum make its appearance where the siphon begins. On the contrary the siphon incloses but a single tube and only at about the distal third of its length does any division or partition appear. All this distance the somewhat attenuated gills extend, nearly filling the tube, and united at their bases. The gills on each side consist of a W-shaped pair of sacs, but the outer stem of the W is not produced into an appendicular lamella as in *P. costatus*. The anus is thin-edged with a valvular infolding of the edge but less cup-shaped than in *P. costatus*. Following the line which would have been taken by the siphonal septum, had it existed, are two double-edged, little-elevated ridges. It is probable that the stem of the gills so expanded in life as to conduct the effete products of the intestine to the anal tube of the siphon without allowing them to come in contact with the respiratory face of the gills. Taken as a whole *Zirphæa* seems more modified than *Pholas* and shows fewer traces of the *Myacean* type from which both are probably descended.

I have not found a description of the soft parts of these two species, after some search in the text books, and so have thought it well to put them on record.

ON THE ANATOMY OF AEROPE AND ZINGIS.

BY H. A. PILSBRY.

I am indebted to Mr. John Ponsonby of London, for alcoholic specimens of a number of South African land-mollusks from which the following anatomical notes are drawn.

AEROPE Albers.

The genus *Aerope* was founded on purely conchological characters by Albers and classed with the Helices, between *Microphysa* and *Pella*.[1]

Mörch, in 1865, having dissected a specimen of the type and only species of the genus, *H. caffra* Fér., placed it in the *Agnatha*,[2] commenting upon the enormous size of the radula, with subulate, elongated teeth disposed in converging lines. From an examination of the animal of *Helix knysnaënsis* of Pfeiffer, I am strongly inclined to refer it to *Aerope*. My specimens having been in strong spirit are much contracted, so that the following description is necessarily imperfect.

Aerope knysnaënsis Pfr. (Pl. ix, figs. A, B, C, D).

The shell is thin but strong, somewhat translucent, yellow, more or less deeply tinged with green. Its surface is very bright and polished, rather coarsely obliquely irregularly striate. There is considerable variation in the contour of these shells, my figure D representing an extremely elevated form.[3]

The foot (Pl. ix, figure J) is rather short, truncated anteriorly and a trifle produced at the antero-lateral angles. The sole is (in my contracted specimens) transversely wrinkled, and although there is no division into longitudinal tracts, the central part is lighter colored. There are no furrows above the lateral margins, nor is there a posterior mucous pore. The upper surface is coarsely granular.

The buccal mass (Pl. ix, fig. J, *b*.) is almost as long as the foot; longer than in any genus with which I am acquainted. The radula is correspondingly elongated. The formula of teeth is about 27–1–

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[1] Die Heliceen, 2d edition, p. 83. Type, *H. caffra* Fér.

[2] Journal de Conchyliologie, 1865, p. 395. Mörch says: "J'ai eu occasion d'examiner un animal desséché, dans lequel j'ai pu constater le présence d'un appareil lingual relativement colossal, pourvu de dents subulées très-longues, et disposées en lignes convergentes."

[3] See Pfeiffer's description, Monographia, i, p. 84. The figures in the 'Conchylien Cabinet' are very unsatisfactory.

27. The rhachidian tooth (fig. E, *r*) is small, narrow, subulate, with well-developed cusp. Its base differs in form from the corresponding part in *Streptaxidæ, Oleacinidæ, or Selenitidæ*, being produced into two slender diverging branches. The lateral teeth are all of purely 'aculeate' form, and increase in size from the first to the twelfth, which is enormously developed. The teeth lying outside of the twelfth are apparently functionless; they are minute, and decrease in size rapidly toward the outer edge of the radula. All of the teeth have distinct basal-plates. The cusps seem simply sabre-shaped when lying in a natural position; in figure F, I have drawn the third, fourth and fifth teeth seen partly in profile. The affinities of the genus seem to be with *Rhytida*, judging from the characters of the radula, differing from that genus in the retention of a well-developed rhachidian tooth.* A complete half-row of teeth is shown in figure E.

The genitalia (Pl. ix, fig. G) present no characters unusual in the *Agnatha*, bearing a closer resemblance to those of *Glandina* than to any other form known to me. Like *Glandina* the penis is rather slender, the vas deferens inserted at its apex, and forming a continuation of the former organ. The ovotestis is formed of a compact mass of club-shaped cœcæ about thirty-five in number. The hermaphrodite duct is considerably convoluted and short between the ovotestis and the albumen gland. Its lower portion ("vagina") is convoluted or twisted several times upon itself. The duct of the spermatheca (again as in *Glandina*) is very long, inserted high upon the oviduct, and terminates in a small oval receptaculum seminis. The genital orifice is very near the head.

ZINGIS, von Martens.

Zingis was proposed for a South African Naninoid species with the following characters: "shell heliciform with simple peristome; hinder extremity of the foot with mucous pore and a little prominence above it; jaw smooth, with median projection; marginal teeth of the radula bicuspidate." Type, *Z. radiolata* Mart., from near

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* See Hutton, Trans. New Zealand Institute, xvi, p. 167, pl. 10, figs. S, R, Q. for dentition of *Rhytida*. Also Binney, Annals N. Y. Acad. Sciences iii, p. 82, pl. xvii, fig L.

In the form of the central tooth, *Aerope Knysnaensis* seems to be nearest to certain species of *Glandina*. See Fischer et Crosse, Moll. Mex. et l'Amer. Cent., pl. 4, fig. 10 (*G. algira*). Other species of *Glandina* have simply a narrow basal plate, without cusp. From all *Streptaxidæ*, *Aerope* differs in possessing distinct basal plates to all of the teeth.

Zanzibar. I find that a number of species referred by authors to Albers' group *Pella* belong to *Zingis* or its immediate neighborhood. *Pella* of Albers, Pfeiffer, Tryon and others, is a heterogeneous group, composed of widely dissimilar elements. It cannot be properly characterized until the anatomy of *H. bisculpta* Benson, its type, is known. Of its other species, *H. raviplicata* Bens. [2] belongs to true Helix; *H. verrucosa* Krauss, seems to be a *Rhytida*; *H. knysnaënsis* Pfr. belongs to *Aerope*; *H. natalensis* Pfr. and a number of other species to *Zingis*.

It is likely that *Zingis* will be found to contain a number of African species usually referred to *Vitrina*, such as *V. pöppigi* Mke., *cornea* Pfr., *natalensis* Pfr., *rüppeliana* Pfr., *transvaalensis* Craven; as well as a portion of the forms included by authors in *Pella*.

Ariophanta (Zingis) natalensis Pfr. (Pl. ix, figs. H, I.)

The shells of my specimens correspond with Pfeiffer's figures and description. [4] The shell is so fragile that I found it almost impossible to remove the animal (hardened in spirit) without breaking it. The foot (pl. ix, fig. I) is rather narrow and long, the sole indistinctly longitudinally tripartite. Above its lateral margins are well-defined longitudinal furrows. The mucous pore is subtriangular, and there is a short horn above it.

The radula (pl. ix, fig. H) has teeth of similar form to those figured by von Martens for *Zingis radiolata*, so far as I can judge from his figures, which do not show the form of the basal plates of the marginal teeth. The rhachidian plate has three cusps with strongly reflected cutting-points. The lateral teeth are similar except that the inner cusp is suppressed. They number nine on each side. The transition to marginals is formed by the elevation of the outer cusp upon the side of the principal one, as is usual throughout *Ariophanta* ('*Nanina*'). The marginal teeth are very numerous, close-set, and are all of the form shown in figure H, even to the tiny outermost ones.

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[1] Monatsb. K. p. Akad. Wissenschaften zu Berlin, 1878, p. 290; and Zool. Record, 1878, Moll, p. 63.

[2] Binney, Ann. N. Y. Acad. Sci., iii, p. 89.

[3] Binney, l. c. p. 82.

[4] Monographia Heliceorum, i, p. 29; Conchylien Cabinet, Helix, pl. 29, figs. 30–32.

ORCADELLA OPERCULATA Wing., A NEW MYXOMYCETE.

BY HAROLD WINGATE.

This curious minute plant presents anatomical characteristics which lead me to propose a new family of the Myxomycetes, and which, in Dr. Rostafinski's classification, would come under Order IV, *Anemeae*, and after Family 13, *Clathroptychiaceae*.

ORCADELLACEAE, fam. nov.

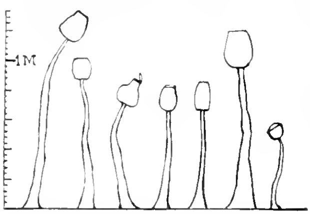
Sporangia without columella or capillitium, and the upper part of the coarse sporangium wall replaced by a delicate membrane having a defined outline.

ORCADELLA, gen. nov.

Sporangia with coarse stipes; sporangium wall likewise coarse, but at the top of the sporangium replaced by a delicate membrane which forms a more or less flattened deciduous lid.

Orcadella operculata Wing., sp. nov.

Sporangia stipitate, without columella or capillitium, very variable in form, barrel-shaped, urn-shaped, vase-shaped, jar-shaped, ovoid or nearly globose, or all varieties appearing in one small group; running from M. 0·05 to M. 0·25 in diameter by M. 0·1 to M. 0·3 in length. Stipe slightly tapering, erect or bent, blackish, rough and coarse from deposits of plasmodic refuse; very variable in height, from M. 0·375 to M. 1·25. Sporangium wall likewise coarse, blackish, containing deposits of plasmodic refuse, but at the top part of the sporangium replaced by a delicate, yellowish, iridescent, lustrous or vernicose membrane which forms a flat or slightly convex, circular deciduous lid, sometimes smooth, sometimes reticulately wrinkled. Mass of spores yellowish. Individual spores almost colorless, globose or irregularly roundish, smooth 8–11 mill. in diameter.



On the trunks of living red-oak trees (*Quercus rubra*).

Fairmount Park and Chestnut Hill, Philada., and also Maine (Harvey). Type in Herb. Acad. Nat. Sci. Philada.

This plant has been very common this year in Fairmount Park on living red-oak trees, owing to the unusual amount of rain. It generally grows in the fissures of the bark, where it is extremely difficult to detect except in the sunlight; but having found it, when the membranaceous lid has a golden or coppery metallic luster, the plant may readily be determined in the sunlight in the field with a hand-lens, minute though the sporangium may be. This lid generally dehisces and may occasionally be seen hanging to one side of the sporangium by a mere point; rarely it bursts in the center leaving a lacerated fringe around the edge of the cup. When the plants are found quite old and weather-beaten the cup frequently has a regular, well-defined circular edge, but oftener it is collapsed. The sporangium wall is often quite thin at the base, sometimes longitudinally wrinkled, and under the microscope appears to be covered with minute granulations, regularly distributed, not unlike the manner of warting of the spores of many species. The middle portion has the deposits of plasmodic refuse. The accompanying cut gives the outlines of the various forms of sporangium and stipe. The plant has frequently been found associated with *Orthotrichia microcephala* Wing., and enough of each was gathered to send to Mr. J. B. Ellis for his N. A. F. Consequently an occasional sporangium of *Orcadella operculata* may be found on the bark of the specimen of *Orthotrichia microcephala* and vice versa.

This family seems to bridge, to a certain extent, the gap between Rostafinski's orders *Anemeae* and *Heterodermeae*, as we here have a stage between the uniform wall of *Licea*, *Tubulina*, etc., and the lacerate upper wall of some species of *Cribraria* where the receptacle is strongly developed and covered with minute granulations. The epispore seems to be absolutely without thickenings even under very high magnification.

AUGUST 6.

Mr. CHARLES MORRIS in the chair.

Thirteen persons present.

AUGUST 13.

Mr. THOMAS MEEHAN, Vice-President, in the chair.

Nine persons present.

AUGUST 20.

Mr. CHARLES MORRIS in the chair.

Eleven persons present.

AUGUST 27.

Mr. CHARLES MORRIS in the chair.

Eight persons present.

SEPTEMBER 3.

Mr. ISAAC C. MARTINDALE in the chair.

Six persons present.

The following papers were presented for publication:—

"Lower Carbonic Gasteropoda from Burlington, Iowa." By Charles R. Keyes.

"Sphaerodoma: a Genus of Fossil Gasteropods." By Charles R. Keyes.

"The American Species of Polyphemopsis." By Charles R. Keyes.

SEPTEMBER 17.

Mr. CHARLES MORRIS in the chair.

Six persons present.

A paper entitled "Orcadella operculata, Wing., a new Myxomycete." By Harold Wingate, was presented for publication.

The death of Dr. Addinell Hewson, a member, was announced.

SEPTEMBER 24.

The President, Dr. JOSEPH LEIDY, in the chair.

Twenty-four persons present.

A paper entitled "On the Taxonomic Value of the Wing Membrane and the Terminal Phalanges of the Digit in the Cheiroptera." By Harrison Allen, M. D., was presented for publication.

The death of Prof. Geo. H. Cook of Burlington, N. J., a correspondent, was announced.

Mr. Thomas Stewardson was elected a member.

The following were ordered to be printed:—

LOWER CARBONIC GASTEROPODA FROM BURLINGTON, IOWA.

BY CHARLES R. KEYES.

Inquiry has disclosed the remnants of an exceedingly rich and varied fauna that, in the vicinity of the present city of Burlington, Iowa, once tenanted the littoral zones of a vast Carbonic sea. The peculiar lithological characters of the depositions are not, however, conducive to the good preservation of the entombed animal remains; and, for the most part, the vestiges of the gasteropods are, in consequence, almost entirely obliterated. Nevertheless, there have been obtained a considerable number of shells the structural characters of which are unimpaired and exhibit in a very satisfactory manner all the generic and specific details. These reveal a very suggestive chapter in the faunal history of the early Carbonic over the broad interior basin.

More than a quarter of a century has passed since the mollusca of the Kinderhook and Burlington beds have elicited attention. The early investigations of Hall, White and Winchell brought to light numerous interesting forms, the greater portion of which were collected in the immediate neighborhood of the locality mentioned. But since the appearance of the original descriptions of the fossils contained in these rocks, there has accumulated considerable additional material, which elucidates some hitherto-obscure questions relative to the zoological position of the various species and their distribution in time and space.

D. D. Owen [1] was the first to call attention, geologically, to the rocks exposed at the city of Burlington. In his general stratigraphic section of the region he distinguished the upper calcareous or "Encrinital" layers from the lower shaly portions which he called the argillo-calcareous group. His line of demarkation coincided approximately with that of the present Kinderhook and Burlington divisions—about fifteen feet above the fossiliferous sandstone. Owen correctly referred these rocks to the age of the lower Carbonic. Shortly after the appearance of the report on the geology of Wisconsin, Iowa and Minnesota, Hall, [2] in his reconnaissance of eastern Iowa, referred the arenaceous member (Kinderhook) to the Chemung and regarded as synchronous the yellow sandstones at the mouth of Pine creek,

[1] Geol. Sur. Wis. Iowa and Minn., 1852, p. 91.

[2] Geol. Iowa, Vol. I, p. 88, 1858.

Muscatine county, fifty miles to the northward. But later investigations prove conclusively, as recently remarked by Calvin, [1] that the strata last mentioned are Hamilton sandstones and therefore not continuous with the beds of similar composition farther southward. White, [2] following Hall, also considered the lower portion of the Burlington section as Chemung, but afterwards [3] concurred with Meek and Worthen [4] that it was not Devonic, but belonged properly to the age following. Thus after nearly twenty years, the original opinion of Owen relating to the correlation in time of the arenaceous beds below the "Encrinital" limestone in southeastern Iowa is finally sustained.

The Lower Carbonic rocks at Burlington have already been treated in detail by Hall and White whose remarks in the present connection will require but little supplementary explanation. Also, recently, [5] the leading topographical and cenological features of the district under consideration have been briefly presented in a preliminary statement.

A generalized section of the depositions in the immediate vicinage of the city exhibits:

Loess	20 feet.
Drift (lower till)	35 "
Upper Burlington limestone and cherts	40 "
Lower Burlington limestone and siliceous shales	45 "
Kinderhook: calcareous layers	6 "
Sandstone	5 "
Limerock	14 "
Blue clayey and sandy shales—exposed	85 "
	250 feet.

It is to be noticed that the stratigraphic rocks of Burlington present a maximum exposed thickness of nearly two hundred feet, a little more than one half of which may be regarded as Kinderhook. Lithologically the strata of the lower member are made up chiefly of bluish sandy shales which in some places pass into fine-grained sandstones. Towards the superior limit of this division are several

[1] Am. Geol., vol. III, p. 25.
[2] Jour. Boston Soc. Nat. Hist., vol. VIII, p. 209 *et seq.*
[3] Geol. Iowa, Vol. I, p. 191. 1870.
[4] Am. Jour. Sci., vol. XXXII, p. 177. 1861.
[5] Keyes: Am. Naturalist, vol. XXII, p. 1049 *et seq.*

feet of gray, compact and oolitic limestones. The upper part of the great arenaceous bed is charged with casts of brachiopod and lamellibranch shells; it also contains a number of gasteropods and a few pteropods. A similar sandstone ten feet above presents like faunal peculiarities. The fossils of the calcareous layers are usually in an excellent state of preservation, especially those occurring in the oolites; and it is from the latter that the most satisfactory material for serial comparisons is obtained.

The Burlington limestone is pre-eminently crinoidal in its composition. It includes also several extensive beds of siliceous shales and cherts. The greater portion of this division is composed of thick- and thin-bedded limerock, the layers of which are frequently separated by clayey or sandy partings. Alternating with the firmer strata are often great beds of coarse friable rock made up almost wholly of the disjointed and comminuted skeletal remains of echinoderms. In all observable characters—stratigraphic, faunal and lithologic—the two members of the Lower Carbonic at Burlington present a very marked contrast. The most distinctive feature, perhaps, is the great preponderance of crinoidal remains in the upper part; while in the lower, or Kinderhook, there are but few traces of the feather stars.

Attempts have been made at various times to subdivide the Burlington limestone into upper and lower sections; the chief basis for separation being the difference in the crinoid faunæ contained. While in the *ensemble* there is a very noticeable dissimilarity in the general expression of the species of the two divisions there is not, as is claimed, a totally distinct group of forms in each. Recent observations indicate that a considerable proportion of the species in the Lower Burlington are also present in the Upper; and even pass with some slight structural modifications into the Keokuk. With the material already accumulated, the transitionary relations of the various species have been traced; and there appears to be but little doubt that the respective faunæ of the two members were the biologic successors of one another, at least in the region of southeastern Iowa. It has further been shown recently [1] that the limestone of the continental interior, usually denominated the Burlington and Keokuk, practically belong to a single epoch.

Briefly summarized, the general faunal features as set forth in the following pages indicate very different bathymetric conditions during

[1] Keyes: Am. Jour. Sci., (3), vol. XXXVIII, p. 183.

the deposition of the Kinderhook and Burlington beds. When the strata of the first were being laid down it would seem that in the vicinity of the present city of Burlington there was very shallow water, which probably did not have, at all times, free connection with the open sea. But in the succeeding epoch it is evident that the depth of the oceanic expanse considerably increased at that place.

In the Kinderhook there is a notable absence of certain classes of animal remains, principally crustaceans, echinoderms, corals, and bryozoans; while in the Burlington these groups, excepting perhaps the articulates, are well represented. On the other hand the mollusca were particularly abundant in the lower, but of rare occurrence in the upper, division. Bryozoa are rare; brachiopoda abundant. The cephalopoda are represented by several genera, but individually they are not common; none have been as yet observed in the superimposing layers. Of the pteropoda several species of *Conularia* have been obtained. The lamellibranchiata are quite plentiful and with the exception of two genera are not found in the limestones above. The gasteropods include upwards of fifteen genera and fifty species. But only two of the generic groups—*Platyceras* and *Straparollus*—have thus far been recognized in the Burlington strata, in which there occur eight species of the first genus and two of the second. In the Upper Burlington *Platyceras* is especially common and is often found attached to the ventral surfaces of crinoids. It is worthy of note that several of those shells observed adhering to the stalked echinoderms are specifically identical with certain Keokuk *Platycerata* and that in both horizons the various forms of gasteropods are associated with crinoids of similar anatomical construction. Some of the species of *Platyceras* which are first known in the upper Burlington became in the Keokuk very abundant, and widely distributed geographically. It may also be remarked that the Keokuk forms seem to follow the Burlington species in direct biologic sequence; but that between the Kinderhook and Burlington no such close affinities are traceable in this genus.

The Straparolli of the Burlington rocks are all angulated forms. In *S. latus* Hall there are two well defined angularities—one on the upper side of the whorls; the other on the under side. The latter is usually more or less rounded; but the former is generally surmounted by a narrow carina which gives it additional prominence. The upper surface of the volutions is flattened and the spire depressed so as to be on a level with the outer turn, thus differing from *S. roberti* White, in which the spire is depressed considerably below the upper surface of the last whorl, making the superior carina very conspicuous. *S. roberti* appears to be the genetic successor of *S. latus*, but there is nothing to indicate that either species was immediately derived from any of the Kinderhook forms, which are all characterized by regularly rounded volutions.

In the absence, from the Burlington beds, of the other generic groups of gasteropods represented in the Kinderhook no further comparisons of the forms from the two horizons can be made. However, as previously intimated, the general aspect of the molluscan remains under consideration, from the lower division, points to the existence over the region of a shallow secluded expanse of water perhaps removed for the greater portion of the time from the immediate influence of the great mediterranean sea that at this period stretched away to the southward.

I. Species from the Burlington Beds.

Platyceras cyrtolites McChesney.

Platyceras cyrtolites McChesney, 1860. Desc. New Palæ. Foss., p. 71.

This form was originally described from the Burlington limestone of Calhoun county, Illinois. It has recently been obtained from the upper layers of the same horizon at Burlington, Iowa. At the latter place it is quite rare; and the shell is usually exfoliated. It appears to have its nearest affinities in certain forms of the superimposing Keokuk beds.

Platyceras equilaterum Hall.

Platyceras equilaterum Hall, 1859. Geol. Iowa, vol. I, Supp., p. 89.

Platyceras equilaterum Meek and Worthen, 1873. Geol. Sur. Illinois, vol. V, p. 518.

Platyceras equilaterum Keyes, 1888. Proc. Am. Philosophical Soc., vol. XXV, p. 236.

This species is one of the most characteristic gasteropods of the Keokuk limestone. In the upper Burlington rocks it has lately been found attached to the ventral surface of *Gilbertsocrinus typus* (Hall). The sedentary habits of the members of this genus have been fully discussed elsewhere and need not be considered here. Suffice it, that fifteen species of this group have been observed on the calyces of various crinoids, particularly those having a more or less depressed or flattened dome. Like all the individuals resting on flat crinoidal vaults, the shells of this species, when thus situated, are very much more depressed than in the normal specimens. The following summary of the habits of certain Platycerata may be here restated: (1) many species of *Platyceras* were stationary during life; (2) the nourishment of these gasteropods was derived in part, at least, from the excrementitious matter of the echinoderms to which they were attached; (3) the surface of attachment governs in great measure the form of the shell and the shape of its aperture. From the evidence at hand it is probable that the genus in America did not survive beyond the close of the Paleozoic.

Platyceras fissurella Hall.

Platyceras fissurella Hall, 1859. Geol. Iowa, vol. I, Supp., p. 90.

Platyceras fissurella Meek and Worthen, 1873. Geol. Sur. Illinois, vol. V, p. 529.

The species under consideration was first obtained from the Keokuk rocks at Nauvoo, Illinois; but it appears also to be represented in the upper Burlington. As shown conclusively by Meek and Worthen the apical portion is not perforated naturally, as supposed by Hall; the opening at the apex being merely an accidental fracture.

Platyceras infundibulum Meek and Worthen.

Platyceras subrectum Hall, 1859. Geol. Iowa, vol. I, Supp., p. 89 (pre-occupied).

Platyceras infundibulum Meek and Worthen, 1866. Proc. Acad. Nat. Sci., Phil., p. 266.

Platyceras infundibulum Keyes, 1888. Proc. Am. Philosophical Soc., vol. XXV, p. 238.

The form for which Hall proposed the name *P. subrectum*, in the supplement to the Iowa report, was altered by Meek and Worthen to *P. infundibulum*, the first term having been preoccupied. Like *P. equilaterum* this species is widely distributed over the interior basin, chiefly through the Keokuk rocks. In the upper Burlington limestone it has been found adhering to the anal side of *Eucladocrinus millebrachiatus* W. and Sp. The blue Keokuk shales of Crawfordsville, Indiana, have afforded for study an extensive series of this species; and the effect of its station in changing the shape of the shell and in giving rise to the great diversity of forms observed, has been very satisfactorily made out.

Platyceras latum Keyes.

Platyceras latum Keyes, 1888. Proc. Am. Philos. Soc., vol. XXV, p. 242.

A broad depressed form from the upper Burlington limestone. In this shell there are no folds or imbricating lines of growth observable; and it is very probable that the habits of this species differed somewhat from its nearest relative *P. equilaterum.* It is of rare occurrence, though associated forms are quite common.

Platyceras obliquum Keyes.

Platyceras obliquum Keyes, 1888. Proc. Am. Philosophical Soc., vol. XXV, p. 241.

A rather large robust species, which, like the majority of the mollascan shells from the white limestones of the upper Burlington division, is usually exfoliated; and crumbling quickly away, it leaves only the internal casts.

Platyceras quincyense McChesney.

Platyceras quincyense McChesney, 1861. Desc. New Foss., p. 90.

Platyceras quincyense Meek and Worthen, 1868. Geol. Sur. Illinois, vol. III, p. 510.

Not uncommon in the upper Burlington; and sometimes found resting on the vault of *Physetocrinus ventricosus* (Hall). One of the most important distinctive features assigned to this species is its peculiar quinquelobate appearance; but the real cause of the *five* broadly rounded lobes did not suggest itself until the discovery of an individual adhering to the dome of a crinoid in which the inter-radial areas were considerably depressed, leaving the ambulacra rather highly elevated. The growing margin of the gasteropod shell, in following the inequalities of the surface upon which it rested, gradually assumed the lobate form.

Platyceras tribulosum White.

Platyceras tribulosum White, 1883. 12 th. Ann. Rept. U. S. Geol. Sur. Ter., pt. i, p. 168.

First known from this locality, where it is found in the upper beds of the Burlington limestone. It is one of the few spiniferous species from the American paleozoic rocks; and differs from *P. biserale* Hall, of the same horizon, chiefly in having three, instead of two, longitudinal rows of spines. These appendages, though seldom preserved entire, are long, slender and tubular. It may be added that the type is somewhat deformed and is not a characteristic representative of the species.

Straparollus roberti (White).

Euomphalus roberti White, 1862. Jour. Boston Soc. Nat Hist., vol. IX, p. 22.

This species is very closely allied to *S. latus* (Hall). It is, however, somewhat smaller, with the spire depressed below the upper surface of the body whorl. The superior flattened area is inclined inwardly thus making the outer carina more prominent than in Hall's species. This form was described from the upper beds, and occurs in the massive white limestone layers. It is, probably, the genetic successor of *S. latus* of the lower Burlington; and has undergone but slight modifications in structure.

There has always been a considerable diversity of opinion as to the real relations of *Euomphalus* Sowerby and *Straparollus* Montfort. The two groups have commonly been regarded as generically distinct, but equally good reasons have been advanced for considering them synonymous, and some writers even go so far as to unite both with *Solarium* Lamarck. Whatever may be the final decision in regard to the genera established by Sowerby and Montfort, there appears, at present, no reliable criteria by which a satisfactory separation can be made of the planorbicular forms with angulated whorls and those having the spire somewhat elevated and the volutions rounded. Although the extreme representatives of the two are apparently very distinct, the individuals are so variable and the gradations so complete, even among those of the same species, that the generic limits usually assigned are not tenable. *Euomphalus* is typified by such forms as *E. pentagonus* Sowerby; *Straparollus* by *S. dionysii* Montfort. Among the Burlington series the first section is, perhaps, best represented by Hall's *Euomphalus latus*, in which the depressed spire is nearly on a level with the body whorl. The upper surface of the latter, being flattened, gives rise to two rather pronounced angularities. The type of the second section has its best analogue in *S. macromphalus*. But there are numerous transitionary forms which are regularly rounded below and with only one carina above or having the angularities very much rounded and in some instances barely perceptible. The spire, which is considerably elevated in some species, in others becomes more and more depressed—even below the level of the upper surface of the last volution. A number of other generic names have been proposed which seem to be identical with

Straparollus; but these require no consideration in the present connection.

In the majority of cases the carinæ or angular prominences on the whorls of the Burlington *Straparolli* appear to be simply thickenings of the shell at those points. The internal transverse section is circular, as shown when the shell is removed from the matrix forming the cast of the inside. Some species have a thickened shell, with the whorls barely in contact, or even separated toward the aperture. In instances of this kind the internal casts have much the appearance of some of the forms for which Sowerby established the genus *Phanerotinus.* But with the latter have evidently been included a number of evolute *Straparolli.*

Straparollus latus (Hall).

Euomphalus latus Hall, 1858. Geol. Iowa, vol. I, p. 605.

Shell rather large, discoid, composed of four to five rather rapidly enlarging volutions, plane above; spire nearly on a level with the upper surface of the outer whorl; suture impressed; deeply and broadly umbilicate; aperture nearly circular, flattened above. The broad flattened area occupying the upper surface of the volutions is bordered on each side by a distinct carina, the inner being near the sutural line. Below the outer ridge are sometimes two scarcely perceptible angularities—one around the periphery and the other along the middle of the whorls below. The latter, as shown in young specimens, is often well defined, but after the shell has become half-grown the obtuse prominence becomes obscured. In some specimens the ridge above the periphery is so pronounced as to leave a narrow concave area immediately beneath. *Straparollus latus* is the most characteristic form of the genus occurring in the Burlington, but it is not very common. It attains a maximum diameter of eight centimeters.

Metoptoma ? umbella Meek and Worthen.

Metoptoma (*Platyceras?*) *umbella* Meek and Worthen, 1866. Proc. Acad. Nat. Sci. Phila., p. 267.

Metoptoma? umbella Meek and Worthen, 1868. Geol. Sur. Illinois, vol. III, p. 506.

The generic relations of this and several similar forms from the Lower Carbonic rocks of the Mississippi basin are not clearly understood. The species in question do not appear to properly belong to *Metoptoma*, as originally characterized by Phillips, in the Geology of Yorkshire, and as typified by his *M. pileus* and *M.*

oblongata. Though some recent writers have greatly extended the limits of the genus and embraced a variety of other shells, it would seem that this enlargement of the generic group is of very questionable utility. It is very possible that this is the same form as that described by Hall as *Platyceras capulus*, in which case the latter term takes precedence.

II. Species from the Kinderhook Beds.

Naticopsis depressa Winchell.

Naticopsis depressa Winchell, 1863. Proc. Acad. Nat. Sci. Phila., p. 22.

No authentic examples from the lower beds of the Burlington section have come under notice, though the collections include several casts which may belong here. If this inference is correct the species certainly presents characters which differ very essentially from the typical forms of the genus.

As originally established by McCoy, in 1844, *Naticopsis* embraced certain paleozoic shells, the best American exemplification of which, perhaps, is the form described by Norwood and Pratten as *Natica ventricosa* from the Coal Measures. The most characteristic shells of the genus are therefore comparatively thin, with the spire very small and short; the outer labrum thin, as is also the callosity of the inner lip; the last whorl usually more or less noticeably flattened or slightly concave on the upper half, and ornamented towards the suture by numerous, small, short, equidistant costæ parallel to the lines of growth; surface otherwise smooth. A number of species have been erroneously referred to the genus, while some others described under different generic titles must evidently be transferred to this group. There are, perhaps, a dozen valid species of *Naticopsis* now known from the American paleozoic rocks.

Platystoma bivolve (White and Whitfield).

Platyceras bivolve White and Whitfield, 1862. Proc. Boston Soc. Nat. Hist., vol. VIII, p. 302.

The recognition of this genus in the lowest division of the Carbonic is of considerable interest, as this is the second American species recorded above the Devonian. A recent examination of the type specimens reveals a very noticeable departure of this form from *Platyceras*, and particularly from the immature shells of *Platyceras ventricosum* Conrad, with which it has been compared. The spire in *P. bivolve* is much more elevated than in the other species, while the inner lip is much thickened, reflexed and anchylosed to the body volution. The form under consideration is with considerable difficulty distinguishable from some individuals of *Platystoma niagarense* Hall, notwithstanding the wide separation of the respective horizons of the two species.

Platystoma as defined by Conrad included those subglobose Natica-like gasteropods, in which the labrum joined the body whorl at right angles to the axis of the shell. The group is typified by *P. ventricosum*, but it is very evident that several species have been assigned to the genus, the correct reference of which is very questionable. In an extensive series of a single species, such as may be obtained of *P. niagarense* at Waldron, Indiana, the shells show an interesting gradation from those precisely like the types to individuals in which the lip is entirely separated from the body whorl, and in some instances the last volution has uncoiled for a considerable distance. These partially evolute forms often approach closely certain *Platycerata*, and it is very likely that a more careful study of the latter will disclose a nearer relationship between the members of the two groups than has heretofore been generally suspected. This tendency of the volutions to uncoil is also very apparent in several Upper Carbonic species of *Naticopsis*, as well as in various individuals of allied genera.

Platyceras cornuforme Winchell.

Platyceras cornuforme Winchell, 1863. Proc. Acad. Nat. Sci. Phila., p. 18.

This is one of the smallest forms of the genus occurring in the lower Carbonic rocks. It has a wide geographic range in the Kinderhook beds, being found not only at Burlington, but also at Lodi and other localities in Ohio.

P. vomerium Winchell, described from the same horizon has been found only in the form of internal casts in sandstone; and its specific relations cannot at present be satisfactorily made out.

Platyceras paralium White and Whitfield.

Platyceras paralium White and Whitfield, 1862. Proc. Boston Soc. Nat. Hist., vol. VIII, p. 302.

Examples have been seen from the Kinderhook beds at Le Grand, Marshall county, and Burlington, Iowa; also from Lodi, Ohio. A careful examination of the type specimens shows that the shell is composed of more than two volutions instead of one, as stated in the original description. The spire, however, is remarkably slender, closely incurved but not contiguous. When partially embedded in the matrix the apical portions are usually not visible, thus giving it the appearance of the obliquely conical forms, whereas it actually belongs to the typical section of the genus. In the type the longitudinal plications are much more prominent than in a representative specimen of the species, while in some forms the longitudinal folds are nearly obsolete. Immature shells are laterally compressed and the surface is perfectly glabrate, with no indications whatever, of plications or imbricating lines of growth. As the individuals became larger the aperture becomes relatively more expanded and assumes a subcircular outline.

Straparollus macromphalus Winchell.

Straparollus macromphalus Winchell, 1863. Proc. Acad. Nat. Sci. Phila., p. 20.

Shell of medium size, composed of about four regularly rounded volutions; spire somewhat elevated; suture moderately impressed; umbilical cavity rather deep; aperture circular.

The spire in this species is more elevated than in any other congeneric form from the vicinity of Burlington, except, perhaps, *S. barrisi* Win., with which, if recent determinations are correct, it may prove synonymous. It has close affinities to *Straparollus* (*Euomphalus*) *cyclostomus* (Hall), from the Iowa Devonic rocks at Iowa City. Among foreign species it bears a striking resemblance to *S. costellatus* Sowerby.* The form under consideration appears to be the most common species of the genus found in the locality, coming from the upper calcareous layers of the Kinderhook.

Straparollus barrisi Winchell.

Straparollus barrisi Winchell, 1863. Proc. Acad. Nat. Sci. Phila., p. 20.

This species is closely related to *S. macromphalus* Winchell. It appears to differ in having three barely perceptible angularities on the body whorl, and the spire slightly more depressed. It is from the arenaceous layers of the Kinderhook.

Straparollus (*Euomphalus*) *ammon* (White and Whitfield), described from the Kinderhook beds of the same locality, has not been noted recently. It is a small form and said to have its closest affinities with *S.* (*Euomphalus*) *spergenensis* (Hall) from the Warsaw.

Straparollus obtusus (Hall).

Euomphalus obtusus Hall, 1858. Geol. Iowa, vol. I, p. 523.

Shell large, planorbiform, composed of five to six regularly rounded volutions; spire on a level with, or slightly below, the upper surface of the last whorl; suture very deeply impressed; upper face of the volutions very slightly flattened on the inner side near the suture; umbilicus very broad and shallow; aperture circular.

This form was the first of the group recognized from the neighborhood of Burlington, and is the most characteristic gasteropod of the Kinderhook at that place. It occurs in the oolitic layer a few feet below the Burlington limestone, and is easily distinguished from all the congeneric species of the locality by its large size—often having a diametric measurement of six centimeters,—its greatly depressed spire, broad shallow umbilicus and regularly rounded whorls. In many examples of this species the volutions are barely in contact with one another, and in a few instances the outer whorl, toward the aperture, has actually become separated from the adjoining inner turns. This fact is of special interest as illustrating the first noticeable departure toward certain evolute *Straparolli* which have been referred to *Phanerotinus* of Sowerby.

From the associated beds Winchell has described a gutta-percha cast, taken from natural moulds in friable sandstone, as *Phanerotinus paradoxus*. One of the specimens figured by Hall (Pale. N. Y., V, ii, pl. 16, fig. 16), shows the inner volutions still contiguous, while the outer whorls are not separated further than very similar casts of undoubted *S. obtusus.*

Sphaerodoma pinguis (Winchell).

Macrochilus pingue Winchell, 1863. Proc. Acad. Nat. Sci. Phila., p. 21.

The specimens which evidently represent the group formerly known as *Macrochilus* are merely imperfect casts from the arenaceous beds of the Kinderhook, and their systematic position can at best only be surmised. But unsatisfactory as the material is, it is of considerable interest to find in America the genus present so early in the Carbonic. Several American Devonic forms have been described under *Macrochilus*, but with perhaps one or two exceptions, they have been very imperfect and in most cases merely internal casts. In Europe, however, *Macrochilus* is equally well represented in the

Devonic and Carbonic, while in this country the genus is confined chiefly to the latter.

Murchisonia prolixa White and Whitfield.

Murchisonia prolixa White and Whitfield, 1862. Proc. Boston Soc. Nat. Hist., vol. VIII, p. 303.

A very characteristic, though not common, shell from the oolitic bands of the upper Kinderhook. It is usually found in a more or less fragmentary condition and the structural features are therefore seldom well shown. The whorls are eight to twelve in number, slightly convex, with a broad obtuse angularity centrally. The surface is ornamented by small well-defined revolving costæ, or thread-like lines, the one passing along the middle of the whorls being the most pronounced, while those below the median one are considerably smaller than those above.

Three other species from this locality have been referred by Vinchell to *Murchisonia*, but all are more or less imperfect and their true affinities uncertain. The first of these, *M. quadricincta*, is said to be characterized by four small costæ below the revolving band. The other two are *M. neglecta* and *M. shumardiana*.

Belerophon bilabiatus White and Whitfield.

Bellerophon bilabiatus White and Whitfield, 1862. Proc. Boston Soc Nat. Hist., vol. VIII, p. 304.

Specimens of this species have recently been obtained in white silicous nodules. The deeply and broadly emarginate lip, the neary glabrate surface and a sharp narrow median carina readily distinguish this form from the associated species of the genus.

Bellerphon panneus White.

Belerophon panneus White, 1862. Proc. Boston Soc. Nat Hist., vol. IX, p. 21.

Shel globose, composed of three or four gradually enlarging volutions, which are visible in the rather small, very deep umbilici; periphery somewhat flattened, with a very prominent longitudinal carina: the surface marked by sharp, equidistant costæ passing transversly across the whorls from the large median ridge; transverse carinæ more or less undulating and irregular, bending forward slightly as they leave the central prominence: finer lines of growth are visible between the costæ. This species bears a striking resemblanc to *B. tangentialis* Phillips from the Carbonic clays of

Tournai, Belgium. The transverse ribs of the latter are, however, slightly farther apart.

Three additional species of *Bellerophon* have also been described from Burlington. These are *B. scriptiferus* White, *B. vinculatus* White and Whitfield, and *B. perelegans* White and Whitfield.

Metoptoma ? undata Winchell.

Metoptoma undata Winchell, 1865. Proc. Acad. Nat. Sci. Phila., p. 131.

A single specimen represented in the collections probably belongs to this species.

Porcellia crassinoda White and Whitfield.

Porcellia crassinoda White and Whitfield, 1862. Proc. Boston Soc. Nat. Hist., vol. VIII, p. 303.

No traces of this group have been noticed recently, except portions of a large cast, probably belonging to this species. The other three forms reported from the Burlington locality are *P. obliquinoda* White, *P. rectinoda* Winchell, and *P. nodosa* Hall.

Among the gasteropods that have been recorded from the rocks at Burlington, but which have not been observed since the appearance of the original descriptions, are two species of *Holopea*—*H. conica* and *H. subconica*, described by Winchell from the Kinderhook beds. Associated with these two forms is a third diminutive shell, apparently belonging to the Turbonidæ—*Holopella mira* Winchell. A cast in sandstone has received the name *Loxonema oligospira* Winchell. *Dentalium grandævum* Winchell, a form said to resemble *D. venustum* Meek and Worthen, is the only representative of this group recognized from the locality. No specimens of *Pleurotomaria* have been obtained lately.

THE AMERICAN SPECIES OF POLYPHEMOPSIS.

BY CHARLES R. KEYES.

Portlock's generic term *Polyphemopsis* was introduced into the literature of American Paleontology by Meek and Worthen,[1] who referred to the genus the species described by Hall[2] in 1858 under *Bulimella*, and also three additional forms, originally placed with *Loxonema* and *Eulima*. A number of other American fossil gasteropods have from time to time been assigned to Portlock's genus. But *Polyphemopsis* was founded on very imperfect material, and its structural characters have never been sufficiently understood to definitely limit the group. It seems to be regarded by the majority of European writers as a synonym of *Macrochilus* Phillips. The latter, however, has recently been shown to be identical with *Soleniscus* Meek and Worthen, which has precedence over Phillips' preoccupied term.

Although more than half a score of species have, in this country, been referred to the genus, it is quite apparent that members of at least two very different groups were included; while a detailed comparison of the various representatives appears to indicate that, with a few possible exceptions, no forms congeneric with Portlock's *Polyphemopsis elongata*, which may be regarded as the type of his genus, have as yet been recognized, with any degree of certainty, in the Paleozoic rocks of America. Until typical specimens of *Polyphemopsis* can be critically examined, the genus must be considered as of very doubtful utility.

As already stated there were embraced in this group such species as constituted Hall's genus *Bulimella*. These perhaps best exemplify the American forms of the section under consideration. The shells are fusiform, with the spire elongated; the whorls more or less decidedly convex, the last rather large; the columella curved, abbreviated or truncated at the base; the inner lip often well defined anteriorly, and usually separated from the outer by a more or less well-marked notch; surface smooth. Accordingly, this group would include not only those forms originally comprehended under *Bulimella* but also the species hereafter enumerated, and perhaps a few others now known under other generic titles.

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[1] Geol. Sur. Illinois, vol. II, p. 372.

[2] Trans. Albany Ins., vol. IV, pp. 29–30.

Since, then, it is manifest that *Polyphemopsis* is not correctly applicable to any known American gasteropods, and inasmuch as *Bulimella* of Hall was preoccupied by Pfeiffer, it is necessary to find some more appropriate term to designate this group. *Bulimorpha*, established by Whitfield, is apparently the only available name for the shells in question, but whether this title will eventually be considered valid cannot now be fully decided.

In connection with *Polyphemopsis* Conrad's genus *Subulites* has frequently been alluded to, and by Lindström [2] and others the two terms have been considered nearly or quite synonymous. The validity of the latter group is however questionable. The type was very imperfect, consisting only of a portion of the body whorl and three or four of the preceding volutions—the upper portions of the spire and the apertural parts being entirely unknown. Strangely enough, of more than a dozen species described under the genus there is not a single one but that is fragmentary, or in the condition of broken casts, indicating only the general shape of the shell.

The following American forms have been referred to *Polyphemopsis*. The group doubtless includes also several other Carbonic species described under *Loxonema* and allied genera.

Bulimorpha bulimiformis (Hall).

Bulimella bulimiformis Hall, 1858. Trans. Albany Ins., vol. IV, p. 29; *Polyphemopsis bulimiformis* Meek and Worthen, 1866, Geol. Sur. Illinois, vol. II, p. 373; *Bulimorpha bulimiformis* Whitfield, 1882. Bul. Am. Mus. Nat. Hist., vol. I, p. 74. Warsaw Limestone.

Bulimorpha canaliculata (Hall).

Bulimella canaliculata Hall, 1858. Trans. Albany Inst., vol. IV, p. 29; *Polyphemopsis canaliculata* Meek and Worthen, 1866. Geol. Sur. Illinois, vol II, p. 373; *Bulimorpha canaliculata* Whitfield, 1882. Bul. Am. Mus. Nat. Hist., vol. I, p. 74. Warsaw Limestone.

Bulimorpha chrysalis (Meek and Worthen).

Polyphemopsis chrysalis Meek and Worthen, 1866. Proc. Acad. Nat. Sci. Phila., p. 267; *P. chrysalis* M. and W., 1873. Geol. Sur. Illinois, vol. V, p. 596. Lower Coal Measures.

In the absence of specimens for examination the exact generic relations of this form cannot with certainty be determined; but it appears to have closer affinities to this than to any other group. It resembles somewhat young shells of *Soleniscus* (*Macrochilus*) *new-*

[1] Bul. Am. Mus. Nat. Hist., vol. I, p. 74. 1882.

[2] Index to Generic Names of Gasteropoda Palæ. Period.

berryi (Stevens) but according to Meek and Worthen it does not exhibit the columellar fold so characteristic of that genus.

Bulimorpha elongata (Hall).

Bulimella elongata Hall, 1858. Trans. Albany Inst., vol. IV, p. 30; *Polyphemopsis elongata* Meek and Worthen (*non* Portlock), 1866. Geol. Sur. Illinois, vol. II, p. 373; *Polyphemopsis teretiformis* Hall, 1877. Miller's Cat. Palæ. Foss., p. 245; *Bulimorpha elongata* Whitfield, 1882. Bul. Am. Mus. Nat. Hist., vol. I, p. 75. Warsaw Limestone.

Bulimorpha inornata (Meek and Worthen).

Loxonema inornatum M. and W., 1860. Proc. Acad. Nat. Sci. Phila., p. 465; *Polyphemopsis inornata* M. and W., 1866. Geol. Sur. Illinois, vol. II, p. 374. Upper Coal Measures.

In specimens of this species recently examined the inner lip appears to be quite variable, sometimes being very pronounced, sometimes scarcely defined.

Polyphemopsis keokuk Worthen, 1884. Bul. 2, Illinois State Cab. Nat. Hist., p. 9. Keokuk Limestone.

Described from casts in Limestone, too imperfect to deserve recognition. Its true generic characters cannot therefore be made out.

Polyphemopsis louisvillæ Hall and Whitfield, 1872. 23 Reg. Rep. N. Y. State Cab., pl. xii. figs. 1 and 2, desc. 24 Rep., p. 193. *P. knappi* H. and W., in some copies of advance sheets of 23d report. Upper Heldberberg.

In the absence of an authentic specimen ist generic position can only be surmised. It bears a close resemblance in some particulars to *Bulimorpha*, but it may belong to another group along with several of the so-called *Macrorhili*, distinguished from the type by the alleged absence of the fold on the columella.

Bulimorpha minuta (Stevens).

Loxonema minuta Stevens, 1858. Am. Jour. Sci., (2) vol. XXV, p. 260; *Actæonina minuta* Meek and Worthen, 1873. Geol. Sur. Illinois, vol. V, p. 594; *Actæonina minuta* Keyes, 1888. Proc. Acad. Nat. Sci. Phila., p. 240. Lower Coal Measures.

If the recent observations upon this species from Des Moines are correct this form is a true *Bulimorpha* having its closest affinities with *B. canaliculata* (Hall). In most specimens examined the inner lip is well developed for half the length of the aperture, but appears to be separated from the outer labium by a distinct notch.

Bulimorpha nitidula (Meek and Worthen).

Loxonema nitidulum M. and W., 1860. Proc. Acad. Nat. Sci. Phila., p. 465; *Polyphemopsis nitidula* M. and W., 1866. Geol. Sur. Illinois, vol. II, p. 374. Upper Coal Measures.

It seems very probable that this is the same form that was described by Hall as *Macrochilus fusiforme* and afterwards, in 1877, changed to *M. attenuatum*. Should this inference be correct the latter must be regarded a synonym of *B. nitidula*. Hall's type however was imperfect and the apertural characters not shown. The confusion has been further increased by a general want of discrimination on the part of some writers, between this and various varietal forms of *Soleniscus newberryi* (Stevens).

Polyphemopsis peracuta Meek and Worthen.

Eulima peracuta M. and W., 1860. Proc. Acad. Nat. Sci. Phila., p. 466; *Polyphemopsis peracuta* M. and W., 1866. Geol. Sur. Illinois, vol. II, p. 375. Coal Measures.

This species manifestly does not belong to the *Bulimorpha* group. At present, it appears that the original reference of this form to *Eulima* is probably correct.

SPHÆRODOMA: A GENUS OF FOSSIL GASTEROPODS.

BY CHARLES R. KEYES.

It has long been known that under *Macrochilus* of Phillips there have been described a number of gasteropodous shells which differ very essentially from the typical forms of the genus. And it has even been intimated that this genus, as generally understood, may comprise, in reality, several more or less well-marked divisions of perhaps more than subgeneric value. In a recent note the differences between the various groups were briefly considered and two well-defined sections made out. At the same time it was shown that the typical forms of Phillips' genus were generically identical with those of *Soleniscus* of Meek and Worthen. The two genera being co-extensive were therefore synonymous. The first of the two terms was, however, pre-occupied and inasmuch as the several other titles, proposed at various times, for shells of the same group were unavailable, the generic term suggested by Meek and Worthen must necessarily be substituted.

In separating the genus from *Macrochilus* the authors of *Soleniscus* emphasized certain structural features as being distinctive in their group, but these characters are now known to be present in the typical species of the genus first established. On account of being more or less obscured by the adhering matrix, the peculiarities in question appear to have been overlooked by most writers. The assumed absence, in the members of Phillips' genus, of these characters, and their existence in the shells that were under immediate consideration were regarded as sufficiently good reasons for the generic separation of the two groups, and for the establishment of a new genus. A single species only was originally assigned to *Soleniscus*. Miller[1] subsequently referred *Macrochilus hallanum* Geinitz to this genus. Shortly afterward White[2] described two congeneric forms from New Mexico and also[3] included several of the *Macrochili*. More recently some additional species of *Macrochilus* were transferred to *Soleniscus*.

With two possible exceptions the described species hereafter enumerated are confined to the Carbonic, the majority occurring in the Coal Measures. Some of the forms are widely distributed

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[1] Cat. Am. Palæ. Foss., p. 162.

[2] Expl. and Sur. w. 100 Merid., Supp., Vol. III, p. xxviii.

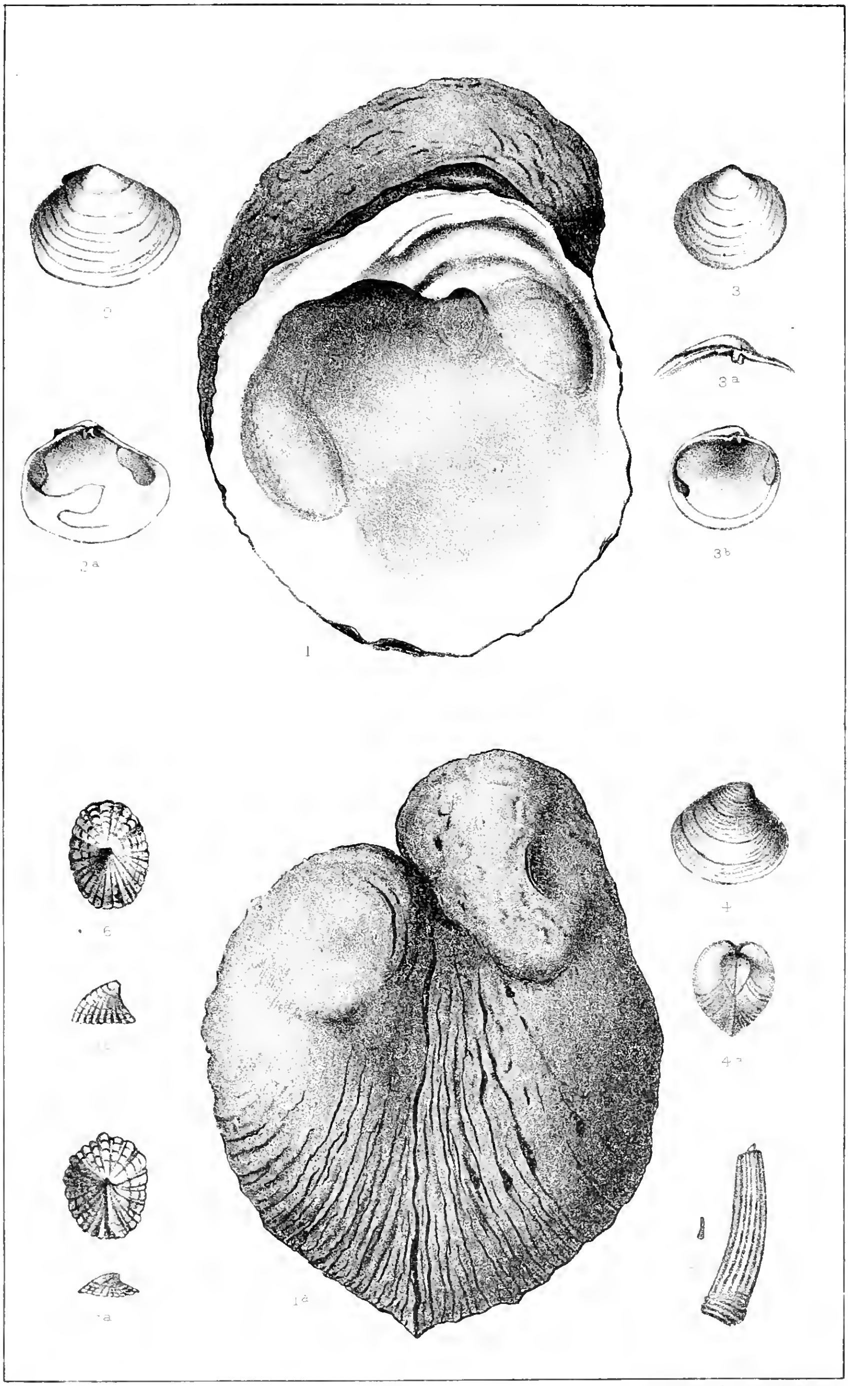
[3] Geol. Sur. Indiana, 13th Ann. Rept., p. 153, *et seq.*

geographically, and a few have also a very considerable geologic range. A number of the now recognized species will probably prove to be identical with forms previously known, but these cannot be, with certainty, determined except by a direct comparison of the type specimens. The synonymy, however, of a portion of the *Macrochili* has been made out as indicated beyond.

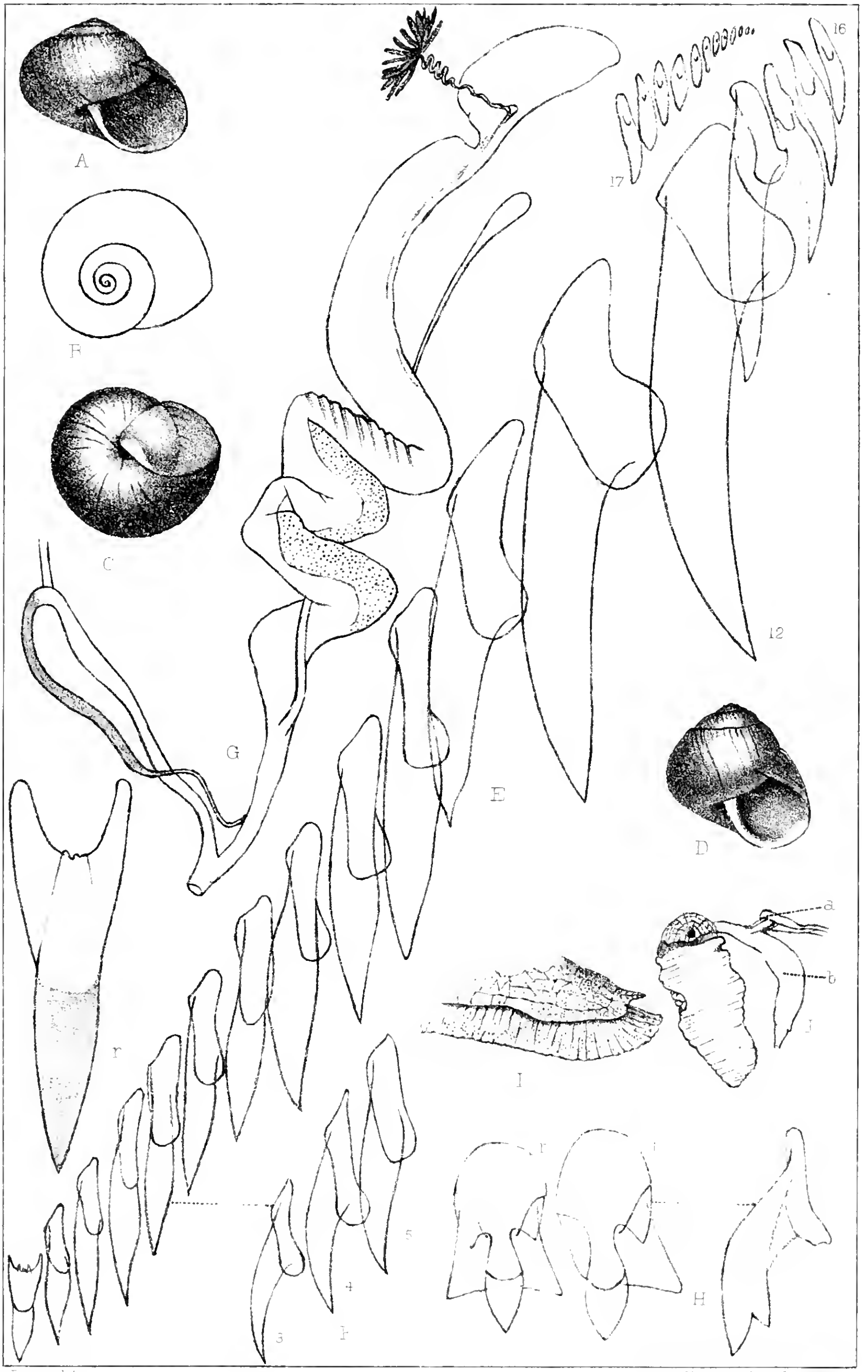
As already suggested the forms of this group appear to be easily separable into two sections: the first typified by *Macrochilus acutum* (Sowerby) and *Soleniscus typicus* Meek and Worthen; and the second having for its typical representative *Macrochilus ponderosum* Swallow. The shells of the first group are characterized by being more or less elongate or fusiform, with the spire elevated, acute; body whorl forming about half the length of the shell; aperture subelliptic, or oval, acutely angular posteriorly; columella imperforate, provided with a conspicuous revolving fold or ridge, which, however, in the perfect specimen is often scarcely descernible exteriorly, but as it passes inward becomes more and more pronounced and is often accompanied by a second, though much less prominent, fold of similar character; test thick.

The columellar ridge is in most examples usually hidden more or less completely by the imbedding matrix filling the aperture. By the removal of the outer lip the twisted fold becomes more apparent. In a perfect specimen of *Soleniscus newberryi* (Stevens) this ridge is scarcely defined at the aperture, but towards the interior of the shell it gradually assumes greater prominence, becoming very much elevated, very sharp, and bordered on each side by a broad rounded canal, the outer of which is narrower and considerably deeper than the other. On the inner margin of the second furrow there is often developed an obtuse prominence much less conspicuous than the first and best defined a short distance from the apertural margin. From this point it soon becomes obsolete inwardly and finally disappears altogether. In the majority of the forms referred to *Soleniscus* the fold on the columella presents essentially the same characters, and is generally well disclosed by breaking away the outer lip of the shell slightly. When the exterior wall of the last whorl is entirely removed the interior features of the columella are still better exhibited and for a much greater distance.

As generally recognized the *Macrochilus* group has a wide range in time, beginning, according to the species described, in the Silurian and continuing to the present time. Some of the forms



HEILPRIN. NEW MOLLUSCA FROM THE BERMUDAS



PILSBRY ON AEROPE AND ZINGIS.

have unquestionably been erroneously assigned to the genus. The typical examples are for the most part from the Devonic and Carbonic, and, although the group probably continued to flourish after the close of the Paleozoic, it is very doubtful whether the majority of the later forms can properly be regarded as congeneric. In Europe the group became greatly expanded during the later Devonic and Carbonic, but in America it is almost wholly confined to the latter age, the other forms referred to the genus being, with perhaps two or three exceptions, referable to other groups.

Polyphemopsis of Portlock has commonly been considered synonymous with *Macrochilus*, but whether it can be regarded as identical with the group as now defined cannot, at present, be satisfactorily determined. Portlock's genus was founded upon such imperfect material as to hardly deserve recognition in any case, and it would probably simplify matters greatly to ignore the term altogether. There appear to be no good grounds for assigning any American gasteropods to *Polyphemopsis*. The species so referred have, in reality, other generic affinities.

The shells of the second section are subglobose, with the spire relatively very small, short; the whorls convex, very rapidly expanding, the last ventricose, and forming, by far, the greater part of the shell; aperture oval; columella thickened, sometimes exhibiting obsolete traces of an obtuse angularity; test comparatively much thinner than in *Soleniscus*. Typified by *Macrochilus ponderosum* Swallow and *M. texanum* Shumard.

The enormous size of the body-whorl compared with the spire, and the undeveloped columellar fold readily distinguish this form from that of *Soleniscus*. In America the genus ranges from the Upper Helderberg to the close of the Carbonic. From the evidence at hand it appears that the species of this group were more strictly marine in their habitat than the members of the first genus.

For this group, as here defined, the term *Sphærodoma* is proposed. It is thought to embrace the following forms:—

Sphærodoma cooperensis (Swallow).

Macrochilus cooperense Swallow, 1863. Trans. St. Louis Acad. Sci., vol. II, p. 100. Kaskaskia limestone.

Sphærodoma littonana (Hall).

Natica littonana Hall, 1858. Trans. Albany Inst., vol. IV, p. 30; *Naticopsis littonana* Meek and Worthen, 1866. Proc. Acad. Nat. Sci. Phila., p. 268; *Macrochilus littonanum* Whitfield, 1882. Bul. Am. Mus. Nat. Hist., vol. I, p. 73. Warsaw limestone.

Sphærodoma medialis (Meek and Worthen).

Macrochilus mediale Meek and Worthen, 1860. Proc. Acad, Nat. Sci. Phila., p. 466; *M. mediale* M. and W., 1866. Geol. Sur. Illinois, vol. II, p. 270; *Soleniscus medialis* White, 1884. Geol. Indiana, 13th Ann. Rept., pt. ii, p. 156; *M. pulchellum* M. and W., 1860. Proc. Acad. Nat. Sci. Phila., p. 467; *M. intercalare* M. and W., 1860, Proc. Acad. Nat. Sci. Phila., p. 467; *M. intercalare* M. and W., 1866, Geol. Sur. Ill., vol. II, p. 371. Upper Coal Measures.

Sphærodoma pinguis (Winchell).

Macrochilus pingue Winchell, 1863. Proc. Acad. Nat. Sci. Phila., p. 21. Kinderhook beds.

Sphærodoma ponderosa (Swallow).

Macrochilus ponderosum Swallow, 1858. Trans. St. Louis Acad. Sci., vol. I, p. 202; *Soleniscus ? ponderosus* White, 1884. Geol. Indiana, 13th Ann. Report., pt. ii, p. 156. Upper Coal Measures.

Sphærodoma primogenia (Conrad).

Stylifer primogenia Conrad, 1835. Trans. Geol. Soc. Penn., vol. I, p. 267; *Macrochilus primogenium* Hall, 1858. Geol. Iowa, vol. I, p. 720; *Soleniscus primogenius* White, 1884. Geol. Indiana, 13th Ann. Rept., pt. ii, p. 157; *Fusus inhabilis* Morton, 1836, Am. Jour. Sci., vol. XXIX, p. 160. Lower Coal Measures.

Sphærodoma ? prisca (Whitfield).

Macrochilus priscum Whitfield, 1882. Annals N. Y. Acad. Sci., vol. II, p. 204. Upper Helderberg.

Sphærodoma subcorpulenta (Whitfield).

Macrochilus subcorpulentum Whitfield, 1882. Annals N. Y. Acad. Sci., vol. II, p. 224. Kaskaskia limestone. This form is perhaps identical with *S. cooperensis* of Swallow.

Sphærodoma texana (Shumard).

Macrochilus texanum Shumard, 1859. Trans. St. Louis Acad. Sci., vol. I, p. 402; *Soleniscus texanus* White, 1884. Geol. Indiana, 13th Ann. Rept., pt. ii, p. 157. Coal Measures.

The various terms proposed at different times for members of the group defined by Phillips have been fully considered elsewhere. It is only necessary to repeat here the synonymy:

Buccinum Sowerby and others (In part) [Non Linné].

Buccinites Schlotheim, 1820. Petrefactenkunde, p. 127 (in part).

Macrochilus Phillips, 1841. Palæ. Foss., p. 103 (non Hope, 1838, Coleoptera).

Plectostylus Conrad, 1842. Jour. Acad. Nat. Sci. Phila., vol. VIII, p. 275. (Non Beck, 1837.)

Soleniscus Meek and Worthen, 1860. Proc. Acad. Nat. Sci. Phila., p. 467.

Duncania Boyle, 1879. Jour. de Conchyliologie (3), vol. XIX, p. 35. (Proposed for Phillips' genus.)

Macrochilina Boyle, 1880. Ibid., vol. XX, p. 241.

Soleniscus embraces the following American forms:

Soleniscus acutus (Sowerby).

Reported, but probably not American.

Soleniscus altonensis (Worthen).

Macrochilus altonense, Worthen, 1873. Geol. Sur. Illinois, vol. V, p. 593; *S. altonensis* Keyes, 1889. Am. Naturalist, vol. XXIII. p. 423. Lower Coal Measures.

Soleniscus ?? anguliferus (White).

Macrochilus anguliferum White, 1874. Prelim. Rept. Expl. and Sur., W. 100 Merid., p. 22. Coal Measures. Probably does not belong to this group.

Soleniscus brevis (White).

S. brevis White, 1881. Expl. and Sur., W. 100 Merid., Supp. vol. III, p. XXVIII; *Macrochilus ventricosum* Hall, 1858. Geol. Iowa, vol. I, p. 718 [preoccupied by Goldfuss]; *S. ventricosus* White, 1884. Geol. Indiana, 13th Ann. Report., pt. ii, p. 155. *S. brevis* Keyes, 1889. Am. Naturalist, vol. XXIII, p. 423. Coal Measures. It is quite evident that the young shells of several other species have been repeatedly mistaken for this species.

Soleniscus carinatus (Stevens).

Loxonema carinatum Stevens, 1858. Am. Jour. Sci. (2), vol. XXV, p. 259; *Macrochilus carinatum* Miller, 1877. Cat. Am. Palæ. Foss., p. 151; *S. carinatus* Keyes, 1889. Am. Naturalist, vol. XXIII, p. 423. Lower Coal Measures.

Soleniscus ? attenuatus (Hall).

Macrochilus fusiforme Hall, 1858. Geol. Iowa, vol. I, pt. ii, p. 718; *Loxonema nitidulum*? Meek and Worthen, 1860. Proc. Phila., Acad. Nat. Sci., p. 465; *Polyphemopsis nitidula ??* M. and W., 1866. Geol. Illinois, vol. II, p. 374; *Macrochilus attenuatum* Hall, 1877. Miller's Cat. Am. Palæ. Foss., p. 244 [M. fusiforme was preoccupied]; *Polyphemopsis fusiformis* White, 1880. Geol. Indiana, p. 519; *Soleniscus fusiformis* White, 1884. Geol. Indiana, 13th Ann. Rep., pt. 11, p. 154. *S. ? attenuatus* Keyes, 1889. Am. Naturalist, vol. XXIII, p. 423. Lower Coal Measures.

Soleniscus gracilis (Cox).

Macrochilus gracile Cox, 1857. Geol. Sur. Kentucky, vol. III, p. 570; *M. gracile* Keyes, 1888. Proc. Acad. Nat. Sci. Phila., p. 239. *S. gracilis* Keyes, 1889, Am. Naturalist, vol. XXIII, p. 423. Lower Coal Measures.

Soleniscus hallanus (Geinitz).

Macrochilus hallanum Geinitz, 1866. Carb. und Dyas in Nebraska, p. 5; *S. hallanus* Miller, 1877. Cat. Am. Palæ. Foss., p. 162. Upper Coal Measures.

Soleniscus ? hebe (Hall).

Macrochilus hebe Hall, 1862. 15th Reg. Rept. N. Y. State Cab., p. 48; *M. hebe* Hall, 1879. Palæ. N. Y., vol. V, pt. ii, p. 32. Hamilton; With considerable doubt referred to the genus.

Soleniscus humilis Keyes.

Macrochilus humilis Keyes, 1888. Proc. Acad. Nat. Sci. Phila., p. 239. *Soleniscus humilis* Keyes, 1889. Am. Naturalist, vol. XXIII. p. 423; Lower Coal Measures.

Soleniscus kansasensis (Swallow).

Macrochilus kansasense Swallow, 1858. Trans. St. Louis Acad. Sci., vol. I, p. 201. *S. kansasensis* Keyes, 1889. Am. Naturalist, vol. XXIII., p. 423; Upper Coal Measures.

Soleniscus klipparti (Meek).

Macrochilus klipparti Meek, 1872. Proc. Acad. Nat. Sci. Phila., p. 328. *S. klipparti* Keyes, 1889. Am. Naturalist, vol. XXIII., p. 423; Coal Measures.

Soleniscus newberryi (Stevens).

Loxonema newberryi Stevens, 1858. Am. Jour. Sci. (2), vol. XXV, p. 259; *Macrochilus newberryi* Hall, 1858. Geol. Iowa, vol. I, p. 719; *M. newberryi* Keyes, 1888. Proc. Acad. Nat. Sci. Phila., p. 240; *Soleniscus planus* White, 1881. Expl. and Sur. W. 100 Merid., Supp. to vol. III, p. xxix; *S. newberryi* White, 1884, Geol. Indiana, 13th Ann. Rept., pt. ii, p. 153. Coal Measures.

Soleniscus paludinæformis (Hall).

Macrochilus paludinæformis Hall, 1858. Geol. Iowa, vol. I, p. 719; *S. paludinæformis* White, 1884. Geol. Indiana, 13th Ann. Rept., p. ii, p. 154. Lower Coal Measures.

Soleniscus typicus Meek and Worthen.

S. typicus M. and W., 1860. Proc. Acad. Nat. Sci. Phila., p. 467; *S. typicus* M. and W., 1866. Geol. Illinois, vol. II, p. 384. Coal Measures.

Synonyms and Spurious Species.

Macrochilus altonense Worthen, 1889. Geol. Illinois, vol. VIII, p. 143. St. Louis Limestone. Preoccupied by Worthen in 1873. Too imperfect to deserve another name.

Macrochilus curvilineatum De Verneuil. Not American.

Naticopsis genevievensis Meek and Worthen, 1866. Proc. Acad. Nat. Sci. Phila., p. 268. Kaskaskia Limestone. Syn. of *Sphaerodoma littonana* (Hall).

Macrochilus hamiltonæ Hall, 1862. 15th Reg. Rep. N. Y. State Cab., p. 49. Hamilton Gr. Perhaps a *Holopea*. Certainly does not belong to the group under which it was described.

Macrochilus hildrethi (Conrad). *Phectostylus hildrethi* Conrad, 1842. Jour. Acad. Nat. Sci. Phila. Simply an imperfect natural cast of a form resembling *S. paludinæformis* (Hall). Coal Meas.

Macrochilus inhabile (Morton). *Fusus? inhabilis* Morton, 1836. Am. Jour. Sci., vol. XXIX, p. 160. Syn. of *Sph. primogenia* (Conrad).

Macrochilus intercalare Meek and Worthen, 1860. Proc. Acad. Nat. Sci. Phila., p. 467. Syn. of *Sph. medialis* (M. & W.)

Macrochilus macrostomum Hall, 1862. 15th Reg. Rept. N. Y. State Cab., p. 49. Belongs not to this group. Probably a *Holopea*.

Macrochilus missouriense Swallow, 1858. Trans. St. Louis Acad. Sci., vol. I, p. 201. Described from imperfect casts. Coal Measures.

Soleniscus planus White, 1881. Expl. and Sur. W. 100 Merid., Supp. to vol. III, p. XXIX. Syn. of *S. newberryi* (Stevens).

Macrochilus primaevium Hall, 1876. Illus. Dev. Foss., pl. xii. Imperfect casts.

Macrochilus pulchellum Meek and Worthen, 1860. Proc. Acad. Nat. Sci. Phila., p. 467. Syn. of *Sph. medialis* (M. and W.)

Macrochilus spiratum McCoy. Not American. Reported by Swallow.

Macrochilus ventricosum Hall, 1858. Geol. Iowa, vol. I, p. 718. Preoccupied by Goldfuss. Syn. of *S. brevis* White.

OCTOBER 1.

MR. CHARLES MORRIS in the chair.

Twenty-one persons present.

Notes on the presence of Umbral or Mountain Limestone in Lycoming County, Penna.—The following communication from Mr. Abraham Meyer, was read as part of the Proceedings of the Mineralogical and Geological Section:—

The Umbral (Red Shale formation) No. XI of Prof. Rogers' survey, divided by the State Survey into XIa, XIb, XIc—the middle member being called the Mountain Limestone—varies very much in the southwestern portion of the State and in its further extension through Virginia and Kentucky northward. It thins very rapidly and is not identified in the late survey north of Huntingdon Co. The formation XIb claims our attention from the fact of its having been altogether overlooked in the late survey of Lycoming County, and from its importance as a horizon for the location of measures occurring immediately above and below it. As it is in the southwestern portion of the State I have deemed the subject worthy of interest. Formations of this character carry with them in their widely distributed areas various deposits of commercial value, such as iron ores and fire clays, which, because of the extent of their exposure or outcrop, invite a very searching examination of their importance. There seems to be the regular succession of measures from No. XII—Seral Conglomerate, No. XIc, Umbral Upper Shale, No. XIb Umbral Limestone followedby No. XIa.

The formation No. XIb is shown in an exposure as a bold cliff on Hogelan Run, 6 miles north of Cogan Station, N. C. R. R. On the west side it is about 250 feet above the adjacent stream, about 1550 feet above ocean level at base of cliff, and about 1650 at the top of the ledge. The cliff extends about 160 rods around the head of a small run and then extends southwest a distance of about 2500 feet or more, the greatest vertical exposure being at the cliff locally known as Kugler's Point, where it is about 50 to 60 feet in height, forming a bold prominent cliff, an interesting feature in the landscape in passing up the gorge of Hogelan Run. Going over the measures we find they can be divided into sections as in the Trough Creek Valley deposits, as there seem to be various qualities of limestone and associated rocks. There are some seventeen or more changes of rock within sixty feet more or less—and among them we can identify three or four limestone strata from two feet to fifteen feet thick, some of which may have a value for agricultural purposes. I have also found an outcrop of this same formation XIb on Loyalsock Creek about ½ mile west of Barbour's Mills P. O. The measures there seem to thicken, especially XIc. Underlying the above formation are a variety of very interesting iron ores, shales, fire clays and mineral paints which deserve further notice.

OCTOBER 8.

Mr. CHARLES MORRIS in the chair.

Twenty-six persons present.

A paper entitled, "New and Little-known American Mollusks, No. 2," by H. A. Pilsbry, was presented for publication.

The Antennæ of Coleoptera.—DR. GEO. H. HORN spoke of the structure of the antennæ of coleoptera and of their being the seat of a special sense the exact nature of which is not definitely determined.

The locality of the sense is indicated by some peculiar surface sculpture and may be either generally diffused, concentrated in spots or limited to a small number of joints. As a general rule in those families in which the diffusion is general there is little or no variation in the total number of joints, while in families with a few terminal joints sensitive the basal joints vary in number within generic and specific limits, and at times the individual specimen may have the two antennæ unequal.

The view was expressed that, in those families with the concentration of the special sensory faculty in a few terminal joints, as in Scarabaeidae, Hydrophilidae and some Ptinidae, the entire number of joints in the antennæ should be used with extreme caution as a character for generic separation, without the presence of some supplementary characters.

OCTOBER 15.

The President, Dr. JOSEPH LEIDY in the chair.

Thirty-two persons present.

OCTOBER 22.

Mr. CHARLES MORRIS in the chair.

Twenty-one persons present.

A paper entitled, "On a new species of Spider of the Genus Dinopis from the Southern United States," by Dr. Geo. Marx, was presented for publication.

OCTOBER 29.

Mr. CHARLES MORRIS in the chair.

Twenty-five persons present.

Mr. Theo. H. Conderman was elected a member:—

The following were ordered to be printed:—

ON THE TAXONOMIC VALUES OF THE WING MEMBRANES AND OF THE TERMINAL PHALANGES OF THE DIGITS IN THE CHEIROPTERA.

BY HARRISON ALLEN, M. D.

When a bat with outstretched wing is held between the eye of the observer and a bright light the membranes are seen to be traversed by numbers of lines. Many of these are delicate trabeculæ of connective tissue,—in some instances continuous with the fascia of the forearm, or palm, in others with the capsules of the joints. They can be seen in some examples passing obliquely from the third metacarpal bone over the palmar surface of the fourth to the membrane between the fourth and fifth bones. The wing membrane is strengthened at the free margin by several trabeculæ which pass from the tibia at a point near the ankle to the second digit of the fifth finger. The course of vessels can be traced, as, for example, from the elbow forward and downward on the wing membrane, and on the interfemoral membrane. Tendons can be seen, as the tendon of the biceps at the elbow, that of the occipito-pollicalis, that of the flexor carpi-radialis at the angle between the radius and the fifth metacarpal bone, that of the abductor minimi digiti (which often permits light to pass beneath it), and that of the palmar interosseous along the first phalanx of the fifth finger. Separate fascicles of the panniculus can be detected either unattached (as is the rule) or continuous with some of the fibrous trabeculæ already mentioned, or united at one end to bone.

Prominent among the markings are those of the nerves. The following have been recognized: branches of the intercostal nerves, of the superficial branches of the lumbar plexus* and of the intercosto-humeral, the internal cutaneous, the external cutaneous and the median nerves.

A study of these details has led me to form a good opinion of their availability in describing families, genera and (sometimes) species.

When a specimen which is held for a moment before a moderately bright light can be assigned in the majority of instances to its true

* Since the superficial branches of the intercostal nerves are homologous with those of the lumbar plexus they are all named for convenience the intercostals,—the crural line is the lowest of the series.

position time is saved and the animal preserved intact. As may be anticipated the value of these characters varies in different groups. But even when they are not sufficiently trenchant to serve for the identification of species or genera, they always indicate affinities, and enable the observer, independently of other aids, to narrow the surmises of recognition to a limited field.

The details are of restricted use in studies of the dried skins. All statements (with three exceptions) must be considered as applicable to alcoholics only.

I have found it convenient to employ a number of names for the subdivision of the dermal expanse. Those which are now used for the first time are italicized.

The membrane which extends from the sides of the trunk to include the anterior extremity is the wing membrane (" bat-wing," patagium).

The membrane between the legs is the interfemoral membrane (uropatagium).

The wing-membrane above the arm and forearm is the *pre-brachium* (antebrachial membrane, propatagium).

The wing-membrane below the arm and forearm would become antithetically the postbrachium. But since the postbrachium could not be separated from the sides of the trunk and the legs it has been found necessary to discard it.

The part of the wing-membrane lying between the body, the humerus, the lower extremity and a hypothetical line drawn downward from the elbow and intersecting the free margin of the membrane, is the *endopatagium*. (Pl. X, fig. 1.)

The boundary at the elbow is often fixed by the vertical terminal branch of the intercosto-humeral line. The subordinate lines (probably platysmal in origin) in the endopatagium incline obliquely either toward the humerus or the trunk.

The part of the wing-membrane which is limited by the line at the elbow as above given, by the forearm, and the fifth metacarpal bone and phalanges, is the *mesopatagium*.* Within the mesopatagium the subordinate lines incline either toward the forearm or the manus.

The part of the wing-membrane limited to the manus becomes the *ectopatagium* (dactylo-patagium). The subdivisions of the ecto-

* The endopatagium and mesopatagium are together the same as plagiopatagium of Kolenati. (Beitr. z. Naturgesch. der Europ. Chir. Dresden, 1857.)

patagium are the first, second, third and fourth *interspaces*. These are named from the pollex toward the quintus. The series of bones which is embraced in the metacarpal and phalangeal lines being conspicuous in the bat, it is desirable to possess a name in refering to each series taken as a whole. The name digit will be used for the rod of segments embracing the metacarpal element. The nerve which appears at the anterior margin of a digit becomes *predigital*, and that of the posterior margin, *postdigital*.

The radio-metacarpal angle is the space defined by the angle of union of the forearm and the metacarpus.

The cartilaginous tip to the terminal bony phalanx respectively of the third, fourth and fifth fingers will receive the name of the third phalanx when three phalanges, and of the fourth phalanx when four phalanges are present.[1] The shapes of the terminal phalanges are of interest and some of these will be described.

I have examined a sufficient number of genera to suggest that an account of the markings of the wing-membranes, and of the shapes of the terminal phalanges enter into all discriminating studies. Inasmuch as the account includes descriptions of these parts in the North American bats the validity of the characters can be at once put to the test.

Artibeus perspicillatus.

The prebrachium with free margin occupied with a band 1mm. wide which apparently represents the tendon of the occipito-pollical—is muscle.

Intercostal markings conspicuous, four in number. The lowest is the largest and extends as far as the ankle. The oblique band, which extends upward and outward from the ankle on the mesopatagium in many genera, is absent in *Artibeus*. The intercosto-humeral line is conspicuous and extends to a point in vertical line with the elbow. The vertical platysmal fascicles are about 30 in number. The internal cutaneous system extends as far as end of the fifth finger. It is composed of three divisions, a vertical, oblique and a horizontal.[2]

The fourth interspace is provided with a faintly marked longitu-

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[1] Kolenati first identified the tips as phalanges.

[2] The horizontal line represents the main trunk of the nerve, and the vertical and oblique lines the branches. "Inferior vertical" and "superior oblique" (terms which are occasionally used in the notes) are amplifications of the last-named terms.

dinal line, which begins at a point 22mm. from carpus and extends to a point 10mm. from the free margin of the membrane. The predigital nerve appears at the middle of the fifth metacarpal bone, and is larger than the postdigital which appears at the metacarpo-phalangeal joint of the third finger.

The third interspace is provided with a longitudinal line as in the fourth. This line extends from near the palm and reaches to within 10mm. of the free margin of the membrane. A nerve appears at the metacarpo-phalangeal joint of the fourth finger and lies obliquely across the lower part of the interspace.

The fourth phalanx of the third digit is sickle-shaped, the membrane extending from its tip; that of the fourth digit is of the shape of an inverted T; that of the fifth finger is triangular, the angle, which is directed toward the body, being prolonged.

Centurio senex.

Centurio is remarkable for the system of unpigmented spaces in the mesopatagium near the radio-metacarpal angle and in having the fourth interspace entirely occupied by these transversely arranged spaces. No nerves appear in any position of this interspace. In other respects the membranes are as in other Phyllostomidæ.

Carollia.

In *Carollia* the lines are essentially of the same type as in *Artibeus* and need not be described.

Vampyrus spectrum.

The prebrachium with several obliquely placed lines which pass upward and forward from the forearm.

In this form the longitudinal lines of the third and fourth interspaces are much the same as in *Artibeus*. The predigital nerve of the fourth interspace is small and appears directly above the metacarpo-phalangeal joint. A well-defined tendon is seen lying parallel to the first digit of the fifth finger. The postdigital arises from the metacarpo-phalangeal joint of the fourth finger. An homologous arrangement of nerves is seen in the third interspace. In the interfemoral membrane an oblique line (pubo-tibial) extends from pelvis to the middle of the tibia and an axial line in the center the entire length of the interfemoral membrane. A line passes from the knee obliquely downward and outward and is apparently one of the intercostal series; but there is none passing upward and outward from the tibia. Of the terminal digits that of the third is the same as in *Artibeus;* that of the fourth is triangular with the long angle directed toward the body; and that of the fifth is much the same but the angle is so far produced that the form of the triangle is scarcely discernible.

Phyllostoma hastatum. (Pl. x, fig. 1.)

Prebrachium. An oblique line crosses prebrachium near the wrist, a branch of a line and which runs parallel to the radius.

Endopatagium, with two intercostal lines, and a number of oblique secondary (muscle) lines. The intercosto-humeral line appears at the middle of the humerus. Its main branch reaches the line of the elbow and thence passes downward to near the free margin. The internal cutaneous line with a vertical line near the elbow, and a single large two-partite superior oblique line. The main line goes nearly to the end of the fifth metacarpal bone, one branch going toward the metacarpo-phalangeal joint. An oblique raised line extends on the membrane from the end of the muscle-mass. The fibers continuous with this line can be traced nearly as far as the end of the fifth digit. A distinct line begins at the tip of the fifth finger and passes upward in a straight line. The terminal branches of these two lines in part mingle.

The fourth interspace presents six lines in the predigital series. Of these one is a raised oblique line from the muscle-mass; a second answers to the nerve commonly found in the order. The postdigital lines are two in number,—one from about each joint.

The third interspace with a large predigital which extends obliquely across the membrane to the end of the third digit. The postdigital is small and unimportant. The longitudinal line is present in both the fourth and third interspaces.

The interfemoral membrane is marked by four vertical lines; the pubo-tibial is absent.

Schizostoma sp ?

The endopatagium is occupied by four vertical lines which are forked above. The lowest (crural) line of the intercostal series alone seen. The intercosto-humeral line absent. Mesopatagium. The internal cutaneous line with a large vertical at the elbow. A single large superior oblique is present which reaches the fifth metacarpal bone. The main line reaches the end of the fifth finger.

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[1] When a line is absent it is implied that it is not seen, and not that, by dissection, it cannot be demonstrated.

The ectopatagium exhibits five predigitals,—the largest appears at the distal third of the fifth metacarpal bone, and apparently is the same as the single predigital of some other species of Phyllostomidæ. The longitudinal line in the fourth and third interspaces conspicuous. No pubotibial line in the interfemoral membrane.

Glossophaga soricina.

The endopatagium without intercostal line present save the lowest or crural. The intercosto-humeral a mere unbranched line near the elbow.

The mesopatagium without a superior oblique line. No fold is seen at the muscle-mass of the fifth metacarpal bone or line along the fifth digit. In the fourth interspace a single predigital appears at the distal fifth of the fifth metacarpal element. In a second specimen a second predigital appeared at the metacarpo-phalangeal joint.

Vampyrops lineatus.

The endopatagium with four intercostals,—the lower being branched. No oblique muscle lines. The intercosto-humeral line is faintly expressed, barely discernible. The remaining lines as in *Artibeus.* An oblique line from the muscle-mass. This line is continuous with one extending parallel to the digit to end at the terminal of phalanx. There are eleven secondary (muscle) lines in mesopatagium.

Vampyrops helleri.

Much the same as in *V. lineatus.* The line from the fifth metacarpal bone in the mesopatagium is not raised at the muscle-mass and is everywhere indistinct.

Desmodus rufus.

The prebrachium with the greater part with depressed tendon so that the space which is inclosed between the tendon and the free margin is crescentic.

Endopatagium. The intercostals inconspicuous, eleven (?) counted. The lowest of these is the longest. The intercosto-humeral is inconspicuous and ends at a point proximal to the elbow.

The internal cutaneous line of the mesopatagium with conspicuous vertical branch in advance of the elbow and with two oblique superior branches. The line ends 1mm. somad of the end of the fifth digit. The secondary lines are about eighteen in number and approach the radio-metacarpal angle.

The fourth interspace. The predigital appears at the middle of the fifth metacarpal bone. The postdigital is curved and appears just proximal to the end of the fourth metacarpal bone.

The third interspace. The predigital from the fourth metacarpo-phalangeal joint.

A well-defined longitudinal line is seen in the third interspace but none in the fourth.

The fourth phalanx of the third finger is flexible as in *Artibeus*. The fourth phalanx of the fourth finger is minute, scarcely visible, axial; that of the fifth finger is membranous, and deflected somad.

Diphylla ecaudata (dried skin).

The endopatagium with intercostals six in number distinct, the lowest is the longest. The intercosto-humeral arises near the axilla and does not reach the elbow.

The internal cutaneous apparently without vertical or oblique branches. A distinct oblique fold, as in *Noctilio*, passes downward from the muscle-mass of the fifth metacarpal bone. Secondary lines about fifteen in number, but do not approach the fifth digit or the radio-metacarpal angle.

The only line seen in the ectopatagium is the oblique predigital of the fourth interspace. It appears at the middle of the fifth metacarpal bone. The terminal digits apparently much the same as in *Desmodus*.

Brachyphylla cavernarum.

Prebrachium ample, volant entire length. A thickened border is seen but no markings.

The lines of the endopatagium, which appear to represent the intercostals, four in number. A great number of more delicate lines, which appear to be connective-tissue trabeculæ with nerve-endings, are also seen. The intercosto-humeral line is first seen at the middle of the humerus. It forks once and ends at the margin of the membrane on a line with the elbow.

The internal cutaneous line sends a vertical branch downward at the elbow, and a second, half-way along the course of the line. Two superior oblique lines are seen. Fifteen vertical lines, most of which transect the main line, can be counted.

The fourth interspace with predigital line from the distal third of the fifth metacarpal bone. The postdigital from the metacarpo-phalangeal joint of the fourth digit. The longitudinal line confined to the space between these lines. The third interspace with nerves as is so generally the case with the Phyllostomidæ, viz., the predigital from the metacarpo-phalangeal joint and the postdigital from the first interphalangeal. The longitudinal line is conspicuous the entire length of the interspace.

The terminal phalanges are much the same as in *Artibeus* but that of the fourth digit is less lobate.

A caudo-tibial line conspicuous in the interfemoral membrane.[1]

Noctilio leporinus.

The prebrachium without distinctive markings. The thickening in the tendon of occipito-pollical muscle as long as the thumb and lies on the radius.

Intercostal lines small inconspicuous. The intercosto-humeral small unbranched, does not reach farther than elbow. The internal cutaneous system of two divisions, the vertical being absent. The oblique line with long horizontal primal branch. The abrupt transition of the oblique fibres from the horizontal line is the same as in *Atalapha*. Thirteen vertical lines traverse the mesopatagium. An elevated oblique fold of skin passes downward and backward from the palmar aspect of fourth and fifth metacarpal bones.

In the fourth interspace the digital nerves appear at the middle of metacarpals. The postdigital is seen running parallel to the fourth metacarpal bone before being distributed to the membrane. A tendon is seen on either side of the fifth rod at its distal third. At the first interphalangeal joint of the third and fourth fingers a nerve appears on the opposed sides of the third interspace and each is distributed separately to the membrane.

Interfemoral membrane scarcely translucent in portion carrying the tail and is traversed by a line without subdivisions on either side of the tail. The infracaudal portion is much thinner than the caudal and is traversed by an oblique line much divided on either side of the terminal point of the tail. Respecting the differences in translucency of the interfemoral membrane it is seen that a similar contrast is seen in the wing-membrane, viz., in the endopatagial and mesopatagial tracts. These portions in *Molossus* and *Atalapha* are apt to be more or less hairy.

The sickle-shaped terminal phalanx of the third finger is free; that of fourth finger is thread-like, sigmoid, and inclosed; and that of the fifth digit acicular, deflected toward body and is also inclosed.

[1] *Brachyphylla* has been described as tailless. In a number of examples recently examined a tail measuring 3mm. was detected.

Emballonura semicaudata.

The prebrachium with middle third of margin thin; answering to it is a concave line about 2 mm. distant in the center but reaching margin of membrane at the ends of the middle third; passing downward from the crescent thus defined are four oblique lines. The prebrachium as it joins the shoulder is slightly thickened.

The endopatagium with indistinct lines, the general disposition of which are the same as in *Miniopteris.* The lowest line appears to arise from the knee. The intercosto-humeral line quite the same as in *Miniopteris.*

The internal-cutaneous much the same as in this genus, but is less developed, the terminal branches being smaller.

A tendon lies on endopatagium forming a concave line along side of the first digit of the fifth finger. The fourth interspace shows a single nerve, viz., the predigital which appears at the middle of the muscle-mass at distal end of the fifth metacarpal bone and passes obliquely downward and forward across the entire interspace. In the third interspace a nerve appears from the opposed metacarpo-phalangeal joints, as in *Vampyrus*, *Noctilio*, etc.

The lines in the interfemoral membrane as in *Noctilio*, with the exception that the pelvic line extends to the free margin instead of to the middle of the tibia.

The terminal phalanx of the third finger sickle-shaped not cartilaginous; the membrane is attached to its tip, and is without pigment in the space which answers to a line uniting the two ends of the phalanx. The terminal phalanx of the fourth finger is acicular, the extreme tip alone projecting from the membrane; that of the fifth finger is half the length of the last named, presents a free tip, and is entirely free on the outer (pollical) side.

Saccopterya leptura.

Prebrachium is abruptly narrowed at the distal end of the muscle-mass of the forearm; thence it gradually widens to the thumb. The margin is crescentic, and almost equals the rest of the membrane in area. The membrane is traversed by a single line apparently from the external-cutaneous nerve.

The intercostals eleven in number. The intercosto-humeral rudimentary scarcely reaching to the elbow. Internal-cutaneous line with a sharply curved branch descending from near elbow. The superior oblique single. The main line extends obliquely toward the end of the fifth digit.

The predigital line of the fourth interspace appears near proximal end of the fifth digit. It crosses obliquely the interspace to the end of the fourth digit. It sends a branch which runs along the fifth digit. In a second example two predigital nerves were present.

Interfemoral membrane with faintly marked caudo-crural lines which extend from the tail to the tibia at the ankle.

Miniopteris schreibersii.

The prebrachium with a broad marginal band (tendon of occipito-pollical?) but without oblique lines to the delicate line extending concentric to the marginal band.

Lines of endopatagium six in number, conspicuous. Intercosto-humeral line originates near the axilla and reaches the free margin of the wing-membrane at a point below the elbow. The internal-cutaneous system composed of the oblique or main fibers only, and ends abruptly after a long horizontal branch, as in *Noctilio*. It is distributed quite to the tip of the fifth finger. Vertical lines beneath main line fibers abundant, at least seventeen in number, crowded toward the end of the line. The oblique line from the ankle conspicuous and joins the intercosto-humeral.

The fourth interspace shows the predigital nerve extending parallel to the fifth metacarpal bone to its distal third and is thence deflected obliquely downward and forward to the end of the fourth digit. The postdigital often absent; when present it is small and inconspicuous. The third interspace has a predigital nerve appearing at the first interphalangeal joint of the fourth finger, and a larger postdigital from the metacarpo-phalangeal joint of the third finger.

The interfemoral membrane shows a distinct pelvo-tibial line and three symmetrical lines from the caudal vertebræ. Two faint lines run down from palm for a centimeter apparently in the position of the fibrous lines which extend from the palm to this membrane in *Molossi*.

The sickle-shaped terminal phalanx of the third finger has a free tip and a cutaneous hem on pollical side.

The terminal phalanx of the fourth finger is small acicular, inclosed and directed dorsal with a slight inclination pollical; that of the fifth finger is about the length of the preceding, is acicular, directed somad, the extreme tip projects, and is free on pollical side.

The distribution of the fur on the interfemoral membrane is of sexual significance. In the female the short hair is sparsely diffused at the base of the tail and along the caudal vertebræ and is absent from the dorsal space defined on the one side by the femur and proximal half of the tibia and on the other by the pelvo-tibial line. In the male the membrane is generally more hairy and the space defined is covered as is the rest.

Rhinopoma microphyllum.

The endopatagium and mesopatagium with numerous vertically disposed bands extending well up in radiometacarpal angle. Intercosto-humeral line inconspicuous. Internal-cutaneous with two very long slender superior-oblique lines one of which reaches the radiometacarpal angle. Muscle-mass without oblique folds. The fourth interspace with conspicuous predigital nerve which appears at the middle of the fifth metacarpal bone. The postdigitals are four in number,—the lowest is also the largest and appears at the distal fourth of the fourth metacarpal bone. The third interspace with three very small predigitals from the first phalanx of the fourth digit, and a single postdigital from the metacarpo-phalangeal joint of the third. Tips to the terminal digits apparently absent.

The general resemblance of these characters with those of Taphozous is striking. The chief contrast is the apparent absence of the postdigitals in the fourth interspace.

Taphozous mauritianus. (?)

Prebrachium with middle crescentic portion as in *Saccopteryx* and a nerve is seen in the membrane near the wrist. The angle of the elbow occupied by a thicker sharply-limited membrane than elsewhere.

Endopatagium with 20 oblique lines of the intercostal series, the lowest not the largest. The intercosto-humeral is axillary, simple, undivided. It reaches the line of the elbow only near the margin of the membrane.

The internal-cutaneous line with three vertical lines from the horizontal portion, four superior oblique lines, the main line ending near the end of the fifth digit. The oblique lines on membrane sixty-seven in number and extend well up towards the radiocarpal angle.

A set of lines distinct from the foregoing occupy the region of the elbow. They are continuous in part with the intercosto-humeral line, and in part are attached to the forearm at the elbow. The mesopatagium near the phalanges of the fifth finger retains a number of delicate lines which appear to be different from those already named.

The radiometacarpal angle occupied by a deep duplicature of membrane. A small portion of the radial side of the fold attached to a fold lying directly upon the membrane. Extending from the radius at this fold a vertical line is conspicuously seen.

Predigital, one only; it arises high up from the fifth metacarpal bone and extends obliquely across membrane. Postdigital absent.

The postdigital is absent in the third interspace.

Interfemoral membrane with pubotibial line. A vertical line is seen extending entire length of membrane at a point midway between the tail and the leg. The membrane occupied by a set of numerous transverse lines and a second oblique set.

Membranous terminal phalanges apparently absent. The specimen is in bad condition.

Atalapha cinerea.

The prebrachium without details. The lines of the endopatagium are indistinct owing to the hairiness of the membranes. The inter-costo-humeral line extends to the free margin as in *Miniopteris* and *Emballonura*.

The internal-cutaneous system crosses the elbow at origin, is without vertical branch, but yields two horizontal primal branches; these extend across the membrane near each other and appear to end in the abruptly determined comb-like endings which do not reach the region of the phalanges of the fifth finger. There are two oblique lines extending downward and somad from the muscle-mass at distal end of the fifth finger.

The fourth interspace has the predigital nerve as in *Miniopteris* while the terminal branches do not reach the digits of the fifth finger but join a branching nerve which appears from the metacarpo-phalangeal joint' of the fourth finger. A small unbranched line (postdigital nerve?) appears at the middle of the fourth metacarpal bone.

Two oblique bands are seen on the fourth interspace near the palm. A fork-like arrangement of lines is seen in the angle between fourth and fifth metacarpal bones and appears to be a branch of the median dividing into the two branches commonly seen in this interspace. In the third interspace a similar arrangement is seen but the main nerve pursues a longer course before dividing. At the region of the digits there are two predigital nerves and three postdigitals. In this portion of the membrane therefore an unusually large number of lines are seen. It is possible some of these lines pertain to the blood vessel system.

The pelvotibial line is not seen on the interfemoral membrane; but the oblique lines from the caudal vertebræ are distinctly visible.

The terminal phalanx of the third finger is curved only at the tip and no part thereof projects; that of the fourth finger is acicular, deflected at a right-angle pollical to the second; it yields a free projecting tip; that of the fifth finger is acicular, is deflected somad and inclosed only on this side.

The membrane of the first interspace can be discerned everywhere along the line of the wing except at part of the first phalanx of the third digit.

Atalapha noveboracensis.

The parts much the same as in *A. cinerea* with the exception of the intercostal lines which are more distinct than in that species and the horizontal limbs of the internal-cutaneous system are farther apart. The third interspace is without predigital lines. The terminal digit of the fourth finger is without projecting lobe; that of the fifth finger is minute.

Lasionycteris noctivagans.

The prebrachium with distinct tendon of occipito-pollical muscle. The external-cutaneous nerve is seen crossing the angle between the arm and forearm near the elbow. Three conspicuous intercostal lines are discerned.

The intercosto-humeral line unites with the internal-cutaneous system. It arises high up near the axilla. The internal-cutaneous system with vertical oblique and horizontal lines discernible. None of the terminal lines of the foregoing, viz., the intercostal intercosto-humeral or internal-cutaneous reach the free margin of the wing-membrane. No vertical lines apart from the foregoing are discernible. The oblique tibial line arises from near ankle and extends as far as the intercosto-humeral at the elbow.

A delicate forked line extends downward and somad from lower part of muscle-mass at the proximal end of the fifth metacarpal bone.

The fourth interspace exhibits the predigital nerve appearing in a well-defined elevated fold of membrane at the side of the muscle-mass just named. The line forms a curve and extends about one-half way down the shaft of the fifth metacarpal bone when it is lost along the line of the shaft. The main branch of the nerve arises from the middle of the curve and passes downward and forward but does not extend beyond the middle of the interspace, nor quite to its free border. The postdigital arises high in the interspace apparently from the palm, approaches the fourth metacarpal bone at its proximal end but soon leaves it and is distributed to the anterior half of the interspace.

The third interspace shows a delicate line from the first interphalangeal joint of the fourth finger and a second longer one from the metacarpo-phalangeal joint of the third finger.

The interfemoral membrane shows the oblique line above called subtibial but in this form it is caudotibial since it arises from the side of the first caudal vertebræ.

The terminal phalanges much the same as in *Atalapha*. The parts are all delicate; the terminal phalanx of the third digit is sigmoid and less rigid than in any species examined. The tip of the terminal phalanx of the fourth digit is minutely lobed and free.

The markings in *Vesperus*, *Vesperugo*, and *Vespertilio* are among the most intricate of any in the order. My material has not enabled me to do more than give a general idea of the parts. The characters appear to be more sharply defined in *Vespertilio* than in *Vesperus*, and often yield good characters in separating species, As may be expected the American species are the most difficult. I may here mention that owing to the close resemblance in general appearance and similarity of habit of *Vesperugo georgianus* and *Vespertilio subulatus* the two species are frequently found in the same jar and both receive the name of the commoner form, *V. subulatus*. Brief examination is alone required to separate them. The two predigitals and absence of the postdigitals in the fourth interspace of *Vesperugo georgianus* being easily separated from the symmetrical arrangement in *Vespertilio subulatus*.

Vesperus fuscus.

The parts throughout much the same as in *L. noctivagans*. There is a small oblique band at the muscle-mass at proximal end of the fifth metacarpal bone on the mesopatagium and one on the fourth interspace. The intercostal lines five in number. The postdigital as a rule appears as one of two terminal branches which arise from a common trunk in the angle formed by the approximation of the fourth and fifth metacarpal bones. The line may in some instances approach the fourth metacarpal and in some the fifth, when the arrangement resembles that of *Vesperugo georgianus*. The predigital nerve shows the line from the muscle-mass scarcely elevated. The terminal phalanx of the fourth digit L-shape.

Vesperugo georgianus.

Intercostals three in number. Intercosto-humeral from the axilla. The fourth interspace with two long conspicuous predigitals, but no postdigital. The third interspace with the nerves from the metacarpo-phalangeal joints. In a few specimens the two postdigitals arise from a common line which extends parallel to the fifth metacarpal bone in which case a close resemblance to some forms of *Vesperus fuscus* is seen. The terminal phalanx of the fourth finger as in *L. noctivagans.*

Vesperus discolor.

Intercostals four; intercosto-humeral at middle of the humerus simple. Internal-cutaneous with two inferior vertical lines. A conspicuous raised oblique line on mesopatagium from the muscle-mass of the fifth digit. A second oblique line (but smaller than the foregoing) on the fourth interspace. The predigital of this interspace appears from the fourth metacarpal bone 2mm. above the metacarpo-phalangeal joint.

Vesperus noctula.

The prebrachium with ridge over position of thickening on tendon of occipito-pollicalis. The mesopatagium retains an oblique fold from muscle-mass and a second from the same in the fourth interspace. The radiometacarpal region without raised folds from radius. This interspace retains a long predigital from the center, no nerve appearing from the fifth digit itself. The predigital is a small nerve appearing a short distance proximal to the fourth metacarpo-phalangeal joint.

In *V. lasiopterus*, a closely allied species, the folds from radius near the wrist are raised and the one nearest the wrist conspicuous as in *Nyctinomus* and *Molossus.* The predigital nerve of the fourth interspace showing a disposition as in *V. fuscus*, viz., to divide high up, the main nerve to be a little convex to the line of the digit, and a large branch to arise from this convexity to be distributed to the membrane. The postdigital as in *V. noctula.*

These distinctions of the markings of *V. noctula* and *V. lasiopterus* correlate with others in the auricle, the outer border in the species last named being less well developed. The terminal phalanx of the fourth finger is L-shaped.

Vesperus hesperus.

Intercostals three in number, the lowest appearing at the knee and passing to the free margin of the endopatagium.

Intercosto-humeral appears at the middle of the humerus; it is simple and apparently joins a vertical line which is extended downward from the elbow.

The internal-cutaneous with a single inferior line, but with no superior obliques.

The fourth interspace with digital nerves as in *Vespertilio*, in this regard markedly differing from other examples of *Vesperus* which have been examined.

The interfemoral membrane provided with a pubocalcaneal line.

Scotophilus temminckii.

Prebrachium with ridge appearing on dorsal surface near the radius as in *V. noctula*. The intercostals two in number raised and bold, the lower receives an accession from the region of the knee. The intercosto-humeral unbranched. It appears at the middle third of the humerus. A well-defined oblique tibial line passes upward and outward. The internal-cutaneous nerve is of great simplicity, the superior obliques small, and imperfectly defined, the inferior two in number, bolder. The nerve ends in a linear structure to the side and beyond the terminal phalanx of the fifth digit, as in *V. murinus* The muscle-mass of this digit with two oblique lines.

The fourth interspace with one oblique line from the muscle-mass. The predigital much the same as in *Vesperugo fuscus* The main nerve in the angle divides below the oblique line, one branch going to the fifth digit and the other forward and downward obliquely across the interspace. The postdigital is small and appears at the metacarpo-phalangeal joint.

The third interspace with the predigital from the first interphalangeal and the postdigital from the metacarpo-phalangeal joint.

The interfemoral membrane with several caudal lines and one long branched line from pubis which does not, however, reach the tibia.

V. subulatus var. from Mammoth Cave.

The prebrachium as in *Vesperus*. The endopatagium with eight oblique lines extending from the trunk and the leg. These lines are distinct from those described in other species. They pursue a different course, end on the intercosto-humeral system, and appear to be distinct from the nerves of the side of the body and the posterior extremity. These last named are so faint and indistinct that they cannot be accurately noted. At the knee an oblique band extends outward and downward and intersects the oblique tibial band, which in this genus is of large size and can be traced across the wing membrane almost to the forearm.

The intercostal humeral line arises high up towards the axilla, is slightly curved with the concavity toward the body, and is intimately associated with the oblique lines already described. Beyond these lines and at a point proximal to the elbow, a delicate line extends below this joint where it terminates on a line between the elbow and ankle. The internal cutaneous system arises to inner side of humerus directly proximal to elbow. It soon divides into two branches, the vertical and oblique. Above the oblique is a delicate line in the position of the horizontal of other forms, but it appears to be fibrous only, that is to say is part of the trabecular system and is distinct from the nerve or vessel. This line may receive the name, *paraneural.* A very delicate oblique band is discernible by careful inspection at the muscle-mass at proximal end of the fifth metacarpal bone, extending on the prebrachium.

The fourth interspace exhibits a single nerve in palmar end of space. This soon divides into a predigital and a postdigital. The predigital runs near the fifth metacarpal bone and parallel with it to its middle; it is then deflected obliquely downward and forward to supply more than half of the fourth interspace. The postdigital lies along side of the fourth metacarpal bone as far as the middle and thence is deflected at a more acute angle than the preceding nerve and is distributed to the anterior third about of the interspace. The predigital divides just before reaching the metacarpo-phalangeal joint. The postdigital is seen just above the first interphalangeal joint. The third interspace has a delicate nerve passing downward and forward from the first interphalangeal joint of the fourth finger and a second longer nerve from the metacarpo-phalangeal joint of the third finger.

The terminal phalanx of the third finger of very flexible cartilage, that of the third finger angulated at distal third, but not L-shaped; that of the fifth finger deflected so as to lie its entire length in the free margin of the membrane.

Interfemoral membrane without distinctive lines.

Vespertilio ciliolabrum.

The membranes throughout as in *V. subulatus.*

The terminal phalanx of fifth finger with lobe-like tip and less deflected from line of the second phalanx toward the body.

Vespertilio nigricans.

Presents a thickened fold on the border of the prebrachium. Intercostal lines four in number. Intercosto-humeral rudimentary.

Fourth interspace with two predigital lines. The lower of these is the largest and crosses the fifth digit. A minute fold extends on the mesopatagium at the point of crossing. The postdigital is less oblique than the foregoing.

Vespertilio murinus.

Endopatagium. Intercostal lines three, conspicuous. Intercosto-humeral line undivided. The internal-cutaneous with four inferior vertical lines, none of them crossing the main nerve. The paraneural ones do not reach to within a centimeter of the radius. A conspicuous linear marking ends in a tip along side of the terminal phalanx of the fifth digit and appears to receive some of the endings of the internal-cutaneous.[1] The oblique line from the muscle-mass is inconspicuous.

In the fourth interspace a marked linear fold lies in angle. The oblique fold from muscle-mass well developed. The predigital and postdigitals as in *V. subulatus,* excepting that a separate nerve appears at the metacarpo-phalangeal joint of the fifth finger.

The terminal phalanx of the fourth finger T-shaped; that of the finger is acicular and is enclosed in membrane.

Corynorhinus macrotis.

The markings are of the same general character as in *Vespertilio.*

Nycyicejus crepuscularis.

Intercostals four. Intercosto-humeral appears near axilla and becomes vertical a little beyond the elbow. The internal cutaneous with a single superior oblique and a single vertical inferior: The line above the main trend of the nerve as in *V. fuscus.* The fourth

[1] The appearance in *V. murinus* at the region of the mesopatagium along side of the terminal phalanx of the fifth digit is due to a rod of cartilage which resembles in structure that of the terminal phalanx. The details of the disposition of this stylus varies in different forms. It is broad and spatulate in *Vesperugo discolor* but acicular in *Vespertilio mystacinus.* The stylus is constant in many forms, and inconstant in others. It is not separately described in the notes since its nature was not detected until the paper was going through the press.

interspace as in this species except that the postdigital appears at the proximal sixth of the fourth metacarpal bone. In one specimen it was absent. Oblique tibial and pubo-tibial lines as in this species.

Mormoops blainvillei.

Prebrachium with a tendon lying parallel to free margin at middle third. An oblique line extends from the humerus forward and upward.

Intercostals nine in number, reaching side of trunk, the lowest not larger. The intercosto-humeral forked, reaching the line of the elbow; several small branches of this line before division pass obliquely downward. Internal cutaneous passes to the extreme tip of the mesopatagium. The main line horizonal to the middle of the membrane and thence abruptly deflected downward and outward. Two superior obliques, six inferior obliques. A broad raised fold extends obliquely on mesopatagium from the muscle-mass of the fifth digit. The fourth interspace with predigital high up on the fifth digit from the side of the muscle-mass and supplies two-thirds of the membrane, the postdigital arises from near the proximal end of the fourth digit and supplies anterior third.

Interfemoral membrane without pubotibial line. Beyond the point at which the tail emerges a straight line continues to the free margin. Two lines pass from the tail, one obliquely to reach the margin, one transversely to reach the calcaneum near the ankle. Three faintly-expressed lines pass from the thigh and leg downward. Terminal phalanges quite different from *Chilonycteris*, that of the third finger ossified with second digit, the remaining two apparently absent, possibly ossified with the second phalanx of their respective digits.

Chilonycteris davyi.

Prebrachium tendon seen parallel to proximal half but no oblique tendon traverses the membrane from the humerus. Intercostals fourteen and do not reach the body. Intercosto-humeral as in *Mormoops*. The internal cutaneous lines thirteen, six of these are confined beneath the main line and are the same as the inferior verticals of other descriptions in this paper. The succeeding two intersect the main line where it turns from the horizontal to an oblique position. The remaining lines pass up toward the radio-metacarpal angle and are ranged on the trabeculæ of the membrane. The tip of the nerve goes to the extreme tip of the fifth digit. A small oblique fold concealed beneath lateral border of the muscle-mass of the fifth digit.

In the fourth interspace the general arrangement as in *Mormoops*. A faint attempt at the formation of a logitudinal line seen. The postdigital arises from the end of the proximal third of the fourth digit. The predigital and postdigital unite.

The interfemoral membrane as in *Mormoops*, the branches from the thigh and leg inconspicuous or absent.

Tips of digits much as in *Molossi*.

Natalus stramineus. (Plate x, fig. 3.)

Endopatagium with seventeen intercostal lines. Intercosto-humeral attached to proximal third of the humerus; it divides once before reaching line of the elbow whence it passes almost to margin of the membrane.

The internal cutaneous with seven conspicuous vertical inferior lines; one doubtful superior oblique present. Above the main nerve two lines run parallel to it. One of these ends abruptly whence a vertical line extends inferiorly. A rectangular disposition of lines. The second passes to the metacarpo-phalangeal joint.

The fourth interspace with pre- and postdigital nerves symmetrically disposed. Each nerve arises high up on the metacarpal.

The angle of this interspace occupied by a sharply defined fold An apparent attempt at the formation of a longitudinal line is the third interspace opposite the first phalanges. The terminal phalanges simple small and inconspicuous.

Thyroptera bicolor.

Intercostals five and reach side of trunk. Intercosto-humeral near axilla, simple unbranched. Internal cutaneous without superior oblique. The line is intersected by four verticals, nine toward radiocarpal angle.

A delicate line appears at the radius near the elbow and ends on the mesopatagium near its middle. This appears to be homologous with the line above the internal-cutaneous in *Vespertilio*, *Vesperugo*, etc.

Fourth interspace. Three predigital lines. All are small, the lowest the largest and arises from the digit at distal fifth of fifth metacarpal bone. Near the angle of the interspace but to the side of the fifth digit is a large nerve which appears to be the same as the postdigital, which in place of arising near or at the apex as in

V. fuscus or from the fourth digit, as in many forms belongs actually to the opposed side of the interspace.

The third interspace with a large predigital which arises from the side of the fourth digit half up the side of the metacarpal bone. The post digital is absent.

The interfemoral with numerous transverse lines as in *Vespertilio* and allies. Two lines are attached to the tail, one passing to the ankle and one to the free margin of the membrane as in *Mormoops*.

The terminal cartilages as in *Vespertilio* except in the instance of the fourth finger which is bilobate.

Nycteris sp?

The intercostal nerves are rudimentary and six in number. The intercosto-humeral leaves the arm at the elbow and descends vertically thence. The internal-cutaneous nerve sends a large branch to the fifth metacarpal bone. The predigital nerve of the fourth interspace appears high up near the angle. The postdigital is absent.

The third phalanx of the third finger one-fifth the length of second phalanx. It is deflected somad at the margin. Well-defined membranous phalanges are seen on the fourth and fifth fingers. The fourth terminal phalanx is of cartilaginous consistence.

Megaderma spasma.

Prebrachium with a line on the distal part as in *Pteropus*. One middle conspicuous intercostal, and one lower line (crural). The intercosto-humeral system composed of two lines, which appear at the distal fourth of the humerus but pass scarcely at all beyond the line of the elbow. The internal cutaneous line sends a branch to the fifth metacarpal bone as in *Nycteris*.

The fourth interspace in addition to the predigitals and postdigitals from the metacarpo-phalangeal joints possess a large nerve which arises by two roots from the side of the fifth metacarpal bone

The interfemoral membrane with remarkably distinct pubotibial bands. The distal third of membrane much less translucent than the proximal two-thirds. The free margin of the endopatagium often presents a similar appearance. All the terminal digits are well developed, membranous and lie somad in the free margins of the membrane.

The third interspace crossed by a line which unites the metacarpo-phalangeal articulations. A number of symmetrically arranged pigment patches are arranged on either side of this line.

Megaderma frons. (Plate x, fig. 2.)

Prebrachium with a vertical line from the angulated portion of the free margin. Endopatagium with six intercostal lines. Intercosto-humeral composed of two lines at its appearance from the proximal end of the humerus; these unite to form a single line below the elbow. The internal-cutaneous with six inferior vertical lines and an equal number of superior vertical. No superior oblique lines are seen. A separate pannicular line lies beyond the range of the internal-cutaneous. The predigitals of the fourth interspace three in number; all are short,—the most proximal of the three being the longest. The postdigital is small and appears a short distance above the metacarpo-phalangeal joint of the fourth finger. The predigital of the third interspace appears at the metacarpo-phalangeal joint of the fourth digit. The postdigital from the first interphalangeal of the third digit. Two delicate trabeculæ extend across the third interspace between the metacarpo-phalangeal of the fourth and the first interphalangeal joint of the third finger.* The interfemoral membrane shows a short caudal line with a long conspicuous line extending thence to the ankle. The movable tips on ends of osseous phalanges, exceedingly rudimental.

Rhiolophus philippinensis.

The prebrachium without characteristic lines.

The endopatagium with well-marked lines extending from body, thirteen in number, the lowest being the stoutest.

The intercosto-humeral line extends beyond elbow before being deflected downward.

The internal-cutaneous system lies below elbow and yields the oblique line only. This traverses the membrane to the region of the phalanges of the fifth finger. The muscle-mass on the fifth metacarpal bone without oblique lines. Pocket at radiocarpal angle.

In fourth interspace there are two postdigital nerves. One of these appearing at distal third of the fifth metacarpal bone, and one at the metacarpo-phalangeal joint. A single postdigital nerve is seen at the distal fifth of the fourth metacarpal bone. In the third interspace there are two nerves, one appearing from each of the metacarpo-phalangeal joints.

The third phalanx of the third finger small, one-eighth of the length of the second phalanx. The third phalanx of the fourth

* In a second specimen in bad condition, which came to hand while the paper was going through the press, these pigment spots were absent.

finger a mere nodule and deflected somad; that of the fifth finger is absent.

The interfemoral membrane with a conspicuous caudotibial line.

Phyllorhina commersonii.

The intercostal lines rudimentary or absent. The intercosto-humeral line scarcely reaches the line of the elbow. In the fourth interspace there are five predigital lines. The third phalanx of the third finger is small and deflected somad on the free margin of the membrane of the third interspace. The third phalanx of the fifth finger is present and of the same character as in *Rhinolophus philippinensis.* The remaining features as in this species.

Phyllorhina diadema.

Resembles *R. philippinensis.* The intercostal lines are numerous. There is but one predigital nerve in the fourth interspace.

Phyllorhina galerita.

The predigital and the postdigital nerves appear at the middle of their respective metacarpal bones.

Epomophorus franqueti.

The prebrachium shows the tendon of the occipito-pollical muscle to be thread-like and to divide at the wrist into two branches. It lies a short distance below the free margin of the membrane. At the distal third of the forearm an oblique line reaches it from beneath. No lines are raised above the plane of membrane as in other genera of the Pteropidæ.

The intercostal lines small but numerous; not counted. The crural line scarcely larger than the others. The intercosto-humeral line small, rudimentary. The line ends abruptly in an open plesh before reaching the elbow. A coarse network of branches are seen on the line of the elbow. A few branches reach the free margin of the membrane.

The superior oblique line branching off from the internal cutaneous inconspicuous. The main internal cutaneous line reaches the middle of the mesopatagium and is thence abruptly deflected downward and outward and terminates in the neighborhood of the second phalanx of the fifth toe. One branch ends at the metacarpo-phalangeal joint, and another at the free margin of the membrane. The radio-metacarpal angle is crossed by a membrane.

The predigital nerve appears at the metacarpo-phalangeal joint of the fifth finger and the postdigital at that of the fourth. Two tendons cross (beneath the skin) the angle of the fourth interspace. These do not correspond to the raised folds of *Pteropus*. In the third interspace the predigital nerve appears at the fourth metacarpo-phalangeal joint and extends parallel to the first digit to the first interphalangeal joint. From the middle of this nerve a branch passes obliquely downward and outward. No arrangement similar to this is seen in any other form. In the second interspace with a distinct predigital nerve.

In *Hypsignathus* (dried skin) the predigital is as in *Pteropus*. Thus this genus is distinguished from *Epomophorus franqueti* by a character of the mesopatagium.

Pteropus vulgaris.

The tendon concealed in margin of the prebrachium, and becomes apparent only at the distal fifth of forearm. Two oblique lines pass upward toward the tendon from the line of the forearm.

Endopatagium with a few faintly traced intercostal lines, two of which become fleshy interiorly. These, the crural line and the inter-costo-humeral line distinct, raised and unbranched.

The internal cutaneous line with two superior oblique branches. The main line ends at the terminal digit of the fifth finger without division. Six vertical raised lines (and several smaller ones near the fifth finger) cross the membrane.

The fourth interspace with the predigital from metacarpo-phalangeal joint, and the postdigital from the first phalanx just below the joint. The angle of the interspace crossed by a raised fold. The third interspace with the predigital nerve appearing from the first phalanx of the fourth finger just above the interphalangeal joint. The nerve is curved forward, while the postdigital is straight and appears near the distal end of the first phalanx of the third finger. As with the fourth, the third interspace is crossed by a raised fold. The cruro-tibial fold of the interfemoral membrane raised.

Pteropus medius, and **Pteropus sp ?**

The same as *P. vulgaris*. In an embryo the transverse bands were as conspicuous as in *P. vulgaris*.

Cynonycteris stramineus.

One adult and six immature specimens of this species were examined. The lines were much the same as in *P. vulgaris*. In the third interspace the digital lines appeared from the interphalangeal joints, and the fourth interspace not crossed by fold in three. Bands were absent across the interspaces in four. The post-digital line in the fourth interspace from the joint in one.

It will thus be seen that the presence of the raised fold in the angle of the third and fourth interspaces is variable in the young of this species and it may be here regarded as a variable, acquired character. In the embryo of *P. medius*, the fold was present.

The arrangement of the lines on the membranes is sufficiently distinct to distinguish the single example of *Epomophorus* from any of the four species of *Pteropus*. It is evident that in the genus last named the same general characters are declared with a disposition to variation in a few details.

Cynonycteris collaris.

The arrangement of lines much the same as in *Pteropus*. There are six raised intercostal lines present. All the digital lines appear at the joints or the phalanges. The oblique line from the forearm absent in the prebrachium. The raised folds are absent from the angles of the interspaces.

Cynonycteris ægyptiaca.

The intercostal lines are rudimentary or absent. The lower or crural line alone well seen.

Cynopterus sp? from Borneo.

A few rudimental intercostal lines seen which do not join the trunk. A large pelvo-crural raised line is present. The intercosto-humeral line is raised, simple and without division until the border of the free margin of the membrane is reached. The nerve does not extend as far as the line of the elbow. The internal-cutaneous line with three superior branches. Numerous small vertical lines traverse the mesopatagium. The main nerve sends a branch to the metacarpo-phalangeal joint of the fifth finger.

The fourth interspace with digital nerves from the metacarpo-phalangeal joints. The third interspace with the postdigital from distal fourth of the first phalanx.

Cynopterus sp? from Borneo.

No branch is given from the internal-cutaneous nerve to the metacarpo-phalangeal joint. In other respects as in foregoing.

Cynopterus sp?

The intercostal lines join the body, and are raised. The meso-patagium with numerous vertical lines, at least sixteen in number.

In all the Pteropidæ examined the terminal digits are throughout of a simple character. No flexible segments are appended to the osseous ones.

Harpyia major. (Dried skin.)

The intercostal lines confined to one line at the lower part. The line apparently divides at the knee. The intercosto-humeral simple, passes downward as usual on the line from the elbow. The internal-cutaneous with a very short horizontal trend, soon becoming oblique and passing thence to the region of the terminal phalanx of the fifth digit gives one inferior vertical branch, and one superior oblique.

The fourth interspace with the pre- and postdigitals appearing at the metacarpo-phalangeal joints. The third interspace with pre-digital appearing from the first phalanx of the fourth finger nearly at its middle and with the postdigital from the third metacarpo-phalangeal joint. Owing to the relative shortness of the meta-carpals these nerves seem to be unusually long.

Remarks: It may be expected that variations in the arrange-ments of the wing-markings will be occasionally found. Thus in one specimen of *Saccopteryx leptura* two predigital nerves were found in the fourth interspace on both sides. The additional nerve evidently arose from the main nerve and pursued its course parallel to the fifth metacarpal bone and so close to it as not to appear through the skin-expanse. Each of the large terminal branches in this way arose separately from the side of the bone. In the same specimen the pre-digital and the postdigital of the third interspace were united by a conspicuous transverse line in the fold of flexion between the pha-langes of the third and the fourth digits.

In *Vespertilio subulatus*, the predigital and the postdigital of the fourth interspace were seen extending parallel to the metacarpals some distance before being deflected on the membrane. In other examples they appeared from a loop-like disposition of lines in-stead of extending directly from the bone. From among numbers of specimens from one locality one of these dispositions prevailed, while examples from a separate locality the other. In one speci-men an additional predigital was seen on the left side.

On the whole they may be said to constitute a wider range of variation than in *Vesperus fuscus*. I have had opportunities of ex-amining large numbers of both forms.

In *Vesperus fuscus* (No. 5973 S. I.) the postdigital nerve of the fourth interspace was the same as in *Vespertilio*. This was the only example of important variation which I noted in this common species.

In one example of *Mormoops blainvillei* a supplemental line appeared on the right side between the intercosto-humeral and the internal-cutaneous systems.

The most constant disposition of nerves was seen in the third interspace, and defined the greatest number of groups. The limitation of smaller groups and the place of most decided variation was in the region of the fifth metacarpal bone. The fifth digit was more highly endowed with muscle—indeed was the only digit which exhibited a well-defined muscle-mass at the proximal end. The varying and important raised folds here took their origin, as well as special lines which extended along portions of the entire axis of the digit. The dispositions of some of the interdermal lines in the mesopatagium bordering the digit, especially at and near the radiometacarpal angle, were so variable, that no attempt was made to describe them. It becomes of interest, therefore, to compare this region of the greatest variability with that of the region of the least variability,—the third interspace,—and infer from such data something of the movements of the several parts of the manus in the living individual. The fifth digit would appear to determine more changes, or at least be associated with more changes, than any other portion.

The general arrangement of all parts was much the same in groups already well defined. Thus the Pteropidæ, Nycteridæ, Vespertilionidæ, Phyllostomidæ, etc., each had a distinctive plan. In the group last named all the true leaf-nosed forms agreed in having a longitudinal line in the middle of either the fourth or the third interspaces or in both. The absence of the line in *Mormoops* is suggestive of the false position of this genus in this group, while the general harmony of the details with those of the Emballonouridæ gives us the hint as to what the true position may be. In the genus *Miniopteris* a similar suggestion can be made. *Natalus* and *Thyroptera* already known to be isolated forms remain so from the evidence yielded by the membranes. *Thyroptera* appears to be a highly specialized aberrant Vespertilionid.[1]

[1] I have reserved for a separate use descriptions of the markings on the wings of *Molossi*. They differ from those of other groups and are distinctive. The pannicular system here attains the highest development.

Explanation of Plate X.

Fig. 1. The wing membrane in *Phyllostoma hastatum*. Diagrammatic. 1, prebrachium; 2, endopatagium; 3, mesopatagium; 4 ectopatagium (it includes the membrane between *all* the digits); 5, fourth interspace; 6, third interspace. The dotted line extending from the elbow to the free margin of the membrane represents the limit between the endopatagium and the mesopatagium. I, first digit (thumb); II, second digit (index); III, third digit; IV, fourth digit; V, fifth digit (quintus). *a*, intercostals; *b*, intercosto-humeral; *c*, internal-cutaneous; *d*, fibrous line appearing at the muscle-mass of the fifth finger; *e*, one of the predigital lines of the fourth interspace; *f*, longitudinal line in the fourth interspace; *g*, one of the postdigital lines of the fourth interspace; *h*, predigital line of the third interspace; *i*, longitudinal line of the third interspace; *j*, postdigital lines of the third interspace.

Fig. 2. Same, of *Megaderma frons*. A delicate pigmented double contour line is seen crossing the third interspace from the first interphalangeal joint of the third digit to the metacarpo-phalangeal of the fourth digit.

Fig. 3. Same, of *Natalus stramineus*.

ON A NEW SPECIES OF SPIDER OF THE GENUS DINOPIS FROM THE SOUTHERN UNITED STATES.

BY DR. GEO. MARX.

My collection of Araneæ of the U. S. contains, amongst other new and undescribed material, several specimens of a new species of the genus *Dinopis* Macleay, which were collected some years ago in Florida and Alabama; they rested in the collection undisturbed and undescribed, but now, in preparing my "Catalogue of the described Araneæ of temperate North America," I avail myself of the opportunity to add this peculiar and interesting spider to the list of the described Araneæ of our country.

Unfortunately the specimens were collected by friends who were not aware of the importance of the biology of this spider, for this alone would guide us in placing the family Dinopidae in its correct natural position in regard to the affinity and relationship with other families. This family has been assigned from time to time to different places, viz., near the Attidæ, the Lycosidæ, the Uloboridæ, etc., according to the respective view of the different authors. Since Doleschall, however (in Vol. V. of Acta. Scient. Indoneerland.), has stated of his *Dinopis Kollarii* that it builds between the trees a free, irregular and wide-meshed web, in the center of which it stands with the two pair of front legs stretched out forwardly, it has been argued of late that the Dinopidæ might be placed near the Agalenidæ.

The late Dr. W. S. Barnard, who collected one specimen of this species in 1880 in Alabama, stated to me then, that he had caught it on a large horizontal web, which resembled very much that of *Agalena*, but he could not find a tubular retreat attached to the web, as is the case with *Agalena*. This statement was made, however, from recollection only, but it corresponds with Doleschall's description and I therefore feel myself safe to place the Dinopidæ near the Agalenidæ.

Dinopis spinosus n. sp.

Cephalothorax ochreous-testaceous with a lighter colored longitudinal median stripe over the cephalic part which appears again on the posterior region of the thoracic part and lines the posterior margin; the dorsal surface is sparsely provided with very little black and blunt spines which are distributed in irregular rows;

the large posterior median eyes are surrounded by a fringe of long reddish-brown hair The mandibles are yellow-testaceous with a dark grayish oblique mottled band and with long reddish-brown dense pubescence at their inner margin, wnile a few little black, blunt spines are irregularly scattered over the front surface Maxillæ and labium of the same color, the latter having the central region lighter colored. Sternum more brownish-yellow with a very light yellowish longitudinal band over median region. Abdomen greenish-yellow with a very narrow and long longitudinal lancet-shaped spot of a more brownish color; four or five transverse semi-circular (procured) rows of little, black and blunt spines which are placed upon round black spots. Underside with a dark grayish longitudinal narrow band which is lined outside by a narrow whitish stripe. Legs and palpi greenish-yellow with a few irregular small black spines and black spots, distal ends of each joint somewhat darker.

Cephalothorax elongate and flat, very nearly twice as long as its broadest width which is between legs II and III and from which it gradually and slightly attenuates posteriorly; cephalic part one-half as wide as thoracic with parallel lateral sides and rather distinctly separated from it by a shallow impression. Clypeus between the P. M. eyes slightly cleft.

Anterior *Eye* row nearly straight, the A. M. eyes standing a trifle higher, and on the sides of a common tubercle, about twice their diameter apart and double as far from the A. L. eyes which are larger than the A. M. and directed out and downwards. The eyes of the 2nd row (the P. M. Eyes) are very large and stand close together; the eyes of the 3rd row (P. L.) are placed close to the lateral border, and the base of the pars cephalica; they are of the same size as the A. L. E.

Mandibles a little longer than the length of the clypeus directed more forward than downward, dilated in the middle region, and diverging.

Maxillæ parallel, constricted in the middle, where the palpi are inserted, the upper part with rounded borders, labium a little longer than ½ the length of the maxillæ with broader base slightly attenuating and with a broadened and rounded tip.

Sternum long, narrow-triangular, flat.

Abdomen cylindrical, nearly 6 times longer than broad, narrower than cephalothorax and truncate in front, in the middle region broadened and elevated by two separate blunt projections which are surmounted by a blunt, rather prominent spine. In youth the abdomen is much higher in the middle region. See Plate XI, fig. *b*.

The inferior *spinnerets* much thicker than the superior, two jointed with the second joint much shorter than the first. Cribellum broad, nearly the width of the abdomen, divided in the middle.

Palpi with prominently thickened patellar and tibial joints and a curved claw, that is provided with three teeth.

Legs long, slender with short close pubescence and few scattered short spines; the base of femur I and II at the inner side suddenly compressed and in that compression a brush of long hair Calamistrum $\frac{1}{5}$th of the length of metatarsus IV. 1. 2. 4. 3.

Cephalothorax long 5mm. abdomen 11mm.

Femur I 12mm.	Patella 1.5	Tibia 10.4	Metatarsus 12	Tarsus 2.5	total 38.4
Femur II 11mm.	Patella 1.5	Tibia 9.6	Metatarsus 10	Tarsus 2.2	total 34.3
Femur III 9mm.	Patella 1.3	Tibia 6.2	Metatarsus 6.4	Tarsus 1.2	total 24.1
Femur IV 9.5mm.	Patella 1.5	Tibia 8.5	Metatarsus 8.	Tarsus 1.4	total 28.9

Explanation of Plate XI.

Fig. a. Dinopis spinosus Marx, enlarged.
Fig. b. Cephalothorax from above.
Fig. c. Cephalothorax from front.
Fig. d. Cephalothorax from the side.
Fig. e. Cephalothorax from below.
Fig. f. Tarsal claws of 1st leg.
Fig. g. Palpal claws.
Fig. h. Epigynum.
Fig. i. Spinnerets with cribellum.
Fig. k. Abdomen of adult from the side.
Fig. l. Abdomen of young from the side.
Fig. m. Metatarsus IV with calamistrum.

NOVEMBER 5.

The President, Dr. JOSEPH LEIDY, in the chair.

Forty persons present.

The deaths of Mary Jeanes and Henry Winsor, members, were announced.

Note on Pinus Banksiana.—Mr. J. H. REDFIELD spoke of the occurrence of a forest of *Pinus Banksiana* upon Schoodic Peninsula on the coast of Maine in latitude 44° 20′. This pine is well-known as skirting the northern borders of our territory from Northern Maine to Minnesota, but it is only recently that its occurrence so far south has been noted. He then gave an account of visits made to the locality by Mr. Edward L. Rand, of Boston, in 1882, and by himself in 1889.

This pine grows in great abundance over a large part of the peninsula, seeming to almost entirely replace the ordinary coniferous growth of that region. Mr. Redfield had also found a very extensive growth of *Corema Conradii* in the open rocky glades in the forest of *Pinus Banksiana.*

Mimicry of the environment in Pterophryne histrio.—Mr. J. E. IVES stated that his attention had been drawn to the remarkable resemblance of the color-markings of the Frog-fish to the Sargassum weed in which it lives. This fish is a member of the Pediculati, and shares the sluggish habits common to the group. On account of the elongation of the carpal bones, and other peculiar modifications, they have poor powers of swimming, their structure being adapted to moving about on the bottom, among corals, seaweed, and other low forms of life, which they closely resemble in color and in many points of outline. By this resemblance they are concealed both from their enemies and their prey. The member of the group best known, is the common Fishing-frog, *Lophius piscatorius* whose remarkable mimicry of its surroundings has been well described by Mr. S. Kent. In the genus *Antennarius*, closely related to *Pterophryne*, the species present wonderful similarity of color to the forms among which they live. Dr. Günther has paid considerable attention to this genus, and he has also given an excellent figure of *Pterophryne histrio*, under the name of *Antennarius marmoratus.*[1]

Pterophryne histrio is found among the floating masses of Sargassum weed in the warm seas. Here it makes its peculiar nest by binding together the fronds of the seaweed with gelatinous threads, and depositing the eggs throughout the mass. The ground color of the fish is of a pale yellow, and on this light background are darker

[1] Journal des Museum Godeffroy, Heft. XI, pp. 161–165, Pls. 99–106.

irregular brownish bands, closely resembling the branched fronds of the Sargassum weed. Along the edges of these darker bands, on the bands themselves, and also to a lesser extent upon the rest of the body, are little white specks of various sizes, on an average about that of a pin's head. On the belly, around the mouth, and on the dorsal spines, are numerous leaf-like cutaneous filaments. Mr. Ives stated that after careful consideration, he had come to the conclusion that the color markings of the fish, and the cutaneous filaments, had been developed in mimicry of the Spirorbis-covered Sargassum weed. Professor Benjamin Sharp who spent last winter in the West Indies, had informed Mr. Ives that on the Sargassum weed, of which he saw large quantities, were invariably scattered great numbers of *Spirorbis* shells. Professor Moseley in "Notes by a Naturalist on the 'Challenger'" (p. 567) speaks of the resemblance in coloration of the forms inhabiting the Sargasso Sea, to the Sargassum weed. He attributes the white spots of *Pterophryne histrio*, and also of some shrimps and crabs to mimicry of the patches of *Membranipora* that encrust the Sargassum weed. The white spots upon *Pterophryne histrio*, however, are much smaller than the patches of *Membranipora*, and are also much more striking to the eye. This latter fact appears to be due to the delicate fenestrated character of this Bryozoan. The patches of *Membranipora*, also do not occur in the same abundance upon the Sargassum weed as do the Spirorbis shells. Professor Moseley probably confounded the numerous Spirorbis shells with patches of *Membranipora*. As far back as 1757, Peter Osbeck describing this fish which he had met with in the Sargassum weed of the Atlantic Ocean while on a journey to the East Indies, said, with reference to the cutaneous filaments, "probably Providence has clothed it in this leaf-like manner, in order that the predaceous fishes might confound it with the sea-weed, and therefore not exterminate it."[1]

NOVEMBER 12.

Mr. CHARLES P. PEROT in the chair.

Twenty-eight persons present.

Notes on Crepidula.—Mr. JOHN FORD exhibited fine suites of *Crepidula*, including *C. convexa*, Say, *C. plana*, Say, *C. fornicata*, Linn. and *C. glauca*, Say, with the view of proving that *C. glauca*, said by some writers to be the young of *C. fornicata*, is not only distinct from that species but from all others of the genus.

Special reference to the matter had been suggested by the omission of the name in Dr. Dall's recently published "Catalogue of the Shell-bearing Marine Mollusks of the South Eastern Coast of the

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[1] Peter Osbeck, Reise nach Ostindien und China. Aus dem schwedischen übersetzt von J. G. Georgi Rostock, 1765. p. 400.

United States," the figure given therein having been taken from Dr. Gould's Invertebrata of Massachusetts, and the name *C. glauca* replaced by that of *C. fornicata.*

The speaker was not unaware of the fact that Mr. Tryon at one time entertained a similar opinion regarding the affinity of the two species, but a more recent examination of a large series of shells convinced him that the two forms were specifically distinct. While it is true that the shells of *C. glauca* are in a measure allied to those of *C. fornicata* it is quite as certain that the one can be distinguished from the other by at least three characters, either of which is fixed and prominent enough to constitute a species.

In *C. fornicata* the following permanent characters may readily be observed:—

1st. The prominent apex, which is nearly always curved laterally and joined by a shelly growth to the shoulder of the shell.

2nd. The saucer-like depression of the arch which is the same in all specimens, whether young or old.

3d. The peculiarly bowed or ogee form of the free edge of the arch.

4th. The ever-present notch at the junction of the arch with the body of the shell.

5th. The pear-shaped outlines of the shells.

A careful examination of the shells of *C. glauca* will show that all of these characters are absent, and that others quite as positive take their place.

The apex of *C. glauca* is not only less prominent but much less inclined to curve laterally. It is also more acutely pointed, usually shining and horn-like in appearance, and the tip is always free from contact with the body of the shell.

The free edge of the arch is also straighter than that of *C. fornicata*, while, in place of the notch, which is so marked a feature in the last-named species, there is a slight forward growth of the arch-plate along and against the wall of the shell. But the most important character, perhaps, is the elevation of the arch. This feature is a constant one and sufficient of itself to separate the species from *C. fornicata*, the arch of which is always depressed. It may also be said that the two species are wider apart at maturity than at any other stage of growth—although we are told that *C. glauca* just at this period merges into *C. fornicata.* Other differences including that of color and the quoit-like form of the shells, might be indicated, but those already referred to will doubtless satisfy the student that the two species are essentially distinct.

NOVEMBER 19.

The President, Dr. JOSEPH LEIDY, in the chair.

Twenty-three persons present.

The following communications were made in connection with the proceedings of the Biological and Microscopical Section:

Activity in Donax.—Dr. BENJAMIN SHARP described an interesting case of activity in a bivalve studied by him on the beach of the island of Nevis, B. W. I. Noticing some active little animals in the swash of the breakers, he took them at first sight to be a form of crustacea. He had some difficulty in catching them and to his surprise found them to be a species of *Donax*. When they wished to flee from a real or supposed cause of danger, they protruded more than half their length from the sand, as the breakers receded. Those that were not carried into the deeper water on becoming exposed to the air by the retreating waves, buried themselves with astonishing rapidity in the sand and waited for the swash to again flow over them, not protruding themselves until the current returned. The method of getting up the beach was just the reverse of the former action; that is, they protruded after the receding water had left them dry, so that the "up-shoot" carried them up the slope. As soon as the water began to recede they anchored themselves and disappeared into the sand rapidly, waiting thus until the approaching wave came to help them again, and so on. The power of appreciating the shock caused by the breaker on the sand, and also the approach of footsteps, the power of recognizing quickly the direction of the current and how to utilize it in avoiding danger, and the ability to place themselves in a more congenial position on the beach, were indicated by these actions. Did they depend on the sense of hearing? These bivalves exist in enormous numbers on the beach, which actually bristled with them when they protruded. They were of all sizes, from exceedingly minute specimens to those a half an inch or more in length.

Change of habit causing change of structure.—Dr. BENJAMIN SHARP also made some remarks on the Flicker or Ground Woodpecker, *Colaptes auratus*, his attention having been called to the subject by an amateur ornithologist, Mr. Long, now of Nantucket.

It is well-known to ornithologists that the flicker has departed from the typical habits of the woodpecker in a number of ways. It feeds on insects, especially ants, taken from the ground in preference to the laborious method of excavating them from under the bark of trees or from decaying wood, and in making its nest it selects a hollow tree, rather than make the effort of boring out a new cavity in the solid wood. The popular name, "Ground Woodpecker," indicates, to a certain extent, the divergence from the woodpecker's habits.

When the bird is examined it will be found that the bill is weaker than is usual in this group of birds, and that it is curved more or less in different specimens, showing a considerable amount of variation. If this curve increases it will soon become impossible for the bird to use it as a drill except in soft substances. The feet in this species are weak when compared with those of the typical woodpecker.

Dr. Sharp held that this deviation from the woodpecker type in the structure of the bird was due to the change of habit; the change of function preceding and causing the change in structure, and not, as was suggested, that the curve in the bill leads to the change in the habit.

This change in the species could hardly be looked upon as being caused by anything but the direct will or desire of the individual itself, as the surrounding conditions, climate, general character of food, enemies, etc., remained the same, as far as is known. He concluded by saying that the changes were as yet so slight that the species could hardly be looked upon as degenerate, but was probably tending to become so.

NOVEMBER 26.

Mr. CHARLES MORRIS, in the chair.

Twenty-two persons present.

A paper entitled "Catalogue of the Owls, Strigae, in the collection of the Academy of Natural Sciences of Philadelphia" by Witmer Stone, was presented for publication.

The following were elected members:—

James F. Sullivan, Thomas M. Lightfoot, C. D. Lippincott, Minford Levis, M. D., Samuel Stryker Kneass, M. D., and Mrs. Elizabeth S. Bladen.

N. M. Romanoff (Grand Duke Nicholas of Russia), was elected a correspondent.

The following was ordered to be printed:—

PROVISIONAL LIST OF THE PLANTS OF THE BAHAMA ISLANDS.

BY JOHN GARDINER, B. S. AND L. J. K. BRACE.

Arranged with notes and additions by

CHARLES S. DOLLEY, M. D.

Introductory Note.—The circumstances under which this Provisional List was prepared are as follows: In the year 1886, I held the post of Scientific Adviser to the Board of Agriculture of the Bahamas, and, in addition to my regular duties, was requested by his Excellency, Governor H. A. Blake, to prepare a list of the flora of the colony. I was directed to give the common names of the plants and their medicinal and other uses; this latter requirement accounts for the frequently (to scientific readers) gratuitous information. At the same time, I was furnished with a list of the plants of New Providence, prepared some years before by Mr. L. J. K. Brace, a Nassau gentleman, afterwards (1886) an assistant in the Botanical Gardens of Calcutta. With this as a basis I prepared and classified the following list. In the course of the year I visited many of the "out-islands," and was enabled to make considerable additions to Mr. Brace's list, which, however, was exceedingly useful. I regret much that his name is not attached to the plants whose occurrence he described; this is due to the fact that I was obliged to leave Nassau a month earlier than I had expected, and before I could prepare a final copy of the list.

It was intended that the list should be published by the Board of Agriculture, whose property it was, but this was not done, owing to the very small funds of the Board. Governor Blake placed it in the hands of my friend Prof. Charles S. Dolley, who has made numerous additions to it, and to whom is due the credit of its present publication.

The list is called "Provisional" mainly because it is not backed throughout by herbarium specimens, though in any case it must have been incomplete. Prof. Dolley has placed in the herbarium and green-house of the University of Pennsylvania specimens covering nearly all his additions, and the plants listed as having been collected by Prof. Herrick, are represented by herbarium specimens. (Johns Hopkins Univ. Circ., Vol. VI, No. 18, p. 46.)

Herborization in so damp a climate as that of the Bahamas is attended with some difficulties, which are considerably increased when the work has to be done on board of a 20-ton sponging schooner. I found, too, that other duties of more practical use to the colony left but little time for this, so I adopted the plan of collecting what plants I could, and diagnosing them while still fresh by the aid of Grisebach, and Maout and Decaisne (Hooker's Ed.), not making any attempt to preserve the specimens, as a rule. This, of course, would have been simply inexcusable if the making up of a Bahama Flora had been my main duty. Thus the list is necessarily very imperfect, and much in need of confirmation.

The islands from which the most interesting results are to be expected, when they are explored, are Andros, Bimini, Inagua, with Mayaguana and Atwood's Cay. Andros (really a group of islands) contains many fresh-water ponds in its northern half. I visited it, with instructions to investigate its agricultural capabilities, a month after I arrived in the colony (1885), when everything was quite new to me, and before my books, etc., had arrived. I was unable ever to visit it again ; but it is pretty certain that good results may be obtained from its exploration. Bimini is on the margin of the Gulf Stream, and I expected interesting "finds" there, but my books were lost overboard in landing, and I was unable to identify what new plants I saw. Its waters are rich zoologically, and on account of its position it deserves botanical investigation. Inagua and the two small islands mentioned are separated from the rest of the archipelago by deep "ocean" water. I made two separate attempts to reach them, but was foiled, once by bad weather, the other time by the theft of my schooner by a Haytian negro. Atwood's Cay is said to possess a small mammal, the Utia or Outi (*Capromys*) not elsewhere found in the colony ; and during my time in the Bahamas, a living alligator was washed ashore on a log of mahogany at Inagua, having probably come from Hayti. Reasoning by analogy, these islands ought to be interesting botanically.

The distribution of natural orders in the different islands would be worth attention. I was not able to pay much attention to this, and the book in which I had made some notes on the subject was lost at Bimini ; but such facts as the restriction of the Bahama Pine to the northern islands (Abaco, Bahama, Berry Islands, New Providence and the northern half of Andros), and the greater number and variety of Cacteae in the more southerly islands indicate what there is to be done. Roughly speaking, the flora of the northern islands generally resembles that of Bermuda (cf. Bulletin No. 25, U. S.

National Museum, also, Plants of the Bermudas, O. A. Reade, Bermuda, 1885). The flora of the more southern ones while still generally resembling that of Bermuda, also shows affinities with that of the Greater Antilles. Probably the flora of Inagua will be found to be much like that of Hayti and Eastern Cuba. Some Florida plants are found in the Northern islands, but it is a question whether they have come from Florida, or gone from the Bahamas.

A grant was made by the British Association, in 1887, for the investigation of the Bahama Flora, and Baron vón Eggers of St. Croix, known for his work in the Lesser Antilles, has accordingly been in the Bahamas during the last year; but I have seen nothing of his results beyond a letter in "Nature" of April 12, 1888, p. 565.

All such plants as have heretofore been listed and the additions made to this list by Professors Dolley and Herrick, are followed by the collector's name in brackets.

JOHN GARDINER.

CRYPTOGAMIA.

ACROGENS.

Class I. ALGAE.

Subclass I. **Melanospermeæ,** or Olive colored Algae.

Order I. FUCACEÆ.

1. **Sargassum affine,** J.Ag.
Gulf weed. Air vesicles spherical pointless. (*Dolley.*)

2. **Sargassum bacciferum,** Ag.
Gulf Weed, Tropical sea grape. (*Dolley.*) Air vesicles spherical, tipped with a longish bristle.

Subclass III. **Chlorospermeæ,** or Green Algae.

Order I. SIPHONACEÆ.

1. **Caulerpa,** several species. (*Dolley.*)
2. **Halimeda opuntia,** Lamour. (*Dolley.*)
3. **Halimeda tridens,** Lamour. (*Dolley.*)
4. **Eudotea flabellata,** Lamour. (*Dolley.*)

Order II. DASYCLADEÆ.

1. **Acetabularia crenulata,** Lamour. (*Dolley.*)
Tufts two or three inches high, consisting of slender stalks bearing peltate disks or cups, radiated like mushrooms; green, coated with lime, rocks and corals, near shore and in Waterloo Lake.

Order III. VALONIACEÆ.

1. **Penicillus phœnix**, Lamk.
Mermen's shaving brushes. New Providence. (*Dolley.*)

Class. FILICES.

Order POLYPODIACEÆ. True Ferns.

1. **Acrostichum aureum**, L.
Abaco. (*Herrick.*)

2. **Adiantum tenerum**, Swz. (*Swains.*) (*Herrick.*)

3. **Aneimia adiantifolia**, Swz.
Abaco. Green Turtle Cay. (*Herrick.*) New Providence. (*Dolley.*)

4. **Aspidium patens**, Swz. (*Griseb.*)
Abaco. (*Herrick.*) New Providence, a very hairy variety. (*Dolley.*)

5. **A. incisum**, Gr. (*Fraser.*)

6. **A. trifoliatum**, *Sw.* (*Griseb.*)

7. **A. adiantifolium**, *Sw.* (*Swains.*)

8. **Davalia clavata**, Swz. (*Swains.*)
Abaco. (*Herrick.*) New Providence, abundant near, "Banana holes." (*Dolley.*)

9. **Polypodium incanum**, Swz.
Abaco, on trees. (*Herrick.*)

10. **P. Phyllitidis**, L.
New Providence. (*Dolley.*)

11. **P. Swartzii**, Baker.
New Providence, on shrubs. (*Dolley.*)

12. **Taenitis lanceolata**, R. Br.
Abaco, on trees. (*Herrick.*)

13. **Pteris longifolia**. L. (*Swains.*)
New Providence. (*Dolley.*)

14. **Pteris aurea**, L.
New Providence, on the trunks of scrub Palmettoes. (*Dickinson* and *Dowd.*)

PHANEROGAMIA.

GYMNOSPERMIA.

Order I. CYCADEAE.

1. **Zamia angustifolia**, Jacq.
Bay-rush. Indigenous. Pith furnishes starch fit for food and for laundry purposes, sold in Nassau by negroes from Andros, and from outlying districts of N. P.

2. **Cycas revoluta**, Thunb.
Bastard Sago-palm. Common in gardens; originally from Asia (China and Japan), but found in many countries, even in New Guinea. Pith furnishes a kind of sago.

Order II. CONIFERAE.

1. **Juniperus Barbadensis**, L. (*Griseb.*)
Bermuda Cedar. Indigenous; furnishes timber and wood suitable for lead-pencils.

2. **J. Virginiana**, L.
Abaco. (*Herrick.*)

3. **Pinus Bahamensis**, Gr. (*Griseb. Dolley; von Eggers; Urban.*)
Grisebach states that at the time of writing (1864) the cones only of this tree were known and that "it may belong to the section *Tæda*." In this surmise he was correct, as can be seen by the specimens of cones and foliage in the Univ. of Pennsylvania, and in the Bot. Mus. Berlin. Shr'k 8. It resembles very closely *P. Tæda* var. *heterophylla*, now known as *P. cubensis* Gr. Bahama pitch-pine, Loblolly pitch-pine. Indigenous. Timber poor; fit for turpentine, of which a certain amount was made on Andros and other islands for the use of the Confederacy during the American Civil War.

ANGIOSPERMIA.

MONOCOTYLEDONS.

Order I. CANNACEAE.

1. **Canna Indica**, L.
"Indian Shot." In gardens. West Indian.

2. **C. coccinea**, Ait.
Said to be natives of India, but now found in most tropical countries.

3. **Maranta arundinacea**, L.
Arrow Root. Tropical America. Many members of this order yield a useful starch; e.g. *M. arundinacea*, *C. edulis* (fleshy rhizome) and others.

Order II. ZINGIBERACEAE.

1. **Alpinia nutans**, Rox.
Shell-plant, Ginger. In gardens. Tropical America.

2. **Costus sp.?**
Wild Ginger. West Indian.

3. **Zingiber officinale**, Rox.

Ginger. Cultivated. E. India. The members of this order are used as aromatic stimulants, in medicine In some forms of dyspepsia; used as condiment.

Order III. MUSACEAE.

1. **Musa paradisiaca**, L.

Plantain. Originally from the E. Indies.

2. **M. sapientum**, L.

Banana. Originally from the E. Indies. These two fruits are too well known to require description. From the leaf-stalks of other members of this order, wood-fibre is prepared.

Order IV. BROMELIACEAE.

1. **Ananassa sativa**, Lindley.

Pine-apple, from Brazil originally. Extensively cultivated for export. Grows best in a peculiar red soil formed by the disintegration of the coral rock, and occurring most extensively in Abaco, Eleuthera, Cat Island and Long Island.

2. **Bromelia Pinguin**, L.

Wild Pine, Pinguin. Indigenous. Good fibre is obtained from the leaves. The fruit is the size of a plum, and is an excellent vermifuge.

3. **Tillandsia utriculata**, L.

Wild Pine. Indigenous.

4. **T. usneoides**, L.

Old Man's Beard. Florida Moss. West Indies and Southern States.

5. **T. fasciculata**, Sw. (*Swains.*)

Wild Pine. Indigenous.

6. **T. recurvata**, L. (*Griseb.*)

Wild Pine. Indigenous.

7. **T. bulbosa**, Hook.

Wild Pine. Abaco. (*Herrick.*)

8. **T. canescens**, Sw.?

Wild Pine. Abaco. (*Herrick.*)

9. **Catopsis nutans**, Gris.?

Epiphytic Bromeliad, Wild Pine. Abaco. (*Herrick.*) Many plants in this order yield very fine silky fibres. The unripe fruit of the Pine Apple and the Pinguin and of other species, is vermifuge and diuretic.

Order V. ORCHIDEAE.

1. **Epidendrum aciculare,** Batem. (*Lindley.*)
Indigenous.

2. **E. gracile,** Lindl.
Indigenous.

3. **E. rufum,** Lindl. (*Lindley.*)
Indigenous.

4. **E. altissimum,** Batem. (*Lindley, Dolley.*)
Indigenous.

5. **E. Bahamense,** Gray. (*Swains.*)
Indigenous.

6. **E. plicatum,** Lindl. (*Swains.*)
Indigenous.

7. **E. cochleatum,** L. (*Catesb.*)
Indigenous. Pansy Orchid.

8. **E. nocturnum,** L. (*Catesb.*)
Indigenous.

9. **Bletia purpurea,** D. C. (*Swains.*)
Indigenous. Common purple Orchid. Purple orchid tubers made into tea are good for fish poisoning. In Andros they are used for cuts, and called wild ginger.

10. **Bletia sp.?**
Indigenous.

11. **Spiranthes tortilis,** Rich.
Probably Indigenous.

12. **S. picta,** Lindl.?
Trinidad.

13. **Oncidium Guibertianum,** Rich. (*Herrick.*)
Epiphytic orchid. Abaco.

Very few orchids of any kind are of use to man and none of the Bahama species are among these.

Order VI. IRIDEAE.

1. **Iris versicolor,** L.
2. **I. violacea,** Swiet.
3. **I. Florentina,** L.

All of these kinds of Iris are cultivated in gardens.

4. **Gladiolus sp.?**
In gardens.

The Iris root is purgative and emetic and is used in preparing orris.

Order VII. AMARYLLIDEAE.

1. **Agave Americana**, Linn.
American Aloe, from Continent; American Agave, Century Plant, Maguey, Magaly, Spiked Aloe, Mexican Maguey, Flowering Aloe, Pita.

2. **A. Mexicana**, Lam.
Mexican Aloe, Pita, Manilla plant, from Mexico; Sisal hemp.

3. **A. variegata**, Hort.
In gardens. Partridge Breast Aloe.

4. **A. striata**, Luc.
In gardens.

5. **Eucharis Amazonica**, Lindl.
Eucharist Lily. In gardens, from Brazil.

6. **Narcissus Jonquilla**, Linn.
In Gardens. Jonquil.

7. **Pancratium sp.?**
Spider Lily. Old and new world in gardens.

8. **Amaryllis Atamasco**, L.
Atamasco lily. Gardens.

9. **Crinum sp.?**
Essequibo lily. Gardens.

10. **Crinum erubescens**, Herb.
Squill lily.

Most of the members of this order are ornamental plants, but some are of great economic value. *Agave Mexicana* and others of the genus yield a fine fibre, known as Pita, Sisal or Manilla fibre. The efforts of Governor Blake and one of the authors to promote the cultivation of these fibres in the colony long appeared unavailing; but now (Feb. 1889), it appears that the cultivation has been begun in earnest. The soil is well suited for these plants, but the want of energy and of capital among the people must make the issue of the experiment doubtful, as yet. A Mexican Agave yields the drink called Mescal. The flowering stalk is used for corks and for razor strops. The juice of the leaves is sometimes used as a resolvent for scrofula and cancers.

Order VIII. DIOSCOREAE.

1. **Dioscorea sativa**, Griseb.

Common Yam.

2. **D. alata**, Linn.

White Yam Negro country Yam, and probably several other species. *D. sativa* includes several varieties. Yams are indigenous in all tropical countries, but the kinds cultivated for food appear to have been introduced from the East Indies, though this is not certain.

3. **Rajania hastata**, Linn.

Wild Yam. In woods.

Dioscoreae are chiefly and exceedingly valuable as food from the abundant starch their root tubes contain. They contain an acrid principle, which is removed by cooking. The leaves of some species are used in intermittent fevers.

Order IX. ALISMACEAE.

1. **Sagittaria lancifolia**, L.

Arrow head. Indigenous. *Sagittaria* has the reputation of being good for hydrophobia, mainly on account of its being a water plant. The rhizomes when cooked are eatable. The members of this family possess very astringent properties, and have been used in the preparation of ink.

Order X. JUNCAGINEAE.

1. **Triglochin**, near **T. striatum**, R. & P.

This order is of no known use to man.

Order XI. POTAMEAE.

1. **Potamogeton sp.?** Pondweed.

Pondweed. This order has no known properties.

Order XII. NAITDEAE.

1. **Thalassia Testudinum**, Koen.

Turtlegrass, Manatee grass. Marine. Serves as food for turtles, and in Jamaica waters for the Manatee.

Order XIII. PALMAE.

1. **Areca Catechu**, L.

Betel-Nut Palm. One specimen in Nassau, called Pianang, native of Cochin China, Malayan Peninsula and Islands.

2. **Oreodoxa regia**, Kth.

Royal Cabbage Palm. Several specimens in Nassau and throughout the colony. West Indian.

3. **O. oleracea**, Mart. (*Coll. Mart.*)

Barbadoes Cabbage Palm. West Indies. From the tree of this genus is obtained the so-called cabbage, which consists of the young leaf bud, and is eaten boiled or pickled. The pith affords a kind of sago. From the fruit oil is obtained.

4. **Sabal umbraculifera**, Mart. (*Coll. Mart.*)

Royal Palmetto. Fortune Island. (*Eggers.*)

5. **Palmetto**, Lodd.

Fortune Island, very common and used for making hats. (*Eggers.*)

Palmetto leaves when young and undeveloped are an excellent vegetable or "cabbage," and later are used for thatch and for making baskets, mats, etc., of best quality. The stem of *T. parviflora* furnishes timber, and fibre is obtained from *S. umbraculifera.* The roots are rich in tannin and very astringent. Canes of Palmetto-wood readily break diagonally, and so can be used as daggers, the edges being very sharp. On this account their use is forbidden in Cuba.

6. **Thrinax parviflora**, Sw. (*Catesb.*)

Fan Palm, Royal Palmetto, Palmetto Thatch.

7. **T. argentea**, Lodd. (*Catesb.*)

Silver leaved palmetto, Silver thatch.

8. **Cocos nucifera**, Linn.

Cocoa nut, Porcupine wood, Palmyra wood, Cocoa Palm. Introduced from West Indies; originally from Indian Archipelago or from Islands west of Panama. It is needless to mention in detail the manifold uses of this palm. One summary of them says, that it yields sugar, milk, solid cream, oil, wine, cloth, cups, wood for building, thatch, etc. Cocoanut oil is obtained by pressing the albumen when fresh; it is transparent, and is used in cookery; used in England under the name of Copra. The thicker portion, stearine, is used in making candles, the clear oil for burning in lamps; for affections of the chest. It is mildly depurative and laxative. Glycerine is obtained from it. The fibre is used for "Coir" ropes, matting, brushes, brooms, upholstery, etc. (Smith Dict., Econ. Pl.) Its young leaves are excellent "cabbage". The pulp and milk of young nuts are said to be strongly anthelmintic.

9. **Euterpe oleracea**, Mart.

Cabbage Palm. 12-25 ft. high. Every where, except Abaco, Bahama, Andros, Eleuthera, Berry Islands. "Cabbage" used as food for hogs; this appears to be causing the extinction of the palm.

Order XIV. TYPHACEAE.

1. **Typha latifolia**, Linn.

Cat's Tail, Bulrush, Reed-Mace. Extends from Brazil to Texas. The young shoots are eatable when boiled, and also the rhizomes, which are astringent and diuretic, and used in Asia for dysentery. The pollen is made into bread in India and New Zealand.

Order XV. AROIDEAE.

1. **Colocasia esculenta**, Sch.

Shot Eddoe, Indian Kale. From E. Indies. "Taro" is the general name for the species of *Colocasia; C. esculenta* is also called "Scratch coco."

2. **Caladium maculatum**, Lodd.

Bleeding heart. E. and W. Indies.

3. **C. bicolor**, Vent., etc.

Bleeding heart. E. and W. Indies.

4. **Richardia Æthiopica**, Kunth.

White Arum, Calla Lily. From Cape of Good Hope.

The rhizomes and leaves of *Aroideae* contain an acrid juice, sometimes a violent poison; but an abundance of nutritive starch is obtained from the rhizomes of *Colocasia* and *Caladium*, the Eddoes Aroideae are said to have diuretic and expectorant properties.

Order XVI. LILIACEAE.

1. **Yucca aloifolia**, Linn.

Adam's Needle, Spanish Bayonet, Dagger Plant. From Southern U. S.

2. **Lilium candidum**, Linn.

In gardens.

3. **L. Japonicum**, Linn.

Easter lily.

4. **Polianthes tuberosa**, Linn.

Tuberose. In gardens. From E. Indies.

5. **Aloe vulgaris**, Willd.

Medicinal aloe. East and West Indies.

6. **Allium,**

Several species cultivated, onions, leeks, etc.

The bulbs of lilies are rich in starch, and in some places are used as food. The fruits of *Yucca* are purgative; its leaves afford fibre used in paper-making. The roots of some species are used for soap in Southern Colorado, New Mexico, etc., a use apparently unknown in the West Indies. Aloes have never been cultivated to any extent, though conditions are favorable.

Order XVII. SMILACEAE.

1. **Smilax Havanensis,** Jacq. (*Swains.*)

China-withe. Indigenous or from Jamaica.

The various species of *Smilax* furnish Sarsaparilla, well known as an alterative. The root of a *Smilax*, apparently *S. balbisiana*, is known here as China-root, and is used by the bush-doctors in syphilis.

Order XVIII. COMMELYNEAE.

1. **Tradescantia discolor,** Sw.

Oyster-plant. Naturalized from West Indies.

2. **Commelyna elegans,** Kth.

Little is known of the properties of this order. The name "Oyster-Plant" is taken from the appearance of the flower-buds.

Order XIX. CYPERACEAE.

1. **Cyperus polystachyus,** Rottb.

2. **C. compressus,** L.

3. **C. Luzulae,** Rottb.

4. **C. rotundus,** Linn.

Nut grass.

5. **C. Vahlii,** Steudel. (*Herrick.*)

6. **Cladium occidentale,** Schrad. (*Griseb.*)

Prickly Sedge.

7. **Rhynchospora** sp.?

8. **Scleria filiformis,** Sw.

9. **Dichromena leucocephala,** Michx.

Common.

10. **Fimbristylis spadicea,** Vahl.

Members of this family have very few useful properties. I do not know of any that are used medicinally in this colony. The rhizomes of *C. rotundus* are said to be diuretic and astringent.

Order XX. GRAMINEAE.

1. **Arthrostylidium,** sp.?
Bamboo. West Indies.

2. **Chusquea sp.?**
Bamboo. West Indies.

3. **Bambusa vulgaris,** Schrd.
Bamboo. In a few gardens. Cosmopolitan, common throughout tropical Asia and America. Height 100 ft. or more. Used for house building, water pipes; young stems for paper making, for which purpose it is cultivated in East and West Indies.

4. **Eragrostis plumosa.**

5. **E. pectinacea,** Gray.

6. **E. ciliaris,** Lk.

7. **Sporobolus Virginicus,** Kth.

8. **S. tenacissimus,** P. B.

9. **Stipa. sp.?**
Feather grass.

10. **Oryza sativa,** L.
Rice. Cultivated sparsely. China.

11. **Chloris ciliata,** Sw.

12. **Chloris radiata,** Sw.

13. **Dactyloctenium Ægyptiacum,** Willd. (*Hjalmars.*)

14. **Eleusine Indica,** G.

15. **Cynodon Dactylon,** Pers. (*Griseb.*)
Bahama Grass, Devil grass.

16. **Paspalum?**
Wire grass.

17. **Digitaria sanguinalis,** Scop.

18. **Stenotaphrum Americanum,** Schrk.

19. **Panicum grossarium,** L.

20. **P. divaricatum,** L.

21. **P. dichotomum,** L.

22. **Setaria glauca,** P. B.

23. **Cenchrus echinatus.**
A decumbent variety. (*Hjalmars.*) Bur Grass.

24. **C. hirsutus,** L. (*Herrick.*)
Courage Bush.

25. C. tribuloides, L. (*Herrick.*)

26. Tricholaena leucophaea.

27. Andropogon Schoenanthus, L.

Lemon Grass, Citronella. India. Grows wild and cultivated, yields essential oil used in perfumery.

28. Anatherum macr urum, Gr.

Fox Tail Grass.

29. Saccharum officinarum, L.

Sugar Cane, cultivated, originally from Asia. See in this connection, "Remarks on the East India and other Canes imported into the French Caribbean Islands, and lately introduced into the Island of Antigua, by Sir John Laforey, Bart. in Edward's Hist. of Brit. Col. in the W. I. Preface to 2nd Edit. p. 32.

30. Zea Mais. L.

Indian Corn, Maize. According to Edwards (Hist. of the West Indies, I, p. 15), this name is derived from the word "Mahez," applied by the aborigines of the West Indies to this plant. Cultivated. America.

31. Sorghum vulgare, Pers.

Guinea Corn, cultivated; from the old World.

32. Uniola paniculata, L. (*Swains.*)

Spike Grass. Common along sand beaches in the Bahamas, as well as along southern coast of U. S.

Grasses are valuable as food for cattle and for man. In the Bahamas, Maize and Guinea Corn are much used, and also Sugar Cane, though but little sugar is made, owing to the prohibition of the manufacture of rum. The cane is of poor quality, short-jointed, fibrous and deficient in sugar, and is used mainly *au naturel* as a sweetmeat. Cane syrup is made in small quantity and used instead of molasses or maple syrup. The true Bamboo (*Bambusa*) is grown in some gardens. *Arthrostylidium* and *Chusquea*, known as Wild Bamboo, are more or less twining plants found in the bush. The lemon-grass, *Andropogon Schoenanthus*, is made into a cooling febrifuge. *Cynodon Dactylon* is emollient and aperient. A troublesome grass, known as Bur-Grass, grows abundantly, and in Andros and other islands, according to Governor Blake, renders the raising of sheep or cattle impossible, it having a very rough bur.

ANGIOSPERMIA.

DICOTYLEDONES.

Order. I RANUNCULACEAE.

1. **Clematis Vitalba,** Linn.
Virgins Bower. Indigenous and nearly cosmopolitan.

2. **Delphinium,** sp.?
Larkspur, Stavesacre. Indigenous from old world. Seeds contain active principle, yield an extremely acrid poisonous alkaloid called Delphinia, originally employed as a cathartic, but discarded because of its violent action; and to destroy parasites.

This order chiefly inhabits temperate and cold climates. Most of its members have acrid and vesicant properties and are sometimes very poisonous.

Order II. ANONACEAE.

1. **Anona muricata,** L.
Sour Sop. West Indian.

2. **A. palustris.** L.
Alligator Apple, Cork Wood, Monkey Apple. Common on low islands near the sea, unpalatable to man, liked by alligators. West Indian and South American.

3. **A. sericea,** L.
Sweet Sop. West Indian.

4. **A. squamosa,** L.
Sweet Sop, Sugar Apple. W. I.

5. **A. reticulata,** L.
Custard Apple. W. I. " Bullock's Heart."

6. **A. laurifolia,** Dun. (*Catesb.*)
Tree like the peach only taller.

The fruits of this order are well known. That of *Anona palustris* is said to be narcotic, but I have eaten it with impunity. The wood of the same plant is exceedingly light and compressible, and can be used instead of cork. It is said in the Bahamas that a decoction of the root of *A. muricata* is an antidote to fish poison and will destroy Chigoes. A leaf of *A. squamosa* laid on a pillow is said to attract bugs, so they can be killed. *A. reticulata* is employed as an anti-dysenteric and vermifuge.

Order III. PAPAVERACEAE.

1. **Argemone Mexicana**, L.

Mexican Poppy, Prickly Poppy, Yellow Thistle, Fin-Bush. Naturalized, from Mexico and Southern U. S. (Green Turtle), *Herrick.*

The narcotic properties of this order are well known. *Argemone* is used here by the bush doctors for the small-pox. Its seeds have been used elsewhere as a substitute for Ipecacuanha; its juice is said to destroy warts, to be efficacious against bites of venomous serpents, and to be useful in ophthalmia.

Order IV. CRUCIFERAE.

1. **Sinapis Brassicata**, L.

Mustard. West Indies.

2. **Lepidium Virginicum**, L.

Pepper Grass. U. S.

Besides these species, which are wild, a large number of others are cultivated, including many of the kitchen vegetables, e. g. Cabbage, Cauliflower, Kale, Turnips, Radish, Cress, Sea-Kale, Horse-radish. None of the plants in this order are poisonous. Most of them are anti-scorbutics; mustard taken internally is an emetic and diuretic, externally a blister.

3. **Cakile æqualis**, L'Her. (*Hjalmars.*)

Turks Island.

Order V. CAPPARIDEAE.

1. **Crataeva Tapia**, L.

Garlic Pear Tree, native of West Indies, called in Jamaica, Garlic Tree, from odor of its fruit. Catesby says that land-crabs feed on this in the Bahamas.

2. **Cleome pentaphylla**, L. (*Swains.*)

Mustard, Sambo. Naturalized throughout West Indies. Originally from old world. This is reputed in the Bahamas to have many useful properties. Boiled, it forms an excellent vegetable. Its leaves *per se* heal sores and relieve the pain of the gout. In oil, they cure skin diseases, especially leprosy. Boiled in water, it causes expectoration and relieves flatulency. The juice of the plant mixed with oil and dropped into the ear relieves deafness. The properties of the order are similar to those of the preceding one.

Order VI. MORINGEAE

1. **Moringa pterygosperma**, G.

Horse-radish Tree, Ben-nut Tree. The root of this tree, finely scraped, is eaten as horse-radish. The oil of Ben, obtained by expression from the seeds, is much used by perfumers, and by machinists, because it does not freeze or become rancid.

Order VII. VIOLACEAE.

Species of *Viola*, such as *V. odorata*, Sweet Violet, are cultivated in gardens in Nassau for their flowers.

Order VIII. CANELLACEAE.

1. **Canella alba**, Murr. (*Grisebach.*)

Bahama White Wood Bark, Wild Cinnamon, White Canella, Wild Canella, False Winter's Bark. The bark from this tree is exported from the Bahamas; it is known in commerce by the foregoing names. It is an aromatic stimulant, tonic and cordial and yields by distillation an oil with the same properties.

Order IX. BIXINEAE.

1. **Xylosma nitidum**, As. Gray.
2. **X. buxifolium.**
3. **Xylosma sp.?**
4. **Casearia lactioides.**
5. **C. serrulata**, Sw.

All West Indian and indigenous. I know nothing of the uses of any of these plants. The order as a whole has (fully) bitter and astringent properties. Some of its members are poisonous.

Order X. POLYGALEAE.

1. **Polygala sp.?**

Milk-wort; almost cosmopolitan.

2. **Badiera Domingensis**, Jacq.

Bastard Lignum vitae. West Indies.

3. **Bredemeyera sp.?**

West Indian and South American.

This order has tonic and astringent properties. *Badiera Domingensis* is a sudorific like Lignum vitæ. Some species of *Polygala* are said to act as antidotes to snake bites. *Bredemeyera* is used against syphilis in Trinidad.

Order XI. PORTULACEAE.

1. **Portulaca oleracea**, L.
Purslane. Tropical countries.

2. **Sesuvium portulacastrum**, L.
Sea-side Purslane. All tropical countries.

Portulaca is used as a Pot herb and in salads, and is cooling, astringent, antiscorbutic.

Order XII. TAMARISCINEAE.

1. **Tamarix Indica.** *Willd.*
Tamarisk. From Asia. Grown in some gardens in Nassau.

Order XIII. HYPERICINEAE.

1. **Ascyrum hypericoides**, L. (*Swains.*)
St. Andrew's Cross, Peter's Wort. Indigenous, American, astringent, diuretic.

Order XIV. GUTTIFERAE.

1. **Mammea Americana**, L.
Mammee, Mammee Apple. Indigenous in West Indies. Oil of seed used for hair oil. Tree upon being wounded yields thick yellow gum. Used as a cure for itch, and to prevent Chigoes from attacking the feet. The bark is a powerful astringent, poisonous.

2. **Calophyllum Calaba**, Jacq.
Galba, Santa Maria Wood, Calaba Tree. Fruit contains one seed yielding an oil fit for lamps. Tropical America, West Indies, Brazil.

The gum-resin secreted by trees of this order is acrid and purgative. The Mammee is a well-known fruit; its seeds are anthelmintic; an aromatic liquor (*Eau de Creole*) is distilled from its flowers. The wood of *Calophyllum* is fit for shingles and heavy work; and its resin is useful as an application to ulcers.

Order XV. MALVACEAE.

1. **Sida carpinifolia**, L.
Wire-weed. Indigenous. America and West Indies.

2. **S. spinosa**, L.
E. & W. I. and America.

3. **S. urens**, L.
Indigenous. America, W. I. and Africa.

4. **Abutilon filiforme,** Jacq.
W. I. and Africa.

5. **A. permolle,** G. Don. (*Swains.*)
Indigenous.

6. **A. Indicum,** G. Don.

7. **Abelmoschus moschatus,** Mchx.
Musk Ochra. Native of Bengal, naturalized in all tropical countries.

8. **A. esculentus,** W. A.
Ochra, Gumbo. Naturalized from Africa.

9. **Hibiscus Rosa-Sinensis,** L.
Red Hibiscus. Naturalized from gardens in Asia.

10. **H. Phoeniceus,** Jacq.
In gardens.

11. **H. Sabdariffa,** L.
Red or Indian Sorrel. In gardens.

12. **Gossypium Barbadense,** L.
Cotton. Cultivated. America.

13. **G. sp.**
Red or Harbor Island Cotton. Harbor Island, wild. Distinguished by colored cotton adhering to green seeds. Comparison with specimens of colored cotton in the Botanical Museum of Berlin show this to resemble more nearly *Gossypium probiculatum* Klstrsch., being of a more uniform reddish-brown than G. *religiosum*, and not so dark as *G. herbaceum* var. *lana rufa*, of Porto Rico and Cuba. (Collected by Krug and Urban.) It is very similar, when manufactured, to Nankeen cotton. Its color resists bleaching agents, sun, acids and alkalies, and has been used by the Harbor Islanders for making gloves. Its color seems to become darker in rich soils. Samples sent to the Colonial Exhibition, London, 1886, attracted much and favorable attention. It seems worthy of cultivation. First account Sebartz, Stockh. Handl., 1790.

14. **Eriodendron anfractuosum,** D. C.
Silk-cotton Tree, Ceiba. S. America. Naturalized in West Indies. The large specimen at Nassau is said to have been brought from South Carolina, and to have given rise to all others on the island.

15. **Helicteres Jamaicensis,** Jacq.
Screw-tree. W. Indian.

16. **H. semitriloba**, Berter. (*Swains.*)
Indigenous.

17. **Thespesia populnea**, Corr.
Sea-side Mahoe. Cork-tree.

18. **Malvaviscus arboreus**, Cos.
Var. Sagræanus, Rich. A shrub.

19. **Sphæraclea abutiloides**, Endl. (*Catesby.*)
N. Providence.

This order is essentially tropical. Many of its members are cultivated in gardens for their flowers. The swollen calyx of *Hibiscus Sabdariffa* makes an excellent preserve, somewhat like cranberry, and used similarly. The unripe fruit of *Abelmoschus* is a well-known vegetable, valuable for its mucilaginous properties; it is said to be diuretic and useful in pulmonary diseases; its seeds are cordial and stomachic, and is said to improve the flavor of coffee. It is also used for scenting pomatum, etc. Most of the members of this order are mucilaginous and have demulcent and emollient properties; none are deleterious. The stems of species of *Sida* and *Abutilon* furnish very tenacious fibre, also *Thespesia*, whose unripe fruits are used in dyeing, and whose wood is fit for timber.

Order XVI. STERCULIACEAE.

1. **Melochia pyramidata**, L. (*Nichols.*)
Indigenous. A common weed.

2. **M. tomentosa**, L. (*Hjalmars.*)

3. **Waltheria Americana**, L.
All tropical countries. This order has similar properties to the preceding one. *Waltheria* is used as a febrifuge in S. America.

Order XVII. TILIACEAE.

1. **Triumfetta althaeoides**, Lam.
Bur-weed. Indigenous.

2. **T. semitriloba**, L.
Bur-bark. Indigenous to all tropical countries.

3. **Corchorus olitorius**, L.
Jew's Mallow, Jute. Introduced from East Indies. Common in Syria where the young sprouts are eaten as a vegetable, like Asparagus. It is said to be a favorite with the Jews, hence its name. (Smith Dict. Econ. Pl.)

4. **C. siliquosus**, L.
Broom weed, Jute. W. Indies and S. America.

5. **C. hirsutus**, L. (*Swains.*)
This order has similar astringent and mucilaginous properties to those of Malvaceae. The species of *Corchorus* furnish valuable fibre known as jute, which is employed in the manufacture of many fabrics, from "Gunny bags" to satin; their young leaves boiled, are excellent pot-herbs. The leaves of *Triumfetta* are said to be useful astringents.

Order XVIII. ERYTHROXYLEAE.

1. **Erythroxylon brevipes**, D. C.
Eboe light wood, Red wood. Indigenous.

2. **E. obovatum**, Macf.
Indigenous.
To this order belongs the plant *E. coca*, used as a stimulant in Peru and Bolivia, from which the anaesthetic cocaine is obtained. Recent investigations show that the West Indian species contain but very small amount of the alkaloid, and they do not appear to be used as bush-medicine. Some species are used for dyeing, from the red color of the wood.

Order XIX. MALPIGHIACEAE.

1. **Byrsonima lucida**, Rich. (*Swains.*)
Fortune Island. (*Eggers.*)

2. **Bunchosia glandulosa**, Rich.
West Indian Cherry. W. I. and S. America.

3. **Malpighia setosa**, Spreng. (*Swains.*)
Indigenous, also in Hayti.

4. **Malpighia sp.?**
Near *M. glabra*. L. Wild Cherry, Barbados Cherry.

5. **Stigmaphyllon Sagraeanum**, Juss. (*Swains.*)
Indigenous and in Cuba.

6. **Triopteris rigida**, Sw.
Narrow-leaved variety. (*Swains.*) Indigenous and in Cuba and Hayti. The plants of this order have medicinal properties and some of them, e. g., *Byrsonia*, *Bunchosia*, *Malpighia*, have eatable fruits. The order is distinctly tropical.

Order XX. ZYGOPHYLLEAE.

1. **Tribulus maximus**, L.

Caltrop. A weed. W. Indian and throughout tropical countries.

2. **Guaiacum sanctum**, L. (*Swains.*)

Lignum vitae, Pock-wood. W. Indian and tropical America. Very plentiful on Acklin Island, Long Cay and Crooked Island, also on Fortune Island. (*Eggers.*)

The wood of Guaiacum is largely used on account of its hardness, toughness and durability. The leaves are used for scouring floors. The resin is very valuable medicinally as a stimulant, diaphoretic and alterative, in gout and rheumatism and in syphilis, in which disease it is largely used in the West Indies and in this colony. A purgative syrup is made from the flowers in this colony.

Order XXI. BALSAMINEAE.

Species of *Impatiens*, the Balsam of gardens, are cultivated for their flowers. From the E. Indies.

Order XXII. AURANTIACEAE.

1. **Citrus Aurantium**, L.

Sweet Orange, Orange, Curacoa Orange, Nerolia Flowers, Forbidden Fruit, Golden Apple, Orange Apple. Native of Southern China. Early cultivated in Persia.

2. **C. decumana**, L.

Shaddock. Large ones called Pomeloes and small ones "Forbidden Fruit." Native of China. Introduced into W. Indies early in the 18th Century by Cap't Shaddock, hence the name.

3. **C. racemosus**, Ris. et Poit.

Grape Fruit. Wild in Northern India. Early cultivated in Persia.

4. **C. Limonum**, Ress.

Lemon. Fruit refrigerant, antiscorbutic. Peel furnishes oil of lemon.

5. **C. Bigaradia**, Dun.

Bitter Orange, Seville orange, Bigarade, Cassia lignea. This species is largely used for marmalades, candied orange peel and bitter tinctures.

6. **C. spinosissima**, Mey.

Lime.

7. **Glycosmis pentaphylla,** D. C.

Mandarin Orange. Cultivated largely in China.

These various species all come from the E. Indies, China or the Malay Archipelago originally. The fruits are known everywhere. Bahama oranges are of fine quality, and a considerable number are exported to the U. S., but owing to want of care in gathering and packing, their price is low. Many so-called Florida oranges come from the Bahamas. Essential oils, used in perfumery and in the manufacture of liqueurs, are obtained from the rind and flowers. In medicine the acids of these fruits are used as refreshing laxatives and antiseptics.

Order XXIII. XANTHOXYLEAE.

1. **Xanthoxylum fraxineum,** Willd.

Prickly Ash, Yellow wood.

2. **X. clava-Herculis,** L.

Hercules' Club, Prickly Yellow wood.

3. **X. emarginatum,** Desco.

All indigenous. The species of *Xanthoxylum* are medicinal. In the Bahamas the root of *X. clava-Herculis* is used as a poultice for ulcers, and the bark is chewed for tooth-ache. The wood yields a yellow dye; the bark is also regarded as anti-syphilitic in this colony. The young trees are made into walking sticks.

4. **Fagara lentiscifolia,** W. (*Swains.*)

Order XXIV. SIMARUBEAE.

1. **Picramnia pentandra,** Sw.

Bitter Wood. West Indies.

2. **Alvaradoa amorphoides,** Liebm. (*Swains.*)

Tassel Plant. All tropical coasts.

3. **Picrodendron Juglans,** Gr.

Jamaica Walnut. Jamaica. The plants of this order contain an exceedingly bitter principle, which gives them tonic properties. *Picramnia* is administered in this colony as a tonic and febrifuge.

Order XXV. BURSERACEAE.

1. **Bursera gummifera,** L. (*Mc. Nab.*)

Mastic Tree, West Indian Birch, Jamaica Birch, Caranna Gum Tree, indigenous to this colony, Jamaica and East Indies.

2. **Amyris sylvatica,** Jacq.

Torch Wood, Shrubby Sweet Wood. W. Indian. Indigenous.

3. **Hedwigia balsamifera**, Sw.

Bois cochon, Gum Elemi. West Indian.

The trees of this family yield resins which are used in the making of gum Elemi. It is said here to be good for pain in the back.

Order XXVI. MELIACEAE.

1. **Melia Azederach**, L.

Pride of India, Azederach bark, Pride of China, Pride of Winter, Bead Tree, Pride Tree, Hoop Tree, African Lilac, China Tree. Asiatic. Naturalized.

2. **Swietenia Mahogoni**, L. (*Catesby.*)

Mahogany. W. Indian and tropical American. Fortune Island (*Eggers.*)

3. **Cedrela odorata**, L.

W. Indian Cedar, Jamaica Cedar. Native of Honduras, Jamaica and southern parts of tropical America; suited to all kinds of cabinet work, color reddish-brown, alliaceous odor to the leaves and bark.

The trees of this family have many medicinal properties. *Melia* is purgative and vermifuge, but poisonous in large doses. The bark of the Mahogany is administered in fevers, with quinine, in tropical America.

Order XXVII. OLACINEAE.

1. **Ximenia Americana**, L.

Wild Olive, Sea-side plum. Tropical America, Africa and Asia.

2. **Schoepfia odorata.** (*Wall.*)

White beef wood. West Indies.

Little is known of the properties of this order.

Order XXVIII. ILICINEAE.

1. **Ilex montana**, Gr.

Winter berry. W. Indian.

2. **I. macoucoua**, Pers.

Southern West Indies and Brazil.

The species of *Ilex* have diuretic and febrifuge properties.

Order XXIV. CELASTRINEAE.

1. **Myginda pallens**, Sw.

West Indian.

The plants of this order contain an acrid principle. The roots and leaves of *Myginda* are diuretic.

Order XXX. RHAMNEAE.

1. **Condalia ferrea,** Gr. (*Swains.*)
   Indigenous and West Indian.
2. **Condalia sp.?**
3. **Colubrina ferruginosa,** Breng. (*Swains.*)
   Saffron, Snake Wood, Green heart. Indigenous and West Indian.
4. **Gouania Domingensis,** L.
   Chew stick. West Indian.

The plants of this order have tonic febrifuge properties. *Colubrina* is employed, in infusion, in fevers in this colony. It is used in dyeing yellow. *Gouania* is used, as its popular name shows, as a tooth-brush. It is said to have stomachic properties.

Order XXXI. AMPELIDEAE.

1. **Ampelopsis quinquefolia,** Michx.
   Virginia Creeper. Introduced from America.
2. **Vitis Caribaea,** D. C.
   Jamaica Grape, Water Withe. West Indian and South American.
3. **Cissus sicyoides,** L.
   Sarsaparilla, China Root, Wild Yam. West Indian. These plants have acid and cooling properties.
4. **C. acida,** L. (*Swains.*)

Order XXXII. SAPINDACEAE.

1. **Serjania sp.?**
   Tropical America. Climbing shrubs.
2. **Thouinia discolor.** Gr. (*Swains.*)
   Indigenous. Climbing shrubs.
3. **Melicocca bijuga,** L.
   Genip. Introduced from S. America.
4. **Blighia sapida,** Koen.
   Akee. Introduced from W. Africa. A handsome tree, 30 feet high.
5. **Hypelata paniculata,** Camb.
   Genip. Introduced from Jamaica.

Many of the plants of this order possess a saponaceous principle. Some of these are poisonous in whole or in part. The Genip has eatable fruit and that of the Akee is eatable in part, and is used as a remedy in dysentery; the Akee is considered poisonous when raw, wholesome cooked. *Serjania* is very poisonous.

Order XXXIII. TEREBINTHACEAE.

1. **Rhus Toxicodendron,** L.
Poison Ivy, Poison Oak. America.

2. **R. Metopium,** L.
Burn-wood, Jamaica Sumach, Doctor's Gum, False Hog Gum. W. Indian and America.

3. **Mangifera Indica.** L.
Mango. Introduced from E. Indies. Leaves used for tanning, and powerful purgative and emetic, seeds farinaceous.

4. **Anacardium occidentale,** L.
Cashew-nut. Tropical America.

5. **Spondias lutea,** L.
Spanish Hog plum. Hog plum of Jamaica. W. Indies.

6. **Comocladia integrifolia,** Jacq.
Maiden Plum.

These plants have an acrid, sometimes very poisonous juice, but some of the fruits are largely eaten, e. g. Mango and Cashew-nut. The eatable portion in this last case is the swollen peduncle upon which the nut is borne. The acrid oil in the nut is very poisonous, and is said in the Bahamas to kill Chigoes and cure freckles, and to be useful applied to ulcers. A decoction of the leaves is said also to be a useful wash for ulcers. The Cashew-nut and the Hog-plum are said to be good for dropsy. The fruit of the latter is used for feeding swine. The species of Rhus are poisonous.

The Mangoes of the Bahamas are of comparatively poor quality, the best are known as "Number Thirteen"—a variety which attains great perfection in Jamaica.

The island of Itamaraca, off the coast of Pernambuco, is said to produce the finest Mangoes in the Western Hemisphere.

Order XXXIV. LEGUMINOSAE.

Sub-Order I. MIMOSEAE.

1. **Neptunia plena,** Benth.
Indigenous. West Indies and Tropical America.

2. **Desmanthus virgatus**, Willd.
Indigenous. West Indies and East Indies.

3. **Mimosa Bahamensis**, Benth. (*Swains.*)
Sensitive plant. Indigenous.

4. **Leucaena glauca**, Benth. (*Swains.*)
Jumbai, Mimosa, Guaje. West Indies.

5. **Acacia Bahamensis**, Gr. (*Swains.*)
Indigenous.

6. **A. tortuosa**, Willd.
West Indies and S. America.

7. **A. Farnesiana**, Willd.
West and East Indies and Africa.

8. **A. Coriophylla**, Benth. (*Swainson.*)
Indigenous.

9. **A. acuifera**, Benth. (*Hjalmars.*)
Indigenous. Turks Island.

10. **A. (Albizzia) Lebbek**, Willd.
Black Ebony, Woman's Tongue. West Indies.

11. **Calliandra Portoricensis**, Benth.
South America and West Indies.

12. **C. haematomma**, Benth.
A variety having a strigose-pubescent corolla. (*Swains.*) Indigenous.

13. **Lysiloma Sabicu**, Benth.
Horse-flesh, Sabecue. West Indies.

14. **Pithecolobium Hystrix**, Benth.
West Indies.

15. **P. Unguis-cati**, Benth. (*Swains.*)
Ram's horn.

Sub-Order II. CAESALPINEAE.

1. **Haematoxylon Campechianum**, L.
Logwood, Blockwood, Campeachy wood, Jamaica logwood, Honduras logwood, St. Domingo logwood. W. Indies and Tropical America.

2. **Guilandina Bonduc**, L.
Yellow Nicker, Bonduc nut, Bonduc seed, Beasor nut, Yellow Nicker tree. Bonduc seed is tonic, astringent, anti-syphilitic, antiperiodic. West Indies.

3. **G. Bonducella,** L.
Slate colored Nicker. W. Indies. Indigenous.

4. **Caesalpinia pulcherrima,** Sw.
Pride of Barbadoes. E. Indies. Introduced by Mr. Saunders in 1886 to N. P.

5. **C. crista L.,** Sw. (*Swains.*)
Bahama Braziletto. Indigenous.

6. **Lebidibia coriaria,** Schlecht.
Divi-Divi. South America and West Indies.

7. **Cassia bicapsularis,** L. (*Swains.*)
Senna. Indigenous. West Indies.

8. **C. biflora,** L.
Senna. West Indies.

9. **C. occidentalis,** L.
Negro Coffee, Stinking-wood, Senna. All tropical countries.

10. **C. ligustrina,** L. (*Dill.*)

11. **C. lineata,** Sw.
Senna. Jamaica and Cuba.

12. **C. glandulosa,** L.
Brown Cassia, Dutchman's Butter. West Indies.

13. **C. Chamæcrista,** Sw.
Senna. United States and West Indies.

14. **Tamarindus Indica,** L.
Tamarind, Monkey-Tamarind, Black Tamarind, E. I. Tamarind, Indian Date. The fruit pulp is laxative, refrigerant, acidulous; leaves anthelmintic, bark tonic. From East Indies.

15. **Paullinia tomentosa,** Benth.
Mountain Ebony. West Indies.

16. **Poinciana regia.**
Introduced from Madagascar.

Sub-Order III. PAPILIONACEAE. (Pea Tribe.)

1. **Crotalaria stipularis,** Des.
Rattle-wort. West Indies.

2. **C. verrucosa,** L. (*Griseb.*)
Indigenous.

3. **C. pumila,** Ort.
Indigenous.

4. **C. lotifolia**, L.
Jamaica and Tropical Africa.

5. **C. retusa**, L. (*Griseb.*)

6. **Alysicarpus vaginalis**, Dc.
Introduced from West Indies.

7. **Desmodium incanum**, Dc. (*Swains.*)
Honey suckle. Indigenous.

8. **D. tortuosum**, Dc.
Cock's-head. Florida, South America and West Indies.

9. **Stylosanthes procumbens**, Sw.
Trefoil. Indigenous. Common in pastures.

10. **Arachis hypogæa**, L.
Pea-nut, Ground-nut. Naturalized from Brazil.

11. **Centrosema Virginianum**, Benth.
Var. *angustifolium*. (*Hjalmars.*)

12. **Brya ebenus**, Dc.
Green Ebony. West Indies.

13. **Abrus precatorius**, L.
Wild Liquorice, Crab's Eyes, Black-eyed Susan Tree, naturalized from East Indies.

14. **Rhynchosia minima**, Dc.
Red bead vine, Wort herb. America, West Indies and Africa.

15. **Rhynchosia**, sp.?

16. **Cajanus Indicus**, Spreng.
Pigeon Pea, Congo Pea. Called in India, Dhal; from Asia.

17. **Galactia filiformis**, Benth. (*Swains.*)
Indigenous and in East Indies and Australia.

18. **G. pendula**, Pers.
Jamaica.

19. **Phaseolus lunatus**, L.
Lima or Sugar bean. West Indies, Tropical America, Africa and Asia.

20. **P. semi-erectus**, L.
West Indies, South America and East Indies.

21. **Canavalia obtusifolia**, Dc.
Red Sea-side bean. West Indies, South America, Australia and East Indies.

22. Muouna urens, Dc.

Horse-eye bean. West Indies and Brazil.

23. Erythrina corallodendron, L.

Coral Tree, Red bean tree. West Indies and South America.

24. Piscidia Erythrina, L. (*Swains.*)

Jamaica Dogwood. West Indies. Used for poison by "surging" boughs, or bag containing bruised bark, leaves or roots in water. Bark, narcotic, sedative.

25. Peltophorum adnatum, Gr. (*Swains.*)

26. Sophora tomentosa, L.

All along tropical sea shore.

This large order yields more substances, useful in medicine and the arts than any other in the vegetable kingdom. Many of the plants enumerated above possess useful properties. *Leucaena* affords fodder for horses, but causes their tails and manes to fall off. Many species of *Acacia* yield gums sold as gum Arabic. *A. Farnesiana* has flowers which yield a perfume known as *Cassie;* it is cultivated in other countries on this account. It also yields a valuable gum. *A. Lebbek* yields an ornamental wood.

The species of *Acacia* have powerful astringent properties and are so used in medicine. The species of *Calliandra* have very beautiful flowers. *Lysiloma* furnishes a most valuable timber, well known in Cuba as *Sabecue*, in the Bahamas as "horse-flesh mahogany." The bark of *Pithecolobium* is astringent.

Haematoxylon is the well-known dye wood, and has tonic and astringent properties. *Guilandina* produces the yellow and slate-colored Nicker beans. They have tonic properties and have been used successfully in intermittent fevers. *Caesalpinia pulcherrima* is a handsome garden shrub, and in the East Indies its leaves are used as Senna. *C. crista* is the Bahama Braziletto, valuable as a dye wood. *Lebidibia coriaria* is the *Divi-Divi*, whose pods are used in tanning, on account of their great astringency. The leaves of the various kinds of *Cassia* are much used as purgatives under the name of Senna. *Tamarindus*, a handsome tree, yields the slightly laxative fruit known as Tamarind. The buds and flowers of *Paullinia* are used in dysentery. *Crotalaria* furnishes useful fibre for rope, etc. *Arachis*, the ground-nut, or pea-nut, is interesting in many ways. It ripens its fruit under ground. Its seeds are excellent for eating when roasted slightly, and if the roasting be continued, they can serve as a substitute for coffee. The oil expressed from them can be used for cooking, and is an excellent substitute for olive oil. *Brya Ebenus* furnishes a beautiful wood for fancy work. The handsome scarlet and black seeds of *Abrus precatorius* are used as ornaments, they are said to be poisonous. The roots form a good substitute for liquorice. The seeds of *Rhynchosia* are used for beads. *Cajanus* is the pigeon pea, valuable as an article of food. *Phaseolus lunatus*, the Lima bean, is an excellent table vegetable. *Canavalia* produces the red sea beans or Nickers. The beautiful horse-eye beans come from *Mucuna urens*, the hairs of which, known as Cow-itch, are used sometimes as a mechanical anthelmintic. The juice of *Cassia occidentalis* is said here to be good for eruptions. Its roots are diuretic.

Order XXXV. ROSACEAE.

Of the nine tribes into which this order is divided in Le Maout's and Decaisne's Botany, two only, *Amygdaleae* and *Chrysobalaneae*, are represented in the wild flora of the Bahamas. One other *Roseae* is cultivated in gardens.

Tribe ROSEAE.

1. **Rosa**, Rosa.

Many kinds of roses are cultivated here, where they attain great perfection, and bloom throughout the year.

Tribe AMYGDALEAE.

1. **Prunus sphaerocarpa**, Sw. (*Catesb.*)

Indigenous. West Indies.

Tribe CHRYSOBALANEAE.

1. **Chrysobalanus Icaco**, L. (*Griseb.*)

Cocoa-plum. Indigenous. West Indies and in Tropical Africa. This fruit is eaten fresh and preserved; the bark and leaves are a remedy in diarrhœa

Order XXXVI. CRASSULACEAE.

1. **Bryophyllum calycinum**, S.

Life Plant; from Asia, now naturalized throughout West Indies and Tropical Africa. This plant is well known, from the power it has of producing buds from the margin of the leaves, which afterward become complete plants. Its leaves are said to be a cure for head-ache, and the juice is said to allay inflammation.

Order XXXVII. RHIZOPHOREAE.

1. **Rhizophora Mangle**, L.

Mangrove. Indigenous. West Indies, Tropical America and Africa. The bark is very powerful as an astringent. It is used for tanning and stops bleeding. The fruit is said to be eatable. The Mangrove occupies the low swampy portions of all the Islands.

Order XXXVIII. MELASTOMACEAE.

1. **Tetrazygia cleagnoides**, Dc. (*Herrick.*)

Black-Torch Berry.

2. **T. angustiflora**, Gr. (*Swains.*)

Order XXXIX. COMBRETACEAE.

1. **Terminalia Catappa**, L.

Almond Tree, Country Almond. Introduced from the old world.

2. **Bucida Buceras**, L. (*Swains.*)

Olive Bark, Wild or Black Olive. Indigenous. West Indian.

3. **Conocarpus erectus**, L. (*Swains.*)

Button Tree, Zaragoza Mangrove. Alder. West Indian Variety (*a*) of Grisebach. The glabrous and silvery-haired varieties grow indiscriminately together in small woods on Fortune Island. (*Eggers.*) Indigenous and in West Indies, Tropical America and Africa. No special use.

4. **Quisqualis Indica.**

In gardens. Introduced from Tropical Asia and Africa.

This order possesses astringent properties, on which account the fruits of species of *Terminalia* are used for tanning. *T. Catappa* is a handsome tree. Its fruits are eatable and somewhat resemble almonds, whence its name.

Order XL. MYRTACEAE.

1. **Jambosa vulgaris**, Dc.

Rose Apple. Naturalized from India. Rose apples constitute a part of the food of *Macrotus taterhousii*, American Leaf-nosed Bat.

2. **Eugenia buxifolia**, W.

Indigenous. West Indies.

3. **Eugenia**, sp., near *E. Poiretii* Dc.

West Indies.

4. **E. monticola**, Dc. (*Griseb.*)

Stopper, small leaved Rod-wood. Indigenous and in Jamaica.

5. **E. axillaris**, Poir.
Stopper, Broad-leaved or Red Rod-wood. Indigenous and in Jamaica.

6. **E. lateriflora**, Willd.
Cuba.

7. **E. uniflora**, L. (*Griseb.*)
Surinam Cherry. Indigenous and West Indian.

8. **E. ligustrina**, W. (*Griseb.*)
Indigenous and West Indies and S. American.

9. **Pimenta vulgaris**, W. A.
Pimento, Allspice. In gardens. Introduced from Jamaica.

10. **P. acris**, W. A.
Bay Rum Tree, Wild Cinnamon, Bay Berry Tree. West Indies and South America. In gardens.

11. **Psidium Guava**, Radd.
Guava, Bay Plum. Naturalized originally from Continental Tropical America. Leaves astringent. Many members of this order contain aromatic volatile oils, and so are used in the preparation of condiments, e. g. *Pimento*. Others have eatable fruits such as *Psidium*, various species of *Eugenia* and *Jambosa*. Some of the oils, such as that of *Pimento*, are used in medicine as carminatives. The bark of the *Guava* is astringent.

Order XLI. LYTHRARIEAE.

1. **Ammannia latifolia**, L.
Indigenous. West and East Indies.

2. **Cuphea Parsonsia**, P., Br.
Indigenous. Jamaica and Cuba.

3. **Lawsonia inermis**, L.
Henna Mignonette Tree. West and East Indies.

4. **Lagerstroemia Indica**, L.
Crape Myrtle, Crape Plant. Cultivated; from Asia.

Ammannia is used in India as a vesicant, from its acrid juice. *Lawsonia* yields the famous Henna, used as a dye in Assyria and the East. The Crape-myrtle is a beautiful garden-plant.

Order XLII. GRANATEAE.

1. **Punica granatum**, L.
Pomegranate. Naturalized originally from Persia. The dried flowers, fruit and the bark of the root are used as anthelmintics.

Order XLIII. ONAGRARIEAE.

1. **Jussiæa angustifolia,** Lam.
West Indies and South America.

2. **Fuchsia** sp.?
American. Cultivated in gardens. This order does not possess any marked properties.

Order XLIV. TURNERACEAE.

1. **Turnera ulmifolia,** L.
Holly Rose, Sage Rose. Indigenous and West Indies.

2. **Triacis microphylla,** Gr. (*Swains.*)
Indigenous, and in Cuba and Hayti. *Turnera ulmifolia* has tonic and expectorant qualities.

Order XLV. PASSIFLOREAE.

1. **Passiflora lunata,** Juss.
Indigenous and West Indies.

2. **P. suberosa,** L.
Var. West Indies.

3. **P. multiflora,** L.
West Indies.

4. **P. rubra,** L.
West Indies and South America.

5. **P. laurifolia,** L.
Water lemon. Antigua and Guadaloupe.

6. **P. pectinata,** Gr. (*Hjalmars.*)
White Passion Flower. Indigenous, Turks Island and Fortune Island. (*Eggers.*)

7. **P. ciliata,** Ait. (*Griseb.*)
White Passion Flower. Indigenous and Jamaica.

8. **P. cuprea,** L. (*Linn.*)
Crimson or Maroon-colored Passion Flower. Indigenous and in Cuba.

9. **Carica Papaya,** L.
Papaw, Custard apple. Cultivated. West Indies. Tree and fruit full of acrid, milky juice, palatable when eaten with sugar, flavor of apricots; half ripe fruit pickled.

Some of the Passion flowers, as *P. rubra* (Dutchman's Laudanum), and, apparently, *P. laurifolia* are narcotic, others have eatable fruits. The fruit of the papaw is eaten and its seeds are said to be anthelmintic. The leaves can be used as a substitute for soap. A ferment similar to pepsin is present in the juice and leaves, and hence they have a remarkable power of making tough meat tender, though many Nassau people are skeptical about this.

Order XLVI. CUCURBITACEAE.

1. **Lagenaria vulgaris**, Ser.

Bottle Gourd. Naturalized in all tropical countries. Originally from India.

2. **Luffa acutangula**, Rox.

Strainer vine. Naturalized from East Indies.

3. **Momordica Balsamina**, L.

Balsam Apple. Naturalized from Asia, probably. Known in Egypt from time of Moses to present day.

4. **Cucumis sativus**, L.

Cucumber. Cultivated.

5. **C. Anguria**, L.

Wild Cucumber. Known in Egypt and in Rome by the ancients. Originally from India.

6. **C. Melo**, L.

Musk-melon. Cultivated. Originally from India.

7. **C. Citrullus**, Schrad.

Water-melon. Cultivated. Originally from Tropical Africa.

8. **Cucurbita Pepo**, L.

Pumpkin. Cultivated. From Africa, probably.

9. **C. maxima**, L.

Gourd.

10. **Cucurbita** sp.?

Squash. From tropics of the Old World.

11. **Sechium edule**, Sw.

Chow-chow, from Jamaica. Cultivated throughout West Indies.

The plants of this order all possess an acrid, purgative property, though many are excellent fruits and vegetables. The seeds of *Lagenaria* are purgative, and the fruit of *Luffa* is violently so. From this latter plant is obtained the substance known as vegetable sponge. A decoction of the roots of the Balsam Apple is said to be good for jaundice, while the distilled water from its leaves and fruit is a wash for St. Anthony's fire. The oil from the fruit is good for burns.

Order XLVII. CACTEAE.

1. **Echinocactus**, sp.?
Inagua and Southern Islands. Indigenous to Mexico and South America.

2. **Melocactus communis**, DC.
Turk's Head Cactus. Wild in Acklins Island, etc. One or two specimens in gardens in Nassau. Common in Turk's Islands, which obtained their name from its abundance.

3. **Cereus Swartzii**, Gr.
Dildo. Southern Islands, from Jamaica.

4. **C. pellucidus.**

5. **C. repandus**, Haw.
Torch Thistle. Southern Islands. From Jamaica.

6. **C. triangularis**, Haw.
Night-blooming Cereus, Prickly-withe. New Providence and all Islands, Jamaica and Mexico.

7. **C. grandiflorus**, Haw.
Night-blooming Cereus. All Islands; from Jamaica and Mexico.

8. **Opuntia Tuna**, Mill.
Prickly pear? Cochineal pear. Indigenous.

9. **O. Ficus-Indica**, Mill.
Prickly Pear. Indigenous.

10. **O. triacantha**, Mill.
Indigenous to Southern Islands. e. g. Watling's and Conception.

This order possesses sub-acid and cooling properties. The fruit of *Opuntia* is eatable, and has diuretic properties.

Order XLVIII. UMBELLIFERAE.

1. **Hydrocoytle umbellata**, L.
Pennywort, Sheep's bane. American and West Indian.

2. **Pastinaca sativa**, L.
Parsnip. Introduced originally from Europe.

3. **Daucus Carota**, L.
Carrot. Introduced, originally European.

4. **Anethum graveolens**, L.
Dill. Cultivated for its aromatic fruit, known as seeds, similar to caraway. Dill water is obtained by distilling the fruits. Introduced from Asia.

5. **Foeniculum vulgare,** Gærtn.

Fennel. Anise of New Testament. Introduced from Europe. Native of Southern Europe and Western Asia; appears to have been cultivated in Palestine.

6. **Petroselinum sativum,** Hoffman.

Parsley. Introduced from Europe.

7. **Apium graveolens,** L.

Celery. Introduced from Europe. Native of England and Europe and temperate regions of Southern hemisphere. Poisonous in native state.

8. **Pimpinella Anisum,** L.

Anise. Green Turtle Cay. (*Herrick.*)

Most of these plants are cultivated as vegetables. Some have medicinal properties also; *Hydrocotyle* is used as a remedy for leprosy. *Anethum* is carminative, said to be useful in dyspepsia and colic. *Fennel* is stimulating. The root of celery is aperient. The juice of parsley is emollient and diuretic, and said to cure dropsy.

Order XLIX. CAPRIFOLIACEAE.

1. **Lonicera** sp.?

Honey suckle. Indigenous. From Europe and America.

2. **Viburnum Opulus,** L.

Guelder Rose, Cranberry Tree, High Cranberry Bush, Snow Ball. In gardens. Common along Alleghenies in U. S., in wild state.

3. **Sambucus nigra,** L.

Elder. Introduced from Europe. All parts of the Elder are said to be laxative and diuretic; an ointment made from the leaves is useful in skin affections. *Viburnum* is emetic and purgative.

Order L. RUBIACEAE.

1. **Exostemma Caribaeum,** R. S.

Sea-side beech, Prince-wood Bark, Jamaica Bark, West India Bark. Throughout the West Indies. Indigenous.

2. **Hamelia.** sp.?

Prince-wood, Spanish Elm. Indigenous.

3. **Catesbaea spinosa.** L. (*Swains.*)

Lily-thorn, Catesby-thorn. Indigenous.

4. **C. parviflora,** Sw.

Indigenous and in Cuba and Jamaica.

5. **Randia aculeata**, L. (*Swains.*)
Indigo-berry, Ink-berry, Box-berry. Indigenous.

6. **Gardenia florida**, L.
Cape Jasmine. In gardens. Cape of Good Hope.

7. **Guettarda elliptica**, Sw.
Velvet-seed. Indigenous and in Cuba and Mexico.

8. **G. scabra**, Lam. (*Swains.*)
Indigenous, and in West Indies.

9. **Erithalis fruticosa**, L.
Var. *odorifera* Jacq. (*Swains.*) Indigenous and West Indian.

10. **Erithalis**, sp.?

11. **Chiococca racemosa**, Jacq. (*Swains.*)
Snow-berry. Indigenous and W. Indian.

12. **Coffea Arabica**, L.
Coffee. A few plants. Introduced from Africa.

13. **Strumpfia maritima**, Jacq. (*Swains.*)
Indigenous; on maritime rocks.

14. **Psychotria undata**, Jacq. (*Griseb.*)
Indigenous and in Jamaica.

15. **P. pubescens**, Sw.
Indigenous and in Jamaica.

16. **Psychotria lanceolata**, Nutt. (*Swains.*)

17 **Spermacoce**, sp.?
Button-wood. Indigenous.

18. **Galium hypocarpium**, Endl.
A weed. West Indies.

19. **Stenostomum myrtifolium**, Gr. (*Swains.*)
Indigenous.

20. **Ernodea littoralis**, Sw.
Branched Spurge. Indigenous and West Indian.

21. **Phialanthus myrtilloides**, Gr. (*Swains.*)

22. **Borreria thymifolia**, Gr. (*Hjalmars.*)
Button-weed. Turk's Island. Indigenous.

23. **Rhachicallis rupestris**, Dc. (*Swains.*)
Called by the fishermen, "sea-weed." "It is perhaps the most characteristic shrub of many of the larger Cays. It is prostrate or partly erect, and has dark-green, sprayey foliage and minute saf-

fron flowers. It is usually confined to rocks along the shores." (Herrick.)

24. Genipa clusiifolia, Gr. (*Swains.*)

Seven-year Apple. Fragrant, has colored flowers and a hard green fruit as large as a walnut.

Many members of this order possess valuable medicinal properties. Many are tonic and astringent. Quinine is obtained from one, and others have similar properties, especially *Exostemma*. The snow-berry tree has a diuretic fruit. The root is used here as an anti-syphilitic, and said to have attenuant properties, and to be cathartic and emetic.

Order LI. COMPOSITÆ.

1. Vernonia Bahamensis, Gr. (*Swains.*)

Flea-bane. Indigenous.

2. Ageratum conyzoides, L.

Bastard Hemp-Agrimony. West Indies.

3. Eupatorium aromatisans, D. C.

Thorough-wort, Hemp-Agrimony. West Indies.

4. E. villosum, Sw. (*Swains.*)

5. E. foeniculaceum, Willd.

West Indies.

6. E. conyzoides, V. (*Swains.*)

Indigenous and West Indies.

7. E. ageratifolium, De. (*Swains.*)

Indigenous and in Cuba and Mexico.

8. E. integrifolium, Berb.

9. E. repandum, W. (*Swains.*)

10. Erigeron tenuis, F. & G.

Flea-bane.

11. Baccharis angustifolia, Michx.

Dog-bush. Indigenous and in Florida.

12. B. dioica, V. (*Swains*)

Turk's Island. (*Hjalmars.*) Indigenous and in West Indies.

13. Pluchea odorata, Cass. (*Swains.*)

River-side Tobacco. West Indies and America.

14. P. purpurascens, De. (*Swains.*)

15. **Pluchea**, sp.

16. **Xanthium strumarium**, L.
Cockle-bur. America.

17. **Acanthospermum humile**, Dc.
Jamaica and Cuba.

18. **Parthenium Hysterophorus**, L. (*Swains.*)
White-head, Wild Wormwood, Bastard Fever-few. Indigenous from Southern United States to Patagonia.

19. **Ambrosia artemisiaefolia**, L.
Wild Tansy. Indigenous. Canada to Brazil.

20. **A. crithmifolia**, Dc.
Turk's Island. (*Hjalmars.*) Fortune Island, very common. (*Eggers.*) Indigenous.

21. **Ambrosia**, sp.?

22. **Eclipta alba**, Hask.
Indigenous throughout the world.

23. **Isocarpa oppositifolia**, R. Br. (*Swains.*)

24. **Borrichia arborescens**, Dc. (*Swains.*)
Sea-side Ox-eye, Samphire, Rock Samphire. Turk's Island. (*Hjalmars.*) Indigenous.

25. **Wedelia buphthalmoides**, Gr. (*Swains.*)
Ox-eye. Indigenous in W. Indies.

26. **W. carnosa**, Rich. (*Swains.*)
Marigold. Indigenous. West Indies and Tropical America.

27. **Melanthera deltoidea**, Rich. (*Swains.*)
Indigenous. West Indies.

28. **Bedins bipinnata**, L.
Spanish Nettle, Beggar's Ticks, Shepherd's Needle. West Indies and throughout America and the old world.

29. **B. leucantha**, W. (*Herrick.*)
Beggar's Ticks.

30. **Salmea petrobioides**, Gr. (*Swains.*)
Indigenous.

31. **Pectis linifolia**, Less.
Indigenous.

32. **Helianthus tuberosus**, L.
Jerusalem Artichoke; cultivated in a few gardens; originally from America.

33. **Lactuca sativa**, L.
Lettuce: cultivated: from Southern Europe.

34. **Artemisia vulgaris**, L. (*Herrick.*)
Common Mug-wort. Green Turtle Cay.

35. **A. hispida**, Pursh. (*Herrick.*)
Bastard Geranium.

36. **Zinnia multiflora**, L. (*Swains.*)
Most of the plants in this order possess a bitter principle, which renders them tonic. *Erigeron* is diuretic and much used in diseases of the kidneys. The species of *Eupatorium* are said to have stimulant and tonic properties for snake bites. The seeds of *Vernonia* are anthelmintic. The thickened juice of old plants of the common lettuce is highly narcotic, and is used as a substitute for opium in some cases, and as a nervine. *Eupatorium* is extensively used as a remedy for malaria.

Order LII. GOODENOVIEAE.

1. **Scaevola Plumieri**, L. (*Swains.*)
Low shrub, along the sea coast. Abaco.

Order LIII. ERICINEAE. (Heath Family.)

1. **Clethra tinifolia**, Sw.
Soap-wood, Wild Pear, Bastard Locust Tree. Indigenous and in Jamaica.

This plant does not appear to be of use for anything. The order has astringent properties. Its leaves and flowers are used as a diaphoretic: they are saponaceous and detergent.

Order LIV. PLUMBAGINEAE.

1. **Statice Bahamensis**, Gr. (*Hjalmars.*)
Turk's Island, Marsh Rosemary, Sea Lavender. Astringent. Indigenous.

2. **Plumbago scandens**, L.
Leadwort, Toothwort. West Indies. The Plumbago contains a caustic coloring matter. They are said to be alexipharmic.

Order LV. PRIMULACEAE.

1. **Samolus Valerandi**, L.
Water Pimpernel. Cosmopolitan. This plant is said to be an astringent.

Order LVI. MYRSINEAE.

1. **Myrsine laeta**, A. D. C.
Bully Tree, Black Soft-wood. West Indies and South America.

2. **Ardisia Pickeringia**, Torr. and Gray.
West Indian.

3. **Ardisia**, sp.?
4. **Jacquinia armillaris**, Jacq. (*Herrick.*)
Joe-Bush.
The properties of this order are of little importance.

Order LVII. SAPOTEAE.

1. **Chrysophyllum Cainito**, L.
Star-Apple. West Indies and South America. Tree 30 to 40 feet high. Popular name derived from transverse section of the seed which has 10 cells.

2. **C. oliviforme**, Lam. **Var. Monopyrenum** Sw. (*Swains.*)
Damson Plum, Wild Star-Apple. West Indies.

3. **Sapota achras**, Mull. (*Catesby*)
Sapodilla, said to be a variety (Catesb. Carol. 2, t, 87), Naseberry. Cultivated. West Indies.

4. **Sideroxylon mastichodendron**, Jacq. (*Catesby.*)
Indigenous. West Indies.

5. **Mimusops dissecta**, R. Br. (*Swains.*)
Bullet Tree. Indigenous. West Indies.

6. **Dipholis salicifolia**, A. D. C.
Pigeon-wood, White Bullet-tree.

7. **Bumelia retusa**, Sw.
Ballato Tree. Indigenous. West Indies.

8. **Bumelia**, sp.
This order has several eatable fruits. Other trees are valuable for timber in other colonies, e. g. Sapodilla. The young of many of them yields a substance like India rubber. The bark of these trees is astringent and febrifugal.

Order LVIII. JASMINEAE.

1. **Jasminum officinale**, L.

2. **J. gracile**, Andr.
And other species, in gardens from the old world. This order has no medicinal plants.

Order LIX. APOCYNACEAE.

1. **Thevetia nerifolia,** Juss.
In gardens. West Indies and South America.

2. **Rauwolfia nitida,** L.
Indigenous. Jamaica.

3. **Tabernaemontana citrifolia,** Jacq.
West Indies and South America.

4. **Vinca rosea,** L.
Periwinkle. Naturalized from Old World.

5. **Plumiera rubra,** L.
Jasmine Tree, Frangipani; from South America.

6. **P. obtusa,** L. (*Swains.*)
White Frangipani. Indigenous, This plant is exceedingly common in the windward islands of the group.

7. **Mandevillea.** sp.
Chili Jasmine. Naturalized from South America.

8. **Echites suberecta,** Jacq. (**Rhabdadenia.**)
Described by Herrick as a common and showy climber, often completely covering the lower shrubbery, and distinguished by its large lemon-colored flowers, shining leaves and milky juice.

9. **E. n. sp.?** near **umbellata.** Jacq. (*Catesb.*)
Wolff road, New Providence. Shrub about 8 feet high, glabrous, flowers in axillary cymes, pedicels geminate, corolla white with violet-purple throat. Anthers hispid on back, follicles united at tips 6–8 inches long, other characters like *umbellata.* Corolla limb 6 inches long. Calyx lobe 1–1½ inches, Coma 4 inches, 8 Anthers 1½–2 inches.

10. **E. neriandra,** Gr. (*Swains.*)
Harold's road New Providence, and common.

11. **E. paludosa,** Vahl. (*Swains.*)

12. **E. Sagræi,** A. D. C. (*Swains*)

13. **E. Jamaicensis,** Gr. (*Swains.*)

14. **Nerium Oleander,** L.
Oleander, Rose Laurel, Sweet Oleander, South Sea Rose. Naturalized from India.

15. **Vallesia glabra,** Car. (*Swains.*)

16. **Forestiera cassinoides,** Poir. (*Hjalmars*) Turk's Island.

Many of the plants of this order are intensely poisonous and all are to be suspected. Some are strongly purgative, while the bark of others is tonic. The Periwinkle is said here to have sedative properties, resembling those of opium; an infusion of its flowers is said to be an excellent wash for inflamed eyes. Many plants of this order furnish caoutchouc. *N. Oleander* is narcotic, herpetic, and is used for itch.

Order LX. ASCLEPIADEAE.

1. **Metastelma, sp.?**
Indigenous. W. Indies.

2. **M. Cubense,** Dec. *(Swains.)*
Indigenous and in Cuba.

3. **Vincetoxicum palustre,** Gray.
West Indian and European. *(Herrick.)*

4. **Seutera maritima,** Reichenb. *(Swains.)*
Indigenous. American and West Indian.

5. **Asclepias Curassavica,** L.
Bastard Ipecacuanha, Red-head, Blood-flower. West Indies and tropical America.

6. **A. paupercula,** Michx. *(Herrick.)*
Milkweed.

7. **Oxypetalum, sp.?**
West Indies and S. America.

8. **Stephanotis floribunda,** Thun.
In gardens; from Madagascar.

9. **Hoya carnosa,** Br.
Wax-plant. In gardens; from tropical Asia.

10. **Stapelia maculosa.**
Carrion flower; from Cape of Good Hope. A pot flower. This order has similar properties to the preceding. *Asclepias*, as indicated by its popular name, is used as an emetic like true Ipecacuanha. *Vincetoxicum* is also an emetic. Many species are cultivated for the beauty of their flowers. The milky juice is always to be suspected. Some species are said to be antidotes to snake bites, e. g. *Vincetoxicum*.

Order LXI. LOGANIACEAE.

1. **Spigelia anthelmia,** L.
Worm-grass, Pink-root. Indigenous. West Indies and America. This plant, poisonous when fresh, is, in the dry state, an excellent vermifuge.

Order LXII. GENTIANEAE.

1. **Eustoma exaltatum**, Gr.
West Indies and America.

2. **Sabbatia gracilis**, Salisb. (*Herrick.*)
Joe's Cay, off Little Abaco. A delicate plant which has large rose-colored flowers. This order has tonic and febrifugal properties from the bitter principle which is present in its members.

Order LXIII. HYDROLEACEAE.

1. **Nama Jamaicensis**, L.
West Indies and America. No use is known.

Order LXIV. CONVOLVULACAAE.

1. **Ipomoea Batatas**, Lam.
Sweet Potato. Naturalized from South America.

2. **I. sidifolia**, Chois.
Christmas-flower. West Indies.

3. **I. Pes-capri**, Sw.
Sea-side Potatoe. West Indies and all tropical countries.

4. **I. coccinea**, L.
West Indies and America.

5. **I. purpurea**, Lam.
United States, West Indies and America.

6. **I. Bona-nox**, L. (*Dolley.*)
Moon-flower. Native of India; pure white flowers, 5–6 inches in diameter, opening at night and giving out a delicate perfume.

7. **I. arenaria**, Steud. (*Swains.*)

8. **I. Carolina**, L. (*Catesb.*)
On rocks.

9. **I. cathartica**, Poir. (*Swains.*)
Morning-glory. West Indies and S. America.

10. **Convolvulus micranthus**, R. S.
West Indies and South America.

11. **C. Jamaicensis**, Jacq. (*Swains.*)
Indigenous and West Indies.

12. **Evolvulus arbuscula**, Poir. (*Swains.*)
Indigenous and W. Indies. The plants of this order possess in their rhizomes a highly purgative principle, Jalap; except *I. Bata-*

tas, in which it is replaced by starch, which renders the rhizome of this plant highly nutritious.

13. **E. sericeus**, Sw. (*Swains.*)
 On arid maritime rocks.

14. **E. linifolius**, L. (*Swains.*)
 Arid pastures.

15. **E. mucronatus**, Sw. (*Hjalmars.*)
 Turk's Island.

Order LXV. DICHONDREAE.

1. **Dichondra repens**, Forst.
 This small order has no known properties.

Order LXVI. CUSCUTEAE.

1. **Cuscuta Americana**, L.
 Dodder. Love Vine; Mexico, West Indies and S. America.

2. **C. obtusiflora**, Kth. (*Swains.*)
 Love vine. Indigenous and in Florida and S. America.

Plants of this order are parasitic on other plants; they are said to be purgative. An infusion is used here as a wash for sores on the head.

Order LXVII. BORRAGINEAE.

1. **Tournefortia volubilis**, L. (*Swains.*)
 Basket withe. Indigenous. West Indies and South America.
2. **Tournefortia gnaphalodes**, R. Br. (*Swains.*)
3. **Heliotropium parviflorum**, L. (*Swains.*)
4. **Beurreria tomentosa**, G. Don. (*Swains.*)
 Currant Tree. Indigenous. West Indies. These plants are harmless and mucilaginous and of little value as medicinal agents.

Order LXVIII. CORDIACEAE.

1. **Cordia Lima**, R. S. (*Swains.*)
 Indigenous and in Hayti.

2. **C. Sebestena**, Jacq. (*Swains.*)
 Scarlet Cordia, Aloe Wood. West Indies and S. America.

3. **C. gerascanthoides**, Kth.
 Prince-Wood, Prince-Tree, Spanish Elm. West Indian; Dominican rose wood.

Plants of this order have similar properties to those of the preceding one. Prince-wood is a handsome light brown wood, not to be confounded with tonic Prince-wood bark, the product of *Exostemma Caribaeum.* Vid. order L.

Order LXIX. SOLANACEAE.

1. **Nicotiana Tabacum**, L.
   Tobacco. Introduced, originally from S. America.

2. **Petunia, sp.?**
   Cultivated in gardens. S. America.

3. **Datura Stramonium**, L.
   White Datura, Prickle-Bur, Thorn-Apple. Cosmopolitan, in warm countries.

4. **Datura Tatula**, L.
   Violet Datura.

5. **Brugmansia suaveolens**, G. Don.
   Sweet-smelling Datura. Naturalized from S. America.

6. **Lycopersicum Humboldtii**, Dun.
   Small oval Tomato, originally from Peru.

7. **L. esculentum**, Mull.
   Cultivated Tomato.

8. **Capsicum frutescens**, L.
   Cayenne Pepper, Bird Pepper; from South America.

9. **C. annuum**, L.
   Guinea Pepper, Chilies.

10. **Capsicum, sp.?**
    Other kinds of peppers are grown.

11. **Solanum nodiflorum**, Jacq.
    Night shade, Branched Calalu. West Indies. Used by the Myal men or Obia men of the West Indies as a narcotic, to produce a profound sleep of a certain duration. Vid. Edwards, l. c., Vol. 2, p. 297.

12. **S. Bahamense**, L. (*Swains.*)
    Canker Berry. Indigenous and in Jamaica and Mexico.

13. **S. Melongena**, L.
    Egg-plant, Mad-Apple. Cultivated; from tropical Asia.

14. **S. tuberosum**, L.
    Irish Potato.

15. **S. igneum.**
16. **S. aculeatissimum,** Jacq. (*Herrick.*)
 Apple-of-Sodom. Green Turtle Cay.

17. **Brunfelsia, sp.?** (*Herrick.*)
 A tall shrub. Green Turtle Cay.

18. **Physalis Linkiana.** *Griseb.*
 Winter's Cherry. West Indies.

Very many plants of this order possess useful medicinal and other properties. Tobacco does not grow well in the Bahamas, owing to the poor soil. In medicine, *Datura* is used externally as a local stimulant; the seeds are strongly narcotic and poisonous. In spasmodic asthma it is useful, especially when smoked. Externally, it is an anodyne in its action. Here its juice, made with lard into an ointment, is said to be good for ulcers and burns. The juice of the Tomato is used in the Bahamas as an eye wash, and for a cooling wash generally. The various specimens of *Capsicum* are stimulant, carminative and diuretic and are so used here. The stem, leaves and fruit of the species of *Solanum* are narcotic, antispasmodic and diuretic.

Order LXX. CESTRINEAE.

1. **Cestrum pallidum,** Lam. (*Swains.*)
 Bastard Jasmine, Poison berry. Indigenous and West Indies.

2. **C. diurnum,** L.
 Indigenous.

This order has narcotic and diuretic properties.

Order LXXI. SCROPHULARINEAE.

1. **Scoparia dulcis,** L.
 Liquorice weed, Sweet Broom-Weed. West Indies, tropical America and all tropical countries.

2. **Capraria biflora,** L. (*Hjalmars.*) Turk's Island.
 Goat-weed, West Indian Tea. Indigenous in West Indies.

3. **Buchnera elongata,** Sw.
 West Indian.

4. **Gerardia purpuræ.**
5. **Linaria vulgaris,** Mill.
 Toad Flax. Naturalized from Europe.

6. **Verbascum pulverulentum,** Mull. (*Herrick.*)
 Green Turtle Cay.

7. **Russelia juncea**, Zuccar. (*Doller.*)
New Providence. Probably introduced from Mexico.

8. **Herpestis Monniera**, Kth. (*Swains.*)
The plants of this order must be suspected, as many are poisonous. *Scoparia* is tonic and febrifugal. *Capraria* is sometimes used as tea in the West Indies and Central America.

Order LXXII. BIGNONIACEAE.

1. **Tecoma leucoxylon**, Mart. (*Swains.*)
White wood, white wood cedar. West Indies.

2. **T. stans**, Juss.
Yellow Popper, Yellow Elder, Bignonia. West Indian and tropical American.

3. **T. radicans**, Juss.
Red Trumpet-flower, Trumpet Creeper: in gardens; tropical America.

4. **T. Capensis**, G. Don.
In gardens; from Brazil.

5. **Jacaranda caerulea**, Gr. (*Swains.*)
Cancer-Plant. Indigenous.

Some species of *Tecoma* have astringent properties. The leaves of *Jacaranda* are used in this colony as a cure for cancer, and as an anthelmintic in Panama. *Jacaranda Brasiliensis* Ger. 'Polisander.' Fr. 'Polisandre'—is a beautiful wood for cabinet making, and might be introduced and cultivated with advantage. Smith (Dict. Econ. Bot.) gives this as 'Palissander' or 'Palixander-wood.' The bark of *Tecoma leucoxylon* is supposed to be an antidote to *Manchineel.*

Order LXXIII. ACANTHACEAE.

1. **Blechum Brownei**, Juss.
Tropical America and Asia.

2. **Justicia Carthaginensis**, Jacq.
Violet-Justicia. West Indies and South America.

3. **Justicia, sp.**
Several kinds of Justicia are cultivated in gardens on account of their flowers.

4. **Anthacanthus spinosus**, Gr. (*Swains.*)
Indigenous and West Indian.

5. **Dicliptera assurgens**, Juss. (*Swains.*)
Indigenous and West India.

The two last plants are commonly known as Justicia. This order has no important properties.

Order LXXIV. SESAMEAE.

1. **Sesamum orientale**, L.
Benne Oil plant. Naturalized in West Indies from East Indies.

2. **Martynia diandra**, Glox.
West Indies and tropical America.

The uses of the Benne plant are well known, the seeds are eaten for food like rice. The oil is pungent when first drawn, but later is mild and used for salads, in the adulteration of olive oil and in the manufacture of soaps. The plant is an important one in bush medicine. A decoction of the leaves is said to be useful in coughs, pleurisy, inflammation of the lungs and hard tumors and to cool the blood. The leaves and seeds mixed with honey form a poultice for tumors. The dried leaves powdered over an ulcer will dry it up and heal it. The oil is said to be good for the itch and for pains in the stomach.

Order LXXVI. VERBENACEÆ.

1. **Tamonea verbenacea**, Sw.
West Indies.

2. **T. scabra.**
3. **Tamonea**, sp.
4. **Verbena triphylla.**
Lemon scented Verbena. In gardens, from tropical America. Some other species are cultivated in gardens.

5. **Bonchea Ehrenbergii**, Cham.
W. India and tropical America.

6. **Stachytarpha Jamaicensis**, V. (*Swains.*)
Blue-flower, Vervain. West Indies and tropics of both worlds.

7. **Lippia nodiflora**, Rich. (*Swains.*)
Indigenous and almost cosmopolitan.

8. **L. geminata**, Kth. Var. **microphylla**. (*Hjalmars.*) Turk's Island.
9. **Lantana crocea**, Jacq. (*Swains*)
Wild Sage, yellow. Indigenous in W. Indies.

10. **L. involucrata**, L.
Wild Sage, white or lilac. West Indian and Indigenous.

11. **L. Camara**, L. (*Swains.*)
Wild Sage, yellow changing to red. Indigenous and West Indian.

12. **Citharexylum cinereum**, L.
Fiddle-wood, Savanna Wattle. West Indies.

13. **Duranta Plumieri**, Jacq. (*Swains.*)
Pigeon-berry, Blue-flower. Indigenous and West Indies.

14. **Petitia Domingensis**, Jacq.
Yellow Fiddle-wood, Spur Tree. Greater Antilles.

15. **Avicennia nitida**, Jacq.
"Courida" or Black Mangrove. Bark astringent.

16. **Clerodendron Balfourii.**
Mobile Cologne-plant, "white blossoms like tiny double roses, with many garnet sepals and tracts." Dickinson & Dowd, *Loc. cit.*, p. 149.

Most of the plants of this order are aromatic and bitter, but none have important medicinal properties. The wild sage is used here in infusion as a febrifuge and purgative. *Stachytarpha* is said to be purgative and anthelmintic. In Liberia, it is used to produce abortion. Blue-flower tea is a well-known remedy here for fevers; the leaves are sometimes used to adulterate Chinese tea.

Order LXXVI. LABIATAE.

1. **Ocimum micranthum**, Willd.
Basil. West Indian.

2. **Coleus, sp.?**
Several species cultivated in gardens for ornament.

3. **Hyptis suaveolens**, Poit.
Spikenard. West Indies.

4. **Salvia occidentalis**, Sw.
Wild Sage. West Indies.

5. **S. coccinea**, L.
Crimson Salvia. West Indies.

6. **S. serotina**, L. (*Swains.*)
Several species of *Salvia*, e. g. *S. splendens*, are cultivated in gardens for the flower.

7. **Nepeta coerulea**, L.
Blue catnip. Introduced from the old world. (?)

8. **N. Cataria**, L.
White Catnip. Introduced from old world.

9. **Leonurus Sibiricus**, L.
Motherwort. Introduced. Cosmopolitan.

10. **Leonotis nepetaefolia**, R. Br.
West Indian.

11. **Teucrium Cubense**, L. (*Swains.*)
Indigenous, and tropical America.

12. **T. inflatum**, Sw.
West Indies and tropical America.

13. **Marrubium vulgare**, L.
Horehound. Introduced from old world.

None of the plants of this order are poisonous, and they are usually aromatic and carminative, and sometimes tonic and stomachic. *Basil* is said to be stimulant and diuretic, and *Salvia* has similar properties. *Teucrium* is a tonic from the presence of a bitter principle. Horehound is also a tonic and is a well-known remedy for coughs. Many of these plants, e. g. *Nepeta* and *Leonurus*, are used in bush medicine. They are probably not of very much use.

Order LXXVII. PLANTAGINEAE.

1. **Plantago major**, L.
Plantain. Almost cosmopolitan. The leaves are slightly astringent, and an eye wash is distilled from the entire plant.

Order LXXVIII. NYCTAGINEAE.

1. **Mirabilis Jalapa**, L.
Marvel of Peru, Four o'clock Flower, False Jalap. West Indies and South America.

2. **Bougainvillia spectabilis**, Poir.
Wild. In gardens; from South America.

3. **Pisonia aculeata**, L.
Cockspur. West Indies and South America.

4. **P. inermis**, Jacq.
West Indies.

5. **P. obtusata**, Sw.
West Indies.

6. **Boerhaavia scandens**, L. (*Swains.*)

The roots of the plants of this order are purgative and emetic. *Mirabilis* acts similarly to the true Jalap, but is less efficacious, and is sometimes administered for dropsy. *Pisonia* is said to be febrifugal and antisyphilitic.

Order LXXIX. PHYTOLACCACEAE.

1. **Phytolacca icosandra**, L.

Pokeweed, Foxglove, Redweed, Spanish Calalu. West Indies and South America.

2. **Rivinia laevis**, L.

Hoop-Withe.

3. **Petiveria alliacea**, L.

Guinea-hen's Weed, Strong Man's Weed. Southern United States, Mexico and West Indies.

4. **Suriana maritima**, L. (*Hjalmars.*)

Turk's Island.

Phytolacca is highly purgative; *Petiveria* is febrifugal and diuretic.

Order LXXX. POLYGONEAE.

1. **Polygonum glabrum**, W. (*Swains.*)
2. **Coccoloba uvifera**, Jacq. (*Swains.*)

Seaside Grape, Lobe Berry. West Indies and S. America.

3. **C. leoganensis**, L.

Grape. Indigenous, and Jamaica and Hayti.

4. **C. tenuifolia**, L.

Grape. Indigenous and Jamaica.

5. **C. punctata**, L.

Grape, Small-leaved Pigeon-wood. West Indies.

6. **Antigonon leptopus**, Hook.

Coral Vine, Coral Plant. Cultivated for ornament in gardens; West Indies and South America.

The different species of *Coccoloba* are well known here as Sea Grape. The fruits are eatable. The wood and bark yield a very strong astringent known as American Kino. Bark used for tanning.

Order LXXXI. AMARANTACEAE.

1. **Achyranthes aspera**, L.

West Indies and all hot countries.

2. **Iresine celosioides**, L.

Juba's Bush. West Indies, Southern United States and South America.

3. **Euxolus viridis**, Moq.

West Indies, Southern United States and almost all hot countries.

4. **Amblogyna polygonoides**, Raf. (*Swains.*)

5. **Amarantus spinosus**, L.

Amaranth, Prickly Calalu. West and East Indies, South America and Africa.

6. **A. paniculatus**, L. (*Linn. Mart.*)

7. **Gomphrena, sp.?** (*Herrick.*)

Turtle Grass. "Running prostrate plant with turgid stems and leaves."

8. **Alternanthera Achyrantha**, R. Br. (*Swains.*)

9. **A. flavescens.** Moquin. (*Herrick.*)

10. **Philoxerus vermiculatus**, R. Br. (*Swains.*)

The properties of this family are unimportant. *Achyranthes* is said to be an astringent and diuretic.

Order LXXXII. CHENOPODIEAE.

1. **Batis maritima**, L. (*Hjalmars.*)

Turk's Island.

2. **Chenopodium ambrosioides**, L.

Goose-foot, Hedge-mustard. West Indies, South America and in all warm countries.

3. **C. murale**, L.

Naturalized from Europe. Some kitchen vegetables, such as Spinach (*Spinacia oleracea*) and Beet (*Beta vulgaris*, Moq.) belong to this order. *Chenopodium* is an anthelmintic and antispasmodic.

4. **Suaeda linearis**, Torr. (*Herrick.*)

5. **Salicornia ambigua**, Michx. (*Hjalmars.*)

Turk's Island.

Order LXXXIII. BASELLEAE.

1. **Basella alba**, L.

White Spinach, Indian Spinach, called Malabar Night in Kew Gardens. Introduced from East Indies.

2. **Boussingaultia baselloides**, Kunth.

Introduced from South America.

Basella alba is eaten as a pot herb.

Order LXXXIV. LAURINEAE.

1. **Persea gratissima**, G.

Alvocado Pear, Alligator Pear, Avocado Pear. Naturalized from Mexico. Leaves used as a medicine. Balsamic, pectoral, vulnerary; seeds astringent.

2. **Persea Indica.**

Madeira wood. Naturalized from Africa.

3. **Nectandra sanguinea**, Rottb. (*Swains.*)

Yellow or Lowland Sweet-wood. Indigenous and West Indies.

4. **N. Willdenoviana.**
5. **Cassyta Americana**, Ns.

Dodder Laurel. West Indies and South America.

The fruit of *Persea gratissima* is well known and esteemed. *Nectandra* furnishes good timber, as does *P. Indica.* The plants of this order have tonic and stimulating properties.

Order LXXXV. URTICEAE.

1. **Fleurya aestuans**, Gaud.

Nettle. West and East Indies.

2. **Pilea microphylla**, Liebm.

Nettle. Jamaica and Cuba.

These plants have no known properties.

Order LXXXVI. MOREAE.

1. **Brosimum Alicastrum**, Sw.

Bread-nut. West Indies and Mexico. Nut eatable when roasted. Wood has fine grain like Mahogany. Nuts eaten by *Macrotus Waterhousii*, American leaf-nosed bat.

2. **Artocarpus incisa**, L.

Bread-fruit. Naturalized from East Indies. Introduced into Jamaica in 1793 after many unsuccessful attempts, by Capt. Wm. Bligh.*

The bark is very tough and is beaten out into fine white cloth by the natives of Otaheite and other Islands of the Pacific.

3. **Ficus pertusa**, L.

Fig. Jamaica and West Indies.

4. **F. trigonata**, L.

Wild Fig. Green Turtle Cay.

* Vide Edwards' Hist. Brit. Col. in the W. I. vol. I. Preface to 2nd Edition, p. 30.

5. **F. elastica**, Roxburgh.

Caoutchouc Tree. In gardens. Introduced.

6. **F. Carica**, Willd.

Fig. This furnishes the well-known fruit; from the old world.

7. **Maclura tinctoria**, Don.

Fustic. Berries eaten by bats. South America.

The milky juice of many members of this family is poisonous. The nut of *Brosimum* is eaten in Jamaica. *Maclura* gives a valuable dye. The berries of the latter tree furnish a gargle for sore throat used in this colony. Its ashes are also said to be good for rheumatism. The plants of this order possess tonic and astringent properties and furnish caoutchouc. Several species of *Ficus* are grown for ornament.

Order LXXXVII. CELTIDEAE.

1. **Sponia Lamarkiana**. Desc. (*Swains.*)

Jamaica Nettle Tree. Indigenous. No known use.

Order LXXXIII. MYRICEAE.

1. **Myrica cerifera**, L.

Wax Myrtle, Bay berry.

Introduced from America. This plant is valuable for the wax which is obtained from its fruit, and which can be used for lighting. Its roots are a violent purgative, and an infusion of its bark is said to be a remedy for scrofula.

Order LXXXIX. CASUARINEAE.

1. **Casuarina equisetifolia**, Forst. (*Eggers.*)

Toa Tree. Introduced from the East and planted as an ornamental tree. The wood (Beef-wood) is hard and heavy, and can be used in ship building. The bark is astringent and useful (in a decoction) in diarrhea; healing to fresh-cut wounds.

This family is widely distributed. Indian Archipelago and Pacific Ocean. The Australian species are called "She Oak, Swamp Oak, Forest Oak, Beef-wood." The wood is also known as Ironwood. It takes a fine polish (war clubs). Bark furnishes a dye. (Smith Dict. Econ. Pl.)

Order XC. EUPHORBIACEAE.

1. **Drypetes sp.?**

West Indian. Indigenous.

2. **Cicca disticha**, L.
Otaheite Gooseberry. Introduced from India.

3. **Phyllanthus Niruri**, L.
All tropical countries.

4. **P. angustifolius**, Sw.
Hard-head Bush, Seaside Laurel.

5. **P. falcatus** Sw. (*Swains.*)
Jamaica and West Indies.

6. **P. sp. ?**
Rock bush. Astringent.

7. **Jatropha Curcas**, L.
Physic-nut. South American. Naturalized in all tropical countries.

8. **J. gossypifolia**, L. (*Swains.*)

9. **Janipha Manihot**, Kth.
Cassava. Cultivated; from South America.

10. **Ricinus communis**, L.
Castor Oil Plant, Palma Christi. Naturalized; from East Indies.

11. **Croton Cascarilla**, L. (*Swains.*)
Linear-leaved variety. Cascarilla, Wild Rosemary. Indigenous.

12. **C. Eluteria** Sw. (*Swains.*)
Cascarilla, Eleuthera. New Providence. Indigenous.

13. **C. flavens**, L.
Yellow Balsam. West Indian.

14. **C. flocculosus**, Geis. (*Swains.*)

15. **C. niveus**, Jacq.
West Indies and South America.

16. **C. lucidus**, L. var. **pubigerus**. (*Swains.*)
Basket-hoop. Indigenous and in West Indies.

17. **C. lobatus**, L.
West Indies and South America.

18. **C. Ujalmarsonii**, Hjalm. (*Hjalmars.*)
Turk's Island, also frequent on Fortune Island. (*Eggers.*)

19. **C. humilis**, L. var. **origanifolius**, Lam. (*Swains.*)

20. **Argythamnia sericea**, Gr. (*Swains.*)
Indigenous.

21 **Acalypha polystachya**, Jacq.
West Indies.

22. **A. persimilis.**
West Indies.

23. **A. alopecuroides.**
West Indies.

24. **Pera, sp.?**
25. **Sapium laurifolium,** Gr.
Gum tree. West Indies and Cuba.

26. **Hura crepitans,** L.
Sand-box tree. West Indies and South America. Fruit acrid, emetic rubefacient, poisonous; juice causes injury to the eyes.

27. **Excœcaria lucida,** Sw.
West Indies.

28. **E. Cubana.**
West Indies.

29. **Euphorbia buxifolia,** Lam.
Spurge. Indigenous and West Indian.

30. **E. serpens,** Kth.
Indigenous and West Indian.

31. **E. maculata,** L.
Eye bright. All tropical countries.

32. **E. pilulifera** L.
All tropical countries.

33. **E. hypericifolia,** L.
West Indian, Southern United States and Europe.

34. **E. punicea,** Ait. (*Swains.*)
Wild Physic-nut. Indigenous.

35. **E. heterophylla,** L. Var. **prunifolia,** Jacq. (*Swains.*)
Joseph's-Coat. Indigenous and West Indies.

36. **E. (Poinsettia) splendens.**
In gardens. Native of Madagascar.

37. **Euphorbia, sp.?**
38. **Hippomane Mancinella,** L.
Manchineel. West Indies and South America. A common tree in Fortune Island. (*Eggers.*)

The *Euphorbiaceae* have a milky juice, which in almost every case is more or less poisonous, but it becomes innocuous when heated. From this property of the juice, it is possible to make use of the valuable starch which some of the plants contain, e. g. *Tapioca*, obtained from *Janipha Manihot*. *Sapium*, *Hura* and *Excoecaria* are especially poisonous, and *Hippomane Mancinella*, the true Manchineel, the most poisonous of all. *Cicca* has an acrid, eatable fruit. *Phyllanthus* is used here as a wash for sores, being very astringent. *Jatropha* is a drastic purgative. As mentioned above, washing and heating removes the poisonous juice which, concentrated by boiling, becomes a sauce known as *Cassareep*. *Ricinus* furnishes the well-known castor oil. The Cascarilla or Sweet-wood bark exported from this colony comes from a species of *Croton*; it is an aromatic tonic; also purgative and emetic. The various species of *Euphorbia* are purgative.

Order XCI. NEPENTHEAE.

1. **Nepenthes, sp.?**
In gardens. Asia and Africa. No known properties.

Order XCII. LORANTHACEAE.

1. **Loranthus parviflorus,** Sw.
Mistletoe. West Indies.

2. **L. uniflorus,** Jacq. (*Catesb.*)
Mistletoe. Indigenous and W. Indian. The mistletoe is used in this colony as an antisyphilitic. Its properties appear to be very important.

3. **Phoradendron rubrum,** Gr. (*Catesb*)
Fortune Island. (*Eggers.*)

December 3.

The President, Dr. Joseph Leidy, in the chair.

Forty-five persons present.

A paper entitled "On the Modification of the Apex in Murex," by Frank C. Baker was presented for publication.

Notes on the drift on Block Island.—Mr. Theo. D. Rand remarked that this island, lying in the Atlantic Ocean off the extreme easterly point of Long Island, shows the drift formation as he had seen it nowhere else. The shores in many parts rise from the ocean as precipitous bluffs to a height from one hundred to two hundred feet. The outer surface is constantly eroded while the summits are preserved by a growth of grass generally too high above the water for drifting sands to cover. Thus excellent sections are exposed.

The island is pear-shaped, about seven miles from north to south and between three and four from east to west at its widest point which is probably a mile and a half from its southern edge.

There is not a creek or running water of any kind on the island except a few springs bordering the ocean, neither is there a valley strictly so called. The whole island is made up of rounded hills and bowl-like depressions, the bottom of the latter usually occupied by a fresh-water pond, in many of which flourish water lilies of remarkable size and beauty. Most of it is covered with a soil of sand, clay and gravel which seems to be quite fertile.

Here and there are boulders ranging down from two thousand cubic feet (visible above ground), but the stone fences, which everywhere divide the farms often into quite small fields, testify that man's industry has removed many thousands from the surface.

The island has been described as pear-shaped, but a little north of the middle of the pear is a brackish pond of more than a thousand acres in extent, with but a narrow isthmus of sand separating it from the ocean on the east and on the west. On the west this isthmus has been dredged through and the tide now flows in and out. On the east the isthmus is not over one hundred yards wide and not over, probably, five or ten feet above high tide. North of this isthmus the ground gradually rises to high bluffs. South and southwest of it almost all the land is elevated, the extreme height being some three hundred feet at Beacon Hill.

On examining the bluffs it would appear at first sight that erosion is progressing with great rapidity, as along most of the bluffs large boulders line the shore and extend a considerable distance seaward forming a breakwater. The cause of this was not at first apparent. With few exceptions the bluffs were clothed with grass to their extreme edges. The descent from the edge was generally precipitous with perhaps one-tenth of the contour indented to a slope of thirty degrees or more.

In the precipitous portions the sections were very perfectly shown. There is some clay but the larger portion of material is gravel intermixed with pebbles and boulders of various sizes, the boulders some times rounded and often not. The variety of rock was great. The material evidently came chiefly from the Laurentian. Granite and syenite are probably in the largest quantity and greatest variety. White quartz is abundant; several varieties of porphyry, porphyritic gneiss, garnetiferous gneiss, mica schist and epidote occur more rarely.

Careful examination shows that considerable drainage from the island takes place through these bluffs. This was plainly visible in July when the ponds evidently were not at their highest, and he was inclined to attribute much of the erosion to this trivial but constantly acting cause. During times of frost its influence must be considerable.

In these sections, as a rule, the material is heterogeneous, clay, sand, gravel and boulders being commingled in seeming confusion, but at times there is evidence of a sorting. Thus at Clay Head near the north part of the island, there is a great preponderance of clay, but in the sections may be seen what were evidently the beds of ponds, in which muddy water had, for a time, deposited its clay free from stones, this being afterwards buried in the coarser detritus. He saw nothing whatever organic in any of the exposures.

These alternations of clay and gravel account for the existence of the numerous ponds which appear to be simply collections of rain water in clayey bottoms, the water rising until a porous stratum is reached through which the water percolates to the ocean. At one place a higher pond had an outlet to a lower and here erosion by running water was apparent, but it was trivial and almost the only one seen, except what might be attributed to excessive rainfall, such as may be seen along our roadsides after a heavy rain. Some of the grass-covered slopes are very steep and this absence of recent erosion shows the extreme porosity of the general surface.

What most impressed Mr. Rand was the probable very slight change of surface since the glacial epoch. Contrasting this with the erosion in south-eastern Pennsylvania of rocks so very much harder than the loose sand gravel and clays of Block Island the time within which the erosion of the former must have been progressing would seem almost infinite.

December 10.

The President, Dr. Joseph Leidy, in the chair.

Thirty-three persons present.

DECEMBER 17.

Mr. CHARLES MORRIS in the chair.

Thirty persons present.

The following papers were presented for publication :—

"On a Petroglyph from the Island of St. Vincent, W. I.," by Daniel G. Brinton, M. D.

"Description of a new species of Eutænia," by Arthur Erwin Brown.

DECEMBER 24.

Mr. CHARLES MORRIS in the chair.

Nineteen persons present.

The following papers were presented for publication :—

"Description of New Species of Shells," by W. D. Hartman, M. D.

"On new forms of Vertigo," by Dr. V. Sterki.

"On the distribution of color-marks in the Pteropodidæ," by Harrison Allen.

DECEMBER 31.

Mr. THOMAS MEEHAN, Vice-President, in the chair.

Twenty-five persons present.

The deaths of José O. Schimmel, Charles A. Ashburner, James H. Hutchinson, M. D., members, were announced.

The following were ordered to be printed :—

NEW AND LITTLE-KNOWN AMERICAN MOLLUSKS, No. 2.

BY H. A. PILSBRY.

Pupa calamitosa Pilsbry. Pl. 12, figs. 16, 17.

Shell minute, cylindrical, very blunt at apex, chestnut colored; whorls $4\frac{1}{2}$, the first one and one-half smooth, the following regularly costulate striate, the costulæ separated by spaces wider than themselves; last whorl abruptly turning forward, rounded beneath, encircled by a slight central constriction or furrow; aperture about one-third the total length of shell, rounded, truncated above, contracted within; peristome thin, expanded, without crest or callous thickening behind; columellar margin rather dilated; parietal wall bearing two entering lamellæ, one arising near the termination of the outer lip, the other more deep seated, elevated, entering less obliquely; columella with a strong white deep-seated obliquely entering fold; outer lip with two short white lamellæ.

Alt. 1·70, diam. ·80 mill.

Two trays of this tiny species are before me. One received from Henry Hemphill, collected near the mouth of San Tomas river, Lower California, the other collected by Orcutt near San Diego, Cal. Most specimens show the widening inward of the outer lip shown in the figure. Several specimens have only one lamella on the outer lip, and are rather larger than the typical form described, measuring 1·90 mill. alt. The second parietal lamella is usually much larger than the first, but in one or two specimens before me this is not the case. The umbilical rimation terminates in a tiny depression, perhaps minutely perforated at the axis. The formula of denticles or folds (according to Dr. Sterki's scheme*) A A B D E or A A B E. The species is of a decidedly different type from any known American *Pupa*. *P. hordacea*, *californica*, and *rowelli*, abundant western forms, belonging in quite diverse groups; the first being allied to *P. corticaria* and *pellucida*, the latter grouping with *P. decora*, *rowelli* and *corpulenta*.

From the *Pupæ* of the Mexican fauna, *leucodon*, *pellucida* and *chordata* the present species is quite distinct in every respect.

The inward continuation of the parietal and columellar folds is shown in figure 17. They are white, regularly veined with darker, like polished plates of agate.

* See Proc. U. S. Nat. Mus. 1888, p. 369. I have repeated the letter representing the parietal fold, as the two seem to be of equal importance.

Pupa sterkiana Pilsbry. Pl. 2, figs. 2, 3.

Shell rimate, perforate when young, cylindrical, blunt at both ends, opaque, chestnut-brown; surface obliquely sculptured with strong, rather irregular costulæ, which often split or branch; suture very deeply impressed; whorls 7, the first one smooth, the last five of about equal diameter, very convex; last whorl a little ascending to the aperture, without crest or scrobiculation behind the peristome; aperture a trifle oblique, rounded, truncate above; lip expanded, continuous, thin, white. without teeth or folds; umbilicus deeply impressed, appearing very narrowly perforated.

Alt. $4\frac{1}{2}$, diam. $1\frac{3}{4}$ mill.

Alt. 4, diam. $1\frac{1}{2}$ mill.

Specimens of this species are in the Academy from Lower California. They were received from Mr. C. R. Orcutt of San Diego, Cal. The large size (much exceeding any other West American *Pupa*) toothless lip and strongly costate surface will at once distinguish it. The peristome is continuous as a slightly elevated lamina across the parietal wall. The columella has a very obtuse, blunt, deep-seated fold.

Zonites simpsoni Pilsbry. Pl. 12, figs. 8, 9, 10.

This species belongs to that group of *Hyalina* comprising *capsella* Gld., *lawi* W. G. Binn.. and *placentula* Shutt.,—species with narrow umbilicus, numerous closely coiled narrow whorls, and without a callus or thickening within the base of the last whorl. *Z. simpsoni* differs from *placentula* in its much smaller size, nearly straight, instead of arcuate basal lip, seen from beneath, proportionately wider last whorl, and the more trigonal, wider aperture. With *Z. lawi* I need not compare, as that species is much larger and more elevated. *Z. capsella* is about the same size, color and texture as *simpsoni*, but has a narrow umbilicus and very much narrower aperture, narrowly semilunar instead of trigonal in outline. *Z. simpsoni* has 5 whorls. Alt. 2, diam. maj. $4\frac{1}{2}$, min. 4 mill.

The specimens before me were collected by Mr. C. T. Simpson at Limestone Gap, Indian Territory. The trigonal form of the aperture is so peculiar that the species may be separated from *Z. capsella* at a glance. My comparisons were made with specimens of *capsella* received from Gould, and *placentula* from W. G. Binney. The figures are camera lucida drawings.

Zonites selenitoides Pilsbry. Pl. 12, figs. 13, 14, 15.

This species is similar in form and general appearance to *Z. minusculus* Binn., though decidedly larger. The umbilicus is broad, as in the latter species. The shell is thin, light yellowish-horn color, almost white. Surface shining, covered with close strong oblique rib-striæ, like *Patula striatella;* these striæ while generally regular, sometimes bifurcate, or separate to give room for another to be intercalated. The spire is flatter than *minusculus*, nearly plane. The earlier 1¾ to 2 whorls are smooth, polished, not striate; the sutures are well impressed. There are 3½ whorls in all, convex, gradually widening, the last proportionately wider than in *Z. minusculus*. Aperture slightly oblique, lunate, narrower than in *Z. minusculus*, its margins thin, acute, scarcely converging, the columellar shortly subreflexed.

Alt. 1·2 mill., diam. 3 mill.

The specimens were presented to me by Mr. W. G. Binney, who regarding them as new, kindly permitted me to describe them. They were gathered by Hemphill, Prince of collectors! at Mariposa Big Trees, California. The name *selenitoides* is given because of a certain resemblance to the little *Selenites duranti* of Southern California.

Helix (Hemitrochus) streatori Pilsbry. Pl. 12, fig. 1.

Shell imperforate, depressed, thin but rather strong, resembling in contour *Hemitrochus amplecta* Gundlach of Cuba. It is white, with dark purplish-brown apex and a narrow, well-defined supra-peripheral band of the same color. Above this band there are two lighter, interrupted subobsolete bands (sometimes confluent into one); on the base there is a zone composed of several interrupted lines or narrow bands, close together or confluent, broken into blotches, fading into the ground-color on the edges, with a tendency to form short streaks in the direction of the growth lines. Surface shining, finely obliquely striate, except the smooth 1½ apical whorls. The spire is low-conoidal; apex blunt; sutures evenly, moderately impressed; whorls 4½, slightly convex, the last depressed, deflexed toward the aperture. Aperture very oblique, transversely oval, obliquely truncated by the parietal wall, distinctly showing a band within; peristome thickened inside, upper margin simple, outer a little expanded, basal narrowly reflexed, *brown*, appressed over and closing the narrow axial perforation.

Alt. 7, greater diam. 12, lesser diam. 10 mill.

I received this species from Mr. John Ford, to whom it was transmitted by Mr. Geo. J. Streator of Garrettsville, Ohio. It was collected on Cayman Island (an islet lying about 200 miles south of Central Cuba) by Mr. Clark P. Streator, whose name I have given the species.

H. streatori belongs evidently to the section *Hemitrochus;* and like the other species of that division the axis is perforated in young shells. There is a general resemblance in form and color-pattern to *H. amplecta* but that shell and its allies are umbilicate. Its affinity is greatest with Tryon's *H. guassoini*, [1] described from the tiny islet of Navassa, but the *streatori* is more depressed, with more oblique aperture, fewer more rapidly enlarging whorls, etc. These two shells, *guassoini* and *streatori*, should be inserted in my monograph of *Hemitrochus* in the Manual of Conchology immediately following the group of *amplecta, rufoapicata* and *graminicola* (p. 37). It may be noted that with the exception of the last-named form, these two are the only species of *Hemitrochus* ranging south of Cuba.

Helix (Mesodon) kiawaensis Simpson. Pl. 12, f. 11, 12.

The jaw (fig. 11) and dentition of this species are here figured from one of the original specimens. A rhachidian tooth with three adjacent laterals (*l.*) are figured, with a group of transition teeth (*tr.*) and three marginal teeth (*m.*). The affinities of the species are with *H. sayi* Binn., agreeing with that form in the long penis, and other details of genitalia.

NOTE: The following description and figures 6 and 7 of pl. 12 have been communicated to me by Dr. V. STERKI, of New Philadelphia, Ohio. Figures 4 and 5 of the same plate are camera-lucida drawings of a specimen received from Dr. Sterki.

Pupa holzingeri Sterki. Pl. 12, figs. 4, 5, 6, 7.

Shell narrowly perforated, turreted-cylindrical, vitreous (or whitish), very minutely striate, shining; apex rather pointed, whorls 5, regularly increasing, well rounded, especially the upper ones, the last somewhat narrowed and a little ascending towards the aperture, compressed at the base but not carinated, at some distance from the outer margin provided with an oblique, rather prominent, acute crest corresponding in direction to the lines of growth, extending

[1] See description and figures from types, Manual of Conchology (Pilsbry's continuation), vol. v, appendix, p. 197, pl. 63, figs. 14, 15.

from the base to the suture, formed by a whitish callosity; behind the crest the whorl is flattened, and corresponding to the lower palatal lamella, impressed; aperture lateral, scarcely oblique, relatively small, inverted subovate, with a slight sinus at the upper part of the outer wall, margins approximated; peristome moderately reflected; lamellæ 6; one parietal, rather long, very high, in its middle part curved outward, towards the aperture, bifurcated, the outer branch reaching the parietal wall; one columellar, longitudinal, rather high, its upper end turning in nearly a right angle towards the aperture, but not reaching the margin; basal exactly at the base, short, high, dentiform; 3 in the outer wall, viz.: the lower palatal long, ending in the callus, highest about its middle; the upper short, rather high on the callous; above the upper one a supra-palatal, quite small, dentiform, nearer the margin.

Length 1·7 mill., diam. 0·8 mill.

In the spring of 1887, Mr. John A. Holzinger, of Winona, Minn., sent me a lot of small *Pupæ*, among which there was one specimen of a new species. It was a dead, weather-beaten, poor shell, but evidently adult. By repeated, ever so careful examinations it broke to pieces, but not before I had made a drawing and description of it. Mr. Holzinger as well as a few of his students then endeavored to secure more specimens, but all their efforts have been in vain, so far. In 1888, in a vial of *Pupa* from northern Illinois sent by Mr. Wm. A. Marsh, I found a few more specimens of evidently the same species, the shells fresh and good. This year, at last, among a number of small *Pupa* collected at Davenport, Ia., I was fortunate in detecting three more examples. The validity of the species was, consequently, established; and on the other hand it proved to be a form quite distinct, and readily separable from all other species.

It is a most interesting and valuable addition to our malacological fauna as it belongs to a specifically American group,[1] viz.: that of *P. armifera* and *P. contracta* Say; but it is much smaller than the latter of the two named as this is than the former. Yet the three together form a well characterized and well-defined group of evidently common origin, and it may be possible sometime, and would be an interesting task of paleontology, to detect a fossil form, or forms, from which the recent ones are derived.

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[1] It is possible and even probable, however, that certain species of *Pupa* described from eastern Asia range among the same group; yet as I have seen no specimens and know them only from the descriptions, I am unable to judge of them.

So far, it has not been possible to examine the soft parts and thus complete our knowledge and description of the species; but it is to be expected that the necessary fresh, if possible living specimens will be found, and I hereby would invite the active collectors of the north-western states to look especially for this *Pupa*, in order not only to make a complete examination, but also to know more about its geographical distribution, and possible variation.

As already stated, our species ranges with *P. armifera* and *P. contracta* Say, standing nearer the latter. Yet it is different from this species by the shape of the aperture, the wanting callus[1] connecting the margins on the body-whorl, by the longer crest behind the aperture, which in *contracta* disappears in about the middle of the (height of the) whorl, and by the wanting constriction, especially in the columellar wall, not to speak of the size and shape of the whole shell. The lamellæ also show some marked differences, such as the presence of a high basal, the shorter columellar not reaching the base, but with relatively larger horizontal part, the bifurcation of the parietal and the presence of a supra-palatal, the last just as it is in *P. armifera.*

It must be added here that the specimen first obtained from Minnesota in several respects differs from those found in Illinois and Iowa, which I consider as typical, by its size which is $\frac{1}{3}$ smaller, by the basal lamella developed in a peculiar way, being rather longer at the truncated top than at its foot, and by the stronger, thicker palatal lamellæ. Yet, as there was only one specimen, it is likely to be an individual peculiarity; even then, of interest. Should, however, more specimens be found with the same configuration, they would represent a distinct and well-characterized variety; possibly it is a peculiar northern form.

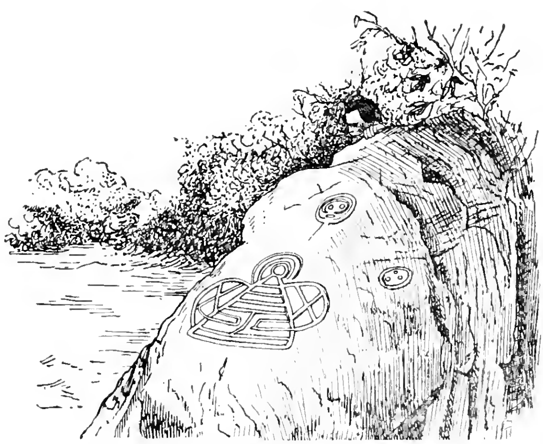
[1] In many specimens of *P. contracta* so strongly developed, that the peristome is rendered continuous.

ON A PETROGLYPH FROM THE ISLAND OF ST. VINCENT, W. I.

BY DANIEL G. BRINTON, M. D.

The rock-inscriptions or petroglyphs which are found in various parts of the American Continent offer a curious subject of study, and one that may ultimately furnish valuable ethnological data. They appear to present definite characteristics both of subject and technical execution extending over wide areas, but not repeated outside of fixed geographical boundaries.

The one which I submit to the Academy to-night was photographed by Professor Benjamin Sharp in the Island of St. Vincent, West Indies, last winter.



The rock upon which it is inscribed is an ancient lava which had flowed into the sea, making a spur into the water, from which the inscription itself was about twenty feet distant. The lines were about a quarter of an inch in depth, the edges rather sharply defined, though from the nature of the rock and the action of the elements, they do not now present the appearance of having been formed by a cutting implement, but rather of having been ground in, as by a process of rubbing. Which of these technical methods was employed is of considerable interest, as will shortly be seen, but the present condition of the surface is such that the point must remain in doubt.

There is no question that this inscription is attributable to the native tribes who formerly occupied St. Vincent. These were the Caribs who had populated it from the adjacent mainland, distant about seventy miles. When first discovered, St. Vincent was the most densely peopled of all the Caribbee Islands and exclusively by this tribe.

One of the early writers says that they had many villages in its valleys and enjoyed entire repose from their enemies; hence it was selected as a rendezvous for the tribal bands from other islands and the mainland when organizing expeditions against their enemies, the Arawacks.[1] We may credibly affirm therefore that this inscription is a product of Carib art.

It is well known that on the adjacent portions of South America many petroglyphs have been observed, some of remarkable size and designs. They have been copied by Humboldt, Schomburgh, Wallace, Im Thurn and others. The last mentioned who is also the most recent observer, has made the important discovery that they are divided into two classes, differing widely in design and technical procedure. The one he calls the "deep" the other the "shallow" petroglyphs. The "deep" are from $\frac{1}{8}$ to $\frac{1}{2}$ an inch in depth; the "shallow" are mere surface scratches; the former have been incised with the edge of a sharpened stone; the latter rubbed in by friction with a stone and moist sand. The figures represented differ, and the two varieties never occur together, nor even near each other. The shallow variety is seen on the Corentyn river and its tributaries in the extreme east of British Guiana; the deep occur on the streams west of that region.[2]

The present Indians know nothing of the origin, age or meaning of these monuments, and do not pretend to imitate them. The position they occupy is generally, but not always, close to some body of water. Not unfrequently they are upon almost inaccessible rock-surfaces, and could have been executed only with enormous toil and risk. This fact, and the well-known aversion of the natives to labor of any kind, are sufficient to invalidate the theory of Dr. Richard Andree that these figures were merely the product of idle hours, without meaning and without object.[3]

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[1] De Rochefort, Histoire des Iles Antiles de l'Amérique, pp. 24, 25.

[2] Among the Indians in Guiana. By Everard F. Im Thurn, p. 394.

[3] Ethnographische Parallelen und Vergleiche, s. 258.

Some, on the other hand, have attributed to them a profound symbolic meaning, or supposed they possessed far-reaching historical significance. This is an error quite as much too far on the other side.

I am convinced that in regard to those found in Guiana and the Carib district the theory of Professor Von Martius is correct. He believed that they were intended as conjurations for luck in fishing and hunting, propitiatory to the spirits of the fish and animals sought for, objurgatory towards envious or malicious supernatural powers.[1]

There is a passage in De Rochefort's *History of the Antilles* confirmatory of Von Martius' view, though he omits to quote it. This early French historian speaking of the island Caribs says: "To turn aside the anger of the demons whom they dread, they paint their hideous figures on the most prominent parts of their canoes."[2] He does not specifically say that they also engraved them upon the plain surfaces of the rocks, but there can be no doubt they did, as the Carib word *temehri* which is applied by them to rock inscriptions means "to paint" or "a painting."[3]

We may safely decide therefore that the photograph before us represents one of the Carib demons or deities, and that its figure was cut in the rock as a propitiatory act.

It may partake of temerity to proceed further, and undertake to identify a particular deity; but I am tempted to do so. The main figure of the glyph clearly represents a human form with arms extended over and laid upon the abdomen, but with no legs visible. The abdomen is disproportionately large, as if greatly distended. The suggestion is at once at hand that the figure is that of a woman in parturition. Immediately above the head of the figure is the rude representation of a human face, and another smaller one is to the left of the figure, both without limbs.

Turning now to the mythology of the Carib we learn that their principal beneficent deity was the Earth. They spoke of it as a female, as the good mother, from whom proceeded their food and other necessaries of life, and to her they paid their principal homage. They also regarded the sun and moon as animate beings, and

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[1] Ethnographie und Sprachen-Kunde Amerikas, Band I, S. 571, 2 qq.

[2] Histoire des Iles Antilles, p. 479.

[3] Im Thurn, ubi supra, p. 394.

paid them much respect in their ceremonies, but not actual worship, as they did to Mother Earth.[1]

In the rock sculpture before us this evening, I believe we have these three nature-spirits represented, the Earth as the parturient All Mother, the sun and moon as accessories. The purpose of the carving was propitiatory to these powerful forces, and was intended as a permanent conjuration of their good-will.

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[1] See De Rochefort, ubi supra, pp. 469, 470.

DESCRIPTION OF A NEW SPECIES OF EUTAENIA.

BY ARTHUR ERWIN BROWN.

Eutaenia nigrolateris, species nov.

A snake belonging to this genus, now living in the collection of the Zoological Society, presents characters differing from any other species with which I am acquainted, to a degree requiring recognition and to the following description I append the above name.

Form moderately stout, about as in *E. sirtalis.* Tail short. Head short and broad, flattened on crown. Vertical and occipitals short and broad; superciliaries short in front; one ante-orbital, much elevated and pointed above, in contact with the fronto-external angle of the vertical; three post-orbitals, the lower one lying on the 5th and 6th superior labials; upper labials eight, 6th and 7th largest; lower labials ten, 6th largest. Eye rather large, center just behind the suture between the 4th and 5th labials. A vertical series of three temporals in contact with the post-orbitals, the lower one small and lying on the 6th and 7th labials, but mainly on the 6th; the middle one above and behind it, is much larger and elongated; the upper one, somewhat smaller than the last is in contact with the occipitals. On one side, in this specimen, the large, middle temporal is divided into two portions, the anterior being the smaller.

Twenty-one dorsal rows of scales; the outer one but little larger than the 2nd, the former smooth anteriorly, faintly carinated towards the tail; carinæ on the remaining rows increasing towards the dorsal line.

A golden yellow stripe occupies the median row of scales from nape to tip of tail, widening slightly on the edges of the contiguous rows at the anterior end; a lateral stripe of same color, very indistinct anteriorly, where it is mostly confined to the 3rd row, but better defined on the posterior third of the body, where it invades the upper half of the 2nd. Color above the laterals, brownish-olive with two series of alternating dark spots (66 pairs, in this specimen from head to anus), the lower series on the 4th, 5th and 6th rows, the upper on the 7th, 8th and 9th; below the lateral lines, the 1st and lower half of the 2nd rows (anteriorly, occasionally to the lower half of the 3rd) with the ends of the abdominal scutellæ, are lustrous pitch-black. The upper surface of the head in front of the occipitals is greenish-olive; behind that, to the neck and the sides of the head, including the 7th and 8th superior labials, blackish-brown, slightly maculated with dull chestnut just behind the occipitals; the dorsal yellow line being slightly indicated on the dark patch. Beneath white, with a creamy tinge anteriorly, becoming pale greenish on the sub-caudals. The labials are margined with blackish-brown; a post-oral cream-colored crescent with the concave side forward; a similar band passing down on the post-orbitals widens on the 6th upper labial and runs into the throat color and a third light band is indicated on the ante-orbital, becoming lost on the 4th upper labial. Iris bright copper color.

Abdominal scutellæ 156. Sub-caudals 63 pairs. Total length m .510 (20 1-8 in.) length of tail .110 (4 5-16 in.)

This species somewhat resembles *E. marciana* in form and general pattern of coloring, as well as in an extreme boldness and aggressiveness when handled, but is much darker; has the lower row of spots replaced by a shining black band below the lateral light stripe and is well marked by the extension of the ante-orbital upward to meet the vertical and the increased number of temporals.

The specimen was captured in September last, in the vicinity of Tucson, Arizona, and was sent to the Zoological Society through the courtesy of one of its corresponding members, Mr. Herbert Brown, of that city.

The following annual reports were read and referred to the Publication Committee:—

REPORT OF THE RECORDING SECRETARY.

The Recording Secretary respectfully reports that the meetings of the Academy during the greater part of the year have been unusually well attended and that the communications have been varied and interesting. The improvement is due in great measure to the plan of joint meetings of the several Sections with the Academy which was first carried into operation in March. A programme of the meetings was issued to the members with the effect of materially increasing the attendance. While communications from members of the Section to which the night is assigned have precedence, they do not exclude those from other members of the Academy and while there have been few meetings without some matter of special interest no difficulty has been experienced in affording opportunity to all who wish to obtain a hearing. Verbal communications have been made by Messrs. Leidy, McCook, Meehan, Ryder, Heilprin, Ives, Binder, Morris, Wingate, Goldsmith, Pilsbry, Foote, Kœnig, Perot, Horn, J. B. Brinton, Rex, Hall, Woolman, Wilson, A. H. Smith, Hartzell, Willcox, Redfield, Dolley, Rothrock, Ford, U. C. Smith Campbell, Sharp, Jefferis, Skinner, Baker, Thomas, D. G. Brinton, Leffman and Aaron.

Two hundred and twenty-eight pages of the Proceedings for 1888 and three hundred and thirty-six for 1889 have been issued since the last report. The current volume will be illustrated by thirteen plates. In connection with the Academy's regular publications mention should also be made of the Manual of Conchology which, since the death of Mr. Geo. W. Tryon Jr., in Feb. 1888, has become the property of the Conchological Section and has been promptly issued in two series under the editorship of Mr. H. A. Pilsbry. Of the Marine Series three hundred and twenty pages of text and seventy-five colored plates, and of the series devoted to Land Mollusca two hundred and seventy-nine pages and seventy plates have been issued during the year. It is gratifying to know that the high standard established for the work by Mr. Tryon has been maintained and that the subscription list is sufficient to more than pay the expense of issuing the work.

In addition to the Transactions of the American Entomological Society, of which three hundred and twenty pages and seven plates have been issued, the Entomological Section of the Academy is about to begin the publication, under the editorship of Eugene M. Aaron, of a monthly journal to be entitled, "The Entomological News." It will thus be seen that no less than one thousand four hundred and eighty-three pages and one hundred and sixty-five plates have been published by the Academy and its Sections since the last annual report and that operations in this department are to be extended during the coming year.

Forty-three papers have been presented for publication in the Proceedings by the following authors:—H. A. Pilsbry 4, J. E. Ives 3, Witmer Stone 3, Charles R. Keyes 3, J. A. Ryder 2, Eugene N. S. Ringneberg 2, W. D. Hartman 2, George Marx 2, F. C. Baker 2, F. A. Genth 1, T. Meehan 1, Jos. Leidy 1, Angelo Heilprin 1, E. Goldsmith 1, W. B. Scott 1, W. H. Dall 1, Harold Wingate 1, H. Allen 1, John Eyerman 1, S. W. Williston 1, Chas. S. Bollman 1, J. P. McMurrich 1, J. Gardner 1, W. L. Morrison 1, P. H. Kirsch 1, David S Jordan and Burt Fesler 1, S. E. Meek and C. F. Bollman 1, J. M. Safford and A. W. Vogdes 1, P. H. Kirsch and M. W. Fordice 1. Four of these have been withdrawn by the authors and the others have been published or are now in the hands of the printer. Among the most important matter contributed to the volume were the papers by various authors in continuation of those published prior to the last report giving the results of Prof. Heilprin's explorations of the Bermudas in July, 1888.

The number of copies of the Proceedings distributed is as follows: Foreign exchange 399, domestic exchange 70, subscribers 107; total 576.

Twenty-two members and five correspondents were elected. The deaths of six members and three correspondents were announced. The resignations of two members, Samuel Wagner and W. H. Eisenbrey, were accepted.

The vacancy in the Council, caused by the death of Geo. Y. Shoemaker, June 18th, was filled by the election, June 25th, of Uselma C. Smith.

A committee consisting of Messrs. Jos. Leidy, J. P. Lesley, Persifor Frazer, Angelo Heilprin and W. B. Scott was appointed February 5th, to consider the proper award of the Hayden Memorial Medal. No action on the subject has yet been reported.

One of the most important events of the year was the consideration of an invitation from the University of Pennsylvania to the Academy to remove to a plot of ground in West Philadelphia in immediate proximity to the University. After mature consideration by the Council, to which the subject was referred for consideration and report, a resolution respectfully declining the invitation was adopted by the Academy by a vote of sixty-eight in the affirmative to three in the negative.

A committee was appointed January 29th to consider the propriety of giving a series of social entertainments to serve as reunions of the members with a view to promoting the interest and efficiency of the meetings of the Academy. The committee having reported favorably they were authorized to receive subscriptions to the necessary fund, the understanding being that no expense should be incurred by the Academy. Sufficient encouragement has been received to provide for at least three of the contemplated reunions, arrangements for the first of which will be made when a favorable opportunity presents itself.

The Academy is to be congratulated on having received from the Legislature substantial recognition in an appropriation of $50,000 towards the erection of the new building so pressingly needed for the arrangement and exhibition of the rapidly growing collections. A detailed statement of the steps taken to begin the work of erection at an early date will be found in the report of the Curators.

By resolution of the Academy the hall was placed at the service of Dr. J. T. Rothrock for the delivery of a course of seven Michaux Lectures to extend from Dec. 4, 1889, to Jan. 29, 1890.

All of which is respectfully submitted.

EDW. J. NOLAN,

Recording Secretary.

REPORT OF CORRESPONDING SECRETARY.

The correspondence of the past year has been almost entirely in reference to the publications of the Academy and has consisted of acknowledgments from corresponding societies or letters of transmittal from them, usually accompanying their publications.

The plan adopted several years ago of sending our publications by mail to the more active societies at home and abroad seems to be working very satisfactorily and the prompt acknowledgment, usually by card, and the very small number of inquiries for missing parts show that there is practically no loss in the mail. A great advantage results in making known, at the earliest possible moment, the researches of those who make our pages valuable and the various zoological and other records are enabled to give an epitome of them within the year for which they are published.

Acknowledgment of the reception of our publications has been made, by sixty-three postal-cards and by seventy-three letters, the former all representing mail transmissions while a large number of the latter should be so counted. Letters of envoy number barely forty, being a decrease in number from past years due, doubtless, to the use of the mail in sending to us.

A pleasing indication is afforded by a portion of the correspondence from various parts of our country, desiring copies of our by-laws and asking for such information as will enable the formation of a society on the plan of our organization. These have been promptly answered and the future will doubtless show some results.

During the year three correspondents have been elected and notification has been promptly sent. Replies have been received from all where time has been sufficient to permit it.

The additions to the Museum have been numerous, and have been acknowledged by the Curator-in-Charge, as will be learned from his report.

Respectfully submitted,

George H. Horn, M. D.,

Corresponding Secretary.

REPORT OF THE LIBRARIAN.

The annual statistics of the Librarian's report indicate that the year ending November 30, 1889, has been an unusually prosperous one in the department of the Academy of which he has charge. The additions received number 4,446, an increase of 489 over the growth of 1888 and of 1,066 over that of the preceding year. Six hundred and eighty volumes, 3,786 pamphlets and parts of periodicals and continued works and 26 maps are recorded.

They were received from the following sources:

Societies,	1842	Minister of Public Works, France,	3
Editors,	895	Geological Survey of Kentucky,	3
I. V. Williamson Fund,	815	Government of Victoria,	3
Miss Frances Lea,	295	Australian Government,	3
Authors,	186	U. S. War Department,	2
Prof. A. Heilprin,	58	Wm. W. Jefferis,	2
East Indian Government,	36	Geological Survey of Minnesota,	2
U. S. Department of the Interior,	34	Geological Survey of Portugal,	2
Wilson Fund,	28	Department of Mines, N. S. W.,	2
Thomas Meehan,	28	Geological Survey of N. J.,	1
U. S. Department of Agriculture,	28	University of Pennsylvania,	1
Purchased by special appropriation,	19	New York State Museum of Natural History,	1
U. S. Department of State,	16	Pennsylvania State Board of Health,	1
John C. Sinclair,	16	State Mineralogist, California,	1
Stewart Culin,	15	Geological Survey of Texas,	1
Charles M. Betts,	13	Michigan Forestry Commission,	1
New York State Library,	12	J. H. Redfield,	1
U. S. Treasury Department,	11	Department of Mines, Nova Scotia,	1
U. S. Fish Commission,	10	Geological Survey of New Zealand,	1
Geological Survey of Roumania,	9	Messrs. Tiffany & Co.,	1
H. B. M. Government,	7	Harold Wingate,	1
Geological Survey of Penna.,	5	Charles Morris,	1
Wm. John Potts,	5	Lewis Woolman,	1
Trustees of the British Museum,	5	Geological Survey of Canada,	1
H. A. Pilsbry,	4	Mrs. R. C. Taylor,	1
Henry N. Rittenhouse,	4		
Geological Survey of India,	4		
Engineer Department U. S. A.,	4		
Geological Survey of Finland,	4		

They have been distributed to the several departments of the library as follows:—

Journals,	3418	Encyclopedias,	17
Geology,	366	Mammalogy,	16
Botany,	153	Public Documents,	15
Conchology,	77	Ichthyology,	14
General Natural History,	76	Helminthology,	11
Entomology,	50	Medicine,	8
Anatomy and Physiology,	44	Herpetology,	6
Anthropology,	37	Chemistry,	5
Ornithology,	28	Bibliography,	4
Mineralogy,	28	Geography,	3
Voyages and Travels,	20	Agricultural,	3
Physical Science,	18	Unclassified,	29

The accompanying lists of donations, exchanges and purchases render unnecessary any special comment on the character of the additions.

In consequence of over-draft of the I. V. Williamson Fund as reported last year by the Treasurer, a special appropriation of $500 from the general funds of the Academy was made. Orders to the full amount of the Library Committee's resources are outstanding.

The necessity for a binding fund becomes more urgent, only one hundred and thirty-eight of the volumes most constantly in use having been bound during the year.

A priced catalogue of the duplicates in the library has been prepared. To derive the most benefit from the list it should be printed and distributed to those likely to be interested in separate numbers and incomplete sets of periodicals of which the collection for the most part consists.

A large and valuable collection of maps, the extent of which had not been suspected, has been classified and catalogued. It is very desirable that special receptacles be prepared for these so that they may be more readily examined than is at present possible.

Early in the year the title entries of journals and periodicals were completed and the catalogue arranged in the drawers for use. The work has been supplemented by a convenient hand-list or guide to the arrangement of periodicals on the shelves and also by a general subject index.

These lists are all, of course, kept complete to date so that nothing remains to be done in the department of journals and periodicals short of a subject-catalogue of scientific communications which is an undertaking of such extent as to be at present beyond the means of the Academy. Such a work would be an invaluable aid to the naturalist, supplying to him what the superb Index-Catalogue of the Surgeon-General's Office provides for the physician, but it must be either the result of co-operation among several scientific societies or the cost must be defrayed by government appropriation, as in the case of the work referred to, or by an institution possessed of a large income such as the Royal Society of London, to which we are indebted for the indispensable author-catalogue of scientific papers.

Although such work on the periodicals of the library must, therefore, be deferred, satisfactory progress has been made on a subject-catalogue of the special departments. The subject-registry of Voyages and Travels and Geology has been completed and the work is now going on rapidly in the section of General Natural History. The arrangement of the cards will be continuously alphabetical without any sub-division into classes other than that which depends on the initial subject word. It is believed that clearness and simplicity will be thus secured and that those who use the library will be able to avail themselves of the catalogue without the assistance of the trained attendants or pages who are usually required to interpret elaborate systems of bibliographical classification. If in the future it be found desirable to prepare special hand-lists for the use of students in the different departments of the Academy this can readily be done by copying the author and subject entries belonging to the several classes as indicated by the class abbreviation written on the upper left-hand margin of the cards.

Most of the work here reported, apart from the daily routine of the library, has depended on the continued engagement, thanks to a number of liberal friends of the Academy, of Signor Emanuele Fronani whose efficient assistance the Librarian has pleasure in acknowledging. In the current work of the year the intelligent aid rendered by William J. Fox is also worthy of note.

All of which is respectfully submitted,

Edw. J. Nolan,

Librarian.

REPORT OF THE CURATORS.

The Curators present the following statement of the Curator-in-Charge as their report for the year 1889 :—

The Curator-in-Charge respectfully reports that the general condition of the Academy's collections is satisfactory, except in so far as excessive crowding of material has interfered with the proper display and systematic placing of specimens. This lack of room has been an evil badly felt by the Academy for several years—indeed, almost from the date of the first occupation of the present building. The surprisingly rapid growth of the collections in certain departments has kept far ahead of the Academy's power to provide suitable accommodation, and the time has at last arrived when even excessive crowding has reached a practical limit. The numerous appeals for relief, that have been made from time to time, several of them addressed to the Legislature of the State, and which have been but indifferently responded to, have finally met with substantial recognition in an appropriation of $50,000 made by the last Legislature. The hope is held out that a like appropriation, to cover the full amount of the Academy's application to the State for the purposes of a new building, may be made by the Legislature at its next session.

With the necessities of existing conditions, and the encouragement of a friendly response from the generous citizens of our metropolis, the Academy has seen fit to prepare plans for the much-needed new building, and it is expected that active work on the structure will begin with the early part of the present winter. The main portion of the contemplated new museum-building will be in the form of an irregular square, fronting on 19th street 155 feet and on Cherry street 130 feet, thus presenting a surface-area of 20,150 feet. Four tiers of galleries, each in the main, 32 feet in width, will surround an open central hall, to which unbroken illumination will be afforded by a tunnelled glass roof, springing at a height of some 80 feet above the floor. Office and laboratory rooms will be provided on the ground floor beneath the first gallery, while a number of external preparation rooms will adjoin the building on the north side. A two-story building, measuring 54 feet by 48, and furnishing a lecture-amphitheater designed to accommodate 650 persons, will unite the new structure with the edifice now occupied by the Academy. With this separation of the two buildings there will be little interference with the necessary illumination.

The cost of the building, which will permit of some 67,000 square feet of floor-surface available for museum purposes alone—not counting here the offices and laboratories—is placed at $239,000. The needs of the Academy make it imperative that this amount, together with a further sum of $50–60,000 for cases, be secured, and it is earnestly hoped that the best endeavors will be made to provide the desired funds at as early a day as possible. All delay is now directly hurtful to the institution, and to the interests to which the Academy ministers.

The collections of the Academy have been efficiently cared for during the year, and the Curator-in-Charge is again obliged to acknowledge his indebtedness to the numerous workers who have voluntarily or otherwise rendered their services to the Academy. The Conservators of the Botanical, Conchological, Geological and Entomological Sections may be specially mentioned in this connection; likewise, the Conservator of the Wm. S. Vaux collections. The ornithological department has profited largely through the labors of Mr. Witmer Stone, who, apart from other work in connection with classifying and arranging, has systematically applied himself to the redetermination of the species of Falconidæ, Vulturidæ, Strigidæ, Corvidæ, Paradiseidæ, Oriolidæ, Dicruridæ, Campephagidæ and Muscicapidæ. Three thousand four hundred specimens representing these families have been identified, numbered and catalogued during the year. The systematic cataloguing of the entire collection of birds is now fairly under way, and with such progress as has been made, it is believed that the work will be completed before many years. The publication of special annotated lists, accompanying the identifications, is an important feature of Mr. Stone's work.

To my special assistant, Mr. J. E. Ives, I am indebted for a large amount of labor in connection with the determination and classification of new and old material in the possession of the Academy, principally among the alcoholics. The refuse of accumulated material is thus being gradually disposed of, and with the additional space which is assured to the Academy, the full collection will shortly be in a condition to be systematically placed. Dr. G. Baur, of New Haven, has rendered valuable assistance through his critical studies of the Academy's Testudinata, which were placed in his hands for revision and cataloguing. This collection, which is rich in types and rare species, numbers 429 specimens. These have all been redetermined and labeled.

The elaboration of the large collection of material brought from the Bermuda Islands in the summer of 1888 by the Curator-in-Charge and a class of students from the Academy has been completed, except as to one or two of the lower groups of organisms (sponges). This material has furnished subject for several important papers by different specialists, which have been published in part in the Proceedings of the Academy and in part in an independent publication on the physical history and zoology of the Bermudas by the undersigned. The greater part of the material collected proved new to the Academy's collections, while much of it was new to science. The success of, and very light expense attending, the expedition show how much may be accomplished even with little effort in zoogeographical research, and encourages the hope that researches of a similar nature may hereafter be systematically conducted under the auspices of the Academy.

The losses to the Academy's collection during the year have been insignificant. Less than a dozen specimens have been removed from the museum as having passed beyond the period of their usefulness. Specimens were loaned for study during the year to Prof. Alfred Newton, of Cambridge, England; to Prof. O. C. Marsh and Dr. G. Baur, of New Haven; to Dr. W. B. Clark, of Batimore; to Dr.

Harrison Allen, of this city; and to Mr. Charles B. Cory, of Boston. Some of this material is still outstanding.

Respectfully submitted,

ANGELO HEILPRIN,

Curator-in-Charge.

JOSEPH LEIDY,

Ch'n Curators.

REPORT OF THE BIOLOGICAL AND MICROSCOPICAL SECTION.

During the past year ten meetings were held with an average attendance of eight members.

The following new members were elected:—Harold Wingate, Lancaster Thomas, Edward Bancroft.

H. H. Burchard was admitted as a contributor.

The following is a summary of the work done during the year:—

December 3, 1888. Resumé of biological work during 1888, lecture by Prof. John A. Ryder.

December 3, 1888. Communication upon Helicosporium ellipticum, by Dr. Geo. A. Rex.

December 3, 1888. Notacordal cells, by Prof. Ryder.

January 7, 1889. Upon the Pitcher plants in reference to their digestive function, by Dr. J. B. Brinton.

January 21, 1889. Upon the cultivation of Fungi, by Dr. Rex.

February 4, 1889. Rock sections, by Lancaster Thomas.

February 4, 1889. Upon Botrytis, by Dr. L. Brewer Hall.

February 18, 1889. Upon two new species of Trichia from Montana, by Dr. Rex.

February 18, 1889. Diatoms from Mobile Bay, by Dr. Hall.

March 4, 1889. Upon Psoriasis, and on different methods of staining, by Dr. Hartzell.

March 4, 1889. Upon Hemiarcyria Karstenii, by Mr. Wingate.

May 6, 1889. Upon Karyokinesis, by Prof. Ryder.

May 6, 1889. A new Fuligo from Nebraska, by Dr. Rex.

June 3, 1889. Upon Fungi, by Dr. Rex.

November 4, 1889. Upon the generic characteristics of Comatricha, by Dr. Rex.

November 4, 1889. Upon a new Myxomycete Chondrioderma, by Mr. Wingate.

In addition to the above, many interesting communications were made at the joint meetings of the Academy and the Section.

The officers elected for the ensuing year were:—

Director, ...	Harold Wingate.
Vice Director, . . .	John C. Wilson.
Recorder, ...	Dr. Robert J. Hess.
Treasurer, ...	Dr. Isaac Norris, Jr.
Conservator, . . .	Charles P. Perot.
Corresponding Sec. . .	Dr. Charles Schæffer.

Very respectfully submitted,

Robert J. Hess, M. D.,
Recorder.

REPORT OF THE CONCHOLOGICAL SECTION.

The Recorder of the Conchological Section reports that the more important work transacted during the year has been the regular issue of the Manual of Conchology and the arrangement of the cabinet in connection with the necessary study of material as the several families have been reached. Four numbers of each of the two series of the Manual have been published, the parts of the marine series embracing the Turbinidæ, Delphinulidæ and portion of the Trochidæ, while the parts of the second series devoted to the land mollusca treat of the Helicidæ of the West Indies and South America. The former consists of 320 pages of text and 75 plates while the latter includes 279 pages and 70 plates. The Section has pleasure in acknowledging the efficient services of the editor, Mr. Henry A. Pilsbry, to whom belongs the credit of maintaining the standard of excellence established by Mr. Tryon. It is gratifying to be able to report that the work is more than self-supporting. The meetings held in connection with the Academy, in harmony with the suggestion adopted by the latter last spring, have been rendered interesting by communications from Messrs. Pilsbry, Baker, Heilprin, Ford, Campbell and U. C. Smith. At the meeting held Dec. 5th, the following officers were elected to serve during the ensuing year:—

Director, ...	W. S. W. Ruschenberger.
Vice Director, . . .	John Ford.
Recorder, ...	Edward J. Nolan.
Secretary, ...	J. H. Redfield.

Treasurer, ...	S. R. Roberts.
Librarian, ...	Edward J. Nolan.
Conservator, . . .	Henry A. Pilsbry.

Since the last annual meeting of the Section specimens have been received from forty-three persons, numbering in all 851 trays and 6,636 specimens. This brings the aggregate number of trays in the museum to 52,787. The more valuable series received are those collected by Prof. Heilprin at the Bermuda Islands, the Lower Californian shells purchased by the Conchological Section from Henry Hemphill, and a series of shells from Tonquin, China, and the East Indies obtained of the Abbé Vathelet. Valuable additions to the fauna of our eastern coast have been received from Messrs. Uselma C. Smith and John Ford. We have also received from various correspondents of the Conservator, several hundred species of United States and Mexican land and fresh-water shells, including a number of new species, part of which have been already published in the Proceedings of the Academy.

During the year the arrangement of the families Neritidæ and Turbinidæ, in progress at the time of the last report, has been completed, and that of the Trochidæ, Stomatellidæ and Scissurellidæ will be completed by the end of the present month. Of the Helices, the groups monographed in the Manual during the year have been arranged, and work begun on the groups of European Helices, heretofore in a chaotic condition. The conservator having secured the assistance of Mr. Baker during a part of each day, can now complete the arrangement of all unarranged groups as far as the Manual has progressed as soon as additional cases can be secured. Museum work on the land shells has at present temporarily ceased from lack of room.

H. A. Pilsbry, *Conservator*.

Edward J. Nolan, *Recorder*.

REPORT OF THE ENTOMOLOGICAL SECTION.

The Entomological Section, during the past year, has been much benefited by an evident increase of interest at its meetings. These have been held regularly each month, excepting during the July and August vacation. There has been a large attendance of members and associates. One member and one associate member have been elected since the last report.

The collection in the care of the Section has been carefully examined by the Curator of the American Entomological Society, and its condition is now much better than heretofore.

The entomological collection of the late Titian R. Peale, Esq., which was presented to the Academy, has been transferred to the care of the Section. After selecting therefrom much that was spoiled for want of care, the remainder has been reset and labeled as the "T. R. Peale Collection," in accordance with the expressed wish of the heirs.

In compliance with the request of the Academy, the Entomological Section has selected the meeting of the second Tuesday of each alternate month at which to bring before the Academy matters pertaining to entomology.

The meetings of the Section have been much enhanced in interest by the reports of collections and observations by its members, some of whom have still further detailed the same in published articles.

The Section desiring to make its influence more generally felt by the students of Entomology, has determined to issue a publication to be known as "The Entomological News and Proceedings of the Entomological Section of the Academy Natural Sciences of Philadelphia." It will be issued monthly in parts of not less than 16 pages, and will contain, together with the proceedings, articles from contributors and a general resumé of entomological matter. Mr. E. M. Aaron has been appointed editor, with a supervisory committee to assist in the details of the work.

At the meeting in December the following officers were elected:—

Director, ...	Geo. H. Horn, M. D.
Vice Director, . . .	H. C. McCook, D. D.
Treasurer, ...	E. T. Cresson.
Recorder, ...	E. M. Aaron.
Publication Com. . . .	J. H. Ridings. Philip Laurent.

Respectfully submitted,

JAS. H. RIDINGS,
Recorder.

REPORT OF THE BOTANICAL SECTION.

The Vice-Director of the Botanical Section respectfully reports that the stated meetings have been held regularly during the year.

and that the attendance on, and interest in them have been fully maintained. The section is out of debt, and has a surplus in its treasury; including a donation of $100 from W. G. Warden towards a share in the botanical explorations in Asia Minor, now undertaken by Prof. Bornmuller, Director of the Royal Gardens of Belgrade.

Through the interest of members of the Section a number of Botanical Works have been added to the library of the Academy, while the additions to the Herbarium number 2,174, of which 1,585 are of flowering plants and ferns. Of these 36 represent genera not before in our collection, while of species, 585 are new additions. These new additions bring the number of vascular species represented in the Herbarium to about 28,805. The additions to the lower cryptogams are 589.

The conservator's account of the additions in detail is appended as part of this report; as also an abstract of the detailed work of the Section by the Recorder.

Respectfully submitted,

THOMAS MEEHAN,

Vice-Director.

Conservator's Report for 1889.—The Conservator respectfully submits the following annual report upon the state of the Academy's Herbarium:—

The most important additions made during the past year are of species from Tropical America, among which are worthy of special enumeration, 300 species from the State of Tabasco, Mexico, persented by Prof. José N. Rovirosa; 373 species from Guatemala, collected by H. Von Türckheim and presented by John Donnell Smith, of Baltimore; 243 species from the northern provinces of Mexico, collected by C. G. Pringle in 1888, presented by the Conservator, and 116 species collected by Dr. E. Palmer at San Quentin Bay in Lower California and presented by the U. S. Department of Agriculture.

Through the kindness of Dr. Sereno Watson, of Cambridge, Mass., we have received from J. Thistleton Dyer, of the Kew Herbarium, Drummond's Mosses of the Rocky Mountains and British America, mounted in two volumes and embracing 249 species and 33 varieties.

From Ellis and Everhart we have received the 22nd and 23rd Centuries of North American Fungi, also a special and selected

Century of rare Fungi, in exchange for duplicate earlier Centuries received from the Estate of Dr. Geo. Martin.

Other important additions which will appear in the detailed list presented to the Academy, will raise the whole number of species received during the year to 2,174, of which 1,585 are Phanerogams and Ferns. Of these 585 are new to our collection, and 36 are of genera not before represented. Two hundred and thirty-nine are North American, 1,077 are from Tropical and South America, 144 are from the Eastern Continent and 125 are Australian and Polynesian. The remaining 589 species received are of Lower Cryptogams. How many of these are absolutely new to us we are at present not able to determine, from the fact that we lack catalogues of our large collections in that department. It is much to be desired that the Committee in charge of our Fungi shall be able soon to accomplish the work committed to them, for its completion will be a great step towards supplying the need referred to.

The number of species of vascular plants now in the Herbarium is estimated at 28,805.

All of the accessions of the past year have been carefully poisoned to prevent the ravages of insects, and the North American species have been mounted.

Respectfully submitted,

JOHN H. REDFIELD,

Conservator.

The Recorder makes the following report of the transactions of the Section during the current year:—

Nine meetings have been held with an average attendance of eight members each, excluding the present meeting.

Communications of great interest have been made by Messrs. Meehan and Redfield, and Drs. Rothrock, Wilson, Brinton, Rex and others.

During the present year a special effort has been made by the Section, at the request of the Academy, to add to the interest of the general meetings, by bringing matters of Botanical interest before the Academy at stated periods.

The announcement of the rediscovery of an old locality of *Corema Conradii* on the New Jersey coast was made; also of a new locality of the same plant on the Maine coast; also the finding of the arctic *Stellaria humifusa* on the Maine coast was announced.

An excursion of great interest, to the Pocono Mt., in company with the Torrey Botanical Club of New York, was made, in which *Botrychium simplex* was found.

The following officers were elected to serve during the ensuing year:—

Director, ...	W. S. W. Ruschenberger.
Vice Director, ...	Thomas Meehan.
Corresponding Sec. . .	Isaac C. Martindale.
Treasurer, ...	Isaac C. Martindale.
Conservator, ...	John H. Redfield.
Recorder, ...	Charles Schäffer.

All of which is respectfully submitted,

CHARLES SCHAFFER,

Recorder.

REPORT OF THE MINERALOGICAL AND GEOLOGICAL SECTION.

The Director of the Mineralogical and Geological Section would respectfully report that owing to the unusual absence from the city of the members most active in the Section, the meetings have not been as numerous or as large as in former years but there has been no lack of interest. The meetings jointly with the Academy have been generally regarded as interesting and successful. Considerable additions have been made to the collection. Many of the specimens were procured by purchase with the funds of the Section.

The following officers were elected to serve during the ensuing year:—

Director, ...	Theodore D. Rand.
Vice Director, ...	W. S. W. Ruschenberger.
Treasurer, ...	John Ford.
Conservator, ...	William W. Jefferis.
Recorder and Secretary, . .	Charles Schäffer.

Respectfully submitted,

THEO. D. RAND,

Director.

REPORT OF THE PROFESSOR OF INVERTEBRATE PALEONTOLOGY.

The Professor of Invertebrate Paleontology respectfully reports that owing to the unfortunate circumstances attending the illness of the late Chairman of the Committee on Instruction, and the failure to have the course of lectures outlined ratified in time for the spring season, he has been obliged to forego the delivery of the regular course of instruction in his department this year. An attempt to have these lectures delivered in the autumn months was frustrated by the unusual amount of work which had fallen into his hands.

The geological and paleontological collections of the Academy are steadily receiving important accessions of material, but, as in all other departments of the institution, they suffer largely from lack of room for their proper disposition and arrangement. A further systematic display without stacking is no longer possible; indeed, the foreign collections have long since been dispossessed of their proper space to make room for the rapidly increasing collections illustrating American geology. The growth during the last few years has been most rapid in the field of tertiary paleontology, where the Academy's collections stand unrivalled. This is also true of the representation of the cretaceous series, but as regards paleozoic paleontology the Academy has always been sadly deficient. The extensive collections of the Pennsylvania Geological Survey, which are now in the custody of the Academy, and to the exhibition of which ample space will be given in the proposed new building, will make good this deficiency, and place the entire collection in a condition of unusual completeness. The cataloguing and numbering of the Survey's collection was completed during the year by officers of the Survey.

Among the more important accessions to the Academy's collections during the year may be instanced the extensive series of tertiary fossils transmitted to the undersigned by the State Geologists of Texas, representing the collections recently made by the Survey of that State. These have not yet been thoroughly worked over. They represent much the largest series of tertiary fossils that has been thus far obtained from the State, and throw important light upon the geology of the Gulf basin. A report will accompany their final study. Another important addition to the collections made during the year is a series of fossiliferous and highly metamorphosed rocks from the Calciferous (?) horizon of the region about Philadelphia, the first fossil-bearing rocks which have been obtained from this horizon in that portion of the State. The greater part of this important donation the Academy owes to the generosity of Mr. Louis Woolman.

Respectfully submitted,

Angelo Heilprin,

Professor of Invertebrate Paleontology.

REPORT OF THE PROFESSOR OF ETHNOLOGY AND ARCHÆOLOGY.

Owing to my absence in the late winter and spring of the current year, the usual course of lectures was omitted, compensation for which will be made by an unusually full course planned for the present season.

No important additions have been received in the collections of these departments, though it would be easy to acquire large accessions were proper space for their display available. This we may expect at an early date in the new building.

Respectfully submitted,

D. G. Brinton,

Professor of Ethnology and Archæology.

REPORT OF THE PROFESSOR OF INVERTEBRATE ZOOLOGY.

The Professor of Invertebrate Zoology respectfully reports that, having a leave of absence, he spent the winter of 1888–1889 on the Islands of the Lesser Antilles, for the purpose of making collections. Some specimens have been already given to the Academy and he hopes soon to have them all ready for presentation. Owing to his absence from Philadelphia he was unable to deliver any lectures during the past year.

It is proposed to give a course of five lectures during the spring of the coming year on "The Caribbean Islands."

The additions to the museum for the year have been quite important. In addition to specimens of general interest, Mr. W. N. Lockington has presented a collection of starfishes, echinoderms, crustacea and coelenterates, collected on the Californian coast of the United States. A large number of coelenterates, principally coralline forms and sponges, anthropods, echinoderms and a few worms and ascidians —collected by the expedition to the Bermudas conducted by Prof. A. Heilprin, have been presented. Many new species have been found in this collection and described. Prof. H. C. Chapman has also added to the collection, worms, crustaceans and coelenterates, collected on the coast of Maine.

Respectfully submitted,

BENJAMIN SHARP,

Professor of Invertebrate Zoology.

SUMMARY OF THE REPORT OF WM. C. HENSZEY, TREASURER.

For the Year Ending Nov. 30, 1889.

Dr.

To Balance from last account	1602 66	
" Initiation Fees	160 00	
" Contributions (semi-annual)	1597 50	
" Life Memberships	700 00	
" Popular Lectures	132 50	
" Sales of Proceedings, Journals, etc	466 60	
" Interest on Investments	3998 24	
" State tax on Mortgages	209 10	
" Rentals from Real Estate	1485 27	
" Wilson Fund, towards Salary of Librarian	300 00	
" Sale of duplicate Books	11 65	
" Interest on Money awaiting Investment	638 44	
" Miscellaneous	1 40	
" Donation, Conchological Section	9 45	
" Donation, Biological and Microscopical Section	50 00	
		$11362 81

Cr.

By Salaries, Janitor, etc	3668 32	
" Insurances	55 00	
" Coal	295 75	
" Life Memberships transferred to Investment account	700 00	
" Printing and Binding Proceedings, etc	1155 95	
" Taxes and Water Rents	347 46	
" Printing and Stationery	81 90	
" Plates and Engravings	367 10	
" Postage	18 50	
" Gas	128 12	
" State Tax on Mortgage Investments	209 10	
" Miscellaneous	382 77	
" Cards, Trays and Boxes	115 04	
" Glass and Glassware	210 15	
" Lecture Fees paid to Professors	182 50	
" Specimens	7 00	
" Expenses Publication Committee	200 00	
" Cases and drawers	85 20	
" Repairs and Expense to Real Estate	1502 69	
" Books	314 16	
" Mounting Specimens	12 00	
" Alcohol	46 50	
" Binding	210 80	
" Expenses, Curators	300 00	
		10596 01
Balance		$766 80

I. V. WILLIAMSON LIBRARY FUND.

Balance overdrawn last statement		1233 03
Books		841 54
Collection		79 96
Taxes and Water Rents		196 57
Repairs to Houses		318 29
Miscellaneous		18 00
		$2687 39
Rents collected	956 20	
Ground Rents collected	653 10	
		1609 30
Balance overdrawn		$1078 09

THOMAS B. WILSON LIBRARY FUND.

Income from Investments		525 00
Balance overdrawn last statement	63 85	
Books	140 17	
Transferred to General Account toward Salary of Librarian	300 00	
		504 02
Balance due Academy		20 98

JESSUP FUND (For assistance of Students).

Balance last statement	368 01	
Interest on Investment	560 00	
		928 01
Disbursements		750 00
Balance due Academy		178 01

WILLIAM S. VAUX FUND.

Balance last statement	619 29	
Interest on Investment	700 00	
		1319 29
Cash paid for Minerals	250 00	
Cash paid for cases for Collections	500 00	
		750 00
Balance due Academy		569 29

INVESTMENT ACCOUNT.

Balance at last statement	6624 95	
Cash received from W. C. Smith legacy of Jno. L. Mill dec'd	3400 00	
" received from J. Clarence White Extinguishment of two Ground Rents	3150 00	
" received from Richard Boswell Extinguishments of Ground Rents	3937 00	
" transferred from General Account of Life Memberships	700 00	
		17811 95

Cash received from State of Pennsylvania on account of appropriation to the new Building of the Academy	6250 00

The election of Officers, Councillors and Members of the Finance Committee, to serve during the year 1890, was held, with the following result:—

President, . . .	Joseph Leidy, M. D.
Vice-Presidents, . .	Thomas Meehan,
	Rev. Henry C. McCook, D. D.
Recording Secretary, .	Edward J. Nolan, M. D.
Corresponding Secretary,	George H. Horn, M. D.
Treasurer, . . .	William C. Henszey,
Librarian, . . .	Edward J. Nolan, M. D.
Curators, . . .	Joseph Leidy, M. D.
	Jacob Binder,
	W. S. W. Ruschenberger, M. D.
	Angelo Heilprin,
Councillors to serve three years, . . .	Uselma C. Smith,
	Aubrey H. Smith,
	Geo. A. Koenig, Ph. D.
	Geo. A. Rex, M. D.
Finance Committee, .	Isaac C. Martindale,
	Aubrey H. Smith,
	Wm. W. Jefferis,
	Joseph Willcox,
	Charles Morris.

ELECTIONS DURING 1889.

MEMBERS.

January 29.—W. Xavier Sudduth, M. D., Edward Bancroft, Henry Phillips Coleman, W. Moylan Lansdale.

February 26.—Edwin J. Houston.

March 26.—Louis Selmeider.

April 30.—W. B. Van Lennep, M. D., Charles E. Ridenour.

May 28.—Miss Emma Walter, Henry Bentley, Henry C. Johnson, William M. Meigs.

June 25.—William Gerlach, A. Sydney Biddle.

September 24.—Thomas Stewardson.

October 29.—Theo. H. Conderman.

November 26.—C. D. Lippincott, Minford Levis, M. D., Samuel Stryker Kneass, M. D., James F. Sullivan, Mrs. Elizabeth S. Bladen, Thomas M. Lightfoot.

CORRESPONDENTS.

January 29.—José N. Roverosa, San Juan Bautista, Mexico; Sir John Lubbock, London.

April 30.—Max Fürbringer, Jena.

May 28.—Geo. H. French, Carbondale, Ill.

November 26.—N. M. Romanoff (Grand Duke Nicholas of Russia).

ADDITIONS TO THE MUSEUM.

1889.

Mammalia.

H. C. Chapman. Prepared lungs of the Manatee. Bat (unidentified) from Nassau, W. I.

Zoological Society of Philadelphia. *Herpestes Ichneumon*, Egypt; hybrid between *Macacus cynomolgus* and *Cercocebus fuliginosus*; *Macacus innuus*, Rock of Gibraltar; *Galictis vittata*, Africa; skeleton of *Cercocebus fuliginosus*; *Phascolomys latifrons*; *Felis concolor*; *Felis pardus*; *Gulo luscus*; *Ovis tragelaphus*; *Bos gruniens* (skeletons); *Midas ursulus*; *Cercopithecus Campbelli*; *Didelphys Virginianus*; *Canis procyonides*.

Benjamin Sharp. Two specimens of red howling monkey (obtained in the island of Trinidad).

Birds.

H. C. Chapman. Skull of the Flamingo.

M. M. Tray. One hundred and thirty eggs, principally of North American birds; twenty eight skins, collected in vicinity of Philadelphia.

Zoological Society of Philadelphia. *Chrysotis autumnalis*; *Aramides Cayennensis* and *Brotogenys tori*; *Phasianus versicolor*, Japan; *Cariama cristata* (skeleton).

Reptiles and Amphibians.

Zoological Society of Philadelphia. *Varanus Bengalensis*, India; *Trachysaurus rugosus*, Australia; *Cyclura nubila*, Isle of Pines, West Indies; *Iguana tuberculata*, Tropical America; *Eunectes murinus*, South America; *Tubinambis teguixin*; *Iguana tuberculata*.

H. C. Chapman. A collection of snakes and lizards from West India Islands (*Dromicus*, *Bothops lanceolatus*, *Thecadactylus*, *Mavonia*, *and Anolis*).

A. F. Gentry. *Chrysemys picta*.

F. C. Baker. *Phrynosoma coronata* found by E. H. Baker in Cat Swamp, Providence, R. I.

A. B Macklay. *Chelydra serpentina*, Hatborough, Pa.

Fishes.

H. R. Heyl. *Cyprinus carpio*, Delaware River.

Witmer Stone, Skeletal parts of the Cod.

W. N. Lockington. Collection of fishes from the West Coast of North America.

H. C. Chapman. Sixteen species, Mt. Desert, Me.

Recent Invertebrata (excluding Mollusca).

H. C. Chapman. *Thelyphonus giganteus*, California; a collection of Invertebrates from Mt. Desert, Me.; Centipedes from Nassau, W. I.

J. Ford *Eupagurus pollicaris*, Atlantic City, N. J.; *Echinarachnius excentricus* Monterey, Cal.

U. C. Smith. *Asterias arenicola*, Atlantic City, N. J.

H. A. Pilsbry. *Asterias arenicola*, Atlantic City, N. J.; Two species of Crustacea from Atlantic City, N. J.

W. N. Lockington. An extensive collection of Invertebrata from the West Coast of America.
Witmer Stone. Seven species of Crustacea from the New Jersey Coast.
F. Beamer. *Asterias arenicola*, Atlantic City, N. J.
J. Leidy. *Gonyleptes curvipes*, Aymas, Peru; *Solpuga Cubæ*, Florida.
J. Walton. *Arbacia punctulata*, Atlantic City, N. J.
J. E. Ives. *Cirolana concharum*, Atlantic City, N. J.
Benj. Sharp. *Ophiura cinerea*, Guadeloupe, West Indies.
E. Goldsmith. *Gordius*, Philadelphia.
W. J. Fox. *Lepas fascicularis*, Atlantic City, N. J.
Geo. H. Horn. Three specimens of *Microciona prolifera*, Great Egg Harbor, N. J.
J. Willcox. *Meyenia fluviatilis*, Everglades, Fla.
Acad. Nat. Sciences. Collection Invertebrata made in the Bermudas in 1888 by A. Heilprin and others.

Mollusca.

F. C. Baker. Twelve sections marine shells; 9 species land, 7 marine shells; *Ocinebra Jenksii* Baker, type.
W. G. Binney. Three species California Land Shells; one *Physa*, Manitoba.
J. H. Campbell. Three species land shells from South America.
Alfred Caruana. One species *Pupa*, Malta.
H. C. Chapman. Twenty species marine shells, Mt. Desert.
T. D. A. Cockerell. Twenty-five species Colorado land Mollusks.
Conchological Sect. (By exch.), twenty-five species European land shells.
W. H. Dall, *Helix ceca* from Florida.
A. Dean. *Terebra aciculina*, Singapore.
John Ford. *Helix parietidentata* Miller Ecuador; *Helix stractori* Pilsbry, Cayman, Id.; two species marine, one sp. land shels; *Cyclonassa neritea* L.
W. D. Hartman. Three species *Melania* and *Neritina*—type of *M. Schmackri*—N. Hebridese; eight species from New Caledonia, New Hebrides, etc.
Angelo Heilprin. Five species marine shells, Nantucket.
Acad. Nat. Sciences. One hundred twenty five trays Bermuda Mollusks, collected by A. Heilprin and others in 1888.
Henry Hemphill. (Purchased by Conch. Sect.) 300 species of land and Marine Mollusks from Lower California.
Robt. Jetschin. (In exch., through Conch. Sect.), thirty-two trays European land and fresh-water shells.
C. W. Johnson. Four species Florida Marine shells.
Joseph Leidy. Two species land shells, Salt Lake, Utah.
W. N. Lockington. Forty species West Coast Mollusks
H. A. Pilsbry *Fulgur canaliculatus*, with ciliate cuticle; twenty-one trays *Strophia*, West Indies; *Trivia pediculus* var. Fla.; six species American shells (types).
H. Rolle. *Helix serpentina*, Corsica, and *Cylindrella Eugenia*, Haiti.
E. W. Roper. Eighteen species marine and land shells from western United States.
F. A. Sampson *Gonibasis cubicoides*, etc, Mo.
W. S Teator. *Succinea* and *Anodonta*, Duchess Co., N. Y.
C. T. Simpson. Two species *Succinea* and *Anodonta*, Florida
J. A. Singley. Fifty-six trays land and fresh-water shells from Texas, thirty-three trays Texas land shells, thirteen species Texas shells.
U. C. Smith. *Venus mercenaria* from Holly Beach, N. J; *Tellina Balthica*: *Mactra lateralis*: *Urosalpinx cinerea*: *Eupleura caudata*; *Scalaria Humphreysii*: *S. lineata*: *Anachis avara*: *Gemma Manhattanensis*, *etc.*, New Jersey coast.
V. Sterki. *Pupa Holzingeri*; *P. rupicola*: *Zonites Sterkii*.
L'abbé Vathelet Sixty three species shells from Tonkin, etc.
F. H. White. Two forms of *Selenites Vancouverensis* Lea from Astoria, Oregon.
Jos. Willcox. *Turbo stamineus* and *Unio jucatus*; four species Florida shells.

Fossil Invertebrata.

R. H. Wyeth. Fossiliferous rock fragment, Big Horn, Wyoming.
J. Singley. *Estheria Morsei*, Texas; forty-seven species of Eocene fossils from Texas.
J. Ford. Two species from the Post-Pliocene of California.
L. Woolman. Rock with *Trochosmilia Atlantica*, cretaceous of New Jersey; Fossils from Lower Silurian of Montgomery Co., Pa.
Conchological Section of the Academy. Collection of Post-Pliocene fossils from California, collected by H. Hemphill.
H. M. DuBois. Fossils from Trenton limestone, Duchess Co., N. Y.
E. T. Dumble, State Geologist of Texas. Series of fossiliferous rocks from the Eocene of Texas.
Miss E Lyndall. *Orthoceras* (*Gyroceras?*) from Lower Silurian of Montgomery Co., Pa.
W. W. Jefferis. Crinoid stem and calyx, from near Glens Falls, N. Y.
H. Hemphill. Collection of Post-Pliocene fossils from Lower California.

Fossil Plants.

C. H. Sternberg. Thirty-eight trays of Cretaceous plants from Kansas.
R. H. Wyeth. Fossil plant impressions, Leaf Spring, Montana.
C. Van Schiver. *Stigmaria*, Coal Measures, Pa.
H. M. DuBois. *Lepidodendron aculeatum*, Locust Gap, Pa.

Minerals, Rocks, Etc.

W. W. Jefferis. Phlogopite, Rossie, N. Y.; Sphalerite with quartz, Cumberland, England; Rose Calcite, Mineral Point, Wis.; Quartz, Zamone, Italy; Zincite, Joplin, Mo.; Deweylite, Christiana, Del.; Elæolite and Sodalite, Salem, Mass.; Apophyllite, Keweenaw Co., Mich.; Quartz Crystals, Arkansas; Lepidolite, Paris, Me; Quartz on Hematite, Cumberland, England; Sphalerite, Granby, Mo.; Calamine, Altenburg, Saxony; Cymatolite, Redding, Conn.; Chalcedony, Lancaster Co., Pa.; Orthoclase, Russell, N. Y.; Magnetite, Essex Co., N. Y.; Beryl, Hebron, Me.; Rhoetizite, near Baltimore; Pebbles, Nantucket Beach, Mass.; Glaciated rock from near Glen Falls, N. Y.; Ancient Hudson River gravel and sand from near Ft. Edward, N. Y.; Vanadinite, Yuma Co., Arizona; Prehnite, Sommerville, Mass.; Magnetite, Port Henry, N. Y.
Miss A. M. Fielde. Specimen of Rock from Borneo.
H. M. DuBois. Hydromica schist, impregnated with Graphite, Gulf Mills, Pa.
P. S. P. Conner. Galenite (England?); Quartz Crystals; Serpentine, New Texas, Lancaster Co., Texas; Stalactitic Pyrite; Magnetite in Vesuvian larva; Blende; Pyromorphite and Coquina.
Miss Frances Lea. Forty-four trays of rocks and quartz crystals from the collection of the late Dr. Isaac Lea.
Mr. Deshong. Large crystal of Orthoclase, Deshong's Quarry, Leiperville, Pa.
Theo. D. Rand. Chalcopyrite, Leiperville Quarries, Pa.; Quartz pseudomorph after Asbestus, Maple, Delaware Co., Pa.

Plants.

José N. Roverosa. Three hundred species of plants from the province of Tabasco, Mexico.
U. S. Department of Agriculture (through Dr Geo. Vasey). One hundred and sixteen species of plants collected by Dr. E. Palmer at San Quentin Bay, Lower California, in Jan. 1889; fourteen species N. American and Mexican Grasses.
Wm. M. Canby. Forty-nine species plants from Southern Europe and Sardinia.

Thos. C. Porter. Twenty species plants from Pennsylvania and New Jersey.
Thos. Meehan. One hundred and twenty species plants from various parts of the world, mostly cultivated.
J. Bernard Brinton. *Cryptomeria Japonica*, Cult., native of Japan; *Taxus baccata* var. *Canadensis* Cult.
Jos. T. Rothrock. *Bartsia Odontites*, naturalized at Squirrel I., coast of Maine.
Geo. W. Holstein. Nine species of plants from western Texas.
J. Thistleton Dyer, of Kew Herbarium (through Dr. Sereno Watson); Drummond's Mosses of the Rocky Mountains, mounted in two volumes, embracing two hundred and forty-nine species and thirty-three varieties.
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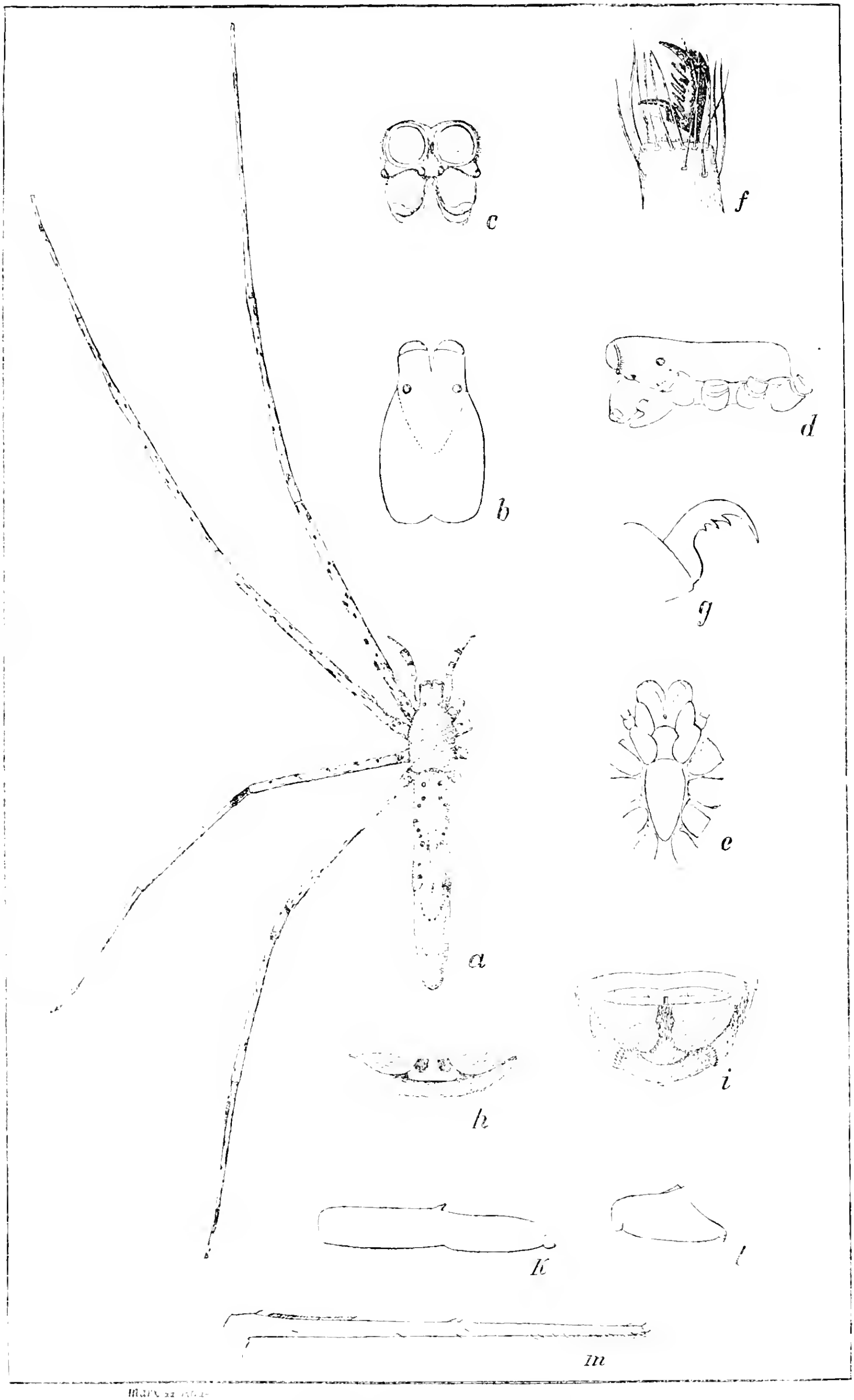

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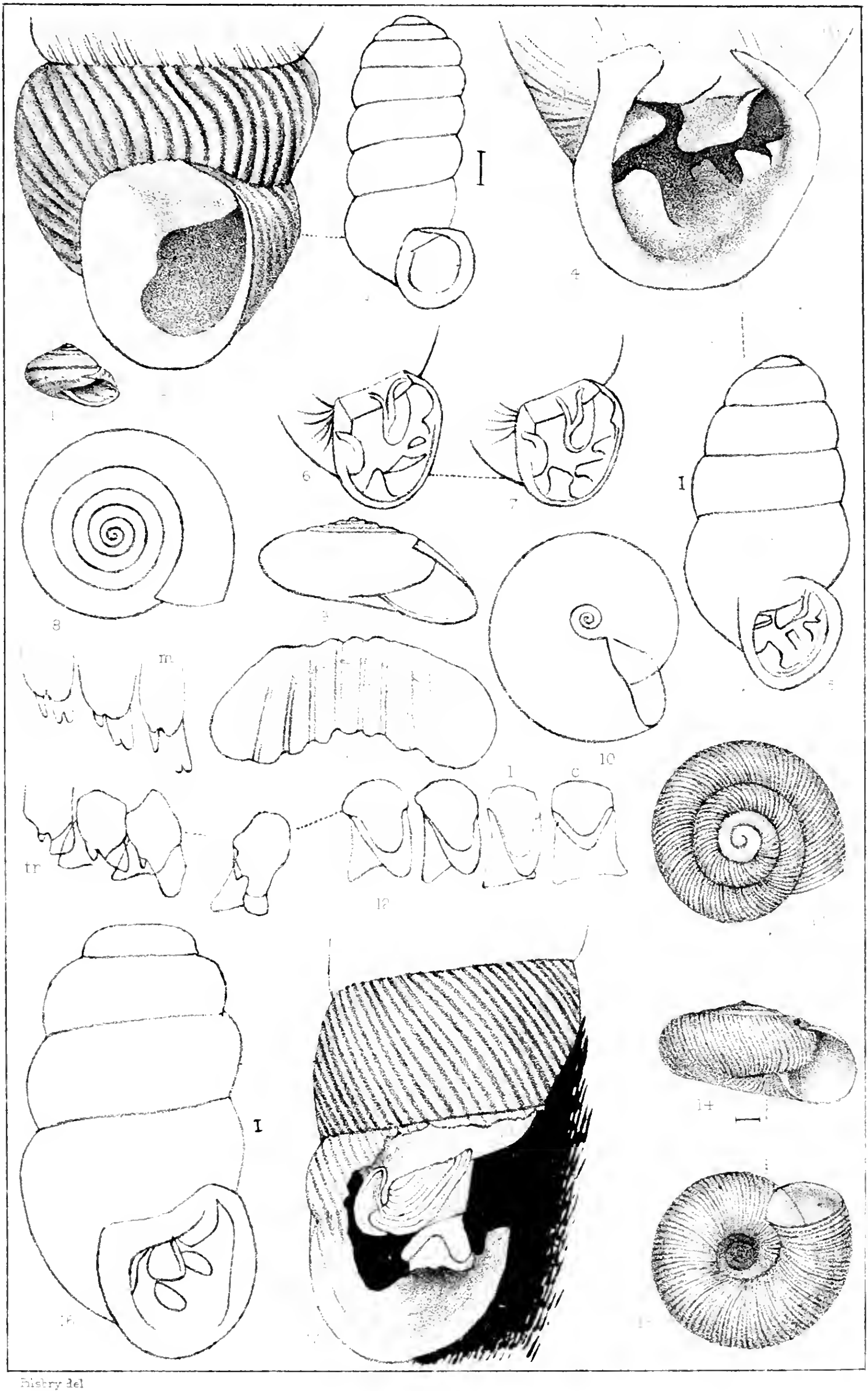

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OF THE

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OF

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PART I. JANUARY–APRIL, 1889.

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EDW. J. NOLAN, M. D., THOMAS MEEHAN,
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1889.

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