728

45

I

PROCEEDINGS

OF THE

ACADEMY OF NATURAL SCIENCES

OF

PHILADELPHIA.

1876.

25767.

PUBLICATION COMMITTEE.

JOSEPH LEIDY, M.D., GEO. W. TRYON, JR.,
WM. S. VAUX, W. S. W. RUSCHENBERGER, M.D.,
GEO. H. HORN, M.D.

EDITOR: EDWARD J. NOLAN, M.D.

PHILADELPHIA:
ACADEMY OF NATURAL SCIENCES,
S. W. Corner Nineteenth and Race Streets.
1876.

Hall of the Academy of Natural Sciences,
Philadelphia, February, 1877.

I hereby certify that printed copies of the Proceedings for 1876 have been presented at the meetings of the Academy, as follows:—

Pages	9 to 24	April	18, 1876.
"	25 to 40	"	25, 1876.
"	41 to 56	May	23, 1876.
"	57 to 72	June	13, 1876.
"	73 to 104	July	11, 1876.
"	105 to 120	August	8, 1876.
"	121 to 152	September	5, 1876.
"	153 to 184	November	14, 1876.
"	185 to 200	"	28, 1876.
"	201 to 232	January	2, 1877.
"	233 to 264	"	9, 1877.
"	265 to 328	"	23, 1877.
"	329 to 376	"	30, 1877.

EDWARD J. NOLAN, M.D.,
Recording Secretary.

PHILADELPHIA:
COLLINS, PRINTER.

LIST OF CONTRIBUTORS,

With reference to the several articles contributed by each.

For Verbal Communications see General Index.

PROCEEDINGS

OF THE

ACADEMY OF NATURAL SCIENCES

OF

PHILADELPHIA.

1876.

January 4, 1876.

The President, Dr. Ruschenberger, in the chair.

Forty-four members present.

On Petalodus.—Prof. Leidy exhibited a tooth of Petalodus, which in shape and size resembles those from the carboniferous limestone of Illinois, described by Dr. Newberry under the name of *P. linguifer*. The specimen was brought to his notice only this evening by Edward Bradin, a medical student of the University, who desired to know what it was. It was stated to have been found by another student, Oakford D. Acton, in the green sand marl, about six miles from Salem, New Jersey. Remains of the genus have previously never been found in formations later than those of Carboniferous age, and it was therefore open to suspicion whether the present specimen really belonged to the green sand deposit of Cretaceous age. Some portions of ash-colored matter adherent to the tooth consist of carbonate of lime, and this would indicate that the specimen had been derived from limestone.

January 11.[1]

The President, Dr. Ruschenberger, in the chair.

Sixty-one members present.

[1] Note.—This day the Society met in its new building, S. W. corner of Race and Nineteenth Streets, for the first time.

January 18.

The President, Dr. Ruschenberger, in the chair.

Forty-three members present.

January 25.

The President, Dr. Ruschenberger, in the chair.

Forty-five members present.

The following were elected members: Chas. L. Sharpless, Dr. Alfred Whelen, Rev. W. Q. Scott, Dr. Henry M. Fisher, Edwin H. Fitler, Dr. Wm. R. Cruice, Chas. H. Rogers, and Dr. W. F. Waugh.

February 1.

The President, Dr. Ruschenberger, in the chair.

Forty-six members present.

A paper entitled "Description of a New Generic Type, Bassaricyon Gabbii, of Procyonidæ from Costa Rica," by J. A. Allen was presented for publication.

On a Gigantic Bird from the Eocene of New Mexico.—Prof. Cope exhibited a tarsometatarsus of a bird, discovered by himself during the explorations in New Mexico, conducted by Lieut. G. M. Wheeler, U. S. A. The characters of its proximal extremity resemble in many points those of the order *Cursores* (represented by the *Struthionidæ* and *Dinornis*), while those of the distal end are, in the middle and inner trochleæ, like those of the *Gastornis* of the Paris Basin. Its size indicates a species with feet twice the bulk of those of the ostrich. The discovery introduces this group of birds to the known faunæ of North America recent and extinct, and demonstrates that this continent has not been destitute of the gigantic forms of birds, heretofore chiefly found in the Southern Hemisphere faunæ. The description is as follows:—

The hypotarsus is moderately prominent, with broad truncate face, and does not inclose the ligamentous groove of its inner side. Its superior angle is broken away in the specimen. The two foramina which pierce the shaft just below the head, are well separated from each other both on the posterior and anterior faces, marking nearly equal thirds of the transverse diameter of the bone. The cotyloid cavities for the tibio-tarsus are bounded by an elevated margin, and are separated medially by a single low oblique ridge. The groove of the posterior face is particularly wide, and the inner part of the shaft is thinned, while the outer border is broadly convex. The proximal part of the inner border (as far as it is preserved) is marked with a flat surface which is roughened with ridges, which is perhaps the sutural articulation of the proximal end of the metatarsus of the hallux. No such surface exists on the corresponding bone of the ostrich or emeu. Only two of the free distal phalangeal extremities are preserved. The shaft is broken, showing that its interior is filled with cancellous tissue. The free extremities are remarkable for the great inferior extent of the articular trochlear face. The median is strongly grooved with an obtuse excavation, and the lateral or bordering ridges are equal and rounded. The groove is continuous with the superior surface, but not with the inferior. There the convergent lateral ridges inlosing the open groove, terminate in an abrupt elevation above the adjacent surface of the shaft. The sides at this point are concave. The inner free condyle has an oblique articular face, the external ridge dropping away internally as in many birds, and produced beyond the inner ridge, distally. The articular face becomes then a part of a spiral, and is little grooved above, but strongly grooved medially. The vertical diameters of the sides differ, the inner being much greater, and both are concave. A strong foramen pierces the shaft just within the point of junction of the inner and medial free extremities.

Measurements.		M.
Transverse diameter of proximal end of tarsometatarsus		.100
Antero-posterior do. (partly inferential)		.070
Interval between penetrating foramina on anterior face shaft		.017
Median distal condyle	Long diameter	.050
	Vertical diameter	.048
	Transverse diameter	.040
Internal distal condyle	Long diameter	.037
	Vertical diameter	.040
	Transverse diameter	.031

The large size and wide separation of the penetrating foramina, and the thin internal edge with sutural articular facet, distinguish this form as distinct from any of the genera of Struthionidæ and Dinornithidæ. It is therefore named *Diatryma gigantea.*

On Strontianite and Associated Minerals in Mifflin Co.—Mr. Henry Carvill Lewis remarked that it might be of interest to mention the occurrence of Strontianite in Pennsylvania—a mineral which he believed had not been heretofore recorded as occurring in our State.

He had found it quite abundantly in Mifflin County on the Juniata opposite Mount Union. It exists as tufts of white acicular crystals, lining pockets in limestone, or when in shale, disseminated throughout the rock-mass. The specimen presented to the Academy is of the latter kind. Its geological position is in hydraulic limestone near the lower horizon of the Water Lime Group. (No. VI. of Penna. Survey.)

Several other minerals have been found associated with the strontianite; among them a strontianitic aragonite, found in fibrous crystalline crusts, generally about half an inch thick. When heated before the blowpipe it gives a red flame, and sometimes slightly exfoliates. A specimen was examined by Dr. Genth, who finds the amount of strontia present to be about one-half of one per cent.

Calcite, ferrocalcite, common aragonite, and fluorite occur at the same locality.

A statement in Prof. Rogers' "Geology of Pennsylvania" (Vol. I. p. 215), referring to the occurrence of strontianite at Marble Hall, Montgomery County, is probably incorrect; barites, which is there plentiful, being mistaken for it.

FEBRUARY 8.

The President, Dr. RUSCHENBERGER, in the chair.

Twenty-nine members present.

Mr. THOMAS MEEHAN remarked that the American correspondent of "Nature" had characterized some recent remarks of his on fertilization by insect agency, as an attack on Mr. Darwin. He thought the members of the Academy would bear him out in the statement that the facts and observations he had from time to time offered were submitted in no spirit of antagonism to Mr. Darwin, but often favored as much as they opposed views held by that distinguished gentleman. Even those who were avowed partisans of Mr. Darwin felt it necessary to strengthen their positions by searching for new facts; surely the mere student who was willing to wait till the evidence was all in, might offer the facts as he found them, without being liable to the charge of direct antagonism. However, he felt fortunate to-night in having two new facts to offer, one of which might favor, and the other oppose some generally accepted views.

Variation in Quercus macrocarpa.—Mr. M. remarked that among many other characters distinguishing oaks, the color of the one-year-old twigs was marked. Some species had purplish-red twigs, as, for instance, the white oak; others, as the burr oak, had gray twigs. This character was remarkably constant through all the species. He exhibited some branches of the burr oak (*Quercus macrocarpa*) in which was a tendency to develop the character of the white oak. From the articulus of the fallen leaf downwards, in some cases extending several inches, was a purple line similar to the color of the white oak, giving the twig a striped appearance. There was no reason why the whole twig might not lose its gray color and become purple or brown, instead of partially so as now, and no reason why it might not become a permanent and enduring character. It was undoubtedly a fact favoring evolutionary views.

Self-Fertilization in Browallia elata.—Mr. MEEHAN exhibited specimens of this common green-house annual in flower and with an abundance of perfect seed, and said it had been produced from plants which had no aid whatever from insects in fertilization. The tendency of thought at the present time was to present the generalization that plants were benefited by cross fertilization; that they had come to abhor, so to say, in-and-in breeding, and that color, fragrance, and honeyed secretion in flowers had been developed in these later ages solely as inducements to insects to visit them, and thereby secure this cross fertilization. He did not regard this necessity for cross fertilization—this supposed injury to plants, from in-and-in breeding—to be proved by any means, as there are abundant evidences to the contrary. But undoubted self-fertilizers have existed as long and are every way as healthy as those that cannot now fertilize themselves. It was essential, he thought, that this point should be more fully proved before we could say much about special contrivances for insuring insect fertilization.

That there was a considerable number of plants that could only be fertilized by insect agency, was certainly true, and as remarkable as it was true, and whatever the purport of this arrangement might ultimately be proved to be, they who were working up this field and increasing the number of instances were doing inestimable service to science. But while there were instances of structure which *seem to be* specialized particularly with the object of insect fertilization, it was but right that we should not close our eyes to other structures which just as strongly *seemed* specialized to prevent it. That was the case with the Browallia now exhibited. Not only was it a fact that this plant with such an attractive blue color perfected every seed vessel without insect aid, but the structure of the flower was such that should an insect endeavor to collect the pollen it would only aid, if that were necessary, in self-fertilization. The stigma was nearly the length of the corolla tube; and the anthers, a trifle longer, were arranged closely around it. Two of these were inverted just over the stigma, their backs being densely bearded, and appearing to the naked eye like petaloid processes effectually closing the mouth of the throat. No insect could thrust its proboscis into the tube, except through this dense bearded mass, and if it had foreign pollen, would be thoroughly cleaned by the beard; but the very act of penetration would thrust these anthers forward on to the pistil, and thus aid in rupturing the pollen sacs, and of course the self-fertilization of the flower. If we are to be told that "all flowers with brilliant colors" have been so developed by the "unconscious agency of insects," as Sir John Lubbock tells us; and if we are to regard peculiarities of structures which prevent self-fertilization, as having been arranged especially with that view and to that end, what are we to say of cases like this of Browallia, with brilliant color, and special structure favoring self-fertilization?

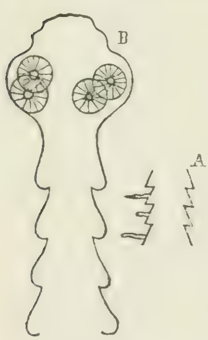
FEBRUARY 15.

The President, Dr. RUSCHENBERGER, in the chair.

Thirty members present.

A paper entitled "Description of a Monstrosity," by H. C. Chapman, M.D., was presented for publication.

Description of a new Tænia from Rhea Americana.—Dr. CHAPMAN called the attention of the members to a new species of Tænia which he had found in the alimentary canal of the Rhea Americana. According to Diesing there exists in the Struthio a tænia, but as no description is given he could not say whether the species are the same. It is very probable, however, that they are so. If future investigation should show this to be correct, it will offer another illustration of closely related forms having the same entozoa. The tænia from the Rhea varies from 9 to 10 inches in length. Its head measures $\frac{1}{33}$ of an inch in breadth and $\frac{1}{25}$ of an inch in length (to beginning of 1st segment). The head is provided with four suckers. The cervical segments are rounded off at the articulations, but the mature ones are serrated. The genital aperture is lateral and alternates from side to side. Sometimes there will be as many as five successive segments on one side exhibiting these apertures, and then five will be seen on the opposite side of the next five successive segments. The penis could be protruded by compression and the vagina readily seen.



From the fact of the head being rather thickly set upon this species, the name *Tænia tauricollis* was proposed for it.

FEBRUARY 22.

The President, Dr. RUSCHENBERGER, in the chair.

Thirty-two members present.

A paper entitled "Descriptions of New Species of Fossils from Paleozoic Rocks of Iowa," by Chas. A. White, M.D., was presented for publication.

On the Theory of Evolution.—Prof. COPE gave a history of the progress of the doctrine of evolution of animal and vegetable types. While Darwin has been its prominent advocate within the last few years, it was first presented to the scientific world, in a rational form, by Lamarck of Paris, at the commencement of the present century. Owing to the adverse influence of Cuvier, the doctrine remained dormant for half a century, and Darwin resuscitated it, making important additions at the same time. Thus Lamarck found the variations of species to be the primary evidence of evolution by descent. Darwin enunciated the law of "natural selection" as a result of the struggle for existence, in accordance with which "the fittest" only survive. This law, now generally accepted, is Darwin's principal contribution to the doctrine. It, however, has a secondary position in relation to the *origin* of variation, which Lamarck saw, but did not account for, and which Darwin has to assume in order to have materials from which a "natural selection" can be made.

The relations exhibited by fully grown animals and plants with transitional or embryonic stages of other animals and plants, had attracted the attention of anatomists at the time of Lamarck. Some naturalists deduced from this now universally observed phenomenon, that the lower types of animals were merely repressed conditions of the higher, or in other words, were embryonic stages become permanent. But the resemblances do not usually extend to the entire organism, and the parallels are so incomplete, that this view of the matter was clearly defective, and did not constitute an explanation. Some embryologists, as Lereboullet and Agassiz, asserted that no argument for a doctrine of descent could be drawn from such facts.

The speaker, not adopting either view, made a full investigation into the later embryonic stages, chiefly of the skeleton of the Batrachia, in 1865, and Prof. Hyatt, of Salem, Mass., at the same time made similar studies in the development of the Ammonites and Nautili. The results as bearing on the doctrine of evolution were published in 1869 (in "The Origin of Genera"). It was there pointed out, that the most nearly related forms of animals do present a relation of repression and advance, or of permanent embryonic and adult type, leaving no doubt that the one is descended from the other. This relation was termed *exact parallelism.* It was also shown, that, if the embryonic form were the parent, the advanced descendant was produced by an increased rate of growth, which phenomenon was called *acceleration;* but that if the embryonic type were the offspring, then its failure to attain to the condition of the parent is due to the supervention of a slower rate of growth; to this phenomenon the term *retardation* was applied. It was then shown that the *inexact parallelism* was the result of *unequal* acceleration or retardation; that is, acceleration affecting one organ or part more than another, thus disturbing the combination of characters, which is necessary for the state of *exact parallelism* between the perfect stage of one animal, and the transitional state of another. Moreover, acceleration implies constant addition to the parts of an animal, while retardation implies continual subtraction from its characters, or atrophy. He had also shown (Method of Creation, 1871), that the additions either appeared as *exact repetitions* of preëxistent parts, or as *modified repetitions*, the former resulting in simple, the latter in more complex organisms.

Professor Haeckel, of Jena, has added the keystone to the doctrine of evolution in his gastræa theory. Prior to this generalization, it had been impossible to determine the true relation existing between the four types of embryonic growth, or, to speak otherwise, than that they are inherently distinct from each other. But Haeckel has happily determined the existence of identical stages of growth (or segmentation) in all of the types of eggs, the last of which is the *gastrula;* and beyond which the identity ceases. Not that the four types of gastrula are without difference, but this difference may be accounted for, on plain principles. In 1874, Haeckel, in his Anthropogenie, recognizes the importance of the irregularity of time of appearance of the different characters of animals, during the period of growth, as affecting their permanent structure. While maintaining the view that the low forms represent the transitional stages of the higher, he proceeds to account for the want of exact correspondence exhibited by them at the present time, by reference to this principle. He believes that the relation of parent and descendant has been concealed and changed by subsequent modifications of the order of appearance of characters in growth. To the original, simple descent he applies the term *palingenesis;* to the modified and later growth, *cœnogenesis.* The causes of the change from palingenesis to cœnogenesis, he regards as three, viz.: acceleration, retardation, and heterotopy.

It is clear that the two types of growth distinguished by Prof. Haeckel are those which had been pointed out by Prof. Cope in "The Origin of Genera," as producing the relations of "exact" and "inexact parallelism;" and that his explanation of the origin of the latter relation by acceleration or retardation is the same as that of the latter essay. The importance which he attaches to the subject was a source of gratification to the speaker, as it was a similar impression that led to the publication of "The Origin of Genera" in 1869.

It remains to observe that the phenomena of exact parallelism or palingenesis, are quite as necessarily accounted for on the principle of acceleration or retardation, as are those of inexact parallelism or cœnogenesis. Were all parts of the organism accelerated or retarded at a like rate, the relation of exact parallelism would never be disturbed; while the inexactitude of the parallelism will depend on the number of variations in the rate of growth of different organs of the individual, with additions introduced from time to time. Hence it may be laid down, that *synchronous acceleration* or *retardation* produces exact parallelism, and *heterochronous acceleration* or *retardation*, produces inexact parallelism.

In conclusion, it may be added that acceleration of the segmentation, the protoplasma or animal portion of the primordial egg, or retardation of segmentation of the deutoplasma or vegetative half of the egg, or both, or the same relation between the growth of the circumference and centre of the egg, has given rise to the four types which the segmentation now presents.

An analysis of the laws of evolution may be tabulated as follows:—

		Exact parallelism, the product of *Palingenesis*, which is *synchronous*....	*Inexact parallelism*, the product of *Cænogenesis*, which is *heterochronous*....
acceleration, which proceeds by	Exact repetition..............	*	*
	Modified repetition	*	*
	Heterotopy	*	*
retardation, which proceeds by	Exact atrophy	*	*
	Inexact atrophy (or senility)[1]..	*	*

A Human Skull exhibiting unusual Features.—Dr. ALLEN exhibited a human skull showing a number of peculiarities. The most conspicuous of these was a large bridge-like process of bone extending backward from the base of the pterygoid process and adjoining the under surface of the sphenoid bone in front of the foramen spinosum. It was symmetrical, and visible through the foramen ovale, from within the brain-case.

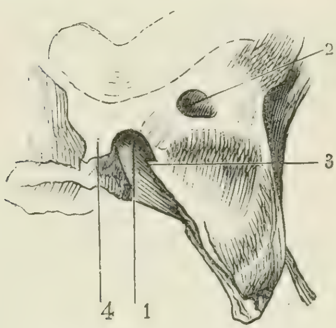
Variations in this portion of the skull are frequent.

[1] So called by Professor Hyatt.

The posterior edge of the outer pterygoid plate is exceedingly variable. A small process (3) is often seen jutting backward from the border of the outer plate on a level with the end of the spinous process. Several specimens in the collection exhibit a bridge formed by this process uniting with the spinous process.

That the variation in the skull under consideration is not of this kind is proved by the specimen exhibiting this process, which for the need of distinguishing it from the other may be called the *accessory process.*

The foramen (2) caused by the bridge-like process opens without in the zygomatic fossa, and within at the anterior border of the foramen ovale. It probably carried a large branch—the motor trunk—of the inferior maxillary division of the fifth cranial nerve.



1. Oval foramen. 2. Abnormal foramen. 3. Accessory process. 4. Spinous process.

Among other peculiarities of the same specimen may be mentioned a duplication of the foramen spinosum of the right side; the almost oval shape of the sphenoidal fissure; the presence of several island-like patches of the upper surface of the greater wing of the sphenoid bone through openings in the orbital plates of the frontal bone; the exceedingly bold sculpturing of the inner layer of the brain case; the great thinning of the wall at the temporal fossæ; pronounced depression for the cartilaginous portion of the Eustachian tube, and two slit-like infra-orbital foramina. The latter are situated five lines below the orbit, and associated with a canal extending outward and backward. The infra-orbital canal is eight lines long.

With all these peculiarities the muscular impressions are weak; the mastoid processes of ordinary proportions, and the styloid processes very small.

Dr. Allen concluded that the inner or *true* cranial plate had been *over*-developed. The outer plate remained nearly the same, excepting at the base of the pterygoid process.

Variations in the skull can be arranged in three groups. (1) Those peculiar to modification in the form of the entire skull, due to arrests or excesses in development. (2) Those due to plus development of the inner or true plate. (3) Those due to traction of muscles. This latter causes no change on the inner plate, unless the error occurs at an early age. Ordinarily, muscular action affects the *outer* plate of the skull only.

FEBRUARY 29.

The President, Dr. RUSCHENBERGER, in the chair.

Fifty-nine members present.

The meeting having adjourned until March 7, the following were then elected members :—

Jesse W. Starr, Crozer Griffith, James H. Windrim, Wm. Harris Kneass, Chas. Wilt, Howard Spencer, Thomas S. Root, Jas. W. McAllister, James Ridings, Horace F. Jayne, George Biddle, Geo. B. Dixon, James H. Ridings, Charles A. Blake, Robt. Wood, John Meichel, Wm. S. Pine, Wm. L. Abbot, and J. Sergeant Price.

M. Alphonse Pinart, of Paris, and Edward T. Stevens, of Salisbury, England, were elected correspondents.

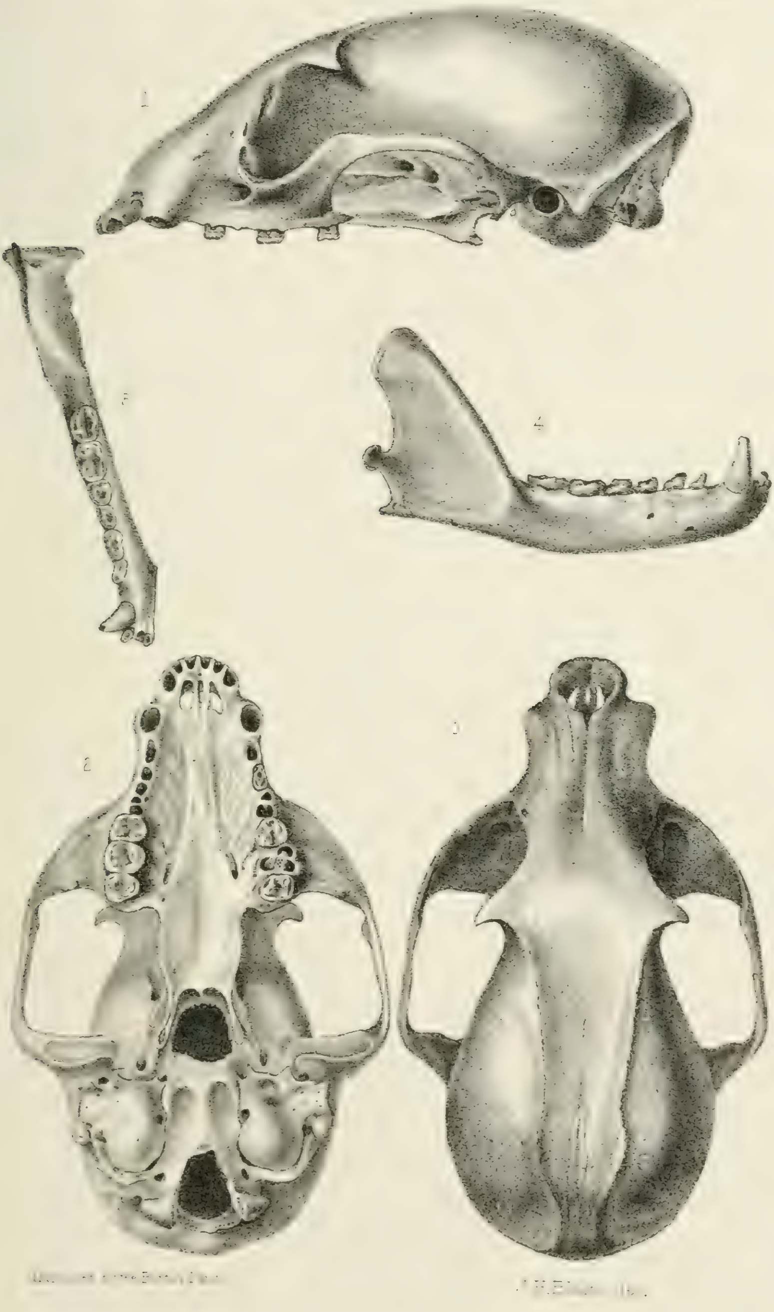
The committees to which they had been referred recommended the following papers to be published :—

DESCRIPTION OF A NEW GENERIC TYPE (BASSARICYON) OF PROCYONIDÆ FROM COSTA RICA.

BY J. A. ALLEN.

The large collection of skulls and skins gathered by Professor W. M. Gabb during his scientific survey of Costa Rica, and now deposited in the National Museum at Washington, includes an undescribed species of *Procyonidæ*. This species forms also a new generic type, and, furthermore, one which differs so widely from the forms previously known as to warrant its consideration as the type of a new sub-family, it being as unlike *Nasua* or *Procyon* as these genera are unlike each other. The new form is at present represented in the collection by only a single skull (Nat. Mus. No. 14,214), the skin that came with it (Nat. Mus. No. 12,237) having in some way been mislaid. The skull is that of a rather aged individual, as shown by the obliteration of nearly all of the sutures, and the somewhat worn state of the teeth, but is in excellent condition with the exception of the loss of a few of the teeth.

The outline of the skull in profile (plate 1, fig. 1) is much as in *Procyon*, but the anterior portion is more depressed and is relatively shorter and narrower; the postorbital processes, however, are much more developed, as much so as in *Bassaris* or *Felis*, and the temporal ridges are widely separated, even in old age. As seen from above, the skull has quite a resemblance to that of *Bassaris*, especially in the large size of the orbits, the strongly developed postorbital processes, and the wide interval between the temporal ridges, in all these points resembling *Bassaris* far more than either *Nasua* or *Procyon*, its really nearest affines. The auditory bullæ also differ widely in form and position from those of either *Nasua* or *Procyon*, presenting in some respects features that are exceptional among the carnivora. One of the most important characters, however, of the new type consists in the form of the malar bone, which is greatly depressed and expands abruptly outward in a nearly horizontal plane from the alveolar border of the maxilla, thus forming a nearly horizontal, triangular expansion beneath the orbit—a feature not possessed by any of its nearest affines, and only approximated in *Bassaris* and in the cats. This



Bassaricyon Gabbii.

results in giving a breadth to the skull at the anterior end of the zygomatic arch but little less than that at its posterior end, at which point the skull has its maximum width. The orbits are relatively twice the size of those of *Procyon*, and being directed considerably forward, give to the skull a quite cat-like aspect. In consequence of the low origin of the malar bone, the small infra-orbital foramen is placed very low, scarcely more than its breadth above the alveolar border of the maxilla.

In respect to other features, the dentition is much as in *Procyon* and *Nasua* $\left(\text{M. }\frac{6}{6}\text{ C. }\frac{1}{1}\text{ I. }\frac{3=20}{3=20}=40\right)$. The canines, however, are smaller than in *Nasua*, and the molars are shorter and more nearly square than in either this genus or *Procyon*, as shown by the subjoined table of measurements:—

		Length.	Width.
Bassaricyon Gabbii,	1st upper molar . .	0.15	0.17
Nasua Sumichrasti,	" " " . .	.30	.27
Procyon "Hernandezii,"	" " " . .	.34	.35
Bassaricyon Gabbii,	2d upper molar . .	.19	.20
Nasua Sumichrasti,	" " " . .	.33	.30
Procyon "Hernandezii,"	" " " . .	.37	.33
Bassaricyon Gabbii,	3d upper molar . .	.14	.14
Nasua Sumichrasti,	" " " . .	.30	.38
Procyon "Hernandezii,"	" " " . .	.28	.34
Bassaricyon Gabbii,	1st lower molar . .	.15	.13
Nasua Sumichrasti,	" " " . .	.32	.18
Procyon "Hernandezii,"	" " " . .	.28	.18
Bassaricyon Gabbii,	2d lower molar . .	.17	.15
Nasua Sumichrasti,	" " " . .	.37	.20
Procyon "Hernandezii,"	" " " . .	.42	.30
Bassaricyon Gabbii,	3d lower molar . .	.20	.17
Nasua Sumichrasti,	" " " . .	.32	.24
Procyon "Hernandezii,"	" " " . .	.41	.25

In the present species the last upper molar is nearly quadrate with rounded angles; in *Procyon* it is subtriangular, with the inner and posterior outer angles rounded; in *Nasua* it has the same form as in *Procyon*, except that the posterior outer angle is sharp.

The palate is flat, not arched as in *Procyon* and *Nasua*, and well produced posteriorly. The auditory bullæ are greatly swollen posteriorly; depressed and laterally compressed anteriorly. The basi-occipital margin of the bullæ is deflected inward, so that posteriorly the bullæ converge, just the reverse of what obtains in *Procyon*, in which the bullæ diverge posteriorly, and are most swollen and deflected anteriorly. In *Nasua* the auditory bullæ are placed much as in *Procyon*, but they are more globular, and are well developed anteriorly. The converging of the bullæ posteriorly rarely occurs among the Carnivora. The pterygoid processes are relatively smaller than in *Procyon* and *Nasua;* the paroccipital and mastoid processes are but slightly instead of strongly developed, and the paroccipital are not incurved. The anterior end of the intermaxillæ is more pointed than in *Procyon*, but less so than in *Nasua.*

The lower jaw differs from that of *Procyon* in its straight instead of slightly concave alveolar border, straighter lower border, and more diverging coronoid process. The coronoid process is also nearly straight on the anterior border to its apex, instead of greatly rounded, and is much less hollowed posteriorly. The apex of the coronoid is also pointed, and is situated in a line with its anterior border. The angle of the jaw is also much less developed, and the inferior dental canal opens considerably more posteriorly than in *Procyon.* In most of these points the lower jaw much more closely resembles that of *Nasua* than that of *Procyon.*

The skull indicates an animal as small or smaller than *Bassaris astuta*—decidedly smaller than *Bassaris Sumichrasti*—and hence not more than one-fourth the size of the smallest known form of either *Procyon* or *Nasua*, as indicated by the following table of

Measurements of Skulls of Procyon, Nasua, Bassaris, and Bassaricyon.

	Bassaricyon Gabbii. S. I. No. 14,214.	Nasua leucorhynchus. S. I. No. 14,193.	Procyon cancrivora. S. I. No. 6949.	Procyon "Hernandezii." S. I. No. 14,191.	Bassaris Sumichrasti. S. I. No. 7082.
Total length	3.10	5.52	5.10	4.95	3.42
Length (anterior end of intermaxillæ to occipital condyles)	2.95	5.02	5.00	4.63	3.30
Greatest width	1.95	3.23	3.40	3.35	2.22
Width at mastoid processes	1.33	2.15	2.00	2.80	1.45
Distance between the orbits . . .	.60	1.30	1.05	1.10	.75
Width at orbital processes	1.15	1.75	1.33	1.30	1.23
Length of nasal bones	...	...	1.38	...	...
Width of nasal bones at the middle . .	.20	...	.53	...	...
Anterior end of intermaxillæ to molars .	.83	1.60	1.30	1.35	.83
Anterior end of intermaxillæ to posterior margin of palate	1.73	3.37	3.10	2.97	1.47
Anterior end of intermaxillæ to orbit . .	.84	2.25	1.50	1.60	1.00
Anterior end of intermaxillæ to orbital processes	1.55	3.00	3.53	2.40	1.72
Width of muzzle at the canines . . .	.67	1.00	1.30	1.15	.67
Width of palate at second molar . . .	.60	.75	.83	.92	.47
Length of upper molar series . . .	.92	1.50	1.60	1.60	1.07
Length of the three true molars . . .	.47	.87	1.10	.97	.63
Length of lower molar series . . .	.95	1.67	1.87	1.70	1.13
Length of the three true molars . . .	.55	1.03	1.26	1.17	.72
Length of lower jaw	2.20	3.82	3.75	3.40	1.37
Height of lower jaw	1.03	1.30	1.65	1.52	1.03

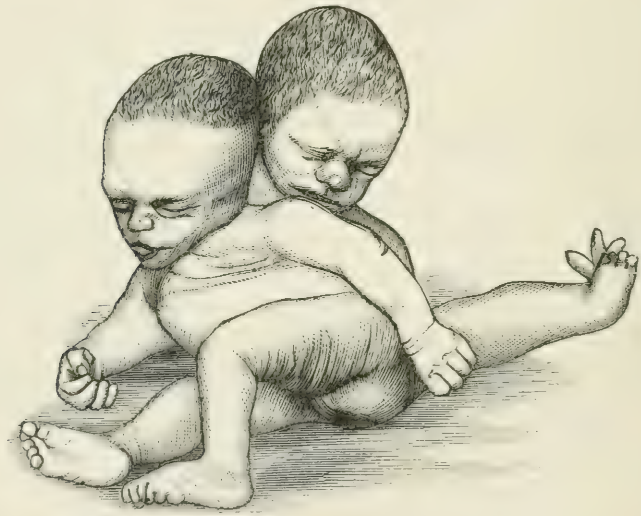
The loss of the skin renders it impossible to now properly characterize the species, but as it is presumably only temporarily mislaid, we hope soon be able to make known its external characters. The large size and position of the orbits, and the large bullæ, seem to indicate an animal of nocturnal habits. It is also evidently rather rare, or very difficult to obtain, since Professor Gabb's collection, which embraces very large series of all the more common species, contains but a single example of this.

For the genus I propose the name *Bassaricyon*, in allusion to its strong resemblance in several features to *Bassaris*, and for the species that of *Gabbii*, in recognition of Professor Gabb's invaluable contributions to our knowledge of the zoology and general natural history of the Republic of Costa Rica. As the species differs more from either *Nasua* or *Procyon* than the latter do from each other, it seems to form a type quite as well entitled to rank as a sub-family of the *Procyonidæ* as do either of the others, and may hence be called *Bassaricyoninæ*.

DESCRIPTION OF A MONSTROSITY.

BY HENRY C. CHAPMAN, M.D.

I am indebted to Dr. James Ogden, of Paschalville, Philadelphia, for the opportunity of dissecting the monstrosity, of the general appearance of which, the illustration gives a good idea. I learn from the doctor that the father and mother are both colored people. The mother is only 18 years old, and has had one child. The children were born dead. The labor lasted 12 hours, the head of the right child presenting first. There was but one placenta.



As regards their mode of attachment, the children were joined together anteriorly by a common sternum and posteriorly by the ribs, the left ribs of the right child being joined to the right ribs of the left. (In my description the children are supposed to be lying upon their backs.) There were two distinct vertebral columns; the heads and necks were quite separate and freely movable. The right upper and lower extremities of right child and the left upper and lower extremities of left child were normal. The two inner arms seemed to be represented in a rudimentary condition by a lump growing out of a scapula more or less divided into two. The inner clavicles of the children were united. The bone was found fractured, this being caused no doubt in labor. The inner legs of the children were fused into one, which articulated with the acetabulum formed by the inner innominates. The foot exhibited eight toes. Five of these belonged to the left foot of right child and three to right foot of left child. The pelves were double. The left innominate of right child was fused with the right innominate of left child.

Circulatory Apparatus.—There were two distinct hearts with a sinus between them, which received the innominate veins and opened into the right and left auricles of the heart of the right child and the right auricle of the heart of the left child. The heart of the left child was twice as large as that of the right, the common carotids in both children arose by a single trunk from their respective aortas. The outer subclavians were normal, the inner ones feebly developed. The two aortas were well developed, but there was but one hypogastric artery; this, however, was large, and came off from the aorta of left child. Two pairs of lungs were present.

Alimentary Apparatus.—While there were two distinct stomachs, the two small intestines, however, united twenty-seven inches above the cæcum to form one large intestine, which terminated in a single rectum with one anus. The two livers were continuous, the umbilical vein divided into two branches, one for each liver. The two pancreas' were massed together, but only one spleen was seen.

The Genito-urinary Apparatus.—Four kidneys were found, those of left child lying rather loosely in the abdominal cavity; they exhibited enormous ureters which terminated in a bladder in front of the uterus of the left child. As there was no external opening, their size arose possibly from their chronic dilatation by urine. The kidneys of the right child were found in their normal condition, their ureters terminated in a bladder which was seen lying in front of the uterus of right child. The uterus of the right child terminated in a bifid vagina with two external openings; the uterus of left child was longer and narrower than that of right; its vagina was imperforate. The rectum lay between the two uteri.

Reflection on the Cause of Monstrosities.—It is well known that there are two views offered by physiologists as explanations of the formation of monstrosities: either they are to be regarded as due to the fusion of two individuals, or the secondary individual is to be considered as having budded from the first. As an argument in favor of this latter view there is instanced the fact of there having been found in one yolk two embryos more or less united. While the fact is true, the inference that such embryos have been developed from one germ cannot be drawn until it has been shown that such a yolk has not resulted from the fusion of two yolks while in the oviducts. As an objection to the former view, it is urged that as the presence of an additional finger or toe is merely regarded as an exhibition of extra nutrition, a sort of budding, to be consistent an almost perfect secondary individual should also be regarded as such, inasmuch as there exists a gradual series between the very simple malformations and the more complex ones, and further, if an additional finger for example has resulted from the fusion of two individuals, what has become of the rest of the secondary being? It may be answered that the presence of an extra finger cannot be fairly compared with that of a secondary system, alimentary, circulatory, etc., well developed. Again, it is quite conceivable in certain cases that only a part of a secondary individual should develop and the rest atrophy. While not denying that there can be budding from certain parts, it appears to me that a fact like that just described of two intestines fusing into one, with the remaining organs double and fully developed, is more readily understood by supposing that two individuals have been joined together than that one has budded from the other. The different pups in a litter are developed from distinct ova. Most authorities consider human twins as having the same origin. It seems a natural inference, therefore, that a monstrosity such as I have just described is the result of the union of two individuals in the early stages of gestation.

DESCRIPTION OF NEW SPECIES OF FOSSILS FROM PALEOZOIC ROCKS OF IOWA.

BY CHARLES A. WHITE, M.D.

RADIATA.

ACTINOZOA.

Genus CHÆTETES, Fischer.

Chætetes Muscatinensis (n. s.).

Polypary not usually large or massive, but generally encrusting some object, upon which it attains considerable thickness by concentric layers; cells exceedingly slender, but under a good lens they show their numerous septa and the slight constriction of the cells between them quite distinctly.

This species seems never to become ramose, or even elongated except by encrusting some elongated object; by this habit and the unusual minuteness of the cells it may be distinguished from all other species.

Position and locality.—Devonian strata, near Muscatine, Iowa.

Genus MONTICULIPORA, D'Orbigny.

Monticulipora monticula (n. s.).

Polypary usually consisting of small expanded masses, flat or concave below, convex above, thin at the edges, but the middle portion being thickened and considerably elevated; the upper surface having the papillary elevations peculiar to the genus and the under side sometimes having the appearance of being provided with an epitheca; cells of ordinary size, not radiating from a common centre but extending upward more or less perpendicularly with the plane of the base of the polypary.

The uniformity of habit of this species is its most distinguishing characteristic, and by which it may be readily recognized.

Position and locality.—Devonian strata, Iowa City, Iowa.

Genus LOPHOPHYLLUM, Edward et Hairne.

Lophophyllum expansum (n. s.).

Corallum broadly conical, slightly curved, transverse section subcircular, calyx broad, not deep; rays numerous; septal fossette not very distinct, situated at the convex side of the corallum; columella prominent, laterally flattened so as to form a more or less sharp edge along its crest.

This species is proportionally much broader than usual, and when its interior structure is better known it may possibly be found to belong to the genus *Axophyllum*, but its external characters seem to warrant its reference to *Lophophyllum*.

Height of corallum and diameter of calyx each about two centimetres.

Position and locality.—Keokuk limestone (subcarboniferous), Henry County, Iowa.

ECHINODERMATA.

Genus STROBILOCYSTITES (n. g.).

Body ovoid or subspherical; pectinated apertures forming three inclosed rhombic areas, one on each of the four parts of the body except the posterior part; those of the two lateral parts situated above the middle of the body, and that of the anterior part below the middle; ovarian aperture distinct, situated a little below the summit of the posterior side; the four principal arm-grooves distinct, radiating from the summit as far as, or below, the middle; small secondary arm-grooves extending obliquely downward from each side of the principal grooves, their length and distribution being made irregular by the presence and unsymmetrical position of the pectinated rhombs.

The principal plates are probably similar to those of *Callocystites*, but our examples do not show their shapes distinctly; the secondary plates bordering and near the arm-grooves numerous and small.

Two specimens only of the species representing this genus have been discovered. One of these is very imperfect, and the other, although in a comparatively good state of preservation, does not show clearly the arrangement of all the plates. Enough, however, is shown of its structure to separate it from any described genus. It is also, so far as I am aware, the first cystidian ever found in Devonian rocks, the family having hitherto been regarded as characteristic of Silurian strata.

Strobilocystites Calvini (n. s.).

Body subovoid in form; principal arm-grooves distinct, extending nearly to the base of the body; the two antero-lateral and the two postero-lateral grooves respectively coalescing before they reach the summit, across which continuous connection is made with all of them by a short groove ; the front, and the two lateral parts, of nearly equal width ; the posterior part narrower than either of the others, and bearing the ovarian orifice a little below its summit ; the pectinated rhombs divided longitudinally by a distinct suture ; the rhomb of the left side situated about one-third the height of the body below its summit, the direction of the long diameter being nearly at right angles with the axis of the body, and its length a little more than two-thirds the full width of the side : the rhomb of the right side situated at about the same distance below the summit as that of the left, but its long diameter is nearly vertical and twice as great as its transverse diameter; the rhomb of the front side situated near the base, its long diameter being obliquely transverse with the axis of the body, and its shape and size being similar to that of the left side; secondary plates small, tumid, placed in alternating series along each side of the arm-grooves, and outside of these first rows there are other similar pieces, some of which alternate with the first, but others are more irregularly distributed, all giving the surface a papillose appearance.

Column and appendages unknown.

Height of body eighteen millimetres; transverse diameter thirteen millimetres.

Specific name given in honor of its discoverer, Professor Samuel Calvin of the Iowa State University.

Position and locality.—Devonian strata, Iowa City, Iowa.

Genus **MEGISTOCRINUS**, Owen.

Megistocrinus Farnsworthi (n. s.).

Body below the arms moderately deep, its sides slightly expanded, but broadly convex below, and its immediate base a little concave; dome broadly convex, composed of numerous small tumid pieces, and apparently having a short, sub-central proboscis; arms sixteen, four to each of the postero-lateral, and to the anterior rays, and two to each of the antero-lateral rays ; the basal series of pieces moderately large, slightly concave, more than half its diameter covered by the last joint of the column; the anal series of pieces occupying a comparatively broad space ; the plates generally, having the proportions, shapes, and arrangement common to the genus ; the central portion of all the plates is prominent, or they have their borders so depressed as to produce the appearance of central prominence to the plates, and of broad sutures between them.

Height of calyx fourteen millimetres; diameter of body at the base of the arms, twenty-seven millimetres.

This species differs from *M. latus* Hall, from rocks of the same age in Iowa, by its smaller size, its tumid plates and depressed sutures, and in having only sixteen arms instead of twenty, as in that species.

Specific name given in honor of Professor P. J. Farnsworth, of the Iowa State University, who first discovered it.

Position and locality.—Devonian strata, Iowa City, Iowa.

MOLLUSCA.

BRACHIOPODA.

Genus STRICKLANDINIA, Billings.

Stricklandinia castellana (n. s.).

Shell moderately large, sublenticular, broadly subovate or subcircular in marginal outline; valves almost equally convex.

Dorsal valve usually showing a slightly elevated, indistinctly defined mesial fold, which is quite narrow upon the posterior portion of the valve, but widens toward the front, of adult shells; umbo broadly convex; beak not prominent.

Ventral valve usually having a slight flattening of the anteromedian portion, corresponding with the indistinct fold of the other valve; umbo broadly convex; beak not prominent, projecting backward little if any beyond the beak of the other valve; area distinct, narrow, its length less than half the greatest width of the shell.

Surface of both valves marked by numerous, rather coarse, radiating, more or less recurving, angular or sharply rounded plications, of unequal size and separated by spaces of unequal width.

Length and breadth of the largest example discovered, each forty-two millimetres; thickness, both valves together, twenty-one millimetres.

Position and locality.—Niagara limestone, Upper silurian, near Castle Grove, Jones County, Iowa.

CONCHIFERA.

Genus PARACYCLAS, Hall.

Paracyclas Sabini (n. s.).

Shell sublenticular; subcircular or subovate in marginal outline; beaks small, approximate, pointing forward, elevated little if any above that portion of the dorsal margin which lies behind them, but considerably above that portion in front of them; dorsal, posterior and basal margins forming nearly one uniform curve, but the prominent front, which is the narrowest and thinnest part of the shell, has its margin more abruptly rounded; ligament small, slightly prominent, but it is made apparently more prominent by two distinct, moderately deep narrow grooves, one on each side of it, which extend from between the beaks backward, and become obsolete upon the postero-dorsal region; valves broadly and nearly uniformly convex, the surface being marked by ordinary lines and slight undulations of growth.

Length of the most perfect example discovered, seventeen millimetres; height fifteen millimetres; thickness eight millimetres. The proportionate thickness of fully adult shells is usually much greater than that here given.

The specific name is given in honor of Mr. A. H. Sabin, of Mason City, Iowa.

Position and locality.—Devonian strata at Rockford, Floyd County, Iowa.

Genus ALLORISMA, King.

Allorisma Marionensis (n. s.).

Shell small, elongate, ventricose anteriorly, and laterally flattened behind, where it is usually a little broader from base to dorsal margin than the anterior portion is; umbones prominent, elevated; beaks incurved, placed far forward; dorsal margin straight or slightly concave; postero-dorsal margin sloping backward to the posterior extremity, the greatest prominence of which is at, or a little below, midheight of the adult shell; base broadly rounded or straightened about midway where the slight umbonal flattening of each valve meets it.

Surface marked by the ordinary concentric lines and undulations of growth.

Length twenty-eight millimetres; height thirteen millimetres.

A few examples have been obtained that are about one-third larger than that of which the dimensions are here given, but it is an unusually small species.

Position and locality.—St. Louis limestone (subcarboniferous) of Marion and Mahaska Counties, Iowa, where it is sometimes found quite plentiful, in both the calcareous and magnesian layers of that formation.

GASTEROPODA.

Genus BELLEROPHON, Montfort.

Bellerophon Bowmani (n. s.).

Shell small, somewhat flattened vertically; umbilici small, and sometimes nearly or quite closed by the overlapping of the callus-like, slightly reflexed expansion of the postero-lateral portions of the margin of the aperture; volutions broadly convex both laterally and longitudinally; aperture comparatively large, but the external margin is not reflexed or flattened by its expansion; mesial band distinct, slightly raised; mesial notch not deep.

Surface marked by numerous concentric folds which are crossed by revolving raised lines of nearly the same size, giving the surface a neatly cancellated appearance.

Length eight millimetres; breadth of aperture the same; height, lying with its aperture downward upon the table, five millimetres.

Specific name in honor of Mr. S. C. Bowman, of Andalusia, Ill., who first discovered it at that place.

Position and locality.—Devonian strata, New Buffalo, Iowa, and Andalusia, Illinois.

Genus EUOMPHALUS, Sowerby.

Euomphalus Springvalensis (n. s.).

Shell rather large; spine much extended for a species of this genus; volutions six or seven, gradually increasing in size from the apex to the aperture; flattened upon the distal or upper side, regularly and continuously rounded upon the outer and proximal sides, and into the deep umbilicus; aperture nearly circular, its outline being modified only by the slight flattening of the distal side and the short contact of the preceding volution.

Length about five and a half centimetres; breadth of last volution seven centimetres; diameter of aperture twenty-three millimetres.

Position and locality.—Kinderhook formation (Subcarboniferous), Springvale, Humboldt County, Iowa.

PTEROPODA.

Genus CONULARIA, Miller.

Conularia Molaris (n. s.).

Shell having the ordinary four-sided conical shape, each side having an indistinct very faintly impressed longitudinal line, not placed in the middle of the side but nearer to one angle than the other, each angle having the adjacent lines at equal distances, these distances being of course greater from two of the angles than from the other two. Surface marked by fine, sharply raised, minutely crenulated, transverse lines, which present the convexity of a broad curve toward the front as they cross the sides, but bend very slightly forward at the angles, the grooves of which most of them cross continuously to the adjacent side. These raised lines are at slightly irregular distances apart, the distance being usually a little greater than their own width. A cast of a portion of the interior of the shell shows that the inner surface has also markedly slightly raised lines corresponding with those upon the outer surface, and opposite, instead of alternating with them. In the case of mending a fracture of the shell while the mollusk was living, the lines appear to have never been reproduced.

Position and locality.—Devonian strata, Troy Mills, Linn County, Iowa.

CEPHALOPODA.

Genus CYRTOCERAS, Goldfuss.

Cyrtoceras dictyum (n. s.).

Shell not large, curvature broad; section elliptical, the longer diameter of the ellipse being transverse.

Surface marked by fourteen narrow, longitudinal raised ribs, placed at unequal but symmetrical distances from each other, thus: One at each lateral side, a little exterior to the transverse diameter, where it produces a more or less distinct angularity; six between these on the inner or incurved surface, all nearly equal distances from each other; and six upon the outer surface. The spaces between these last-named ribs are nearly equal except those between the first two ribs on each side of the central space, which are narrower than any of the others. Crossing these ribs are distinct lines and sharp undulations of growth, which bend backward more or less distinctly between all the ribs, but much more so between the two middle ribs upon the outer surface.

The inflexion is so great at the margin of the aperture as to produce a distinct notch there, resembling that of some species of Bellerophon.

The only portion of this species yet discovered is nearly or quite the whole of the outer chamber; none of the septa being shown, but the surface markings are so peculiar that the species may be readily identified by these alone.

Transverse diameter of the aperture, about four centimeters; the shorter diameter, about three centimeters.

Position and locality.—Devonian strata, Troy Mills, Linn County, Iowa.

ARTICULATA.

Vermes.

Genus **TENTACULITES**, Schlotheim.

Tentaculites Hoyti (n. s.).

Shell moderately large; marked by strong, sharply elevated annulations, separated by spaces considerably greater than their own width; spaces and annulations regularly decreasing in width towards the apex, where they are both minute, and both more nearly equal than at its larger end.

Average length, about fifteen millimeters; diameter of aperture, nearly two millimeters. Specific name given in honor of Mr. B. F. Hoyt.

Position and locality.—Devonian strata, Iowa City, Iowa.

MARCH 7.

The President, Dr. RUSCHENBERGER, in the chair.

Forty-six members present.

A paper entitled "On Pachnolite and Thomsenolite," by Geo. Aug. Koenig, Ph.D., was presented for publication.

On Pre-historic Relics.—Prof. HALDEMAN exhibited some prehistoric antiquities, part of a collection he had recently disinterred from a recess in a cliff at his residence on the Susquehanna. The remains include about 200 fragments of pottery, 150 stone arrow-heads, together with stone chisels, tomahawks, mallets, flake knives, broken pebbles, and chips left from the manufacture of arrows, and fragments of bones of various animals. They occurred in a rich, black mould, thirty inches deep, and from the decomposed condition of some of the arrows and chisels, we may presume that the retreat was occupied for not less than two thousand years, but not within the last two hundred, as no articles of European trade were found, such as glass beads and objects of iron, which occur in the Indian graves of the vicinity, and which could be procured at the mouth of the Susquehanna as early as 1631. The discovery is important from the number of objects found in a definite locality.

MARCH 14.

The President, Dr. RUSCHENBERGER, in the chair.

Thirty-seven members present.

Additional Note on the Spanish Moss—Tillandsia usneoides.—Referring to some recent remarks before the Academy, Mr. THOS. MEEHAN said the Tillandsia usneoides was an epiphyte and not a parasite, as stated by Elliott in his botany, and it increased by small pieces blowing from tree to tree, and very rarely by seeds.

In a recent visit to an old orange orchard on the shores of Lake Ponchartrain, seven miles below New Orleans, where the increasing level of the waters of the lake had made a subsoil too wet for the trees, and thus caused a large proportion of them to be in a dead or dying condition, he had had an excellent opportunity to study within eye reach the development and propagation of the Tillandsia. As before stated, nearly all the increase was from the scattered pieces of the plant, which attached itself by twisting of the branches or leaves, and then went on increasing its growth annually. Here and there on the trees a seed had evidently started a young plant, and it was remarkable to note that these cases were always on the under side of the branches, the young plant growing straight down. As these branches were very smooth, it becomes a problem how the seed attach themselves to this under surface so as to remain and germinate. Some of the young plants which Mr. Meehan exhibited were taken from dead branches, as well as from living ones, showing the plant's true epiphytal character.

On the Age and Origin of certain Quartz Veins.—Prof. Persifor Frazer, Jr., exhibited a fragment of hornblendic dolerite which was found in York County, intersected by a vein of quartz. The alteration of the former along the planes of contact was indicated by bands of half an inch or more of darker color than the rest of the specimen. Within the vein of quartz are observed many fragments—some of them angular, of nearly the same appearance as the altered portions of dolerite. This occurrence is interesting in view of the light which it throws on the origin of some quartz veins. Had the quartz been thrust up from below in a molten condition (as some geologists have believed possible), its combination with the basic constituents of the neighboring dolerite would have followed as a matter of course. The small fragments would have dissolved in it, and there would have been no sharp line of demarcation between the two rocks.

Even had the gelatinous silica (orthosilicic acid) been maintained at a high temperature during its transition into quartz, it seems almost certain that it would have exerted a considerable chemical action upon the trap, producing compounds richer in silica, while the smaller fragments imbedded in it would have left traces of their former position in colored spots throughout the vein. The infiltration was probably slow, and the solution at a moderate temperature, but chemical action progressed slowly through the contact walls, resulting in their partial alteration.

In connection with this subject he called attention to a paper by Lowthian Bell on the "Whin-Stones," or traps of the north of England (Proc. Royal Soc.), replete with analyses, and in which the author advances hypotheses as to the depths to which alterations of sedimentary strata by intrusive rocks takes place, and as to the volatility of the generally supposed unvolatile substances, which are remarkable, and, from the high authority of Mr. Bell in iron metallurgy, worthy of attention.

Mineralogical Notes.—Dr. Geo. A. Koenig said, that, having been engaged upon the investigation of the minerals occurring at Magnet Cove, Arkansas, for some time past, he desired to give a preliminary notice of some of his results, reserving the details for a memoir, which he hoped to place before the Academy at a future date. Some of his observations were communicated to the National Academy of Science at its last meeting, but have not been published. From a mineral, resembling schorlomite very much as to its physical properties, he obtained in the place of titannic acid a *white oxide*, which differed from the latter in a number of important reactions very considerably. In the fragment analyzed, it was contained to the amount of 30 per centum. However, in this, there is comprised a certain quantity of titannic acid. Owing mostly to the want of material, he had, hitherto, been unable to effect a satisfactory separation. Some of the reactions are so peculiar, that the existence in it of a *new metal* is highly probable. However, the nature of titannic acid itself, with the study of which he was now engaged as a preliminary, is yet so little understood, that he refrained from a positive statement for the present. From the same mineral, from schorlomite, and from garnet, he had been able to separate vanadic acid in amounts varying between 0.5 per cent. and traces. This body was overlooked by the authors who analyzed some of the minerals before. Its presence interferes to some extent with the specific reaction of titannic acid before the blowpipe. Having a strong coloring property, its green color with microcosmic salt in the reducing flame is complementary with the violet color of titannium in the same salt, so that a colorless bead may be obtained, and the presence of the latter metal or of both remains hidden. This was verified by experiment. For the purpose of obtaining the true molecular composition of the light-brown garnet, he had selected a very brilliant and pure crystal of the combination $\infty 0.202.0$ for analysis, reserving a suitable fragment for a microscopic section. He had formed a hypothesis in the course of this examination, about the molecular isomorphism of calcium titannate (perowskite), and calcium iron silicate (garnet), and to prove this, it was necessary to learn the true constitution of the latter molecule. He had obtained in due course, about 6 per cent. of titannic acid, acting very similarly with the problematic oxide, above described. Now it was clear, that this garnet was not a homogeneous compound. The microscopic slide exhibited characters corroborating this assumption. Around an opaque nucleus was found a yellow, transparent substance (garnet) in concentric layers, following the outline of the dodecahedron. The layers separated by dark lines, which dissolved under a high power into a series of opaque particles. The striation resembles the structure of agate. What is the opaque substance? Is it schorlomite (the specific nature of which he doubted), is it perowskite, or is it brookite?

He hoped to be able to answer these questions in time. It was but another instance showing that the results of an analysis from an apparently homogeneous material cannot be utilized for the construction of a trustworthy formula, unless the mineral is examined optically. Those cases are excepted where the atomic ratios are simple, and the affinities untortured.

The death of Joseph H. Dulles was announced.

March 21.

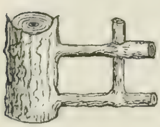
The President, Dr. Ruschenberger, in the chair.

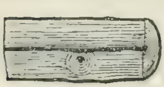
Forty-six members present.

Mastodon andium.—Prof. Leidy directed attention to a specimen consisting of the greater part of the left ramus of the lower jaw of Mastodon andium. It belonged to a mature individual, and contains the last true molar in functional position. The penultimate molar had been shed, and its alveoli are partially obliterated. The crown of the retained molar presents four transverse ridges, besides a strong tubercular talon. It measures $7\frac{1}{2}$ inches fore and aft, and 3 transversely. The specimen was obtained by Dr. Isaac T. Coates, of Chester, Pa., from a land slide, at Tarrapota, near the town of Chasuta, on the Huallaga River, a branch of the Amazon, in 7° south latitude.

On Natural Inarching.—Mr. Thomas Meehan remarked that observations on natural inarching among forest trees were common, but now and then were some incidental phenomena worthy of note, an instance of which, on a Hemlock Spruce on the grounds of Amos Little, Esq., of Germantown, was recently brought to his notice.

In this case, a branch had ascended to one above, and appeared to have pierced through it, coming out on the upper side; and the pierced branch, beyond the point of union, had increased to nearly double the size of the part below. The illustration on the black-board was simply from memory, but served to show the position and proportions of the branches. In this case, the upper portion of the seemingly penetrating branch had died soon after the union, and the annual deposits of wood had, of course, in time surrounded it, making it appear very nearly in the centre. The lower portion had continued to live, and all its nutritive collections had gone to feed the branch to which it had become attached. A plant growing in rich soil would make shoots perhaps double the thickness of the same growing in poor soil; in other words, the size of a branch was proportionate to the amount of nutrition at its command. In this case, two branches feeding one main one, gave that branch a double advantage on the score of nutrition, and its increased size naturally followed.





Many strange phenomena reported in the newspapers in connection with natural inarching may, no doubt, be as easily explained, if all the details were correctly reported.

On the Tæniodonta, a new group of Eocene Mammalia.—Prof. Cope described the characters of some mammalia from the Eocene of New Mexico, obtained by him during the Wheeler expedition of 1874, which he regarded as allied to the *Insectivora*. The feet are armed with compressed claws. The dental characters are seen first in the supposed superior incisors. Unfortunately, they have not yet been found in place in the cranium, but their association with a rodent type of inferior incisors, which have been found in place in the mandible, confines us to the alternative choice between superior incisors and canines. From the small size, or absence, of inferior canines, a similar character may be inferred for the superior canines.

These superior incisors present two bands of enamel, an anterior and a posterior. They are compressed in form, the sides presenting a surface of dentine or cementum. Attrition produces a truncate or slightly concave extremity. The inferior incisors are rodent-like.

Two families represented this suborder in the Eocene period in New Mexico. The first, or *Ectoganidæ*, possesses molar teeth with several roots; in the *Calamodontidæ*, each molar has a simple conic fang. But one genus of each family is known. In both the enamel of the molars is principally a band on the outer side of the crown; the deficiency is supplied in *Calamodon* by a deposit of cementum, which invests the molar and superior incisor teeth, covering the crowns, excepting where the enamel bands are present. The latter investment is so much thinner, that the cementum forms a raised border all round at the point of junction of the two substances. The general structure of *Calamodon* affords some points of approximation to the *Edentata*, which indicate that the *Tæniodonta* partially fill the interval between that order and the *Insectivora*, presented by the existing fauna.

Prof. Cope also pointed out the close resemblance between the mandibular dentition of the cotemporary Eocene genus *Esthonyx*, and the existing *Erinaceus*, and stated that that of *Anchippodus* and allies chiefly differs from the latter in the persistent growth of the incisor teeth.

On Tantalite from Yancey County, North Carolina.—Dr. Geo. A. Koenig spoke of a mineral from Yancey County, North Carolina. It occurs there with beryll, samarskite, columbite, spessartite, and other rare and interesting minerals. It is found in large massive pieces, has a black color and metallic lustre, streak dark reddish brown to black. The specimen in my possession weighs about a pound. It posesses three crystal faces, two of which are at right angles, all three in the same zone. One face is large, smooth, and bright, the other two are rough and uneven, and brown from ferric hydrate. There appears to be an imperfect cleavage parallel to the two faces at right angle. Fracture uneven to sub-conchoidal.

Specific gravity = 5.807 (made with 4.6 grms.) B. B. Infusible and unaltered. With borax in oxidizing fl. dissolves in large quantity, and gives a glass which is blood-red when cold (iron, manganese). In reducing flame turns green, and when highly charged a blood-red; the same with tin or charcoal. With microcosmic salt in reducing flame, light brown.

The mineral decomposes readily when fused with about six parts of sodium hydrosulphate, the fused mass being yellowish when cold.

The analysis gave

Metallic acid =	76.60
FeO =	14.07
MnO =	0.50
MgO =	7.70
	98.87

The metallic acid dissolves in very large quantities in microcosmic salt, and the bead turns brown only upon complete saturation, when treated with the reducing flame. From this behavior he surmised the larger portion to be tantalic acid, and the smaller portion to be hyponiobic acid. But in order to satisfy himself more thoroughly, he converted the acids into the sodium salts by fusing with sodium hydrate. This fusion was extracted repeatedly with cold water. From the liquid the acid was precipitated by dilute sulphuric hydrate filtered under pressure, and the moist precipitate treated with tin and hydrochloric acid to test for dianic acid; a dirty-blue mass was obtained, no blue solution, and the absence of dianic acid was proven. The blue color was due to hyponiobic acid. The larger portion of sodium salt had not been dissolved in cold water, it was dissolved in boiling water and precipitated with dilute sulphuric hydrate. The precipitate was treated with zinc and very dilute sulphuric acid, whence the white metallic acid assumed a pale, bluish-gray color, and is, therefore, tantalic acid. Based upon these reactions, the mineral under examination must be pronounced a *tantalite*.

It will be remarked that magnesium forms the principal basis besides iron, and not manganese, as in other tantalites and columbites, and this is, therefore, a distinct and new variety.

He had endeavored to decompose the mineral in a sealed tube under pressure, but failed to do so both with strong and weak acid during several days' treatment. The question whether the iron is ferrous or ferric could not be settled therefore, and in assuming it to be ferrous, he followed the example of the illustrious Heinrich Rose.

Being engaged for the present in other investigations, and aware of Professor Allen's intention to increase our knowledge of these compounds, he refrained from a more thorough examination of the quantitative proportions of the two acids in this mineral.

March 28.

The President, Dr. Ruschenberger, in the chair.

Forty-two members present.

The death of Mr. John S. Phillips was announced.

The following were elected members: John Akhurst, Chas. W. Trotter, Chas. Roberts, Edw. K. Tryon, Edw. Potts, Pierre Munzinger, W. H. Baker, M.D., Rathmell Wilson, Henry Pemberton, J. S. Martin, John T. Lewis, James M. Rhoads, Benj. H. Smith, Edward Tatnall, Jr., John Eckfeldt, M.D., Stuart Wood, and Theodore L. Mead.

Baron Ferd. Von Mueller, of Melbourne, Australia, and Prof. Austin Flint, Jr., M.D., of New York, were elected correspondents.

The committee to which it had been referred recommended the following paper to be published.

ON PACHNOLITE AND THOMSENOLITE.

BY GEORGE AUG. KOENIG, PH.D.

In a very able paper ("Ann. Chem. & Pharm.," vol. cxxvii. 61, 1863), A. Knop called the attention of mineralogists to two forms of a mineral, which occurs incrustating the cryolite from Arksud-fiord, Greenland. One kind he describes as rectangular parallelopipedic crystals, which are possessed of three perfect, but unequal, cleavage directions, parallel to the faces of the crystal, the latter being mostly covered with ferric hydrate. The cleavage directions seemed to coincide with those of the underlying cryolite (identified by quantitative analysis); but an accurate determination of the angles was not possible on account of insufficient reflecting power of the faces. Approximately they were found to be 90°.

The second form of crystals occurs in cavities, whose walls are covered with brilliant, colorless, and transparent crystals.

Both kinds were found chemically identical, and, therefore, belong *to one* mineral, to which Knop gave the very characteristic name, *Pachnolite*—frost stone—from the frost needle-like incrustations covering the cryolite.

From measurements of the small crystals, they were found to belong to the rhombic system, offering combinations of $\infty P . P$; $\infty P . oP . P$; and $\infty P . oP$. The first kind of crystals are of the combination, probably, $oP . \infty \bar{P} \infty . \infty \breve{P} \infty$. The small crystals show a perfect basal cleavage. The angles were found $\infty P : \infty P = 81°24$ —$98°36'$ (mean of 12 determinations). $P : \infty P = 154°40$ (mean of 5 measurements).

Other angles were deduced by calculation:—

Specific gravity = 2.923.

Composition found in mean

F	= 50.79	: 19	= 2.673	6.202
Al	= 13.14	: 27.5	= 0.477	1.106
Na	= 12.16	: 23	= 0·530	1.206
Ca	= 17.25	: 40	= 0.431	1.000
HO	= 9.60	: 18	= 0.533	1.236
	102.94			

Knop takes the atom $Al = 13.75$, and $Ca = 20$, $HO = 9$, therefore his ratio is

F	Al	Na	Ca	HO
6.20	2.21	1.20	2.00	2.236

and he constructs the formula

$$3\left\{\begin{matrix}\frac{3}{5}Ca\\ \frac{2}{5}Na\end{matrix}\right\}F + Al_2F_3 + 2Aq.$$

This, however, is not a correct deduction, because Ca : Na is not 3 : 2, but much nearer 2 : 1, and the formula must necessarily be

$$\left\{\begin{matrix}Ca_2\\ Na\end{matrix}\right\}F_3 + Al_2F_3 + 2Aq.$$

Or, if we introduce the present atomic weights, the formula is

$$\left\{\begin{matrix}Ca\\ Na\end{matrix}\right\}F_3 + AlF_3 + Aq.$$

or the empirical formula

$$\left.\begin{matrix}Al\\ Ca\\ Na\end{matrix}\right\}F_6 + Aq.$$

It will be seen from the foregoing that, taking the calcium as unit, all the other atoms are too high, and that the analysis adds up to nearly 103.00, which is rather more than the mean from several analyses should be. Considering, however, the nature of the substance, too high a result is explicable, and the formula as deduced by me, being of the greatest simplicity at the same time, may be taken to represent fairly the molecule of *Pachnolite.*

It is to be regretted that Knop does not state whether he used the small brilliant crystals affording the above crystallographic results, or whether he used the larger parallelopipedic crystals, or both. It should never be omitted to describe exactly the material taken for analysis, and how it was selected.

Knop's erroneous formula is admitted into Dana's "Handbook" without challenge.

Hagemann also published an analysis of *Pachnolite* ("Am. Journ." ii. xli. 119), which yields the following atomic ratio:—

F	Al	Na	Ca	H_2O
6.17	0.865	1.200	1.00	1.09.

Ca : Na is nearer 2 : 1 than 3 : 2 (taking Ca = 20) as it is in Knop's analysis, and confirms the above formula.

Professor Dana, in the fifth edition of his "Handbook of Mineralogy," introduces a new species, *Thomsenolite*, which had been described by Hagemann ("Am. Journ. Sci." ii. xlii. 93) as *Dimetric Pachnolite.*

Hagemann made no crystallographic determinations, except what may be adduced with the naked eye, and his description coincides with that given by Knop for the variety A of *Pachnolite*, the parallelopipedic crystals of the combination $\infty \bar{P} \infty, \infty \breve{P} \infty . oP$.

According to Dana, the crystals are monoclinic prisms 89°—91° —$0 \wedge 1 = 92°$ and 88″.

The faces of the prism are usually striated horizontally, cleavage basal, very perfect.

Specific gravity, 2.74–2.76. Lustre vitreous, of a cleavage face a little pearly, color white or with a reddish tinge.

Composition.			Na = 1, the ratio is
F	= 50.08	: 19	= 2.63
Al	= 14.27	: 27.5	= 0.515
Ca	= 14.51	: 40	= 0.362
Na	= 7.15	: 23	= 0.311
H_2O	= 9.70	: 18	= 0.54

Taking Na = 0.311 as unit, the atomic ratio becomes

F	Al	Ca	Na	H_2O
8.46	1.656	1.109	1.000	1.740

and reducing to whole atoms, the nearest approach is

$$17 : 3 : 2 : 2 : 3$$

or

$$\left.\begin{matrix} Al_3 \\ Ca_2 \\ Na_2 \end{matrix}\right\} F_{17} + 3Aq.$$

This formula appears improbable from its complexity, and from the fact that the affinities of fluorine are not satisfied by the metals. Dr. Hagemann states the crystals to have been covered with a white earthy material (SiO_2?), and accounts for $SiO_2 = 2.00$ in the analysis.

Whenever a mineral substance is so obviously heterogenous as this one, its analysis should not be considered reliable enough to deduce a formula, or form an opinion of molecular composition.

Dr. Hagemann's formula

$$2(\tfrac{2}{3}Ca + \tfrac{1}{3}Na)F + Al_2F_3 + 2H_2O$$

is not consistent with the analysis; it is a mere conjecture, as may be seen by comparing with the above atomic ratio.

Having lately obtained a number of specimens from the Greenland cryolite locality, through the Reverend Dr. Beadle, of this city, to whom I herewith express my thanks, I thought it worth the trouble to corroborate the few analyses of these very interesting minerals.

A specimen, agreeing completely in its physical properties with the description of Knop's variety A of pachnolite, was first investigated. The structure of the specimen is very like that of crusts of salt, as they are often obtained by slow evaporation—tabular aggregations of cubes, arranged parallel to each other, and at right angles, leaving interstices between themselves into which the cubic crystals project. The tabular masses have apparently one common cleavage face for all individuals, which is of a decided pearly lustre, as described for Thomsenolite. The faces projecting into the interstices are striated and tapering. The crystals are perfectly colorless for the most part. The basal plane O is well developed in all individuals, but the pyramidal faces 1, 1, are usually suppressed. Some of the projecting prisms carry very small octahedrons, either Chiolite or Ralstonite. In selecting the material for analysis, the greatest care was taken to select only perfectly clear cleavage crystals, on which any admixture might be most easily discovered.

An attempt to measure the angles of cleavage direction proved unsatisfactory; the measurements differed several degrees, but (in most cases) were found to be near 90°.

Spec. grav. = 2.937 (made with 5.6921 grammes); 0.5000 grm. gave—

Al_2O_3 = 0.127
CaO = 0.1176
Na_2SO_4 = 0.1560 (Na = 0.0505)
H_2O = 0.0450

1.0000 grm. gave NaCl = 0.2535 (Na = 0.0997) and MgO = 0.0023.

Al	= 13.74	: 27.5	= 0.496	
Ca	= 16.79	: 40	= 0.420	
Na	= 10.10	: 23	= 0.44	
H_2O	= 9.00	: 18	= 0.50	
F	= 50.37	: 19	= 2.63	(by difference)

Taking Ca = 0.42 as unit, the ratio is—

F	Al	Ca	Na	H_2O
6.30	1.17	1.00	1.05	1.30

agreeing to the formula—

$$\left.\begin{matrix}Al\\Ca\\Na\end{matrix}\right\} F_6 + Aq$$

as deducted from Knop's analysis of Pachnolite.

I selected now another specimen, which contains very brilliant crystals in a druse. I broke the crystals off with a forceps, so as to leave a stump on the matrix to be sure of a thoroughly homogeneous material.

These crystals were very slender, of quadratic section, and gently tapering to a point. The basal plane O seemed entirely suppressed in nearly all the crystals, and the pyramidal faces in many, but the very brilliant faces of the prism were distinctly striated horizontally. Basal cleavage very perfect, with pearly lustre. A series of measurements with specimens about $\frac{1}{8}$ inch long and $\frac{1}{32}$ inch wide gave for the prismatic angles the following figures:—

1	2	3	4
90° 30′	90° 10′	90° 15′	90° 5′
89° 36′	89° 52′	89° 25′	90° 15′
90° 14′	90° 13′	90° 15′	89° 25′
89° 40′	89° 45′	90° 5′	90° 15′

The angles are not very constant, but the deviation from a right angle is very small. The angle of the basal plane with the prism could not be determined to my satisfaction. Considering the tapering forms, it seems impossible to say whether the form is rhombic or monoclinic, or quadratic. The points of all the crystals were colored yellow or brown by ferric hydrate, and some crystals had a light straw-color all through.

Specific gravity = 3.008 (determined with 0.7153 grm. in a pyknometer holding about 2 cub. cent. of water).

0.5000 grm. gave—

Al_2O_3 = 0.1170
CaO = 0.1270
Na_2SO_4 = 0.1575 (Na = 0.0511)
H_2O = 0.0252 (from 0.3075 grm.)

Yielding percentage—

$$\begin{array}{llllll} Al & = 12.50 & : & 27.5 & = 0.454 \\ Ca & = 18.14 & : & 40 & = 0.453 \\ Na & = 10.23 & : & 23 & = 0.444 \\ H_2O & = \;\;8.19 & : & 18 & = 0.455 \\ F & = 51.54 & : & 19 & = 2.702 \\ \hline & 100.60 & & & \end{array}$$

Taking Na = 0.444 as unit, the ratio obtains—

F	Al	Ca	Na	H_2O
6.080	1.042	1.020	1.000	1.030

or—

$$\left.\begin{array}{l} Al \\ Ca \\ Na \end{array}\right\} F_6 + Aq.$$

(The fluorine is calculated for the percentages of the metals.)

About the correctness of this formula, and the true molecular composition of the mineral, there can be no longer any doubt in view of the above analytic results.

A mineral occurring in small stalactitic and warty masses which project from parallel walls or partitions made up of a compact mineral. It is colored strongly brown, and shows a velvety lustre. On closer observation the stalactites and warts appear to be aggregations of very minute prismatic needles of strong vitreous lustre. No selection was attempted.

0.5000 grm. gave—

$$\begin{array}{ll} Al_2O_3 & = 0.1235 \\ CaO & = 0.1195 \\ Na_2SO_4 & = 0.1135\ (Na = 0.0367) \\ H_2O & = 0.047 \\ F_2Ca & = 1.0577\ (F = 0.5194)\ \text{from } 1.000\ \text{grm.} \end{array}$$

Yielding percentage—

$$\begin{array}{llllll} F & = 51.94 & : & 19 & = 2.734 \\ Al & = 13.16 & : & 27.5 & = 0.478 \\ Ca & = 17.07 & : & 40 & = 0.429 \\ Na & = \;\;7.35 & : & 23 & = 0.320 \\ H_2O & = \;\;9.40 & : & 18 & = 0.525 \\ \hline & 98.92 & & & \end{array}$$

Taking Ca = .429 as unit, the ratio obtains—

F	Al	Ca	Na	H_2O
6.3	1.11	1.00	0.746	1.22

The sodium is too low in this ratio to admit of anything more than an approximation to the general formula, and I consider this substance as a mixture like the one analyzed by Dr. Hagemann (*l. c.*).

The blowpipe and other general chemical properties I found to be as stated by Knop. In analyzing these substances it is necessary to evaporate the solution in the sulphuric hydrate to dryness, to redissolve by boiling with about 300 cubic centimetres of water slightly acidulated, when all the calcium sulphate will pass into solution.

In separating calcium and aluminum I encountered no difficulty, although the aluminum hydrate is very gelatinous. Filtering under pressure, without washing the precipitate, I found, after redissolving it in HCl and reprecipitating by NH_4HO, but a trace of Ca in the filtrate.

It is necessary, however, to ignite the aluminum oxide on a blast in order to obtain a correct weight. In decomposing the mineral in HCl it dissolves, as in H_2SO_4, to a viscous mass, but a complete elimination of fluorine was not effected even after evaporating with strong acid (to dryness 6 times). The aluminum precipitate contained about one-half of the calcium as fluorid.

As is well known, the determination of fluorine presents a number of difficulties, which render an accurate result very uncertain. Fresenius's method, although capable of yielding reliable results, is nevertheless almost impracticable, from the accumulation of errors by changing weights in the numerous parts of desiccating and absorbing apparatus. I endeavored, therefore, to set the fluorine free as fluorid of hydrogen, and collect the latter in an alkaline solution. This method has been proposed (Rose—Analytical Chem.), but I am not aware whether it was ever practised with natural fluorids. Having a platinum still at my disposal, I thought of testing the applicability to the analysis of the above minerals.

In a first experiment sulphuric hydrate was used to decompose the mineral at a temperature rising gradually to the boiling point of the acid. After 45 minutes, on opening the still and dropping in water, a strong disengagement of HF took place. In a second experiment one part of hydrate was mixed with one part of water. The distillation proceeded very well, and was only interrupted after the alkaline liquid in the receiver (containing 25 p. c. more of NaHO than was approximately required by the fluorine) turned acid. On opening the still and adding water, no HF was disengaged, and the entire residue from distillation passed into solution when heated with a large quantity of water; hence a complete decomposition of the mineral had taken place, and the acid vapors had carried all HF into the receiver. After neutralizing the liquid in the latter, a solution of $CaCl_2$ was added, containing slightly more than the fluorine would prospectively require, and the liquid heated to boiling. The calcium fluorid coagulated perfectly and filtered very easily. It was twice returned into the capsule and boiled with water to extract all calcium sulphate. The precipitate weighed after ignition 1.0577 grammes.

To the filtrate a solution of sodium carbonate was added in excess and boiled, the precipitate ignited, and extracted with precaution by acetic acid. It weighed 0.0085 after being again ignited. The alkaline filtrate was acidulated and precipitated by $BaCl_2$. Precipitate weighed 0.1580. In order to ascertain the exact quantity of sodium hydrate which had been combined with the acids, an equal volume (30.2 c.c.) was evaporated with HCl. The sodium chlorid weighed 1.7205 grms. = 0.9117 Na_2O. But 0.2 c. c. had been used to restore the blue color, and has to be subtracted, giving 0.9117 — 0.0060 = 0.9057 Na_2O combined with fluorine and sulphuric anhydrate.

We found—

$BaSO_4$ 0.1580 = SO_3 — 0.0542, requiring

0.0420 Na_2O, hence

0.9057—0.0420=0.8637 Na_2O was combined with fluorine, but 31 Na_2O : 19 F = 0.8637 : 0.5230.

By precipitation was obtained 0.5194 F, a difference of 0.0036.

This result was quite promising. It was obtained with the stalactitic aggregations of pachnolite. But on applying the method to the analysis of the parallelopipedic crystals of pachnolite, I encountered difficulties quite unaccountable. I did not succeed in decomposing the mineral completely, either with one part of sulphuric hydrate and one part of water, or with more dilute acid, or by fusing with $KHSO_4$ in repeated trials and proportions.

I am, however, still confident that the method can be so modified as to be applicable to these fluorids.

Regarding silicium dioxde, which Hagemann found in his analysis, I endeavored to find it, but failed. It was certainly owing to superficial impurity.

Potassium I could separate in traces only.

The determination of water I found to be most satisfactory when I used calcium oxide mixed with the minerals instead of lead oxide. The latter when heated to expel moisture is very apt to be partially converted into sesquioxide, which will at a red heat lose oxygen, and the quantity of water will be found too high.

Conclusions. 1. The mineral analyzed by me is identical in composition with Knop's pachnolite.

2. It is identical in form and physical properties with thomsenolite.

3. The measurements are so uncertain that the true form of the parallelopipedic crystals cannot be deduced, and the form may be explained as Knop did.

4. The mineral measured by Knop and Descloizeau has *perhaps* not been analyzed, since Knop does not describe his material taken for the analysis.

5. From the foregoing it does not seem justified to separate the parallelopipedic forms as a distinct species, and the name pachnolite being very expressive and older, all the forms should be designated as *pachnolite* until further investigation.

I may be permitted to state that I do not intend to discard the crystallographic results of Knop, Dana, and Descloizeaux (the original of the latter's work I am unacquainted with). I should be very glad to obtain the crystals which gave the prismatic angles 98° and 81°, so that we should know whether there are two different molecules with two different forms, or whether there is only one dimorphic molecule. But from the measurements I was able to make, I should be very doubtful of dimorphism.

Note.—While this paper is in press, I find a very recent publication by Professor Wöhler (*Ann. d. Chem. u. Pharm.* vol. clxxx. p. 231), in which he gives an analysis and description of the variety A of pachnolite, and arrives at results closely corresponding to my own.

April 4.

The President, Dr. Ruschenberger, in the chair.

Forty-nine members present.

On the Brains of Fishes.—Prof. Burt G. Wilder, of Cornell University, stated that his investigations on the brains of fishes had three objects: 1. To determine, by careful structural comparison, the extent to which such brains may be homologized with those of the higher vertebrates. 2. To see whether brain characters will enable us to define the limits of the group commonly known as Ganoids. 3. To ascertain how far brain characters, alone or in combination with heart characters, will serve for the characterization of all the more comprehensive subdivisions (classes or sub-classes) of Vertebrates.

During the last century fishes' brains have had at least five different interpretations. Their unsatisfactory nature may be inferred from the fact that Prof. Huxley, who generally clears up difficult subjects, makes no attempt in his Manual of Anatomy of Vertebrates to reconcile the figures and descriptions of fishes' brains either with each other, or with his admirable diagrammatic representation of the brain type, to which the brains of Batrachians, Reptiles, Birds, and Mammals are easily referred. He gives a figure of the brain of a typical Ganoid (*Lepidosteus* or "gar-pike"), but makes no allusion to it in the text.

Prof. Wilder believed that brains can be fully understood only by careful comparison of preparations made from fish *just taken from the water* and hardened in strong alcohol; that there should be several of each typical form, and embryos or young as well as adults; and that, instead of trusting to the outward aspect, the mesial surfaces should be examined and sections made at several points.

Finally, he believed it necessary to keep constantly in mind the typical brain as given by Huxley, and which he then briefly described.

By these methods he had been able, as he believed, for the first time, to find the clue to the homology of the two anterior pairs of lobes of the fish brain with parts of the brain of the higher Vertebrates.

The front pair of lobes have usually, though not always, been called olfactory lobes. In Myzonts or Marsipobranchs (lamprey eels, etc.), in Ganoids and some Teleosts as in the higher Vertebrates they are sessile; but in many Teleosts and most, if not all Selachians (sharks and skates) they are connected by elongated *crura* with the second lobes.

These latter are almost universally called *hemispheres*. Yet the essential features of hemispheres, namely, lateral ventricles and foramina of Monro, have never been found in the second pair of lobes of any fish-like form excepting those of the Dipnoans (*Lepidosiren*, *Protopterus*, and *Ceratodus*, the last just described by Huxley), which seem in most respects more like those of Batrachians than of fishes.[1] The second pair of lobes are either lateral solid laminæ joined below but with the upper borders more or less everted, as in Teleosts and Ganoids, or joined above also so as to inclose a cavity, as in Selachians. In either case the median space must be regarded as a forward continuation of the median or 3d ventricle and the lateral walls as anterior enlargements of the thalami. These enlargements Prof. Wilder proposes to call *prothalami;* in Selachians and some Ganoids they are connected by more or less elongated and depressed *crura thalami* with the optic lobes behind.

From the anterior part of the space between the prothalami and, in Ganoids and Teleosts, apparently in the base of the olfactory lobes, Prof. Wilder had found two openings leading into the cavity of the olfactory lobes. These openings he regarded as foramina of Monro, leading into distinct, though small, lateral ventricles.

He has found them in *Myxine* and *Petromyzon* (Myzonts); *Mustelus*, *Carcharias*, and other Selachians; *Acipenser*, *Polyodon*, *Amia*, and *Lepidosteus* (Ganoids), and *Perca*, *Scomber*, and *Anguilla* among Teleosts.

The true hemisphere of Ganoids may be represented by a raised lip of the foramen of Monro.

In an embryo *Mustelus* the anterior part of the brain is a single large vesicle with thin walls. From each side is a little bud which elongates to become the olfactory crus and lobe. By gradual thickening of the walls especially above, the single large cavity of the prothalamus becomes reduced to the two canals found in the adult brain near the ventral surface, which diverge forward from a median point to become continuous with the ventricles of the olfactory lobes. Prof. Wilder does not feel sure respecting the true hemispheres and the manner of their formation.

In the Teleost brains so far examined the foramina of Monro are much smaller than in the Ganoids; and where long olfactory crura exist they may be wholly obliterated in the adult. But if, as is anticipated, they are present in most Teleosts, then, so far as the brain is concerned, they may be distinguished from Ganoids only by the optic *chiasma* of the latter, as first suggested by Müller. To a careful comparison of the optic nerves in all fishes, therefore, attention should be directed.

[1] Since this paper was presented I have seen the paper of Paul Langerhans (Untersuchungen über *Petromyzon Planeri* [*branchialis*], Freiburg, 1873), in which is given a figure showing the existence of ventricles in the hemispheres and olfactory lobes of the small lamprey.

The points above mentioned were illustrated by diagrams and specimens, also by tables of a provisional arrangement of vertebrates according to the modifications of the brain and heart.[1]

There is much to be done before fishes' brains can be fully understood. For instance, the brain of *Myxine* has not yet been satisfactorily homologized with that of *Petromyson.*

In conclusion, Prof. Wilder exhibited a *Chimera*, recently obtained through the kindness of Mr. Alexander Agassiz, Curator of the Museum of Comparative Zoology, the brain of which, so far as he had been able to examine it, presented a remarkable combination of characters, intermediate between those of Selachians, Ganoids, and Dipnoans. A full description with figures of the brain of *Chimera*, Prof. Wilder hoped to present to the Academy on a future occasion.

On Spessartite.—Dr. GEORGE AUG. KOENIG placed on record the analysis of *spessartite* from Yancey County, North Carolina. This interesting subspecies of garnet has heretofore been found at Haddam, Conn., as the only American locality. In the new locality it occurs in very large crystals, from six to eight inches long and three to four inches thick. The form is a distorted dodecahedron.

The crystals have a dark, almost black color at the surface, owing to a superficial decomposition, by which black oxide of manganese is formed. But in fragments the color is deep blood-red, turning to reddish-brown in thin plates. The latter are transparent and reveal no admixing mineral. Fracture conchoidal. Hardness nearly = 7; gravity = 4.14.

B. B. unaltered in oxidizing flame, and fuses to a black vitreous globule in point of blue flame. With borax in oxidizing flame dark blood-red bead, which turns dirty-green in reducing flame. With soda, fuses to a green glass. Hot and concentrated acids attack the powder, which is of a brownish color, but very slowly, and complete decomposition cannot be effected.

The very pure selected fragments yield by analysis—

	Oxygen.		Atoms.	
SiO_2 = 35.80	19.092	19.092	0.599	17.06
Al_2O_3 = 19.06	8.881	11.221	0.188	5.08
Fe_2O_3 = 6.25	2.340		0.035	1.00
MnO = 28.64	6.351	8.698	0.384	10.97
FeO = 9.49	2.107		0.132	3.80
MgO = 0.60	0.240		0.015	
99.84			O = 2.432	69.7

[1] These with figures and descriptions of the brain of *Lepidosteus* are published in the Proceedings Am. Assoc. for Adv. of Science for 1875.

The oxygen ratio is $RO : R_2O_3 : SiO_2$—
1 : 1.28 : 2.19

and the atomistic formula is—

$$\left.\begin{array}{l} \overset{\text{IV}}{Si}_{17} \\ \overset{\text{VI}}{Al}_5\overset{\text{VI}}{Fe} \\ \overset{\text{II}}{Mn}_{11}\overset{\text{II}}{Fe}_4 \end{array}\right\} O_{70}$$

It will be noticed that iron is contained in this garnet, both in the ferrous and in the ferric state, while in the analyses on record the iron is given as being all in the ferrous state. When those analyses were made, the method of decomposing minerals in strong sealed tubes at a high pressure was not known, and the mineral cannot be decomposed at the ordinary atmospheric pressure, as stated above. In heating the powder for thirty-six hours with acid containing 25 per cent. of sulphuric hydrate at 160° C., I succeeded in decomposing all but 7 per cent. The ferrous oxide obtained from the solution was then calculated pro rata for the undecomposed part, and the above result obtained.

To suppose that the presence of ferric iron is due to incipient alteration would not be justified, since no water was obtained by ignition, and the pellucidy of the mineral does not appear impaired. To explain the result of analysis the presence either of ferric oxide or manganic oxide must be admitted, which alternation would neither affect the oxygen ratios, nor the atomic composition.

I am indebted to Mr. Clarence Bement of this city for the material used in this investigation, and I hereby express my thanks for his kindness.

The thanks of the Academy were returned to Dr. James S. Gilliams for a portrait of the late Jacob Gilliams, one of the founders of the Academy, painted by Rothermell.

April 11.

The Rev. E. R. Beadle in the chair.

Thirty-four members present.

The following papers were presented for publication: "The Genus Pomoxys, Raf." By D. S. Jordan and H. E. Copeland. "Chemical Notes." By Geo. Hay.

Remarks on Arcella, etc.—Prof. Leidy remarked that the Rhizopods are so exceedingly polymorphous, that, to say the least of them, their specific and generic limits appear less well defined than in higher animals. In speaking of the Difflugian Rhizopods, Dr. Wallich expresses the opinion that the whole are referable to a single specific type, and as regards the Foraminifera, Prof. Carpenter observes "whether it will ever be practicable to arrange the multitudinous forms of this group in natural assemblages, whose boundaries shall be capable of strict limitation, is to us by no means certain."

It would seem that the existing Rhizopods, in respect to classification, may be viewed as an epitome of all organic forms in all times, for if all these could be known it would be found that there were no absolute limits defining species or any other of the usual divisions in classification. The study of the Rhizopods is facilitated by determining the more general and striking forms, and viewing the others as transitional or related forms, and we can better communicate the results of our study if the more characteristic forms are named as species or varieties.

In his studies of the fresh-water Rhizopods, of various localities in this country, he had recognized most of the well-marked forms which have been described by European naturalists as pertaining to other parts of the world. Besides these he had detected a number of new forms, which perhaps in future will be found not to be peculiar to this country. As an example, in the published Proceedings of this Academy for 1874, page 226, will be found the description of a species, *Euglypha brunnea*, from New Jersey. Since then the same has been described in the Quarterly Journal, of the Microscopical Society of London for 1876, page 107, by Mr. Archer, under the name of *Euglypha tincta*. Mr. Archer's description applies so closely to the specimens observed by Prof. Leidy in every detail, that he thought he was not mistaken.

Among the usually recognized generic forms, Arcella had occupied his attention. In this genus the animal is provided with a membraneous test, composed of exceedingly minute hexagonal elements, usually of some shade of brown, but colorless in the young condition. The shape of the test is usually that of a greater or lesser portion of a sphere with a circular plane below more or less inverted towards a central circular mouth. The soft part of the animal rarely fills the test, but adheres to its inner surface by threads of the ectosarc. Pseudopods digitiform.

The species or varieties observed are as follows:—

ARCELLA VULGARIS, Ehrenberg.

Difflugia arcella, Wallich; *Arcella hemispherica*, Perty.

This is perhaps the most common form. Test approximating a hemisphere with the base rounded and often more or less projecting. The dome is even or mammillated, or is impressed at the sides with concave shallow pits or angular facets. The inferior surface is more or less funnel-like, and the mouth elevated and circular. Color of the tests, from colorless in the young through all shades of raw sienna to burnt sienna brown. Sarcode colorless. Breadth of test from .06 mm. to .132 mm., height .036 to .08; mouth .02 to .048.

? Arcella discoides, Ehr.

A discoid variety of the former, and nearly as abundant, has the test of the same form but three or four times the breadth of the height, and with the dome almost constantly convex and even. Mouth large. Measurement of a small colorless one: breadth .112 mm., height .028; breadth of mouth .04. Measurement of a large burnt sienna brown test: breadth .132, height .028; breadth of mouth .048.

Certain discoid specimens from Florida approach those described by Ehrenberg under the name of *A. peristicta*, from South America. They are sub-circular, oval, or irregularly oval, often bent or curved in the shorter diameter; in section concavo-convex, with rounded ends. Mouth large, circular or oval, moderately elevated. Dome convex and even. Test in the vicinity of the mouth with a circle of minute tubercles or pores? Color of test varying as in other Arcellæ. Sarcode colorless. A test measures .14 mm. broad, .128 wide, and .068 high; with the circular mouth .052 diameter. A second is .16 broad, .144 wide, .064 high, and with the mouth .064 broad and .08 wide. A third is .184 broad, .172 wide, and with the mouth .06.

Arcella mitrata.

A variety modified in form from the *A. vulgaris* in the opposite direction of *A. discoides*. Test mostly higher than the breadth at base, inflated above, balloon form, pyriform, mitriform; dome convex, even, or polyhedral with impressed angular faces. Mouth elevated as usual, but with its margin usually crenate and everted. Sarcode colorless, attached by many diverging threads of ectosarc to the inside of the test. Color of the test, from colorless through all shades of raw and burnt sienna to bistre brown. Abundant, and very polymorphous, at Absecom cedar swamps, New Jersey. = *Arcella costata*, Ehr. ?

a. Balloon-shaped sub-variety, forming about four-fifths of a sphere and with an even dome. Height to .14 mm., breadth at middle equal to the height, at base .088.

b. Pyriform, polyhedral sub-variety. Height .096, breadth above middle .076, at base .048.

c. Mitriform, polyhedral sub-variety. Smallest: height .08, breadth above middle .084, at base .068. Largest: height .168, breadth above middle .2, at base equal to the height.

Arcella dentata, Ehr.

A. stellata, Ehr.; *A. stellaris*, *A. Okeni*, and *A. angulosa*, Perty.

Test circular, discoid, usually not so high in relation with the breadth as in *A. vulgaris*. The border is everted, acute and divided into usually from eight to a dozen points; the border and points may also curve more or less upward, and the latter may extend as high as the summit of the test. Dome convex and even or flattened at the summit, or with carinate ridges diverging from the latter to the points of the border.

Breadth from .132 to .184 mm., height .04 to .048.

ARCELLA ARTOCREA.

Test from three to four times the breadth of the height with the margin circular and more or less elevated above the base. Dome convex and usually mammillated. Mouth elevated, central, circular and entire. Color of test, various shades of raw sienna brown; and structure as in other Arcellæ. Sarcode attached by many threads of ectosarc to the inside of the test. Entosarc loaded with chlorophyl balls which appear to be an element of structure.

This singular pie-shaped Arcella with a bright-green sarcode is frequent in a pond at Absecom, New Jersey. Breadth of the test at the rim .16 to .176 mm., at the base .124 to .136; height .04 to .052.

CENTROPYXIS, Stein.

Arcella aculeata and *Difflugia aculeata*, Ehrenberg; *Echinopyxis aculeata*, Claparede and Lachman.

Centropyxis is a nearly allied generic form to Arcella, and is so polymorphous that I have been puzzled to define varieties. The test or basis of the test is membranous, and appears not to exhibit the hexagonal structural elements of that of Arcella. The shape is a modification of that of the latter; the mouth and the summit of the dome being eccentric in opposite directions. The dome varies in degree of prominence and is always convex. The mouth varies in proportionate size, and is more frequently sinuous at the border than completely circular. The test presents all the variations of color presented by *Arcella vulgaris*. It is frequently provided with from two to five or more hollow, conical spines diverging from the wider border or that most distant from the mouth. Sometimes the test is clean or devoid of all adherent matters and appears homogeneous, mostly, however, it is more or less covered with mineral particles. Sometimes it is as completely covered with quartzose particles as an ordinary Difflugia, and frequently it is loaded with larger stones along the deeper border. In some specimens the test appears to be wholly composed of a single species of diatome shells.

I have observed a peculiar point of structure in most tests of *Centropyxis* which appears heretofore to have escaped notice. From the sinuous border of the mouth a number of processes extend upward to the dome. These are expanded at the end, and look as if intended to support the roof of the test, though I have not been able to satisfy myself that they actually reach it. Nor have I been able to ascertain whether the number of processes is constant, but they have appeared to me to vary in number from four to seven. They are not visible looking directly into the mouth of the test, but a glimpse of one or two may be detected when the mouth is aslant as the test is made to turn towards one side. From the usual discoid form of the test it is not easy to retain it in position on edge to conveniently examine the processes, and when the test is observed with adherent sand they cannot be seen at all.

Large spineless tests of Centropyxis, from ditches below the city, measure .26 mm. broad, .22 wide, and .08 high; with the mouth .1 diameter. Large spinous specimens, from the same locality, measure .22 broad by .208 wide, with the spines .48 long and the mouth .084.

A Difflugian of the sub-generic character I have indicated under the name of *Nebela* appears related with *Centropyxis*. Briefly described, it may be distinguished as follows:—

NEBELA CAUDATA.

Test compressed ovoid, laterally pyriform; mouth terminal, oval, entire; fundus obtuse and bordered with from four to five hollow, linear obtuse appendages. Structure of test apparently chitinous and indistinctly areolated. Sarcode colorless. Length $\frac{1}{12}$ mm., breadth $\frac{1}{16}$ mm., thickness $\frac{1}{42}$ mm. Living in sphagnum of a cedar swamp, at Absecom, New Jersey.

On the Nature of Root Fibres.—Mr. THOMAS MEEHAN remarked that two excellent papers had recently appeared on the eccentric growth of the annual layers of wood in some plants—one in the Proceedings of the Poughkeepsie Natural History Society, and the other in the American Naturalist. Reading these, it occurred to him that some observations of his on the nature of fibrous roots of plants were not generally known, and might interest the Academy.

In regard to the eccentricity of the wood, it was long known to observers that the pith of trees was often not in the centre, but varied considerably in its approaches to the circumference. In one case noted in the paper in the Naturalist, the pith of the poison vine was very near the outer edge of the wood, and somewhat elevated, forming a little ridge all along the bark. Various theories had been offered to account for this extra thickening on one side, but none of them, Mr. Meehan thought, accorded with all the known facts, and he believed the true explanation still awaited some fortunate discoverer. The author of the paper in the Poughkeepsie Proceedings had followed the wood chopper, and found that in perfectly erect trees, the pith was exactly in the centre, but in trees that leaned a little, as many would from being drawn towards the lightest places in infancy, the extra thickening was always on the under side. But in the paper in the Naturalist, the observer showed that in the poison vine, though growing to a perfectly upright tree, there was still this remarkable eccentricity, and further, that the degree of this eccentricity varied in the same stem at different places, although all in the same ascending line. The sloping theory, though supported by a remarkable uniformity of figures, could not be correct.

But his remarks had relation chiefly to a suggestion in the *Nat-*

uralist that the rootlets of the poison vine, in some cases referred to by the observer, appeared to be several years old. The fact was that these rootlets were never but one year old, a new set being produced every year. This was the case in the poison vine, the trumpet vine, the English ivy, the Virginia creeper when it sometimes produced them, and amongst others generally in the cases of epiphytal orchids. In this respect they followed the same law as prevailed with fibrils under the ground, and indeed the same law prevailed for the whole system of the tree. We say of the inflorescence, that all its parts are but modified leaves, but this is true of all parts. A whole tree is but a modification of a primordial leaf; the rootlets and the branchlets. The roots and the branches are more or less subject to the same laws that govern leaf structure. Leaves fall annually, unless very favorably situated as regards nutrition. Sometimes, as in some evergreens, the greater part of the leaf is conjoined with the stem, or even becomes an imperfect branch, and in these cases is more permanent. In arbor vitæs, deciduous cypress, and some others, the branchlets and leaves are so closely identified, that the general annual character of the leaves extends to the branchlets, and large numbers drop at the regular fall season. Those which are the most favorably situated as regards nutrition, get through the winter season, and after this become branches, and may live to an indefinite period. The root system is the analogue of that which ascends into the atmosphere, and similar laws prevail. The fibrils are the counterparts of leaves, and die annually; but a few, which are more favorably situated as regards nutrition, manage to live over winter, and then become roots that live to an indefinite period. The rootlets on the stems of the creeping vines are of the same character. Seeming but cellular expansions from the bark, they generally die, but if one get into the decaying portion of a hollow tree, or near rich earth, it is so favorably disposed as regards nutrition, that it will live on and become a root. Cases are on record where English ivy has been cut away at the roots from all connection with the ground, and, having lived, the hasty conclusion was formed, that it was drawing sustenance from the air; but further examinations have shown that in these cases some of the annual rootlets had become true roots, penetrating old mortar, and other congenial matter, and thus lived on and contributed materially to the ivy's support.

It had been suggested that the eccentricity of the wood in the poison vine might be owing to the rootlets coming out on the side next the tree, and in this way favorably affecting that side; but the rootlets of the poison vine come out indiscriminately all round the poison vine branch, and as often on the upper as on the lower side. Besides this, in a branch of the Ampelopsis which he exhibited, covered with these rootlets on every side, and which had been hanging like a rope to a tree for a number of years, the wood was so eccentric that the pith was three-fourths further from one side than the other. That the protrusion of roots on one side had nothing to do with eccentricity, was also clear from the fact that he had examined Symphoria, Wistaria, and many other things with rooting, creeping branches on the ground, in all of which the wood was perfectly concentric.

Notes on two Traps; A Case of Alteration of Earthy Sediments.—Prof. PERSIFOR FRAZER, Jr., remarked, that, at a previous meeting of the Academy the occurrence of a vein of quartz in a mass of dolerite had been described. The specimen has been since cut in two by a lapidary in such a manner as to illustrate (1) the central band of quartz (part of which appears to be hyaline and part anhydrous) inclosing numerous small fragments of the adjoining dolerite. (2) Two bands of darker color than the mass of the latter, which appear to form the boundary walls between the vein and the dyke which it intersects. (3) A broad margin of unaltered dolerite on either side. This specimen is presented for the inspection of the Academy.

The whole subject of the origin and true nature of "traps," and the means of distinguishing those which have been cooled from a molten mass from those which are indurated, baked, or altered to crystalline rocks from earthy sediments by the proximity of sources of heat, is one yet involved in much obscurity. I have here a specimen of what appears to be a baked sandstone belonging to the New Red Formation, in which a part of the mass, occupying an irregular space in one of its ends, has become a coarsely crystallized syenite. The specimen was obtained from near Harman's blacksmith shop, in the northern and western part of York County.

Notes on some Palæozoic Limestones.—Prof. PERSIFOR FRAZER, Jr., remarked that among the many interesting chemical problems connected with geology is that of the relation of a percentage of magnesia to the mode of formation and age of the limestones of the world. Not only have some very interesting speculations been made as to the condition of the earth's crust during the production of dolomites (see T. S. Hunt's Chemical and Geological Essays), but it is easy to see that the subject is capable of very large development.

One of the lines of investigation chief in importance is the influence which dolomitic limestone must exercise on the topography of a country. Prof. Lesley has shown that the grand effects of erosion can be explained by the slow solution and destruction of the limestones of the earth below water level, with the consequent caving in of the strata which rest on them.

It is easy to see that different kinds of effects would be produced by the rapid waste of pure carbonate of lime and the slower destruction of magnesian or dolomitic rocks. And the result of the honeycombing of either of them singly would not resemble that of their combination in separate layers or benches in the manner in which they are so frequently found associated in the great valleys of Silurian and pre-Silurian rocks on the Atlantic border.

As these limestones of the Cumberland and York valleys are more thoroughly investigated, the heterogeneous character of the layers which compose them will be much more clearly evident.

It has been sought to ascertain the horizon of a given stratum in these measures by ascertaining its percentage of magnesia, and, indeed, were any such test reliable, it would be of the greatest importance for the stratigraphical geologist.

With the purpose of submitting to this test as many of the limestones as possible, a selection was made of representatives of the principal beds, whose place in the series has been established by the party of York and Adams. Their names are as follows:—

No. 1 is a sandy limestone from the west branch of Creitz's Creek, in the town of Wrightsville. If the interpretation of the structure given in the Report of Progress of the Party of York and Adams for 1874 is correct, this limestone belongs at or near the base of the "Auroral" series, and immediately upon the chlorite and hydro-mica schists.

No. 2 is a specimen taken from the upper bench of a quarry near Pine Grove Furnace, Cumberland County. It probably represents one of the higher beds of the "Auroral." Upon it was found crystallized calcite containing over 98 per cent. of $Ca'' Co_3$, with hardly a trace of magnesia.

No. 3 is a specimen taken from a lower bench (perhaps 25 feet perpendicular to the measures) of the same quarry.

No. 4 is an example of the white or buff-colored limestones which occur together with the blue limestones often in the same quarry, but, nevertheless, usually exhibiting indications of unconformability with them. These limestones are usually poor in magnesia.

No. 5 is taken from Detweiler's quarry, north of the Columbia Bridge, in Wrightsville. Its position is in all probability midway between the upper and lower benches of the auroral limestone.

No. 6 is taken from Detweiler's quarry, south of Wrightsville, and is (as its analysis shows) a calcareous slate underlying one of the many belts of the formation.

The limestone slates which occur with this one in the foot of the quarry are remarkable for the very large amount of pyrite crystals which they contain. Some of these crystals are half an inch on one edge.

The specific gravity was determined with care.

For this determination the specific gravity bottle was not employed, its mission being considered rather to obtain the density of chemically homogeneous compounds. For determinations of the specific gravity of rocks, coals, etc. etc., whose weight becomes an important item in their transportation for the great industries, it was believed that the weight of a given bulk could be more accurately determined without taking especial care to exclude the air with which they are partly filled.

ANALYSIS OF LIMESTONES.

Constituents.	Sandy limestone, west branch of Creitz's Creek. No. 1.	Pine Grove Quarry, upper bench. No. 2.	Pine Grove Quarry, lower bench. No. 3.	White limestone, 100 yards east of Beller's Cross-roads. No. 4.	Detweiler's Quarry, west of Wrightsville. No. 5.	Detweiler's Quarry, South of Wrightsville. No. 6.
Specific gravity (in lump) .	2.832	2.735	2.731	2.750	2.737	2.770
Insoluble siliceous residue .	4.400	12.270	12.000	3.570	0.490	41.710
Alumina and ferric oxide .	1.170	1.540	0.450	0.210	1.440	6.350
Carbonate of lime . . .	[1]49.920	[2]75.320	81.617	[3]91.580	91.400	43.728
Carbonate of magnesia . .	[1]42.980	10.750	6.400	[4]4.110	7.290	6.450
Sulphur	0.220	0.120	0.422	0.113	0.003	1.480
Sum	98.690	100.000	100.489	99.583	100.623	99.718
Undetermined and loss . .	1.31	....	....	....	....	0.282
Excess	....	...	0.489	0.417	0.623	....
Metallic iron	0.354	0.698	....	....	0.196	1.827
Alumina.	0.505	0.541	....	....	1.454	3.740

Determinations of the carbonate of lime and magnesia in these rocks were made independently by Mr. D. McCreath, and are as follows:—

	No. 1.	No. 2.	No. 3.	No. 4.	No. 5.	No. 6.
Calcium carbonate . . .	49.92	73.60	86.39	91.67	91.25	44.50
Magnesium carbonate . .	42.98	10.98	6.42	4.11	7.58	8.56
Silica	....	....	....	....	0.760	[5]
Some sesquioxide	....	....	....	....	0.196	....

The author is indebted to Dr. Cresson for his courtesy in offering him the facilities of his laboratory for this investigation.

As a supplement to this table the following, taken from p. 113

[1] Determined by Mr. David McCreath.
[2] By loss. 73.6 as determined directly by Mr. D. McCreath.
[3] Mean of two determinations.
[4] Determined by Mr. D. McCreath.
[5] Some sulphide is present, as sulphydric acid is produced when the rock is treated with hydrochloric acid.

of my Report of Progress in the District of York and Adams for 1874.[1]

Limestones.

7. New Red S. S. near Dillsburg, foot of MacWilliams slope.
8. Opposite Allison's Mill, Xenia P. O., York Co.
9. From Shaft No. 5, $\frac{3}{4}$ mile east from Mont Alto Furnace.
10. Half a mile south of Seitzland, in a cutting of the N. C. R. R. (A calcite very similar to that above described as occurring on the upper bench of the Pine Grove Quarry is found here.)

	VII.	VIII.	IX.	X.
Calcium carbonate	73.18	62.35	77.89	93.87
Magnesium carbonate . . .	4.37	6.32	2.83	0.96
Metallic iron	0.52	5.27	1.33	0.30
Insoluble siliceous residue . .	21.50	20.06	15.89	4.30
Sum	99.57	94.00	97.94	99.43
Oxygen, organic matter, water, and loss	0.43	6.00	2.06	6.57

April 18.

The President, Dr. Ruschenberger, in the chair.

Forty-four members present.

On the Geologic Age of the Vertebrate Fauna of the Eocene of New Mexico.—Prof. Cope presented a synopsis of the species described from the Eocene of New Mexico, arranged in the following manner:—

Mammalia	..	..	54
Perissodactyla	..	10	
Amblypoda	..	9	
Pantodonta	9	..	
Incertæ sedis	..	3	
Quadrumana	..	10	
Prosimiæ	10	..	
Rodentia	..	3	
Insectivora	..	19	
Tæniodonta	4	..	
Bestiæ	2	..	
Creodonta	13	..	
Aves	..	..	1

[1] These analyses were made by Mr. A. S. McCreath, Chemist of the 2d Geological Survey of Pennsylvania.

REPTILIA	..	24
Crocodilia	7	
Testudinata	15	
Lacertilia	2	
PISCES	..	8
Ginglymodi	2	
Plagiostomi	6	

This total number of eighty-seven species may be considered in two aspects, viz., in regard to their geological position, and their anatomical structure.

As regards the former, it may be observed, that the record preserved in these beds is doubtless more imperfect than that found in many others, owing to various physical conditions. One of these is an evident disturbance of temperature and moisture which they have sustained, perhaps in connection with the volcanic phenomena which played so important a part in New Mexico during the later tertiary times. The fossils are generally found in a fragmentary condition, and often distorted by pressure. The fractures of the surface are often of such a kind as to indicate that the bones have been in a plastic state (see the figures of *Stypolophus hians*) during which the fissures thus created in them have in many instances been filled with a siliceous limestone. This material now presents a rough external surface of great hardness, and sometimes incrusts the teeth in such a way as to render it a difficult matter to expose them. Nodules of the same material abound on the bluffs (see the geological report). Not unfrequently the bones are covered with an incrustation highly charged with the red oxide of iron, and this substance gives its characteristic color to a large percentage of the fossils, the others being generally black or dark brown. The light colors of our miocene beds are almost unknown, and the bones are always much harder than these, or even than the fossils of the Bridger group of Wyoming. These facts, in connection with the reduced number of exposures of the beds, account for the comparatively small number of species obtained, and the feeble representation of certain groups, *e.g.*, the birds, lizards, rodents, etc. Nevertheless a large number of individuals were obtained, and a considerable extent of country explored, and I believe that the synopsis above given is an approximation to an expression of the characteristics of the most abundant types, or, of the relative numerical representation in the fauna of the different genera, orders, etc.

Comparison with the established scale of geological horizons of Europe has established the fact that the beds in question belong to the Eocene category, as I have already shown[1] to be true of the longer-known Bridger beds of Wyoming. It remains to collate them with the numerous subdivisions of that period. The differences between the Wahsatch and Bridger faunæ have been in part

[1] Proceedings American Philosophical Society, 1872, February and July.

pointed out in my Report on the Vertebrate Fossils of New Mexico, 1874,[1] and may be more fully stated as follows:—

1. Divisions found in the Wahsatch beds not yet reported from the Bridger beds. Aves, genus *Diatryma* (allied to *Gastornis*); mammalia, *Tæniodonta; Phenacodus; Coryphodon;*[2] *Meniscotherium;* most species of *Hyracotherium.*

2. Divisions found in the Bridger beds not yet found in the Wahsatch: fishes, *Amiidæ;* reptiles, *Ophidia; Anostira;* mammals, *Mesonychiidæ; Tillodonta; Achænodon; Dinocerata; Palæosyops;* most species of *Hyrachyus.*

The Wahsatch horizon of Wyoming has not yielded so many species of vertebrata as those of New Mexico, but the close resemblance of the two faunæ may be observed in the following list of forms which I obtained at several localities: Fishes, *Siluroids;* mammals, *Hyracotherium*, two species; *Phenacodus; Coryphodon*, two to three species. As is well known, the Wahsatch beds underlie those of the Bridger group, and we therefore look for their European equivalent in the lower part of the series. It has been already pointed out[4] that the absence of *Hyopotamus* and *Anoplotherium*, and allied genera, from the Bridger horizon precludes an identification with the upper Eocene of Europe. The comparison of the Wahsatch fauna with that of the lowest of the three divisions into which Professor Gervais has arranged the European Eocene, shows a remarkably close correspondence. This epoch, the Suessonien of D'Orbigny (Orthrocene, Gervais), includes the marls of Rilly and lignites of Soissons, the Thanet sands, London clays, etc. Fossils from these beds appear to have been no better preserved than those of the Wahsatch beds of the Rocky Mountains, yet some of the genera are identical, and others closely correspondent, as follows:—

Wahsatch.	Suessonien.
Ambloctonus.	*Palæonyctis.*
Hyracotherium.	*Hyracotherium.*
Coryphodon.	*Coryphodon.*
Diatryma.	*Gastornis.*
Lepidosteus.	*Lepidosteus.*

As a point of difference between the beds, may be mentioned the absence of the *Tæniodonta* from the Suessonien, a suborder not yet known out of North America.

The Wahsatch formation includes the Geeen River beds of Hayden, a name which I formerly used for the entire series. It, however, applies properly to the fish shales of Green River, con-

[1] Annual Report of Chief of Engineers, p. 592.

[2] The species described by me as *Bathmodon* constitute a section of this genus, characterized by the absence of tubercle or ridge between the inner cusps of the last lower molar. I do not maintain this section as a distinct genus.

[3] See Report of the U. S. Geol. Surv. Terrs., 4to., ii. p. 33–39.

[4] Ann. Rept. U. S. Geol. Surv. Terrs., 1873 (1874).

taining *Asineops*, *Clupea*, *Osteoglossum*, etc., which are probably local in their character.

The Bridger formation will then represent on the American continent more nearly than any other, the middle Eocene or Parisien of Cuvier, Brogniart, and Renevier.

The teeth of sharks described in the reports quoted are of uncertain origin. They are associated with oyster shells, and both have the appearance of having been transported; nevertheless some of the mammalian teeth found associated with them have a similarly rolled appearance. It therefore remains uncertain whether the ocean had for a limited time access to the Eocene lake, or whether the shark's teeth and *Ostreæ* were derived from the cretaceous beds which formed its shores. Similar, and in one instance the same species of sharks were found in both formations, the division of the cretaceous being No. 3 and 4 of Hayden.[1]

In conclusion, the classification of the North American Eocene may be represented as follows:—

Formation.	Equivalent.	Locality.	Characteristic Fossils.
Bridger Form.	Middle Eocene.	S.W. Wyoming.	*Palæosyops.* *Tillodonta.* *Dinocerata.*
Wahsatch Form.	Lower Eocene.	N. E. New Mexico, S. W. Wyoming.	*Coryphodon.* *Tæniodonta.* *Phenacodus.* *Diatryma.*

April 25.

The President, Dr. Ruschenberger, in the chair.

Forty-nine members present.

The death of Geo. Washington Smith was announced.

In conformity with Art. III. Chap. V. of the By-Laws, John L. LeConte, Geo. H. Horn, E. T. Cresson, Chas. A. Blake, Wm. S. Pine, John Meichel, Geo. B. Dixon, Horace F. Jayne, Charles Wilt, James Ridings, James H. Ridings, and J. W. McAllister, were constituted the Entomological Section of the Academy of Natural Sciences of Philadelphia.

The meeting having adjourned until May 2, the consideration of certain amendments and additions to the By-Laws was then

[1] The same state of things exists in the siderolitic deposits of the canton of Vaud, Switzerland. Mingled with the mammalian remains are teeth of sharks, of which M. La Harpe remarks that their appearance does not warrant the belief that they have been transported, or are not indigenous to the Eocene fauna.

concluded. The propositions to amend, with the signatures and reasons for the same, together with the report of the council upon said amendments, were read, and Chapters I.–XI., inclusive, and Chapter XVI. were then adopted.

The following were elected members: Oliver Bradin, Geo. A. Piersol, John Wister, Wm. Nelson, Rev. Charles A. Dickey, J. H. C. Simes, M.D., Wm. B. Brewster, M.D., Wm. H. Castle, Robt. Hess, M.D., and Pliny E. Chase.

The committees to which they had been referred recommended the following papers to be published:—

THE GENUS POMOXYS, RAFINESQUE.

BY D. S. JORDAN AND H. E. COPELAND.

Among the fishes sent by Prof. S. A. Forbes from the State Normal University of Illinois to us for examination, were many specimens of Pomoxys, known in the Western States as "Crappie." We have prepared the following review of the species that have been referred to this genus, and append the synonymy for future reference.

The genus was described in 1820 by Rafinesque, page 33 of his *Ichthyologia Ohiensis*, in these words: "Body elliptic, compressed, scaly. Vent anterior. Head scaleless, jaws plaited extensively, roughened by very minute teeth. Gill-cover smooth, scaleless; propercule forked beneath; opercule membranaceous and acute posteriorly. Thoracic fins without appendage, but a spiny ray. One dorsal fin opposite the anal, both with many spiny rays." This description has been accepted as sufficiently accurate by most authors, and the genus adopted. Rafinesque referred to the genus one species, obtained at the Falls of the Ohio, with the following description, drawn undoubtedly from the same specimens that suggested the genus: "Silvery; back olivaceous, with some geminate brown transversal lines; a golden ring at the base of the tail; lateral line straight; dorsal and anal fins with six spiny rays; a marginal black spot behind both fins; tail lobed; lower jaw longer. Length 3 to 6 inches. Diameter equaling three-tenths of the length." He called his species *annularis*.

In the "Report of the Zoölogy of Ohio," Dr. Kirtland described the same fish under the name of *Cichla Storeria*, but dropped this name on information from Dr. Storer that Cuvier and Valenciennes had already described it under the name of *Centrarchus hexacanthus*. We have not seen Kirtland's original description, but in November, 1840, in a report on the "Fishes of the Ohio and its Tributaries," in the "Boston Journal of Natural History," vol. iii. p. 480, he gave a description of the fish, made evidently partly from the specimen in hand, from which a good drawing was made (pl. xix., fig. 2), and partly from the real *hexacanthus* of C. and V., a fish that is now commonly placed in the genus *Hyperistius* of Gill. The localities he mentions show that he supposed *Hyperistius* and *Pomoxys* to be one fish, if the description was not conclusive. In the "Memoirs of the Am. Acad. of Arts and Sciences," new series, vol. ii., 1846, Dr. Storer, in his "Synopsis of the Fishes of N. A.," p. 290, relying on the truth of the information he had given Kirtland, copied the latter's description, with a brief addition, and used the name *Centrarchus hexacanthus*. He gave data of two specimens, one a *Hyperistius*, and the other a *Pomoxys*. The localities and synonymy quoted referred to *Hyperistius*, *Pomoxys*, and what may have been *Centrarchus irideus*.

In 1854 Professor Agassiz, in "The Fishes of the Tenn. River," p. 4 (of reprint), referred a specimen sent to him from that river, to *Pomoxys annularis* Rafinesque, saying it "agreed fully" with his description, except in wanting the ring at the base of the tail. How Professor Agassiz overlooked the statement that the head and gill-covers are "scaleless," is not easily accounted for by us. There can be no doubt, however, about his course in the event of his recognizing this as an error, for he had then taken the ground, since occupied by all our naturalists, that it is better to eliminate error from a recognizable description than to propose a new genus or species.

In the Zoölogical report in the Pacific Railroad Reports, 1858, vol. x. p. 5, Girard reviewed the genus in his characteristic way. He arranged his material in the following manner, that we give in full to show the confusion into which the synonymy was falling:—

1. Pomoxis sparoides, Grd.
   = Labrus spar, Lac.
   = Centrarchus spar. C. and V.
   = " hexacan. Holb. Ich. S. C., pl. 6, fig. 1.
2. Pomoxis nigromaculatus, Grd.
   = Cantharus nigromac. Le Sueur, fide C. & V.
   = Cichla Storeria, Kirt.
3. Pomoxis annularis, Raf.
   "described, or rather recorded, by Rafinesque."
4. P. nitidus, Grd.
   Pl. ii., figs. 5–8 (new species).

We are not bold enough to tell what this all means, except that *Pomoxis nitidus*, Grd., surely is *Pomoxis annularis*, Raf.

In the "Proc. Ac. Nat. Sc. of Phila.," 1865, p. 64, Professor Gill gave a "Synopsis of the genus Pomoxys, Raf.," "to dissipate the confusion." He cleared away, in a satisfactory manner, the mistakes of his predecessors, coming to the undoubtedly correct conclusion that but one species of Pomoxys was yet known, calling that *storerius*, for reasons following, and added three new nominal species of his own. Of *storerius* he says: "This species has been quite unfortunate in its nomenclature;" and, "This species was first intelligibly noticed by Dr. Kirtland, who, in the 'Report on the Zoölogy of Ohio,' introduces it under the name of *Cichla Storeria;*" and "the name *Cichla Storeria* must therefore be accepted as the specific appellation of the species described by Dr. Kirtland if Rafinesque's is deemed unworthy of adoption." As between the *specific* descriptions of Rafinesque and Kirtland, on comparison of a specimen from the Ohio with each, I have no hesitation in saying that Rafinesque's is the better of the two. Without, therefore, resorting to the unanswerable argument that since there is but one species of Pomoxys in the region reported on by the two men, and that, therefore, Rafinesque's specific name must stand on as good footing as his generic name, we retain *annularis* on the ground of its accompaniment by a prior and recognizable description.

In regard to the three new "species," we find by an examination of the specimens from Normal, labelled as from the streams of Central and Southern Illinois, the following data:—

The variation ranges in the dorsal spines from v. to viii.; in the dorsal rays from 14 to 16; in the anal spines from v. to vi.; in the anal rays from 16 to 19; in the scales in the lateral line from 39 to 48. The first dorsal spine goes in the diameter of the eye from 4 to $1\frac{1}{2}$ times; the length of the caudal peduncle is to its height as 19 to 13, or as 16 to 16. Specific characters, based on the number of dorsal spines, the size of the scales, the ratio between the first dorsal spine and the diameter of the eye, or between the height and length of the caudal peduncle, are clearly untenable, falling within the range of individual variation, and therefore *Pomoxys brevicauda*, Gill, *Pomoxys intermedius*, Gill, and *Pomoxys protacanthus*, Gill, fall into the list of synonyms of *Pomoxys annularis*, Rafinesque, it being the only species of Pomoxys now known, unless Hyperistius prove to belong here.

The following is the synonymy of the species, with the localities and common names:—

POMOXYS ANNULARIS, RAFINESQUE.

Crappie (West), New Light (Ky.) Bachelor (Falls of the Ohio).

Pomoxis annularis, Raf. Ich. Oh. 1820, 33. (Falls of the Ohio ; Ky.).—Ag. Fish. Tenn. 1854, 4. (Tenn. River.)—Grd. Pac. R. R. Rep. X. 1858, 6.

" *Cantharus nigromaculatus*, Le Sueur, fide C. and V. Hist. Nat. Poiss. III. 1829, 88" (fide Grd.). (Wabash River, where Hyperistius is not found.)

Cichla Storeria, Kirt. Rep. Zoöl. Ohio, 191 (fide Kirt.).

Centrarchus hexacanthus, Kirt. Bost. Journ. Nat. Hist. III., 1840, 480, Pl. XXIX. (plate; desc. in part). (Big Miami River.)—Storer, Mem. Am. Ac., new ser. II., 1846, 290. (in part), (not of Cuv. and Val. fide Gill).

Pomoxis nitidus, Grd. Pac. R. R. Rep. X. 1858, 6 Pl. II., Fig. 5–8. (Houston River, Ky.)

Centrarchus nitidus, Günther, I. 1859, 257.

Pomoxys storerius, Gill, Pr. Phil. Acad. 1865, 64.—Cope, Pr. Am. Philos. Soc. 1870, 251. (Missouri Riv.)—Jordan, Geol. Surv. Ind. 1874, 215. (White River.)

Pomoxys brevicauda, Gill, Pr. Phila. Ac. 1865, 64. (North Grand Riv., Mo.)

Pomoxys intermedius, Gill, Pr. Phila. Ac. 1865, 64.

Pomoxys procanthus, Gill, Pr. Phila. Ac. 1865, 64. (Tarboro, N. C.)

Pomoxys annularis, Jordan, Fishes Ich. Oh. : (Bull. Buff. Soc. Nat. Hist., April, 1876, p. 89) ; Manual Vertebrates E. U. S. (in press)—Jordan and Copeland, Check-List N. Am. Fresh Water Fishes (in press).

Habitat.—Basin of the Ohio, Illinois, Missouri ; probably in all the tributaries of the Mississippi. Not in the great Lakes ? In North Carolina (fide Gill).

CHEMICAL NOTES.

BY GEORGE HAY.

I. *On the Decomposition of Stannous Chloride in a Geissler Tube.*

While observing, in company with my friend, Dr. Wm. M. Herron, the spectrum of chloride of tin through a powerful spectroscope of four prisms (Browing's make)—the Geissler's spectrum-tube used for the purpose being illuminated by the spark from a large Ruhmkorff's coil connected to six cells and a Leyden jar and a tin foil condenser, the spark being capable of passing six inches in air—the following facts were noted :—

The constricted portion of the tube became hot—the spectrum became gradually feebler and feebler and ultimately ceased—a vacuum had formed within the tube so perfect that the spark would not pass.

On examining the tube I found a metallic deposit or mirror of extreme thinness, but having the well-known metallic lustre deposited upon the glass at the negative end. The wire inside of the tube at the positive end was tarnished, and had lost its metallic lustre, and was covered with a white though thin incrustation. I too hastily concluded that this was anhydrous proto-chloride of platinum, and thank Dr. Koenig for his communication correcting me, as shall appear anon. I had no time just then to investigate further—hence the mistake.

I have used up the tube in making the following observations :—

Before opening the tube I heated the end containing the mirror and found that it did not sublime.

Cut off the tube half an inch above the film, and noticed that the wire within the tube at this end was fused to a globule of the size of a pin-head adhering to the glass projecting within the tube, through which the wire passed.

Introduced one drop of concentrated hydrochloric acid, and, upon spreading this drop over the film and slightly warming, the film dissolved completely.

Rinsed out the solution with water into a small evaporating basin, and evaporated to a few drops, to concentrate as much as possible and remove the large excess of acid.

Treated one drop in a watch glass with hydrosulphuric acid, and got a few brownish-yellow flakes soluble in potash. Treated another drop in a watch glass with hydrosulphuric acid, and introduced fluid and flakes into a narrow tube closed at one end, and evaporated in an air bath—heated this, but only a little free sulphur sublimed, leaving a few grayish flakes in the bottom of the tube. Chased back the sulphur to the bottom of the tube, and covered it and the minute flakes with powdered dry ferrocyanide of potassium and heated again, but, as might have been expected from former experiment upon original mirror, got no mirror anew. Treated another drop with nitric acid, and got upon evaporation the slightest observable white film insoluble in nitric acid. Chloride of mercury yielded a white opalescence. The quantity of metal was so exceedingly small that, had I not experimented upon single drops, I should have got nothing in the way of a reaction. I got no reaction with gold, owing to the extreme minuteness of the quantity of metal. I do not believe that I could have weighed the quantity of metal composing this delicate mirror, but I did not attempt it. It must be remembered that all the chloride of tin within the tube originally was only a vacuum of its vapor; but it yielded the spectrum of chloride of tin, and it is well known that the spectroscope will yield certain results where ordinary chemical tests fail altogether.

The tarnished wire at the other end of the tube was not fused.

Scraped off a little of the tarnish with a penknife blade into a small watch glass and added one drop of water, but the flakes did not dissolve.

To make sure whether the drop of water mentioned had dissolved any chloride, added a small drop of nitrate of silver solution, but obtained no opalescence.

Scraped off the whole of the white tarnish and digested with a few drops of strong hydrochloric acid, and got thus a clear solution. One drop of this solution treated with hydrosulphuric acid gave no precipitate. Another drop treated with ammonia yielded a few gelatinous-looking flakes soluble in caustic potassa.

This white substance, therefore, appeared to be alumina, but, as in the case of the metal, there was extremely little of it—it had probably been chloride of aluminium, and, with the residual air or perhaps some moisture in the tube, had been converted into the oxide at the high temperature produced by the spark, a temperature sufficiently high to fuse the wire at the other end under the protecting influence of the mirror already mentioned. *Within* the tube at this end I found the wire consisted of aluminium, and *outside* of the tube at the same end it consisted of platinum, which had, I suppose, been joined to the aluminium by fusion. The tin salt was undoubtedly decomposed by electrolysis even when existing as an attenuated vapor.

II. *On the Solubility of Tin, Arsenic, and Antimony in concentrated Nitric Hydrate at* 36° *F.*

The following facts have never, so far as I am aware, been published, either by myself or by any one else. I have already communicated to the Academy that the metal tin is soluble in a mixture of pure concentrated nitric acid and water in equal volumes. What I have now to communicate is, that tin forms with the undiluted acid a soluble salt, viz. the proto-nitrate of tin.

The circumstances under which the salt was formed were as follows: Into a dry test-tube I poured a small quantity of pure concentrated nitric acid, and then set the tube containing the acid afloat in a vessel of water at a temperature of 36° F. Into the acid I dropped a fragment of pure tin; it became coated with a white substance, and in the course of fifteen minutes was entirely transformed into this white substance. Several fragments of tin were added at the above intervals, and all were transformed into this white subtance. The action of the acid had now become less decided, although the fluid was still strongly acid, and the contents of the tube presented a gelatinous appearance resembling the recently precipitated hydrate of alumina. It seemed doubtful whether I had not merely obtained the ordinary hydrate of metastannic acid. Upon the addition of about two volumes of water the whole of the white substance dissolved to a clear and colorless fluid, therefore holding the tin in the solution and proving that the white substance was not the hydrate of metastannic acid.

The solution was tested as follows:—

1st. A portion was boiled and the whole of the dissolved metal was precipitated as hydrate of metastannic acid.

2d. After neutralizing a portion of the free acid, hydrosulphuric acid caused the precipitation of proto-sulphide of tin mixed with sulphur.

3d. To a portion of the original solution was added solution of chloride of mercury, and in the course of a few hours a white precipitate formed consisting of sub-chloride of mercury.

4th. Chloride of gold gave no precipitate.

5th. Potash solution gave a white precipitate soluble in excess of potash.

6th. A mixture of ferricyanide of potassium and sesquichloride of iron was made, and to this mixture was added a portion of the original solution—the result was the production in a few hours of prussian blue.

These tests were, in my opinion, retarded by the presence of a large excess of nitric acid, and the production of purple of Cassius was altogether prevented by the presence of an excess of this acid. All the other tests were perfectly satisfactory.

To obviate the difficulty occasioned by the presence of a large excess of free nitric acid, a fresh solution was prepared by adding the metal to the acid until the contents of the tube had become thick and pasty, and there appeared to be little or no action going on, the tube being kept, as before, surrounded by water at 36° F.

Water was now added to the pasty mass, but in this instance a not very considerable portion of white substance was left undissolved. The solution was filtered, and to the clear filtrate was added—

1st. Hydrosulphuric acid. This yielded a brown precipitate soluble in solution of potash, and reprecipitated brown on addition of dilute hydrochloric acid.

2d. Potash yielded a white precipitate soluble in excess of potash.

3d. Chloride of gold yielded a beautiful and strong coloration of purple of Cassius after addition of a drop of dilute hydrochloric acid in five minutes, and when the tin solution was not too dilute the purple of Cassius was precipitated at once.

4th. Chloride of mercury yielded a white precipitate of sub-chloride of mercury immediately.

5th. To a mixture of ferricyanide of potassium and sesquichloride of iron, a portion of the clear filtrate was added, and almost immediately prussian blue was formed.

6th. Boiling the original filtrate caused the precipitation of the tin as hydrate of metastannic acid.

The above experiments prove that not only is tin converted into a soluble salt by concentrated nitric acid, but that proto-nitrate of tin is formed.

Pursuing my investigations still further with regard to the action of nitric acid upon the group of metals usually said to be oxidized, but not dissolved or converted into salts by it, I next experimented upon antimony.

Into a dry test-tube I poured about 2 c.c. of concentrated nitric acid, and then dropped into the acid about 20 grains of powdered antimony. The tube was immediately set afloat in a vessel of water at 36° F. and allowed to remain for about 12 hours, being shaken occasionally to diffuse the powder through the acid. At first there appeared to be no change produced, but by and by the fluid became distinctly green, and by the end of 12 hours a strongly green solution was obtained. On decanting this green fluid from the powdered metal and diluting it with water, a bulky and abundant white precipitate was produced, showing that a large proportion of the antimony had been dissolved in the nitric acid, and in this respect it appeared to behave like nitrate of bismuth when diluted with water. In order to ascertain in what state of combination the antimony was held, the following experiments were made.

Tartaric acid was added to the fluid containing the precipitate, and it at once dissolved to a colorless fluid.

The fluid was now filtered in order to remove any particles of undissolved metal which might have been decanted.

1st. After neutralizing a portion of the free acid in a portion of the filtrate, a strong solution of hydrosulphuric acid was added —the result was a bulky, orange-red, unmistakable precipitate of tersulphide of antimony, readily soluble in potash, and reprecipitated from its alkaline solution by dilute hydrochloric acid.

2d. To another portion of the filtrate, potash was added, and a white precipitate of teroxide of antimony was obtained soluble in excess.

3d. To the alkaline solution last obtained, nitrate of silver was added, and there was obtained a jet-black precipitate of suboxide of silver insoluble in excess of ammonia—this being distinctive of *ter*oxide of antimony.

4th. Neutralized another portion of original filtrate by ammonia to remove free nitric acid, and then acidulated with hydrochloric acid. Put a drop or two of the solution thus obtained upon a clean surface of platinum, and introduced a fragment of zinc—the result was a dark-brown or black stain of metallic antimony not removable by cold hydrochloric acid, but removable by hot nitric acid.

These four tests show that the original solution contained teroxide of antimony, and, as the solution was obtained by means of nitric acid, the probability is that it was a ternitrate of antimony, for a *large quantity* of the metal was dissolved. The HS precipitate was so bulky as at first almost to fill the test-tube.

The solution of antimony in *nitric acid kept cold* will not bear dilution with water except in presence of tartaric or hydrochloric acid.

Boiling the original green solution gave an abundant white precipitate of antimonic acid accompanied by copious evolution of orange-red fumes. Boiled till the red fumes had disappeared—diluted and filtered—the filtrate did not pass through clear, but on passing twice more through the same filter was obtained a perfectly clear filtrate. This filtrate gave every one of the four tests above-mentioned with the utmost readiness, *i. e.*, it yielded in succession tersulphide of antimony, teroxide of antimony, suboxide of silver, and metallic antimony, and therefore held in solution even after formation and precipitation of antimonic acid by boiling a *large quantity* of teroxide of antimony dissolved in nitric acid, or existing as ternitrate of antimony. In this case no other acid but the nitric had been used.

I now experimented upon arsenic in the same manner, *i. e.*, by keeping the pure metal (not pulverized) for 12 hours in contact with pure concentrated nitric acid at 36° F.

The result was a beautiful transparent green solution of the entire quantity of metal. This solution yielded every one of the tests for arsenic acid.

1st. After reduction by sulphurous acid and partial neutralization, it yielded upon addition of hydrosulphuric acid the tersulphide of arsenic.

2d. After complete neutralization, and addition of sulphide of ammonium, followed by addition of hydrochloric acid, it yielded the pentasulphide of arsenic.

3d. After addition of nitrate of silver and a small quantity of ammonia, it yielded the reddish-brown precipitate of arsenate of silver.

4th. In similar circumstances, *i. e.*, after neutralization by ammonia and addition of sulphate of copper, it yielded the greenish-blue precipitate of arsenate of copper.

5th. Neutralized and then mixed with a *large* excess of concentrated hydrochloric acid and boiled with a slip of clean copper, a dark-gray film was deposited on the metal.

6th. Neutralized and added a clear mixture of sulphate of magnesia, chloride of ammonium and ammonia, it yielded at once a crystalline precipitate of arsenate of ammonia and magnesia. The original green solution was therefore either simple arsenic acid or a pentanitrate of arsenic.

The curious fact is here observed that these three metals, arsenic, antimony, and tin, when treated with cold concentrated nitric acid *kept* cold, oxidized in the relation of their several volatilities—arsenic yielding either a *penta*nitrate? or merely arsenic acid, antimony yielding a *ter*nitrate, and tin a *proto*nitrate; while the other curious fact is also to be observed that on boiling the original solutions *all* the arsenic remains in solution, a *considerable portion* of the antimony remains in solution, and *none* or only the merest trace of the tin remains in solution.

I ought to have mentioned in my last communication that the tin employed was not granulated but only cut by a sharp knife from a bar in order to prevent too rapid action of the acid upon the metal. I found it necessary on the other hand, to pulverize the antimony, as without this the action was hardly visible—the arsenic was used in large crystals.

Note upon Mr. Hay's Paper. By Geo. A. Koenig, Ph.D.

The reaction of nitric hydrate upon arsenic at 36° F. results, according to the author, in the exclusive formation of arsenic acid or arsenic pentoxide. This is not substantiated by his experiments. He certainly proved the presence of the pentoxide, but does not speak of any test for the teroxide, the presence of which does not interfere much with the other reactions. It is a fact well known by chemists, that a continued digestion of the teroxide is needed with concentrated nitric acid to change it into pentoxide, and some authors state distinctly that arsenic is changed by nitric acid both into the teroxide and pentoxide.

Since it is known that by the action of nitric acid upon metals heat is generated, and also that antimony and tin are precipitated by heat from their nitric or other acid solutions, it was not astonishing to find those metals go into and remain in solution, by abstracting the heat with a cooling liquid in such measure as heat was generated.

In the case of tin, dilute nitric acid is known to dissolve it as protoxide, and here the water in the acid prevents the heating; in using concentrated acid and applying a cooling liquid at the outside of the vessel. the conditions remain unchanged, and only the application is different.

May 9.

The President, Dr. Ruschenberger, in the chair.

Twenty-six members present.

The following papers were presented for publication:—

"Fourth Contribution to the History of Existing Cetacea," by Edw. D. Cope.

"Zoological and Biological Methods of Research," by Harrison Allen, M.D.

Remarks on Fossils from the Ashley Phosphate Beds.—Prof. Leidy observed that the so-called phosphate beds of Ashley River, South Carolina, were remarkable for the singular admixture of multitudes of fossils of different ages, from the early tertiary period inclusive down to the present epoch. The phosphatic nodules, for which the beds are explored, appear to have had their origin from the eocene rocks beneath. These have also contributed numerous remains of marine vertebrates especially of squalodonts, reptiles, and fishes. Mingled in the sand and clay with the phosphatic nodules and bones of eocene animals, are innumerable remains of cetaceans, sharks, and other marine animals of perhaps the middle and later tertiary ages. Added to these are multitudes of remains of both marine and terrestrial animals of the quaternary period. Pell-mell are found together bones of eocene squalodonts, animals related with the whales and seals; hosts of teeth of the great shark Carcharodon angustidens; myriads of the teeth of the giant of sharks of the tertiary period, the Carcharodon megalodon; bones and teeth of whales and porpoises; and abundance of remains of elephant, mastodon, megatherium, horse, etc.; and occasionally the rude implements of our more immediate ancestors.

From among a collection of fossils, from the Ashley phosphate beds, recently submitted to his inspection by Mr. J. M. Gliddon, of the Pacific Guano Company, the specimens were selected which lie upon the table. One of these is a well-preserved tooth of a Megatherium; another, a characteristic portion of the skull of a Manatee; a third, a complete tusk of the Walrus; indicating a still further point south for the extension of this animal than had been previously known; fourth, a huge tooth of a cetacean allied to the sperm whale, probably the same as those from the crag of Antwerp ascribed to Dinoziphius. Besides these there are the beaks of three cetaceans of the little known family of the Ziphioids. These are porpoise-like animals without teeth in the upper jaw, and usually with but a single pair of teeth in the lower jaw. The beaks composed of the co-ossified bones of the face are remarkable for their ivory-like density which probably rendered them available as weapons of defence.

A fourth beak from the same locality, presented by Mr. C. S. Bement, belongs to a different species of the same family. The beaks and some associated fossils will form the subjects of a paper shortly to be presented to the Academy.

The beaks have been referred to species with the following names and brief distinctive characters:—

CHONEZIPHIUS TRACHOPS.—Supra-vomerian canal open. Intermaxillaries co-ossified and forming a crest along the middle of the beak extending to the interval of the prenareal fossæ. Maxillaries with a rugged tract at the upper part of the base of the beak.

CHONEZIPHIUS LIOPS.—Beak proportionately of less length than in the preceding. Supra-vomerian canal and intermaxillaries the same, except that the crest of the latter in front is acute. Maxillaries without the rugged tract at base.

EBOROZIPHIUS COELOPS.—A new genus as well as species. Beak above forming a broad gutter as in Hyperoodon, and not divided by an intermaxillary crest as in the preceding. Maxillaries with prominent lateral crests at base, convex inwardly. Right prenareal fossa occupied by a thick osseous disk. Intermaxillaries co-ossified. Supra-vomerian canal open.

BELEMNOZIPHIUS PROROPS.—Beak solid, with all traces of the original separation of the constituent bones and the ossified mesethmoid cartilage obliterated.

Fish Remains of the Mesozoic Red Shales.—Prof. LEIDY remarked that the remains of life of any kind were exceedingly rare in the mesozoic red shales which cross our State about fifteen miles north of us. Hence any fossils whatever from these rocks were of interest. The three cycloid fish scales, and a few detached caudal rays, in the fragments of red shale, presented by him this evening, he found on the Perkiomen Railroad, near Yerkes' Station, Montgomery County. One of the scales resembles those described by the late Prof. E. Emmons, under the name of Rabdiolepis elegans, from the mesozoic coal shales of Chatham Co., N. C.

Botanical Correspondence of Zaccheus Collins.—Mr. REDFIELD called the attention of the members to the volume of letters of Zaccheus Collins which had been recently arranged and bound. Mr. Collins was well known in his day as an active philanthropist and as a zealous cultivator of natural science. He was early a member of the American Philosophical Society, was elected a member of the Philadelphia Linnæan Society, in 1809, before this Academy was founded, became a member of our Academy in March, 1815, and was one of its Vice-Presidents at the time of his death in 1831. He devoted himself especially to the sciences of Botany and Mineralogy, and the letters of the most eminent botanists of that time show how highly they valued his knowledge, and how eagerly they sought his advice upon all doubtful questions in their science. Mr. Nuttall complimented him—by naming for him the genus *Collinsia*—containing some plants of exquisite beauty, and now represented by eleven North American species, mostly Californian, but of which the earliest known was discovered in the valley of the Ohio.

The volume now before us contains an unbroken series of sixty letters from Rev. Henry Muhlenberg, of Lancaster, to whom American botany has been so much indebted, also a correspondence with his son Fred. Aug. Muhlenberg, in which we find the history of the transfer of the Muhlenberg Herbarium to the American Philosophical Society. There are also numerous letters from Stephen Elliott, author of a sketch of the Botany of South Carolina; from Dr. Jacob Bigelow, author of Florula Bostoniensis, and still surviving; from Dr. Wm. P. C. Barton, author of the Compendium Floræ Philadelphicæ; from Dr. Wm. Baldwin, the talented and lamented young botanist, who died upon Long's Exploring Expedition; from Nuttall, Torrey, Leconte, Sr., and many others well known to the scientific world.

It cannot be expected that these letters of sixty years ago can add any new botanical facts to our stock; but they have great interest as illustrating the early history of botanical science in our land, and as revealing to us the obstacles which the students of that day encountered in the scarcity of books, and in the difficulty of communication.

Mineralogical Notes; Hydrotitanite, a New Mineral.—Dr. George A. Kœnig communicated the results of an investigation on a changed *garnet* and a changed *perowskite*, from Magnet Cove, Arkansas. A short time ago he had called the attention of the Academy to the occurrence of opaque nuclei observable in microscopic slides of garnets, in which by analysis 6 per cent. of titanic acid was found. He had obtained recently, through the kindness of Dr. Foote, a fragment of a garnet crystal weighing about three ounces, on which the faces of the dodecahedron are visible, and concentrically a nucleus, contrasting by its bright pitchy lustre with the dirty circumferential part of the crystal. The line of contact is apparently very well defined, but on producing on it a fresh fracture, no difference in color and lustre and no line of division can be seen. The streak of the centre is reddish-gray, that of the circumference light greenish-gray. Starting with the hypothesis of a gradual change from inside towards the outside, or, *vice versa*, a cut was made through the crystal, about parallel with one of the principal planes of symmetry, and thus a slice was obtained half an inch thick; this was divided radially into three sections, and one of these was cut into five parts at equal distances from the centre. On reducing the pieces to powder, each by itself, a very gradual change in color was noticeable from the reddish-gray of the central part to the greenish-gray of the circumference. 0.5 gr. of each sample was fused with 5 grs. of sodium hydro-sulphate, the solution reduced with hydrogen sulphide, after filtration, diluted to 700 c. c. of volume and boiled. Numbering the samples 1, 2, 3, 4, 5 from centre to circumference, the author obtained precipitates by boiling, of respectively 25.00, 16.2, 9.2, 6.0, and 5.0. These precipitates were titanic acid with normal reactions in numbers 3, 4, and 5; very abnormal in number 1, and less in number 2. The description of the purely chemical investigation into the nature of those abnormal reactions will be reserved for a future memoir.

In order to obtain more light upon the cause of this gradual decrease of titanic acid from centre to circumference, one of the sectors was ground to a microscopic section, which showed a banded structure at the circumference with a few opaque crystalline fragments imbedded, but besides this the material appeared homogeneous, the color only changing from light-brown, very gradually into black opaqueness. Had the banded structure continued to the core, the explanation might be looked for in the growing of the crystal at intervals in solutions of different composition, but the change being so gradual, the author is inclined to believe in a metamorphic action from the centre. The chemical fact that titanic acid does not replace one or two of the constituents, as revealed by further investigation, but that silicon, iron, and calcium diminish in the same proportion as titanic acid increases, speaks in favor of the metamorphosis by intrusion of titanic acid.

The crystals of perowskite, pure octahedrons, or octahedrons modified by the cube, are often found to have yellowish-gray spots much softer than the rest of the mineral, and, in some instances, the whole crystal is composed of the same yellowish-gray substance. The specific gravity of one of these crystals was found to be 3.681; nearly 0.2 less than the fresh mineral. An analysis of the same made with 0.5 gramme, gave the following:—

TiO_2	=	82.82
Fe_2O_3	=	7.76
MgO	=	2.72
CaO	=	0.80
H_2O	=	5.50
Yd		Undetermined, but distinct reaction.
		99.60

By metamorphic action nearly all the calcium and some iron have been removed, and water added. The result is a new mineral for which the name *Hydrotitanite* is herewith proposed if the analysis of more specimens should prove the constancy of the composition.

On the Microscopic Observation of Minute Objects.—Prof. Frazer remarked, that he desired simply to put on record a thought relating to Helmholtz's now famous establishment of the limit of vision through the microscope. As this limit was determined by half the length of a wave of light and since the wave-lengths of the most refrangible rays of the light spectrum (*i. e.* the violet) are somewhere near the 1-57000th part of an inch, the conclusion was reached that nothing more minute than the 1-114000th part of an inch could be seen. But actinic waves or others of smaller length (of greater refrangibility too) in passing through a substance on which are lines or other markings less than 1-114000th inch apart, may be altered to light waves, and become visible, provided, that the substance through which they pass is capable of fluorescing, *i. e.*, increasing their wave length, and provided the distance apart of the marks to be seen is not less than one-half the wave length of such actinic waves.

The meeting having adjourned until May 16, the following were then elected members of the Council:—

For three years—Edw. S. Whelen, R. S. Kenderdine, M.D., J. H. Redfield, J. G. Hunt, M.D.

For two years—Geo. H. Horn, M.D., Jos. Wharton, Jos. Jeanes, Geo. A. Kœnig.

For one year—Geo. Vaux, J. S. Haines, W. H. Dougherty, Harrison Allen, M.D.

May 16.

The President, Dr. Ruschenberger, in the chair.

Thirty-four members present.

The "Sleep of Plants" as an Agent in Self-Fertilization.—Mr. Thomas Meehan said that what is popularly known as the "sleep of plants," the closing of some kinds of flowers at nightfall, though a matter within common observation, had not, so far as he was aware, been made a subject of physiological investigation, with the view of ascertaining the value, if any, of this kind of motion in the economy of plant life. He had recently discovered that by means of this peculiar motion the common Claytonia Virginica and some butter-cups were fertilized by their own pollen. The fertilization of these plants had been somewhat of a mystery to him, as, in view of some prevailing theories of cross-fertilization by insect agency, these plants ought not to be self-fertilizers; but from repeated observation he was satisfied that no insects had visited plants that had yet seeded abundantly. Watching the process of fertilization in Claytonia, he found the stamens on expanding fell back on the petals expanded during daylight. At night, when the flower closed, the petals drew the anthers up in close contact with the pistils. Cross fertilization could be accomplished by insects if they visited the flower, but they did not; and actual fertilization only occurred in this way. In many cases, especially in the advance of the season, the stamens recurve so much as to be in a measure doubled up by the nocturnal motion of the petals. The anthers were not drawn into contact with the stigmas in these cases, and the flowers were barren as the result.

In the Ranunculus bulbosus, our common butter-cup, in the evening following the first day's expansion of the young flower, the immature anthers and the young stigmas would be found covered with pollen grains. The inference would generally be that this had been carried there by insects. But as he had been especially on the lookout for insects as visitors to the butter-cup, and feeling sure that none of any consequence had been to them, he examined these flowers carefully, and found that on the first expansion of the flower a single outer series of stamens burst their anther-cells simultaneously with the expansion of the flower, and, by contracting the cell-walls, ejected the pollen to the smooth petals, from which it easily fell to the immature anthers and stigmas, when the flower closed for the night.

Knowing that another species of butter-cup, the Ranunculus abortivus, had fixed spreading petals which did not close at night, and which, though with comparatively large nectariferous glands full of a liquid secretion, was wholly neglected by insects, and yet had every flower seeding profusely, he was anxious to find, in view of his other discoveries, how these were fertilized. Visiting a wood after twilight, to ascertain if any nocturnal insects visited them, he found that though the petals did not close at sundown, the slender pedicles drooped, inverting the flower, and in this way the pollen found its way from the petals to the stigmas without any difficulty whatever.

Plants, of course, had peculiar functions to perform, and there were pre-ordained plans and special arrangements through which these functions are exercised. But the workings of plant life are so complicated, that, though we see certain results follow certain movements, we are not always sure that we perceive the great and deeper object aimed at in the order of nature. Hence arose the differences of opinion prevailing in regard to the object of cross fertilization. Some plants had arrangements which seemed to preclude the possibility of self-fertilization, and the assumption followed that nature abhorred close breeding in plants, and specially designed such structures to secure the plant against it. He believed that nature had a deeper purpose, as yet unknown; and chiefly because of just such instances as he had given this evening, where nature could not abhor close breeding, when the result of the "sleep of plants" was most perfect in securing self-fertilization.

May 23.

The President, Dr. Ruschenberger, in the chair.

Thirty-seven members present.

A paper entitled "Further Notes on Inclusion in Gems, etc.," by Isaac Lea, was presented for publication.

Remarks on Fossils of the Ashley Phosphate Beds.—Prof. Leidy observed, in continuation of his remarks of the previous meeting, on the extinct animals of the Ashley phosphate beds of South Carolina, that they are remarkable for the multitude of remains they contain of fishes, especially of sharks and rays. Among the former were the giants of their kind, the *Carcharadon megalodon* and *C. angustidens*. A tooth exhibited of the megalodon shark is $5\frac{1}{2}$ inches long and $4\frac{1}{2}$ inches broad at the base. The living white shark, pertaining to the same genus, reaches upwards of 35 feet in length and has teeth 2 inches in length. Supposing the megalodon shark to have reached the same proportions in relation with the size of the fossil teeth, it must have exceeded 70 feet in length, and must have proved the most formidable monster of the ancient ocean.

Another specimen, presented for the inspection of the members, is a knob of bone, such as is found at the root of the tail of the devil-fish, the largest of the existing rays. In the latter, the bone is the only one of the body, and it supports a minute spine, a mere rudiment of the barbed weapon of the sting-ray. Our devil-fish, of which a specimen was once exhibited in Peale's Museum of this city, reaches a breadth of 18 feet with the length about 15 feet. The fossil-bone, though the only thing left to tell the tale of its former possessor, is quite a characteristic specimen. It is of more robust proportions than that of its living representative, and probably indicates an extinct species for which the name of *Ceratoptera unios* was proposed.

Specimens exhibited of the dental armature of the roof and floor of the mouth of eagle-rays were referred to extinct species under the names of *Myliobates magister* and *M. mordax*, the former having been one of the largest of its kind. Similar specimens from the eocene marl beds of Monmouth and Burlington Counties, New Jersey, were refered to species with the names of *Myliobates fastigiatus* and *M. jugosus*.

Prof. Leidy further directed attention to a specimen of the snout of an extinct cetacean, which he had recently observed among some fossils from the Ashley beds in the Smithsonian collection of the Government Department of the Centennial Exposition, and which had been obligingly loaned to him for description by Mr.

W. P. Blake. The specimen, $2\frac{1}{2}$ feet in length, had the density of ivory, and indicated one of the largest of the little known family of the ziphioid whales. It was referred to a new genus and species with the name of *Proroziphius macrops.*

The other fossils are of the giant sloth, the Megatherium, presented by Mr. George T. Lewis, of this city. These were also found in the Ashley deposits, and are probably the remains of animals which became mired in marshes after the elevation of the Ashley deposits above the ocean level.

Two New Minerals.—Prof. J. Lawrence Smith exhibited specimens of two new minerals. The first is a mammillary coating on the columbic acid minerals from North Carolina. It is white and soft, being a hydrate columbate of yttria with about 15 per cent. of water. Sufficient of the mineral has not been obtained, in a state of purity for a thorough analysis, but there is every prospect that there will be. It is readily found on many of the specimens of Samarskite and Euxenite (which last mineral Prof. Smith has discovered to be a constant associate of Samarskite). No name has yet been given to the mineral, as Prof. Smith prefers to complete the analysis before giving it a name.

He also gave some little historical account of the columbic acid minerals.

Another species for which the name *Daubrélite* is proposed is an interesting mineral recently discovered by Prof. Smith on the nodule of Troilite existing on the Cohahuida meteoric irons that he has been examining. It is a sulphuret of chromium, is a black shining mineral, with a perfect cleavage in one direction, giving a black powder soluble in nitric acid which solution is of an intense chrome green—and is found to contain sulphuric acid, oxide of chromium, and a little oxide of iron, which last Prof. Smith supposes to come from some Troilite not perfectly separated from the Daubrélite—as this mineral is found on almost all the nodules of Troilite in that iron.

May 30.

The President, Dr. Ruschenberger, in the Chair.

Thirty-eight members present.

Chapters XII., XIII., XIV., and XV. of the Amended By-Laws were adopted.

Article 1, Chap. VIII., was amended by adding after the words "thirteen professors:" "Who shall be appointed and superseded or dismissed only by the affirmative vote of two-thirds of the whole Council."

The meeting having adjourned to June 6th, the following were then elected members:—

Wm. Wharton, Jr., C. H. Cramp, Chas. H. Rogers, A. R. Justice, Edw. P. Borden, Edw. Taylor, J. T. Audenreid, J. S. Helfenstein, Mrs. Gertrude A. Quimby, Henry M. Laing, Maxwell Sommerville, and Chas. A. Slocum, M.D.

Prof. Wentzel Gruber, of St. Petersburg, was elected a correspondent.

On some supposed Lemurine forms of the Eocene Period.—Prof. Cope communicated verbally the following observations:—

I have seen no reason to modify the view originally expressed as to the Quadrumanous affinities of *Anaptomorphus*, but new light has been thrown on the structure of *Tomitherium* and its allies. The fragments of skeletons of two species of this genus (*T. jarrovii* and *T. tutum*) include numerous bones of the tarsus, and these are identical with corresponding parts in the *Creodonta* and different from those of the *Lemuridæ*. The astragalus extends anterior to the shortened calcaneum, and the navicular is short and the cuboid not elongate. The astragalus presents two oblique flat surfaces, one for the internal malleolus, the other for the transverse facet of the tibia. The portions of femur, including the third trochanter, the proximal part of the ulna, and the distal portion of the humerus, are all closely similar to those of the *Creodonta*. The type of *Tomitherium* includes some parts of the skeleton not present in the New Mexican species. Thus the ilium of *T. rostratum*, while furnished with the prominent anterior inferior spine of the *Creodonta*, is flattened towards the crest, and is not angulate on the external face. The femur is furnished with a very elevated third trochanter as in *Chiromys* and *Talpa*, and not low down as in *Creodonta*. The head of the radius is rounder than in *Creodonta*. The skeleton of *Tomitherium* in fact bears strong resemblance to that of *Chiromys*, leaving the skull out of view.

The skeleton of the New Mexican form includes an entocuneiform like that of *Stypolophus hians*, which indicates a non-opposable hallux.

It is apparent that the supposed lemurine *Mammalia* of the type of *Tomitherium*, which have the formula of the molar teeth 4–3, cannot be separated by ordinal distinction from the *Creodonta*. They differ from them, it is true, in their wholly tubercular molar teeth; but relate to them in this as the bears and *Procyomidæ* do to other *Carnivora*. I propose therefore to constitute these a distinct group or suborder, intermediate in position between the *Creodonta* and the *Prosimiæ*, under the name of the *Mesodonta*.

I cannot find characters by which to distinguish this division from the *Insectivora* as an order.

I have applied to this order the name *Insectivora* so as to avoid the creation of a new one. I now think that the latter would have been the better course. The name *Insectivora* has acquired currency as applied to the well-known modern group of that name, and its application to types of such apparent diversity as those now associated under a single head is not a convenience. I therefore propose the name *Bunotheria* for the order, and include under it the suborders, *Creodonta*, *Mesodonta*, *Insectivora*, *Tillodonta*, and *Taeniodonta*. Further investigation will be necessary in order to determine the relations of the *Prosimiæ* to this order.

The committees to which they had been referred recommended the following papers to be published:—

ZOOLOGICAL AND BIOLOGICAL METHODS OF RESEARCH.

BY HARRISON ALLEN, M.D.

The influence of methods of zoology upon biological science has, in some instances, led to confusion of terms. The great or primary principles of life are certainly of deeper significance than the limited and often arbitrary deductions of zoology would lead us to infer. An anatomical process as considered within the range of its own forms, and having no direct reference to the needs of the systematists, often ends without the intervention of any of the hypotheses of evolution; not that they fail to support such hypotheses, but that the anatomist finds the nomenclature adopted by the naturalist to be remote from his purpose.

We propose contrasting a few examples of zoological and biological methods as suggested chiefly by the study of deformations.

These may be freely epitomized as follows: I. The principles of reversion as contrasted with gemmation. II. The terms general and special. III. Teleology as contrasted with morphology. IV. Methods of growth as distinct from typical forms.

I. All monsters are now known to be the results of operation of law. Indeed, we have never advanced from the position taken by Montaigne that "from omniscience nothing but the good, the usual, and the regular proceeds; but we do not discern the disposition and relation."

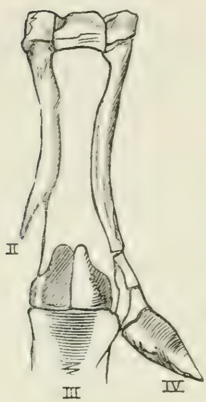
The variance from the type to which the monster belongs cannot for a moment be compared to the variation from the characters of a known specific or generic formula. Indeed, it is singularly rare to have any portion of a monstrosity recalling the normal relation of parts of any animal congeneric with it. If any one compares, for example, the head of a dolphin with its anterior nares in a position somewhat similar to that of the central cavity in the face of a Cyclops sheep, he will find that the rudimentary nasal bones and the exposed position of the vomer, as well as the extraordinary projection of the maxillary processes in the front of the central opening, all suggest that the Cyclops, so far as its osseous parts are concerned, is dolphin-like; it will be seen, nevertheless, that the validity of such a comparison is at once dissipated when the intermaxillæ of the dolphin are detected occupying their normal relation to the superior dental arch; while these bones have never descended from the vertex in the Cyclops.

In the same way, the mammal having cleft palate, in which the vomer is seen occupying a position on the plane of the roof of the mouth, is not to be placed in the same group with the Chelonian skull, in which the vomer normally exhibits an exposure in the hard palate, for the reason that this cleft palate is due in the mammal to some error of union between the fronto-nasal process and the related maxillary arches; this—the real cause of the deformation—is not in any way affected in the Chelonian.

It would appear that a lapsus in the course of the development of a highly specialized animal will cause the defect to be fixed at a point so low that no intelligent study can be made between it and the normal "relation and disposition" of parts in another animal equally if not more highly specialized than the one in which the deformation is seen. It is evident that no defect in a ruminant can be said to be a reversion to a cetacean—when the latter is the more specialized of the two animals.

In the same way, great care should be exercised in comparing mammals, exhibiting defects in the numbers of toes, with related zoological types. Starting with the tentative point that the most generalized form of the mammalian limb is a five-toed segmented axis, we have the type to which all other forms can be compared. This comparison is most successfully carried out in the carpus and tarsus. Confining our remarks to the posterior limb, we find the first, second, and third toes uniting through the intervention of the cuneiform bones with the scaphoid, while the fourth and fifth toes unite directly with the cuboid bone. Any descent from this number of five is seen to occur upon the sides, so that the first and fifth toes are lost before the second and fourth; and if the animal possesses but one functionally active toe, it is invariably the third. Reversion, by which any specialized form of foot shows a tendency to return to a more generalized expression, is thought to be exhibited in the horse. A horse having functionally active splint bones would thus suggest a

Fig. 1.



reversion to Hipparion. Mr. Wood-Mason (Proc. Asiatic Soc. Bengal, Jan. 1871, p. 18) has figured (Fig. 1) and described a horse's foot in which one of the splint bones was hoof-bearing.

While accepting the premises by which can be demonstrated the line of descent of the horse from Hipparion, we think that the proof of the argument rests not upon the number of digits, but upon their "disposition and relation." The tarsus is the key to all parts of the foot arranged distally to it. Observers have too often neglected the necessity of tracing supernumerary toes back to their corresponding tarsal elements, thus impairing the force of their conclusions, and confounding a zoological inference (*i. e.*, a reversion of a special to an embryonic form) with another larger principle (*i. e.*, gemmation).

In some of its expressions, at least, reversion and gemmation are terms of equal value; thus, if we look upon the limb as a bud, the toes partake of the same value as the main shaft of the limb, and may be called distal buds—diverging as rays from the tibia and fibula; the mere substitution of the term bud for toe is here of the first importance, for we can thereby account for any number of toes as well as any interference in the order of the bones of the normal foot. Whereas, if we use the term toe instead of bud, we are limited strictly to the foot as determined by its own tarsus, and anything in excess of that number is atypical, and has no zoological equivalent. It is evident that the mere duplication of a "toe" is no proof of its reversion to anything, whether it occur in the horse or in man. Let us suppose, for example, that a child is born with six toes, it does not follow that the sixth toe is an example of reversion, but is a mere expression of an excessive tendency to budding. In like manner, the so-called second hoof of the horse may have no connection with either the fourth or the second toes, but may be a mere bud or graft from the third. (Fig. 2.)

Prof. Leidy (Proc. Acad. of Nat. Science, 1871, 112) has called attention to the foot of a horse in which the splint bone, becoming functionally active, would appear to be an instance of reversion toward Hipparion. A careful examination of this specimen has convinced the writer that four toes are here present instead of three, and that the first and second are united in a common shaft, bearing a hoof, occupying a position of the functionally active

Fig. 2.

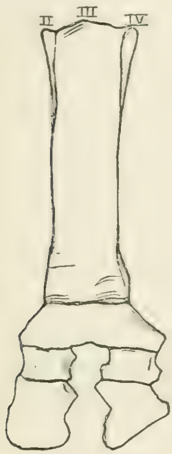
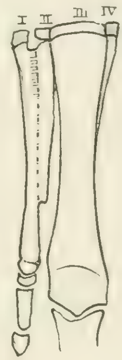


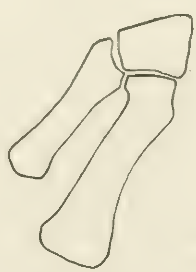
Fig. 3.



splint bone, as in the case recorded by Mason. This specimen cannot be considered, therefore, as a reversion to a three-toed, nor even to a congeneric four-toed ancestor, since the first toe is present. (Fig. 3.)

Fig. 4.

Fig. 5.



Otto (Monstr. Anat. Des.) has figured numbers of examples of six-toed and six-fingered monsters. In some of these the additional digit is a distinct bud from the shaft of a marginal metacarpal or metatarsal bone (Ibid., Tab. xxv., Fig. 9). (Fig. 4.) In others the new appendage extends upward to the tarsus (Ibid., Tab. xxv., Fig. 11). (Fig. 5.) We would place the first-mentioned of these in the group of rayed processes of Goodsir; and in the second group we would place those alone whose divergent rays enter directly into the construction of carpus and tarsus respectively. In this restricted sense, reversion is of subordinate value as compared to the principle of budding.

M. S. Arloing (Ann. des Sciences Naturelles, viii., 1867, 55, pl. II.) figures and describes the anterior extremity of a horse, in which the bovine-like hoof is dependent upon an atypical budding from the end of the third toe (see Fig. 2).

In like manner the union of parts usually distinct, as, for example, the produced digits of a hog—forming a solid terminal bone incased in a single hoof—should not even remotely suggest any variation in the type. Such unions are not known to yield corresponding change in the carpus. For figures, see Otto, loc. cit., and Struthers, Edin. Phil. Journal, N. S., 1863, 272.

II. Pursuant to the method as above suggested, the terms general and special, as applied to the limitation of types, can be made to assume a deeper significance. It is accepted that, in the mammalian limb of a five-toed form having the digits of about equal lengths, we have what is accepted to be a generalized "disposition" of parts; but, at the same time, the muscles in a series of limbs so characterized will have varying degrees of specialization. Thus the separation of the deep from the superficial flexor, in the hand of man, creates a high degree of specialization compared with the paw of the opossum, in which the division of the common flexor is barely manifested.

So with the inferior extremity of man we find all the essential elements of the osseous structure of a remarkably low degree of generalization, so far as the parts below the neck of the femur are concerned. But the bone at that point and the hip-bones present an extraordinary degree of special development. Here, then, is a limb found in a highly specialized zoological form, which is specialized only towards its proximal end.

In the arrangement of its muscles, particularly in the posterior femoral group, we get a marked degree of specialization. The muscles which in most animals belong to the extrinsic group, such as the *biceps flexor*, *semi-membranosus*, and *semi-tendinosus*, are removed entirely from the trunk, and pass between segments of the limb. This arrangement, joined to the excessive development of the *glutæus maximus*, enables man to assume the erect position. The consequences of this assumption are so varied and important as to give the clue to some of his best physical characteristics. It is thus seen that the arrangement of these muscles is of great value, although it need not be taken into consideration if we view the limb, as is commonly done, from the standpoint of the osseous parts only.

III. Now this posterior femoral group of muscles yields an upward prolongation of fascia, which is intimately identified with the *biceps flexor*. This prolongation extends as far as the sacrum, and has received the name of the great sacro-sciatic ligament. Very rarely the *biceps flexor* continues muscular along this tract, thus affording an illustration of reversion. But singularly enough, this reversion is not to the higher quadrumana, where the sacro-sciatic ligament is even less pronounced than in man. Probably we will find the type to which this upward prolongation of the biceps can be located somewhere in the link uniting the lemurs with the rodents. Teleology has been contemptuously regarded. Kitchen Parker has called it "a pretty gilded ball," that lies by the side of the path of severe study, and if it attract attention at all, does it at the expense of true progress. But it will not do to ignore teleology. Here is a group of highly specialized muscles based upon a trifling difference in the arrangement of muscular fibres, which is nevertheless indirectly the cause of retardation or deviation of parts in themselves of great morphic significance.

IV. The several types which have received the names vertebrata, articulata, mollusca, and radiata are no longer considered as expressions of distinct ideas, so much as different expressions of the same idea. The forces of nutrition in all the types are obedient to the same laws. It is evident that it is more interesting to study these laws than the resultant forms. There are no dissonant laws existing in the several types, but a few harmonious laws existing in all.

The law of bilaterality, for example, is seen in all the types. The law of the spiral, the law of gemmation, the laws of conjugation and fissuration are all actively expressed in the tissues.

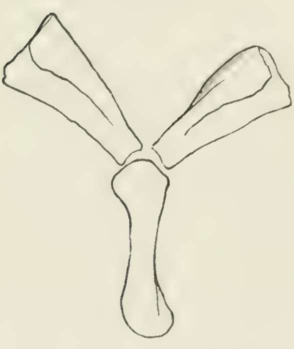
To these accepted data we may be allowed to add another, viz., the law of radiate nutrition. This is one of the most pronounced phases of growth force. Numerous examples of radiate skeletons are seen in the Protozoa, where nothing else in the way of formed tissue need be seen. It is, therefore, together with the force of the spiral, among the *first* expressions of growth force. It gives the entire group of the Radiata its most conspicuous superficial character. In the lower Annulosa it operates in more restricted fields, but often so powerfully as to be alone subordinate to the law of bilaterality. In the Mollusks it appears to occupy a position below both bilaterality and the force of the spiral, although in the compound Ascidians we see examples of it, as well as in the minute anatomy of the tests of many bivalves.

We called attention to the existence of a radiated type of nutrition in vertebrates in 1872 (Proc. Acad. Nat. Sci., 1872, 42), and particularly invited attention to the arrangement of the bones of the pelvic and shoulder girdles.

Prof. Theodore Gill[1] has also suggested the identification of homologous parts, from a central or determinate part outwards. Within certain limitations (viz., the acceptance of the limb as a peripheral quantity, potentialized from distal to proximal ends) this view is in harmony with our own.

The law of radiate nutrition which so powerfully impresses the tissues at both the shoulder and pelvis, maintains its authority in the event of deformation. Thus, in a double monster, the right scapula of one individual, the left scapula of the opposite individual (Fig. 6), and a humerus, bearing ulna, radius, and carpus, will be arranged as rays from a central point. It is evidently impossible to identify this humerus and its associated segments with either of the individuals.

Fig. 6.



In another example the parts of the limb were arranged bilaterally. One division represented the distal portion of the right limb of an individual, the other portion of its opposite—the limb gradually ending in the femur as a single structure. Tracing this single femur toward the trunk, we found, as

[1] Smithsonian Miss. Coll., 247, p. xiv.

in the preceding instance, it bore the relation of a ray to the ossicles representing the pelvic bones.

In addition to radiate nutrition, as shown in small and subordinated areas in an animal in which another type of nutrition is dominant, we may have, as in vertebrates, the principle of bilaterality announcing itself in small territories of tissue apparently uninfluenced by the larger expression of force operating in the same direction elsewhere. Indeed, we may say that bilaterality is not merely a principle of right and left adaptation; but may be found operating anywhere, and, perhaps, in more than one place at a time. Thus, the development of the sternum is independent of the development of the vertebral column. It arises between the ends of opposed costæ, and when this occurs in a single symmetrical individual, it would appear to be influenced by some deep-lying typal condition. But in double monsters the sterna, when present, do not belong to either individual, but arise between the right ribs of one individual and the left ribs of its opposite. Such a sternum thus takes its place on either side of the dual organism. It is very evident that these sterna cannot be identified with either individual, but are rods, symmetrically segmented, orignating *de novo* in an intra-costal space, and entirely irrespective of the bodies from which these costæ spring.

FURTHER NOTES ON "INCLUSIONS" IN GEMS, ETC.

BY ISAAC LEA, LL.D.

In a communication on microscopic crystals contained in *gems*, which the Academy did me the favor to publish in its Proceedings[1] a few years since, I gave some figures of these crystals which I have frequently since verified. I then observed that, beside these *inter-crystalline forms*, there were in most *gems*, *cavities* frequently so numerous that they amounted to tens of thousands.

Since the period of the publication of my paper, I have made very large additions to my cabinet of *gems*, and particularly those of the *Corundum* group, *Sapphires*, *Rubies*, and the so-called *Oriental Topaz*, *Oriental Amethyst*, *Asteria*, etc. In the numerous fine blue *Sapphires* of my collection, I have rarely explored one without finding numerous cavities, and ordinarily also finding the beautiful microscopic acicular crystals, which, when the specimen is cut *cabochon*, cause the three bands, and these by crossing form the star in *Asteria*. The cuneate microscopic crystals are also quite common.

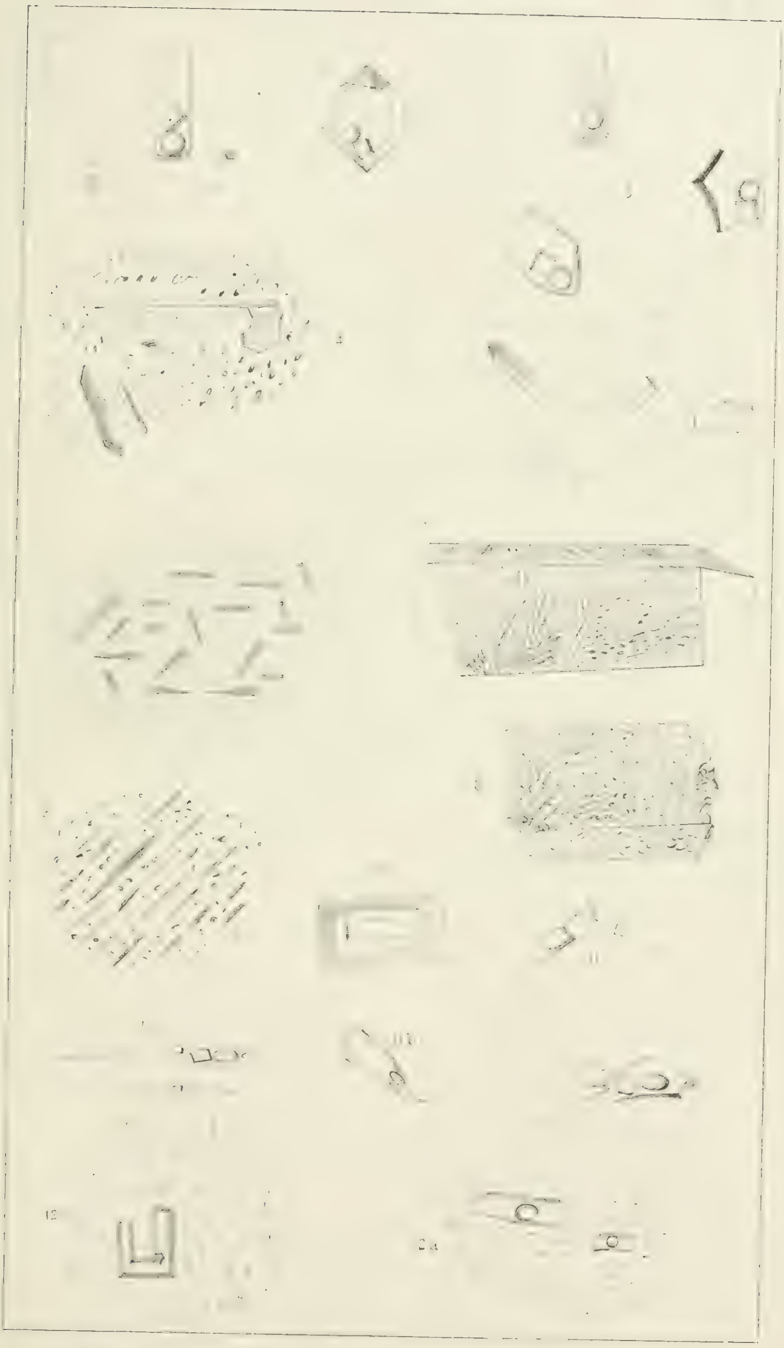
Cavities, with or without the fluids, are so frequent in *crystals*, from the soft *Calcite* to the hard *Corundum*, that little may be said as to their occurrence, as they are so common.

Cavities in quartz crystals inclosing fluids have been observed by the older mineralogists, but the kind of fluid, and gas or air, was not ascertained by them. Sir Humphry Davy, in 1822,[2] investigated the contents of these cavities, and found them generally pure water. The gas bubbles were sometimes found to be "*azote*." Sir David Brewster, in 1823,[3] published a memoir of great research and value. He first had his attention called to the examination of fluid in cavities by the explosion of a crystal of *Topaz* when heating it. He found cavities and air bubbles in nearly twenty different substances, and these inclusions were carefully examined by him. In some of these cavities he observed two fluids[4] and crystals, and these are figured in his plates. Subse-

[1] Feb. and May, 1869. [2] Phil. Trans., 1822.

[3] Trans. Roy. Soc. Ed., 1823.

[4] These two fluids, Prof. Dana without any analysis has called *Brewsterlinite and Cryptolinite.*



MICROSCOPIC CRYSTALS & CAVITIES IN GEMS.

quently, Mr. Sorby published a long and admirable paper[1] on *Fluid cavities and crystals* in minerals, with numerous and interesting figures. He considered that the cubic crystals were probably *Chloride of Sodium.* In his investigation he proved, by forming artificial crystals, that, in a natural state, the fluid cavities, with their "inclusions," must have been formed by aqueo-igneous forces. He gives a figure of fluid in mica, but I have never seen any in that mineral, although many hundreds have passed under my microscope in looking after crystals of *Magnetite*, etc. Mr. Sorby also published a paper on cavities in quartz in the Phil. Mag., vol. xv. p. 153; also with Mr. Butler in Proc. Roy. Soc. London, vol. xvii. p. 299. Kirkel on Microscopic Minerals, Neues Jahrbuch, 1870, p. 80, mentions bubbles and cubic crystals in quartz. He found iron glance and fluid in *Elæolite = Nephelite.* In *Emery*, from Naxos, he found fluid in cavities.

In 1872, Proc. Roy. Soc. Edin., p. 126, Mr. Sang published an account of water in cavities of *Calcite.*

Very recently, Prof. Hartley, King's College, London, has published a very able paper on the subject of the fluid in quartz, etc.[2] He says that Simmler in 1858, offering an interpretation of Brewster's observations, concluded that the expansible liquid was carbon dioxide. Professor Hartley states that in many cases the liquid in quartz is water, but that in some cases he found the two fluids, and his very satisfactory and careful experiments show conclusively that the most volatile of the two fluids is carbonic dioxide. He found in every experiment, that the fluid disappeared when exposed to 31° C., and reappeared on cooling. Prof. Hartley accords with Mr. Sorby in his reasoning that "at the time of its assuming the solid state, the solution endured a high temperature."

Calcite has been found to contain nearly a quart of this fluid,[3] but it is not as common to be found in small cavities as it is in quartz.

Fluorite.—Cavities in this mineral are rarely found, but they are sometimes seen with fluid and air bubbles.

Apatite.—I have never observed cavities in this mineral, but I have not given it much attention in microscopic examinations.

[1] Journ. Geol. Soc., vol. xiv., 1858, Micro-structure of crystals.

[2] Journ. of the Chem. Soc., London, Feb. 1876.

[3] Specimen in the collection of the late Dr. Chilton of New York.

Feldspar Group.—In a former paper,[1] I gave the result of the examination of many specimens of various species. Since then I have examined numerous specimens of *Labradorite*, and found no cavities, but the black crystals were very numerous. In the *Moonstone* of this country, I have not observed cavities or crystals, but in two specimens, out of about one hundred from Ceylon, I have seen a series of very regular quadrate cavities or crystals which do not appear to have any fluid. Fig. 10, Pl. 2.

Tourmaline.—This interesting mineral is found beautifully crystallized and of almost all colors, white, brown, green, red, black, etc. The finest are found at Mount Mica, near Paris, Maine.[2] Some of these specimens have small internal elongate crystals, which are terminated. A red specimen (*Rubellite*) in my collection has many irregular cavities. One green one from Ceylon has cavities with fluid, and another has very minute black acicular crystals in one direction. In brown crystals from Lower Dianburg, Carinthia, there are rough objects in the interior, evidently another mineral inclosed, which do not require the microscope to detect them.

Cyanite.—Of the white and the blue varieties I have not observed any well-defined cavities or crystals, but in the gray-bladed *Cyanite*, found at Cope's Mills, near West Chester, Pennsylvania, there are always, I believe, small black masses which do not take a regular form, but are usually elongate. These may easily be detected by splitting a crystal along its eminent cleavage, and examining the cleavage face with a lens of small power, but a higher power is preferable.

Quartz takes upon itself many colors. In it are found cavities in very great numbers, particularly in the clear fine crystals. Those which exist in such an abundance in Herkimer County, New York, and which are so limpid, and finely and doubly terminated, are sometimes furnished with thousands of cavities, even in small specimens, and these are of many various forms, frequently containing fluid. In some cases the fluid may be seen to move by the unaided eye. In these Herkimer crystals, carbon in the form of *Anthracite* is of very common occurrence,

[1] Proc. Acad. Nat. Sci., May 11, 1869.

[2] Dr. Hamlin has published a beautiful little work on the Tourmaline, with illustrations.

and in one of my specimens a small portion moves in the fluid of a cavity. These cavities often exist in an entire sheet, almost across the prism of a crystal.[1] In *smoky quartz*,[2] these cavities are much rarer, as also in *Amethyst and wine-color and green quartz.* The *Amethyst* is frequently penetrated with crystals of *Rutile*, and these are often very large, sometimes 1 to 4 inches long. The Chester County specimens usually have numerous curved filamentous crystals, easily detected with a common lens. In Way's Feldspar Quarry, near Dixon's, Delaware, there is a very peculiar form of *quartz* which is nearly transparent, but somewhat clouded. The fragments of all sizes, from that of a pin's head to that of a small walnut, are inclosed in a mass of *Deweylite.* These fractured pieces are of indefinite forms. They are evidently cryptocrystalline, and look as if they may have been heated and suddenly cooled, and thus fractured. When these pieces are subjected to a high power, there may be detected in them very minute *oval cavities* in great numbers, and the major axes usually placed in one direction. I have never seen cavities in *milky quartz* or *blue quartz.* Sir David Brewster found many cavities in rock crystal from Quebec with "water and mineral oil."[3]

Topaz.—In the various beautiful crystals which this mineral presents, there are frequently found cavities with fluid, and sometimes in this fluid may be seen the cuboid crystals described by Sir David Brewster. He found a single fluid in some cavities, and in others two fluids with "air bubbles." He says the fluid does not expand with heat. The Saxony transparent white crystals sometimes have cavities, as well as those of pale wine-color. The Brazilian gold-yellow specimens have these cavities very frequently. The clear pinkish are more free from them. I have never observed any microscopic acicular crystals in *Topaz.*

Emerald, *Aquamarine*, *and Beryl*—constitutionally the same—differ very much in regard to their possession of cavities and their commercial value. So far as I have been able to examine fine specimens of *Emerald*, it is rare to see one without cavities. One which I have, of very fine color, has many cavities of various forms,

[1] Sorby, Journ. Geol. Soc., 1858, found many cavities, and thinks that the cubic crystals inclosed are probably chloride of sodium, as mentioned above.

[2] The smoky quartz of Pike's Peak has hexagonal spangles, which may be mica.

[3] Trans. Roy. Soc. Ed., vol. x.

in which are included a fluid enveloping generally two perfect cubic crystals of an unknown mineral. In all cases in this specimen, the second crystal is much the smaller. Fig. 11, Pl. 2.

In Aquamarine, cavities are not frequent, and in *Beryl* I have detected them only in a specimen from Unionville, Penn. Fig. 12, 12*a*, Pl. 2. In this there is a biangular cavity with a small cubic crystal at an inner angle. Throughout the mass there are small suboval cavities.

Garnet.—As a precious stone this is by no means rare, but it is lustrous and of a fine color. Cavities and microscopic crystals are very common in this gem.[1] The cavities are usually irregular and rough, and never to my knowledge have fluid. On a polished surface of a piece of garnet from North Carolina, nearly an inch long, the reflection of these crystals covered the whole surface with prismatic colors.

Cinnamon Stone.—This beautiful variety of *garnet*, from Ceylon, as far as I have been able to observe it, and I have some twenty cut specimens, and numerous rolled pieces, has irregular cavities and some crystals, as I have stated in a former paper.

Zircon.—With its high refractory power, this is used frequently as a *gem*, and sometimes sold as a diamond when white and perfectly transparent. One of the numerous specimens which I have examined has cavities[2] and microscopic crystals, and a specimen from Ceylon has remarkable dark brown, elongate, fusiform spots, with numerous dotted ones intervening. Fig. 9, Pl. 2.

Chrysoberyl.—The few specimens I have of this beautiful *gem* have neither cavities nor microscopic crystals, but Brewster observed "strata of cavities and both the fluids."

Chrysolite = Olivine.—In some of my specimens I have observed small cavities with fluid. Brewster met with them containing "fluid and bubbles of air."

Spinel.—This *gem* occurs of several colors. The *Spinel-ruby*, so called, sometimes is very close in color to the true *Ruby*, but it has not by any means the depth nor brilliancy of the true *Ruby*. In a pale-green specimen of great beauty which I have received recently from Ceylon, I have not been able to detect cavities or

[1] Proc. Acad. Nat. Sci., Feb. and May, 1869.

[2] In a specimen in Dr. Leidy's fine cabinet, there are anastomosing cavities.

crystals. In my former papers I have expressed uncertainty in this matter.[1]

Iolite.—This *gem* is inferior in hardness, color, and specific gravity to *Sapphire*, but is valued for its peculiar change of color, being dichroic. One of my specimens is without any inclusions. The other is filled with blue four-sided prismatic crystals, which are long, and inclosed in a nearly white subtransparent mass. These crystals are sometimes broken and their parts prolonged in the mass, and they are all lying in nearly the same direction.

Turquoise, with its peculiar and agreeable blue, is never transparent, and neither cavities nor microscopic crystals are found in it.

Opal.—This exquisite gem, which displays such brilliant colors, is very highly valued. It is but little harder than glass, and is indeed considered as volcanic glass. Its remarkable flashes of color are attributed to fissures, in accordance with the theory of Newton's colored rings. I have never been able to detect either cavities or minute crystals in this beautiful gem—except in two cases. One of my specimens has a brown, terminated crystal, a six-sided prism of an unknown substance, about one-fifth of an inch long, and terminated by a single oblique plane; the other has several smaller ones.

Lapis-lazuli.—This was used by the ancients as a favorite *gem*, but it is not now valued as such. I have not been able to detect cavities or minute crystals in any specimen in my possession.

Corundum.—This very interesting mineral, when in perfect transparent crystals, is highly valued as a *gem*, under the name of *Sapphire*, *Ruby*, etc., according to color. When yellow, it is called *Oriental Topaz;* when purple, *Oriental Amethyst.* When purely white it is sometimes sold as a *Diamond.* In this country we have two localities only of *Corundum* where any large quantity has been found, that of Chester County, Pennsylvania, and Franklin County, North Carolina. From the mines in Chester County, several hundred tons have been taken, but no transparent crystals. Some opaque ones are bluish and some pinkish. The North Carolina locality has produced some very large crystals, and numerous small ones. Of the latter there have been found many quite pure and transparent, and these are sometimes blue and sometimes red. But none of them yet found are of value as

[1] Proc. Acad. Nat. Sci., Feb. and May, 1869.

gems. The fine *Sapphires* and *Rubies* are chiefly from Ceylon, and they form some of the most beautiful objects in nature. I have many of these in the form of worn pebbles, and some in fine hexagonal form, as well as hundreds of cut specimens. I have examined carefully more than one thousand specimens, with a view to discover whatever "inclusions" they might possess. In a communication to the Academy,[1] I described and figured some microscopic crystals in these and other *gems.* Since then I have added a very large number to my collection, and among these several hundred large and small transparent crystals. In a careful microscopic examination of these, I found a large number which contain cavities and minute crystals, the former sometimes scattered irregularly through the mass, and sometimes forming a sheet or film. These cavities are of all forms, but usually subelliptical; sometimes tubular, and these tubes frequently anastomose in a very beautiful manner. These cavities are so numerous that they frequently give a cloudiness to the specimen, which is less valuable as a *gem*, but most interesting in a scientific point of view. In some specimens these cavities exist by tens of thousands, and Sir David Brewster stated that in a specimen under his observation there were about 37,000 of these cavities. I am sure that in one of my large cut specimens there must be more than double that number. It is a very common thing to see hundreds at a time of these cavities in the Ceylon specimens, partly filled with the fluids previously alluded to in these notes. But it is quite rare that they are found in the specimens from North Carolina. Still I have seen them in the transparent small fragments of deep blue crystals, and sometimes in the transparent light-colored ones. In one specimen of the latter, I discovered some most interesting cavities, which contained, beside the *fluid*, each a *single cubic crystal*, Figs. 1, 2, and 3, Pl. 2. I had never observed an included crystal in any cavity in the numerous Ceylon specimens which I have examined. These cubic crystals have the exact form and appearance of those in the *Emerald* described herein.

In regard to the microscopic crystals in *Sapphire*, having described and figured them in the papers before alluded to, I have little to add now. Further observation has confirmed what I then

[1] Proc. Acad. Nat. Sci., 1869.

stated regarding the radii of *Asteria*. Very recently I have received a number of these *Asteria* of various colors, blue, purple, white, red, and dove-color; several three-quarters of an inch in diameter. The red and purple specimens are of peculiar beauty, and when examined in the sun, or any strong light, they both exhibit the microscopic acicular crystals with peculiar beauty, displayed as they are in hexagonal form, and reflecting the spectral colors. The *Ruby Asteria* is certainly among the most beautiful objects in nature, and the purple are very little less so.

In some crystals of *Corundum*, there is a strong bronze reflection, and this is the case with some of the large hexagonal crystals which were imported by Mr. S. S. White from India for commercial purposes, and which he distributed with so much liberality to our mineralogists. These bronze crystals have also been found at the Black Horse and Village Green localities in Delaware County, Pennsylvania. When examined with a good power, these bronze reflections are at once seen to be caused by minute acicular crystals, and these may sometimes be seen in bunches.

A *pale Ruby*, "Rubicelle," which I lately received from my friend Hugh Nevill, Esq., Ceylon, about three carats, is a most interesting and beautiful *gem*. It has the depth and brilliancy almost of the diamond. It is nearly of a rose-color, and is perfectly transparent. It is cut with a top table and not entirely symmetrical. Its refractive power is unusually great. Yet when this brilliant transparent *gem* is examined with a high power and strong light, the whole mass may be seen to be filled with long acicular crystals in three directions, parallel to the prismatic planes, and interspersed are numbers of very minute and delicate cuneiform crystals.[1] It has also a small cloud of exceedingly small cavities.

Another remarkable specimen may be mentioned here, which has small cavities and minute microscopic crystals. It is of a pale yellow or straw-color, and of a depth and brilliancy scarcely exceeded by the diamond.

During the examination, about two years since, of some hundreds of small crystals of *Sapphire*, perfectly transparent to dark blue, I discovered one which had very singular plumose impressions on the planes of the prism. This induced me to examine carefully all those which I subsequently procured, and I have now over a

[1] Proc. Acad. Nat. Sci., May 11, 1869.

dozen specimens which exhibit this very singular character.[1] I am entirely at a loss to discover the cause of this form of minute impressions on so hard a substance. It evidently has been formed by some collateral mineral substance, against which the molecules in crystallization have been arranged.

Diamond.—The hardest of all substances stands first among *gems.* It has not, however, much interest to the microscopist, as no cavities with fluid have been, so far as known, observed, nor has it included crystals of foreign substances. They are often very imperfect, containing rifts and discolorations. Some of my specimens have beautiful triangular impressions on the surface of the planes. My friend, Dr. Hamlin, of Bangor, Maine, is engaged on an extended work on the diamond. Such a work is much needed, and I know no one as capable as he to accomplish it. This gem sometimes occurs of various colors. In my cabinet I have six different colors.

REFERENCES TO PLATE 2.

Fig. 1, 2, 3, Plate 2. Represent cavities and crystals in a specimen of transparent *Corundum* from Franklin, North Carolina. In no other specimen of the numerous ones I have examined have I found cavities with a fluid and included crystals both, while it is very common in the Ceylon *Sapphires* to have cavities without an included crystal.

Fig. 4. A *Sapphire* from Ceylon, given to me by Dr. Ruschenberger, has cavities without fluid; the cavities being in the form of crystals in the larger ones, but in the numerous small ones subrotund. These cavities are interspersed throughout the mass with numerous acicular crystals running generally in two directions.

Fig. 5. A specimen of blue *Sapphire* (Ceylon), with four nearly perfect subhexagonal crystals, somewhat flattened. These are surrounded by an immense number of minute cavities, some of which anastomose. The crystals seem to be filled with a black fluid. There are also very minute acicular crystals.

Fig. 6. In the same specimen with the above, there is a group of very different crystals which are here represented. These can only be seen with a proper angle of light. Then they reflect all the colors of the spectrum. This group consists of very perfect cuneate and acicular crystals, and is somewhat like that figured in my pl. 9, fig. 2, Proc. Acad. Nat. Sci., May, 1869, but the crystals are much more defined and perfect than in that plate.

---

[1] Figs. 7 and 8, Pl. 2.

Fig. 7. Represents a small blue *Sapphire* one-fourth of an inch long. The very remarkable plumose impressions cover all the six prismatic planes.

Fig. 8. A blue *Sapphire* similar to Fig. 7, about three-sixteenths of an inch. The prismatic planes here are covered with impressions more in a dotted form. These two (Fig. 7 and 8) were examined with a power of one hundred diameters.

Fig. 9. A specimen of *Zircon* from Ceylon has very singular, dark brown, elongated fusiform maculations, in one direction. These are surrounded with numerous dotted ones.

Fig. 10. Among all the numerous specimens of *Moonstone* which I have examined I have found two only with "inclusions." These have numerous parallelograms which look like cavities, but may be true crystals of some foreign substance. There is no appearance of fluid in them.

Fig. 11, *a*, *b*, *c*, *Emerald*. A very fine specimen in my collection is filled with exceedingly interesting cavities with included cubic crystals, enveloped by fluid. The forms of the cavities are exceedingly varied, and the cubic crystals—generally *two*, a small and larger one—are remarkably perfect. These characters make this specimen one of very great interest.

Fig. 12 and 12*a*, *Beryl* from Unionville, Pennsylvania. Fig. 12 represents a remarkable biangular cavity with a cuboid crystal at one of the interior angles—has no fluid. Fig. 12*a* represents in the same specimen two cavities with fluid and air bubble. Both figures represent the numerous irregular cavities and imperfections which exist throughout the mass.

Note.—I have made these drawings with great regard to correctness, and the artist has well represented them.

June 6.

The President, Dr. Ruschenberger, in the chair.

Forty-five members present.

Fertilization of Flowers by Insect Agency.—Mr. Thomas Meehan remarked that the subject of cross fertilization and fertilizing by insect agency, was still one of absorbing interest.

There was no question about the facts; differences of opinion arose as to the meaning of the facts, and the extent to which they prevailed.

Contrary to the belief of many distinguished botanists, he could not see that those plants which were arranged for cross fertilization had any advantage in the "struggle for life" which prevailed in races, over those which were closely fertilized by their own pollen; and again, he found that many plants which were adduced by his friends to prove arrangements for cross fertilization, in fact fertilized themselves.

He said he would to-night refer only to three remarkable cases, the Scrophularia, dandelion and ox-eye daisy, and the red clover, and he selected these, because the distinguished author of "How Plants Behave," Professor Asa Gray, had made much use of the two first named in his book in describing arrangements for cross fertilization; and, as Professor Gray was present this evening, he felt sure that with his usual friendliness and good feeling towards all who were earnestly seeking the truth, he would do the meeting the favor to correct him if he found the speaker's observations not confirmed by his own. Red clover he would refer to, because it was oftener quoted. Red clover was, in fact, the *Vade mecum* of the insect fertilizationist.

Mr. Meehan then exhibited specimens of *Scrophularia canina*, and explained its floral development. The pistil protruded while yet the anthers were rolled back in the throat of the corolla. One by one these stamens were straightened out, the anther coming into close proximity with the stigma, when it burst, and by the contraction of the sacs, the pollen was ejected, falling on the stigma. The pollen was of a brilliant orange color, and the stigma of a pearly white, so that the smallest particle could be seen even by a good naked eye; and could be easily noted if carried to the stigma of other flowers by insects. Small sand wasps and other winged insects visited the flowers in extraordinary abundance; but it could be seen by observers that no pollen appeared on any stigma until the bursting of its own pollen sacs. Professor Gray, he said, in "How Plants Behave," had described "Scrophularia" as acting in a very different way to this, making no exceptions to any species, though it was fair to note that the illustration accompanying the text was of *Scrophularia nodosa*, a species not yet in flower with him.

Composite plants, he said, had been referred to as illustrating the peculiar arrangements for insect fertilization. The colored ray petals had been characterized by his friend as so many flags alluring winged insects to where the sweet secretions were, in order that they might bring foreign pollen at the same time. In his vicinity, surrounded as he was by an abundance of sweet flowers, he had never seen a winged insect on dandelion or ox-eye daisy (*Chrysanthemum leucanthemum*), though, on the waste grounds near him, they were in bloom by the thousand; but every little flower perfected a seed. There were millions on millions of seeds, and even admitting that there might be some winged insects at them that he did not see, they were certainly so scarce that it was out of the question to suppose that each of these had been fertilized by winged insects. He had found thrips in some flowers and on one occasion an ant, but these were too few for the immense work to be done. But this presumptive argument was unnecessary, as a careful observation of how the plants behaved, showed they were self-fertilizers. In the dandelion, he said the united column of stamens perfected, and spread its pollen in advance of the pistil. As the pistil grew it carried the pollen with it. The apex of the pistil then forked, and as the interior surface of the cleft alone had the stigmatic surface, it had been argued that none of the pollen could be used for itself. But a watcher would see that as the cleft opened the pollen on the *line of the cleft* fell in. It was but a little, but that was enough. Then the position of the upper part of the pistil in the dandelion favored this intrusion of the pollen. Just before the expansion of the stigmatic lobes, the pistil curved at the apex, and the slit opened first on the upper side of this then horizontal position. The pollen easily fell into the chasm. The lobes finally separated, until they became directly opposite to each other as generally seen in the dandelion. While this is going on, the lobes, having pollen abundantly on the under side, as they are sweeping the horizon, drop pollen, or even rub their surfaces on the expanded stigmas of the flowers below, and in this way, if they had no pollen of their own, the lower flower would be fertilized by that above. This would be cross-fertilization, but not by insect agency. But what if it were? Physiologically speaking, what benefit can it be to a composite flower to be fertilized by another from its own head, even granting the utmost asked by those who consider composites arranged for cross-fertilization? The composite flower is not a compound flower, it is true. It is but an imperfect umbel. But each umbel for all physiological purposes might as well be a single flower. Side by side the flowers are set, as any one familiar with the dotted thimble-like receptacle of dandelion very well knew. They all had just the same food, the same light, the same conditions of life in every material effect. If the familiar illustration by reference to the human family has any weight in plants, surely these flowers must be brother and sister, in any sense claimed by insect fertilizationists; and the physiological benefits to the race would be no more than if the whole head was a single flower, as a Ranunculus, instead of the compound flower we see. He then explained the manner of fertilization in the ox-eye daisy. The united column of stamens was forced from its holdings by the growing pistil, which finally attempted the cleavage of the apex, while still holding the cap-like covering of anthers over it. The pollen fell into the stigmatic cavity more easily than in the dandelion. Insects might visit it subsequently; it would make no difference, having already received its own pollen.

In regard to clover, Mr. Meehan said that in his remarks at Detroit last year, he had stated that he had watched a field of clover, found remarkably few insects at work, and yet the crop of seed was abundant, and that a careful examination of the clover blossom in all its stages convinced him that from its structure and behavior it was a self-fertilizer. He had been met with the assertion that the first crop of clover never produces any seeds. This was so generally believed that it must be true to a great extent. He could not have been mistaken last year, but he visited a field of two acres again a few days ago, and now exhibited heads nearly mature, all the flowers with seeds, and these (June 6th) about the first flowers that could have formed. On this visit he watched the field for an hour, and in that time saw only eight humblebees at work, rather small grist, he thought, for so large a mill, if all those flowers had to be insect fertilized. He watched their motions closely, and found, to his astonishment, that in spite of the elaborate arrangements for the work of the humblebees in the mouth of the corolla, they did not enter that way at all! They made a *slit in the base of the tube*, extracting the honey in this surreptitious way. With this final fact, if found general, there must be an end of the clover case. There was no bottom for the "arrangements" to stand on.

He had intended, he said, to rest the case here, but he had mentioned to his friend, Professor Gray, that he had noted the common bladder-nut, *Staphylea trifolia*, as being a self-fertilizer. It was one of those observations so recently made by him that he should not have introduced it to this body without further investigation; but Dr. Gray had suggested to him to refer to it, as he thought he could show it could not be fertilized except by insects, so he detailed what he had seen simply in order to have the benefit of Dr. Gray's experience.

Dr. Asa Gray said that Mr. Meehan and himself, looking at the same subjects with somewhat opposing prepossessions, were apt to see different facts; that is, either was likely to notice some particular which was not noticed by the other. For instance, Mr.

Meehan had some little time ago called his attention to the bladder-nut (*Staphylea*) as a case of close fertilization; but Dr. Gray's own observations, made in consequence of this suggestion, convinced him that this was a good case of arrangement for cross-fertilization. Like many other flowers, it was capable of self-fertilizing; for the anthers, charged with pollen, were contiguous to the edges of the dilated stigmas. But what his acute friend had omitted to notice was—that the flowers were hanging, and that, although the anthers surround the stigmas, the pollen is not ejected, but lies on the opened face of the anther in a thick coating, and when it falls, it will drop to the ground instead of upon the receiving stigmatic surface; some, however, may come in contact with its margin. Moreover, Dr. Gray found that the stigma was earlier than the anthers by twenty-four or forty-eight hours. The stigmas, borne on styles then considerably longer than the stamens, occupied the very entrance of the corolla as soon as it began to open, and was, as he found, in condition to be pollenated a day or two before the anthers of that blossom opened. Now in each raceme there were flowers in all stages, and the blossoms, as Mr. Meehan declared, were the favorite resort of bees; these while feeding from a flower with anthers open must needs smear their faces with the pollen, and when visiting flowers a day or two younger deposit some of this pollen upon their stigma, at a time when it could not possibly get any from its own anthers.

As to *Scrophularia*, his observations upon *S. nodosa* had prepared him to make a different reading of the facts now shown in *S. canina*. The arrangements for cross-fertilization in *S. nodosa*, as detailed and figured in the little treatise which Mr. Meehan referred to, seemed essentially similar in *S. canina*, except that both stamens and style were much exserted. Mr. Meehan had described the early protrusion of the style and the straightening and lengthening of the filaments a day or two later, so as then to bring the anthers into proximity with the stigma. But Dr. Gray doubted if any of that pollen ever acted upon the contiguous stigma, even if it reached it, thinking it more probable that the stigma was by this time withered and past fertilizing, as was the case in its relative, *S. nodosa*. The arrangement was a capital one for cross-fertilization, bees passing from flower to flower, brushing the same part of their body against the anthers of an older and the stigma of a younger flower; while self-fertilization was impracticable, at least, in *S. nodosa*, because no one flower shed its pollen until its stigma was past receiving it.

As to clover, Dr. Gray could now say nothing, except that it was a member of a tribe of plants which, though seemingly arranged for self-fertilization, were actually for the most part capital examples of the contrary.

His attention had been called by Mr. Meehan to Dandelions, which, from general recollection, he thought were frequented by flying insects. The first walk he took in his own neighborhood did not confirm this impression; but on the second he found small wasps and a dipterous insect busy with the dandelions, and flying from one to another, and also ants in abundance. It was clear that the narrowness of the style-branches in this and other liguliflorous compositæ gave them a chance for self-fertilization, but their characters were equally good for crossing through insect agency. As to ox-eye daisy, he could not confirm Mr. Meehan's description as to the carrying up of the anthers upon the style, which must have been abnormal. Dr. Gray supposed that the arrangement would be found to be like that of the allied Feverfew, which was well figured by Lubbock, after Ogle, and this clearly betokened cross-fertilization. About Cambridge, ox-eye daisies were so infested with small insects that ladies objected to having them brought into the house among cut flowers; and flying insects, he thought, did not disdain them.

As to the benefit of cross-fertilization, this was a large subject, which could not be disposed of in a few words; but Dr. Gray thought it probable that cross-breeding even of flowers in the same inflorescence was better than self-fertilization, and that wherever this occurred wider crossing was common.

Mr. Martindale called attention to the fact that, in the case of Staphylea, the stigma is ready for the pollen some time before it can receive it, and suggested that, therefore, perhaps the first flowers do not produce seed.

Dr. Gray rejoined that it could seldom happen that the first flower of every branch on a shrub or tree, or on different trees of the neighborhood, all opened on the same day; so that even the earliest flower had a fair chance to be fertilized.

Mr. Meehan handed a specimen of *Orobus atro-purpureus* from the table, and remarked that it might aid in settling that question; as, so far as his recollection now served him, it was the first flower of the season and of the raceme, and only the first flowers that generally perfected seed.

On Samarskite.—Joseph Willcox made some additional statements in reference to samarskite, which, until recently, has been a very rare mineral. The first discovery of it in Mitchel County, North Carolina, occurred in the spring of 1873, in a mica mine; and during that and the succeeding year about 700 pounds of the mineral were found, since which time the mine has not been operated.

June 13.

The President, Dr. Ruschenberger, in the chair.

Thirty-two members present.

A paper entitled "On the Occurrence of Helix terrestris, Chemn., in North America," by Wm. G. Mazyck, was presented for publication.

On a New Genus of Fossil Fishes.—Prof. Cope described a species of fish represented by a fragment of a jaw, which was said to have been derived from the phosphatic deposit near Charleston, S. C. The fragment indicated a species of large size, and supports alveoli or teeth to the number of ten in a space of M. .080. The crowns of the teeth are compressed, with a broadly rounded apex; the section at the base being lenticular, with sides swollen and apices produced. The latter are the sections of a cutting edge, which constitute the apex as well as the borders of the tooth. The longitudinal transverse section is triangular. The root is not composed of dentine, but of an ossified pulp, of osseous tissue, as in the *Pythonomorph* reptiles. This portion is nearly concealed in the alveolus, and there are no foramina along the inner side of the jaw communicating with the pulp cavities.

The succession of the teeth has been from below, as in the *Saurodontidæ*, the crown of the young tooth being developed below the centre of the root. Absorption followed; so that the centre of the root disappeared, leaving a cylinder with thin walls of osseous tissue running at right angles to the fibres of the inclosing jaw. The root has a lateral groove, which at this stage constitutes a fissure opening into the central cavity of the adjoining root. The osseous tissue at the base of the crown is quite spongy. Length of bases of five teeth M. .040, or long diameter of crown at base M. .008. Transverse diameter of base of crown .007; elevation of crown .010.

This fish belongs to a genus hitherto unnamed, presenting resemblance and perhaps affinity to *Pachyrhizodus* and *Conosaurus.* It differs from both in the compressed trenchant crowns, and from the first named in the entire inclusion of the roots in alveoli. From *Saurodontidæ* it differs in the absence of true dentinal roots. It was named *Cyclotomodon*, and the species, *C. vagrans.*

June 20.

The President, Dr. Ruschenberger, in the chair.

Twenty-two members present.

The Botanical Section reported that a meeting for organization had been held, and that officers had been elected, as follows:—

Director,	W. S. W. Ruschenberger, M.D.
Vice-Director,	Thos. Meehan.
Conservator,	Chas. F. Parker.
Recorder,	Isaac Burk.
Treasurer,	Jose O. Schimmel.
Secretary,	Henry Leffmann, M.D.

Remarks on Vertebrate Fossils from the Phosphate Beds of South Carolina.—Prof. Leidy observed that in a further search among the objects of the Agricultural Department of the Government Building of the International Exhibition, he had found another fossil specimen of a ziphioid cetacean. Like those previously described, it consisted of a detached beak, from the property of the Wando Mining Co., on the Ashley River, S. C., and was obligingly loaned by Mr. Amidon.

The specimen, exhibited to the Academy, has nearly the form and other characters of the one last described under the name of *Proroziphius macrops.* The bones are thoroughly co-ossified, and the condition of the beak indicates a mature animal, smaller than the species just named. The beak is 19 inches long in advance of the nasal apertures, and is about $3\frac{3}{4}$ wide near the middle. The supra-vomerian canal is closed over to within less than four inches of the end of the beak by the complete coallescence of the intermaxillaries. The prenareal fossæ are funnel-like, and terminate forward in a canal penetrating the maxillaries instead of first being prolonged into an open groove as in *P. macrops.* The anterior extremity is drilled in a remarkable degree by boring mollusks. With the other specimens previously indicated, the present one will be more fully described in a memoir on the vertebrate fossils of the Ashley phosphate beds. The species was named *Proroziphius chonops.*

Prof. Leidy further remarked that while examining the materials from the different phosphate beds of South Carolina, and mainly those exposed to view at the International Exhibition, his attention had been attracted by the large size of many of the teeth referred to *Carcharodon megalodon.* Among many teeth of this species, and others of *C. angustidens*, etc., contained in a show-case of the Bradley Fertilizer Co., in the Agricultural Hall, there is a megalodon tooth, from the Stono River, which measures 6 inches 8 lines in median length from a level of the ends of the root to the point of the crown, and 4 inches 8 lines in breadth across the base. A second specimen in the same collection and from the same locality is 6 inches in median length, and 5 inches 1 line in breadth.

A specimen from the Ashley River, formerly in the possession of Prof. Holmes, according to him, measures 6 inches 5 lines in length, and 5 inches 5 lines in breadth, and weighs 2 lbs. 8 drachms, apothecaries' weight.

These specimens are probably the largest shark teeth on record. If the animals to which they pertained held anything like the relation of length of body to the teeth as existing in the living white shark, they must have been upwards of a hundred feet in length.

June 27.

The President, Dr. Ruschenberger, in the chair.

Fifty-one members present.

Remarks on the Rhizopod Genus Nebela.—Prof. Leidy stated that in order to facilitate a ready reference to ordinary forms of rhizopods, he was disposed with some other observers to restrict the genus Difflugia to those rhizopods with lobose pseudopods, which ordinarily possess a covering or test composed of extraneous bodies, such as particles of quartzose sand, and diatome cases. In the genus Nebela, which he had viewed as distinct from Difflugia, the test is composed of discoid plates and minute rods, apparently siliceous and intrinsic to the structure of the animal.

To the genus Nebela probably belong the species named by Ehrenberg, *Difflugia collaris*, *D. cancellata*, *D. carpio*, *D. binodis*, *D. annulata*, and *D. laxa*. Likewise the *Difflugia peltigeracca* of Carter, most of the forms described by Wallich under the name of *Difflugia pyriformis*, var. *symmetrica*, and also the *Difflugia carinata* of Archer. Formerly Prof. L. had indicated several species under the names of *Nebela ansata*, *N. equi-calceus*, *N. sphagni*, *N. numata*, *N. barbata*, and *N. flabellulum*. Pr. A. N. S. 1874, 156.

Most of the above-named species of Ehrenberg had been referred by the same author to a group with the names of Reticella and Allodictya, headed with a species named *Difflugia asterophora*, which, so far as could be judged from the description and figure, did not coincide with the characters of Nebela. Of the forms referred to *Difflugia symmetrica* by Dr. Wallich, the first one described has recently, by Schulze, been viewed separately from the others as characteristic of a new genus with the name of

Quadrula symmetrica. The test of this is composed of quadrate plates, arranged in rows, like bricks in a wall.

In all the species referred to Nebela, which have been observed by Prof. L., in all instances the test is compressed pyriform. Wallich remarks in reference to the tests of *Difflugia symmetrica*, that they "are sometimes so compressed as to give the aperture the undulating appearance represented in Figs. 27, 29 and 30, but more frequently the tests are not compressed, and the aperture presents the ordinary circular or nearly circular outline."

The species *Nebela numata*, probably synonymous with *D. collaris*, is an exceedingly abundant form, in much variety in our sphagnum swamps, and illustrates well the character of the genus, and also exemplifies the extraordinary variation in the structure of the test, which appears to be common also in the other species of Nebela.

In some individuals of *Nebela numata*, the test is composed of or invested with comparatively large circular disks of uniform size, as represented in the diagram (Fig. 1). In other individuals the disks are of the same character, but oval as in Fig. 2. In other

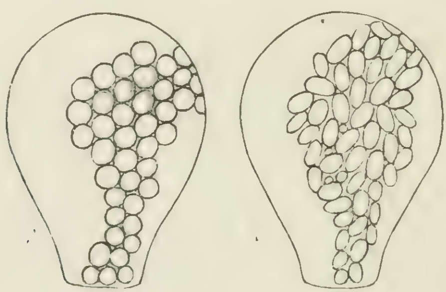


Fig. 1. Fig. 2.

individuals again the test is invested with circular or oval disks as in the former, but separated, uniformly scattered, and with the intervals filled with small circular disks as in Fig. 3. In other instances large circular or oval disks occupy the fundus of the test, and small ones extend from one-half of the body to the mouth, sometimes mingled with a few of the larger disks. In some instances the test is composed of minute circular disks alone, or with a few large oval or larger circular ones scattered here and there.

Generally the disks of the tests are sharply defined, closely placed, and touching at their contiguous edges. Sometimes they are crowded, and assume in a certain focus a more or less polygonal outline. Sometimes they appear to overlap the edges. Usually very distinct; they are sometimes more or less indistinct.

The large disks in a certain focus appear centrally shaded, and exhibit a striking resemblance to ordinary blood corpuscles.

Not unfrequently the test is mainly or almost entirely composed of minute rods, placed in alternating oblique patches, with a few minute round disks, as in Fig. 4. In other tests the disks pre-

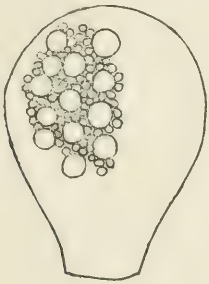


Fig. 3.

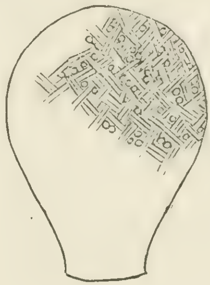


Fig. 4.

dominate. In some tests large and small disks and rods are intermingled. In other tests larger, and fusiform rods, probably diatomes, are mingled with disks, as in Fig. 5.

Between the structural forms of the tests indicated, all sorts of intermediate forms are found. Occasionally, mingled with the more intrinsic elements of the tests, there are undoubted diatome cases, and rarely distinct and comparatively larger particles of siliceous sand.

Fig. 5.

Prof. L. looked upon the disks and rods of the test of Nebela as intrinsic structural elements. They appear to be siliceous, as they undergo no change in heated sulphuric acid. No similar elements could be detected among the ordinary materials among which the animals lived.

Dr. Wallich regards the disks and rods, of the forms he has called *Difflugia pyriformis* var. *symmetrica*, as being derived through the metamorphosis of diatome cases, through the combination of these with the basal substance of the test. In the reference to his figures 27 to 33 *An. and Mag. Nat. Hist.* 1864, pl. he says that they "represent the series of forms exhibiting the transition from the ordinary mineral and chitinoid elements of the test to the evolution of the colloid disks." Prof. L. remarked that notwithstanding he had examined multitudes of Nebela, he was not prepared to confirm this view, though he had too much respect for Dr. Wallich's accuracy of observation to doubt its correctness.

The figures 1–4 represent ordinary forms of *N. numata;* and

Figure 5 the relative compression of the test. Figure 6 is the form described as *N. flabellulum*, which may be regarded as an extremely broad variety of the former. Figure 7 represents the relative thickness of the same test. Between the forms referred to *N. numata* and *N. flabellulum*, all sorts of transitional ones occur. Figures 8, 9 exhibit two views of a narrow form of *N. numata*, which resembles the *Difflugia binodis* of Ehrenberg.

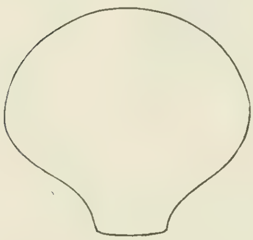


Fig. 6.

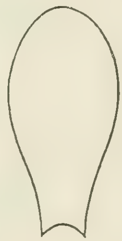


Fig. 7.

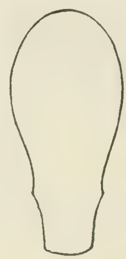


Fig. 8.

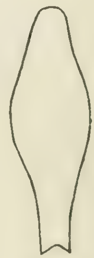


Fig. 9.

Figure 10 represents an outline view of *Nebela carinata*, or *Difflugia carinata* of Archer, from sphagnum of New Jersey. Figure 11 represents a transverse section. Figure 12 *Nebela equi-*

Fig. 11.

Fig. 13.

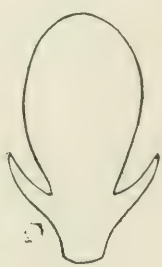


Fig. 14.

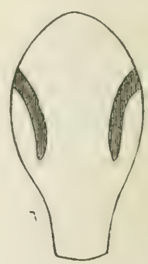


Fig. 15.

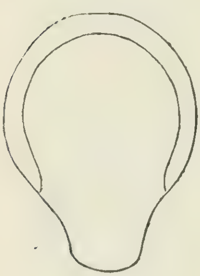


Fig. 10.

Fig. 12.

calceus, a transitional form from *N. carinata*. Figure 13 a transverse section. Figure 14 *Nebela ansata*, which looks as if it were derived from the former by the loss of the horse-shoe-like ribs. Figure 15, another form observed, unnamed, in which, instead of the horse-shoe of Figure 12, there are two hook-like processes projecting in the interior of the test. Figures 16, 17 outlines of *Ne-*

bela sphagni. Figure 18 *Nebela barbata.* For characters of the species see *Proc. Acad. Nat. Sci.* 1874, 156.

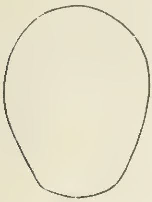


Fig. 16.

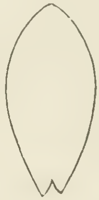


Fig. 17.

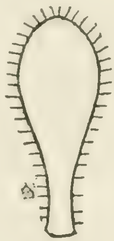


Fig. 18.

On Certain Trap Rocks from Brazil.—Prof. PERSIFOR FRAZER, Jr., stated that during a recent engagement by the Commission of Brazil to the International Exhibition, now being held here, to examine and arrange the ores, minerals, and rocks of that country, a number of traps were obtained, of which thin sections had been submitted to a preliminary investigation.

These have been studied without the aid of chemical analysis, and the results, so far, are hereby laid before the Academy.

It is evident that this mode of determination cannot by itself be exhaustive, but it is believed that some new facts are hereby added to our knowledge of the igneous rocks of the globe, and a close analogy between certain species of North and South America made out. It was not possible to ascertain the localities in all cases. The following is a partial list:—

No. 580.—Between Casa Branca and Rio das Pedras.

No. 587.—Between Ouro Preto and Casa Branca.

No. 610.—From Resaquinha.

No. 790.—Procedencia Morrotos.

The following is a hasty glance at their mineral constituents:—

No. 279.—*Dolerite.* Labradorite, Pyroxene, Chlorite, and Magnetite.

No. 580.—Pyroxenite rock, with microliths.

No. 587.—Pyroxene and Biotite.

No. 591.—Decomposed mass, containing Pyroxene and Magnetite.

No. 610.—Chlorite, with concretions of Ferric Hydrate.

No. 635.—Under 230 diameters, and without polarized light, the "flowing" structure is well shown.

Between crossed Nicol's prisms the lines which resemble microliths exhibit an intricate network and polarize from white to light blue. Under 1080 diameters the above lines seem to be corrugations or clefts in the mass, while a new set of minute black and brown prismatic crystals come into view, indicating by the gradual curve in the line of their direction also a "flow structure." Chrysolite (*Olivine*) and Mica appear to be present in this specimen.

No. 665.—Labradorite rock, with bundles of microliths. Containing also pyroxene and magnetite.

No. 684.—With an enlargement of 350 diameters and between Nicol's prisms this specimen exhibits Labradorite and Pyroxene (one beautiful main section of the latter). The blades of labradorite are smaller and the pyroxene less distributed through the mass than in No. 706.

Another mineral not certainly determined polarizes from green to black.

No. 692.—Pyroxene in a vitreous paste, containing Chlorite.

No. 706.—With a magnifying power of 230 diameters this section exhibits a mass of brown and reddish-brown fragments of irregular shape.

The cross fractures are numerous and irregular. Various angles of fracture were found to give 84° 47′, 78° 51′, 73° 20′, 53° 59′, and 88° 28′, but the micro-goniometer employed could not be relied on for angles of less than 1°.

The latter of these measurements is sufficiently near the prismatic angle of Augite (*i. e.* 87° 5′), to suggest the presence of that mineral.

Many slabs of Labradorite are associated with it, each of which is readily detected by its characteristic mode of twinning.

Black masses of Magnetite are strewn through the field of view, and some rod-like Apatite.

Under 350 diameters more crystals of Apatite appear.

With *one* prism, isolated spots of the mineral first described show feeble dichroism. *Dolerite.*

No. 769.—Decomposed Pyroxene, with Magnetite and Labradorite. The specimen shows signs of the passage of Dolerite into a rock more nearly resembling Diabase from the presence of a chloritic material (perhaps the "Diabantite" of Hawes), and its generally decomposed appearance.

No. 786.—Under 1080 diameters Chlorite and Pyroxene are visible, together with a white, pasty glass.

No. 790.—Feldspar, Olivine, Magnetite, and Apatite.

No. 795.—*Dolerite.* Consists of Pyroxene, Magnetite, Labradorite, and large numbers of Apatite crystals.

(The sections of the Magnetite and of the Apatite crystals are very fine.)

Feeble dichroism is observed in spots on the Pyroxene. No Mica visible.

No. 795.—Pyroxene, Magnetite, Labradorite, and a large number of Apatite crystals.

x. Magnetite, Chrysolite, Labradorite, and some Pyroxene.

x′. Labradorite, Pyroxene, Magnetite, and Apatite. *Dolerite.*

Thin sections of these rocks and also those of similar character from Pennsylvania were projected on the screen in polarized light and compared.

Harvey Fisher, Geo. A. Wright, A. C. Lambdin, M.D., John Russel, J. C. Martindale, and A. E. Brown were elected members.

The following papers were ordered to be published:—

ON CERTAIN MEXICAN METEORITES.

BY MARIANO BARCENA.

At the last meeting of the Academy, Prof. Smith having spoken of an aerolite from Chihuahua, I have thought proper to relate some facts about other Mexican meteorites.

Certainly, my country is most abundantly provided with these meteoric masses; to the present time they have been found in the States of Chihuahua, Sonora, Sinaloa, Nuevo-Leon, Coahuila, Zacatecas, Durango, San Luis Potosi, Mexico, and Oaxaca.

The most notable masses which have been discovered in Chihuahua are found in the "Concepcion hacienda," and in a place called "Chupaderos." I have seen two pictures of one of the meteorites of the former place, and, according to the explicatory scale which the drawing had, I could judge that it was of great dimensions; its form, like that of all the meteorites of Mexico, tends to that of a prism of curved faces, and presenting various irregularities. They have assured me that the mass which is found in Chupaderos is of greater dimensions than the one I have mentioned.

Other meteoric irons of various dimensions are found in the vicinity of the "Presidio del Principe," in the same State of Chihuahua. The National Museum of Mexico possesses various facts about these masses, and probably will get some of the latter, as the inhabitants of that State have promised to send some of them.

The Mexican Society of Natural History of the City of Mexico received last year a picture and some small fragments of an enormous meteoric mass lately discovered in the State of Sinaloa. Although I do not remember at present its exact dimensions, still I can assure the Academy that its length was more than twelve feet. I have commenced to analyze that meteorite, and I will conclude the work on my return to Mexico. Like those to which I have referred, it belongs to the class of the SIDERITES of Mr. Daubrée—as it is composed essentially of iron and nickel. It is of a silver-white and grayish color.

The aerolites of Nuevo-Leon and Coahuila were found in

"Santa Rosa" and in the "Potosi." The facts we have regarding them are few and insignificant.

From Zacatecas they have taken to Europe various samples of meteoric irons; one of them was analyzed by Clark, and had the following composition:—

Iron	86.09
Nickel	9.96
Chromium	0.67
Sulphur	0.84
Magnesia	0.19
	97.75

Baron Humboldt and other persons have also carried to Europe some samples of meteorites from Durango. The analysis made by Mr. Damour of the aerolite of the Mezquital is known; the composition is the following:—

Iron	93.38
Nickel	5.89
Cobalt	0.39
Phosphorus	0.23
	99.89

In the National Museum of the City of Mexico exists another meteoric mass, which came from the "Cascaria" hacienda in the State of Durango. It is composed in great part of iron, and, on attacking its surface with acid, the figures of Widmastaeten appear very clearly—the dominant form of these figures being quadrilateral.

In the State of San Luis Potosi two aerolites of large dimensions were found. One of them, called "Meteorito de la Descubridora," was sent four years ago to the Mexican Society of Geography and Statistics of the City of Mexico, by Messrs. Cabrera and Yrizar of the City of San Luis Potosi. This mass, which weighed 576 kilogrammes, was divided in several pieces for the purpose of making some investigations as to its structure. The form of the meteorite was also prismatic; it resembled that of a pyramid with a triangular base; the drawing taken with a photographic apparatus presented in its outline several lines well determined, which formed triangular and quadrilateral figures very similar to those produced by hydrochloric acid upon the polished surface of the same mass. The color of the aerolite is grayish-white, and its texture is notably crystalline. Its specific weight is 7.38. It is composed of

Iron	89.51
Nickel	8.05
Cobalt	1.94
Sulphur	0.45
Chromium	trace
Loss	0.05
	100.00

The resistance of that iron to rupture by compression is 38 kilogrammes to the square millimetre; the resistance to the rupture by extension is 40 kilogrammes, being the section of the metallic thread of a square millimetre. The coefficient of lineal dilatation between 0° and 100° is 0.0000701.

The analysis of the meteorite in question was made by the Mexican chemist, Don Patricio Murphy; the other studies were made by a commission, of which I had the honor of being a member.

My learned friend, Prof. James D. Dana, of New Haven, possesses a fragment of this meteorite, which I sent to him, and in which the figures of Widmasstaeten are perfectly formed. The meteoric iron of the "Descubridora" is also very notable for the many cavities which it has in its interior, and which are occupied by the troilite or proto-sulphide of iron. It presents itself under the form of a crystalline powder of a bronze-yellowish color.

Another meteorite from the State of Zacatecas, which was found in the vicinity of "Charcas" was taken to the Museum of Paris by the French army. Its form is like that of a triangular pyramid. Its analysis was made by Prof. Mennier, and is as follows:—

Iron	93.01
Nickel	4.32
Insoluble matter in acids	0.70
	98.03

In the State of Mexico have been found several meteorites called "Ocotitlan," "Toluca," "Yxtlahuaca," and Xiquipilco." The first three were taken to Europe: the "Ocotitlan" was studied by Profs. Burkart and Bergeman, who, on analysis, found the following composition:—

Iron	85.49
Nickel	8.17
Cobalt	0.56
Insoluble matter in acids comprising Schreibersite, Graphite, etc.	5.00
	99.12

In Xiquipilco the meteoric irons are very abundant, and all proceed probably from a great mass which was broken into pieces. A sample from that locality analyzed by Mr. Pugh had the following composition:—

Iron	90.43
Nickel	7.62
Cobalt	0.72
Phosphorus	0.15
Sulphur	0.03
Copper and tin	0.03
Schreibersite	0.56
Graphite	0.34
	99.88

The specimens of a meteoric iron from Xiquipilco are very remarkable for their crystalline structure. Schreibersite is found under the form of white and flexible laminæ determining octahedral cleavages. In the same collection which the Mexican Society of Natural History of the City of Mexico sent to the International Exposition, is found a sample of iron from Xiquipilco, in which I discovered a part of a regular octahedron, raising the laminæ of the Schreibersite, which are located in perfect regularity on the specimen.

The National Museum of the City of Mexico sent also to the Exhibition a sample of meteoric iron from the same locality; in it is observed an oxidized layer which presents several green spots produced by the compounds of nickel which it contains. That layer to which I refer is characteristic of the iron from Xiquipilco.

In the State of Oaxaca have been found two very remarkable meteoric masses, which are distinguished by the names of "Mixteca Iron" and "Yanhuitlan Iron."

The first was studied by Profs. Burkart and Bergeman; its composition is the following:—

Iron	86.857	
Nickel	9.917	
Cobalt	0.745	
Phosphorus	0.070	
Sulphur	0.553	0.524 carbon and iron.
Insoluble residue in the acids	0.975	0.451 { 0.053 phosphorus. 0.133 nickel. 0.265 iron.
	99.117	

The meteorite "Yanhuitlan" is found at present in the National Museum of the City of Mexico. It was found in the vicinity of Yanhuitlan, by some countrymen when they were tilling the soil, at the foot of a hill called Deque-Yucumino. Its weight is 916 pounds.

The figure of this mass is very interesting, as it approaches remarkably to that of a tetrahedron. Its color is grayish-white. Its specific weight is 7.824, and its composition, discovered by the celebrated Mexican chemist, Don Leopoldo Rio de la Loza, is the following:—

Iron	96.58182
Nickel	1.83200
Volatile substances	0.36210
Silicious sands	0.00560
Carbon	0.00018
Lime	0.60815
Alumina	0.61015
	100.000

There are other facts about several meteorites from Mexico, but the places where the latter are found are not well determined.

That peculiar property, difficult of explanation, which the Mexican soil has in attracting the meteoric irons, is even noticed at present; numerous are the shooting stars which cross the atmosphere of that republic, and more especially in the months of August and November. This phenomenon, which is also observed in other parts of the world, I have seen on various occasions in my country. Lately one of those shooting stars came against a summer-house in the State of Puebla, causing much damage to the occupants.

The studies which may be made beforehand of the physical characters and the chemical composition of the meteorites of Mexico, will group the latter in series, and will refer many of them, perhaps, to the same origin, as it is the case with the "Xiquipilco" meteorite, which, by its crystalline structure and other properties, may be thought to proceed from the same mass.

ON THE OCCURRENCE OF HELIX TERRESTRIS, CHEMNITZ, IN NORTH AMERICA.

BY WM. G. MAZYCK.

In July, 1875, I accidentally discovered a number of dead shells of Helix terrestris, Chemnitz, in St. Peter's (Episcopal) churchyard, Logan Street, Charleston, S. C., but, notwithstanding a most diligent search, no living examples of the species could be found at that time, owing probably to the prevalence of an almost unprecedented drought.

In September, I was, however, fortunate enough to secure two living specimens; which were sent to my friend Mr. W. G. Binney for examination, who kindly furnishes the following description of the jaw and figures of the lingual dentition:—

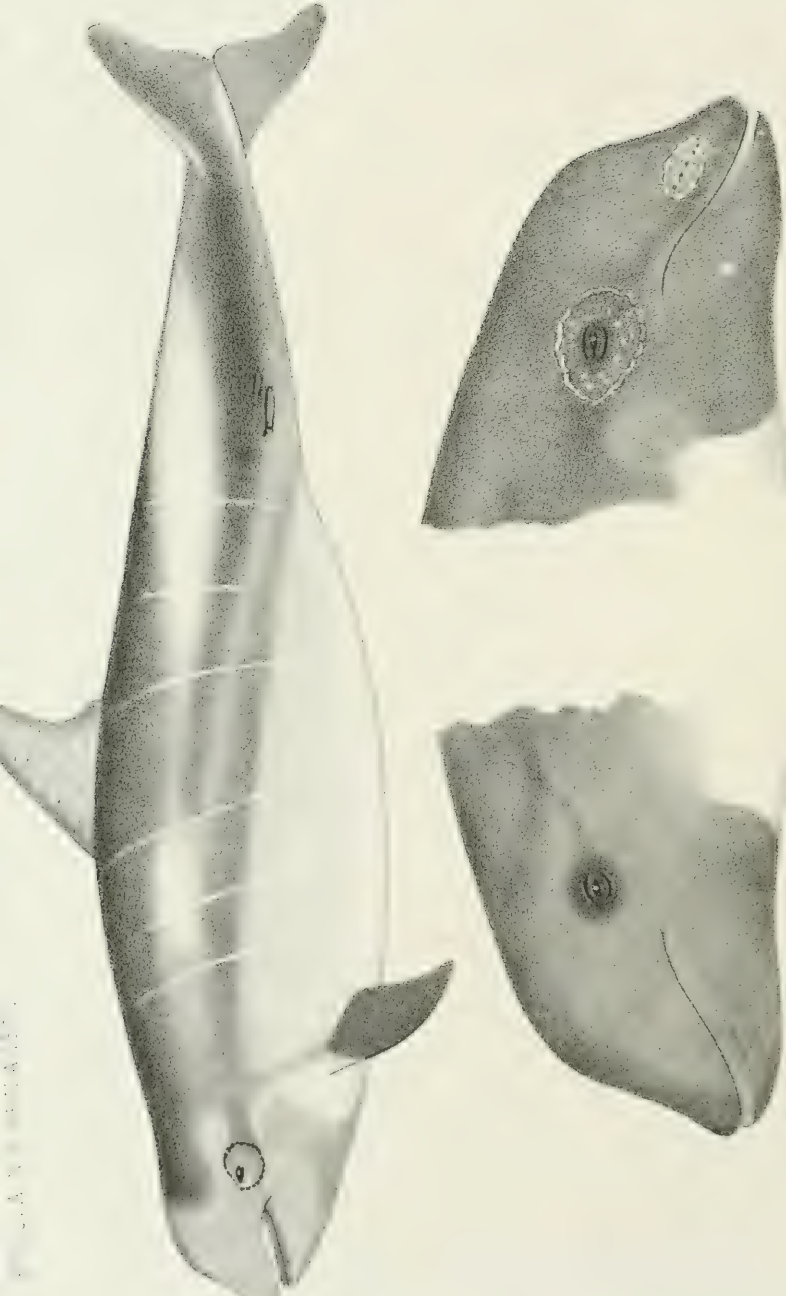
"Jaw slightly arcuate, low, wide; ends blunt, slightly acuminate; anterior surface with over 14 broad, crowded, flat ribs, slightly denticulating either margin."

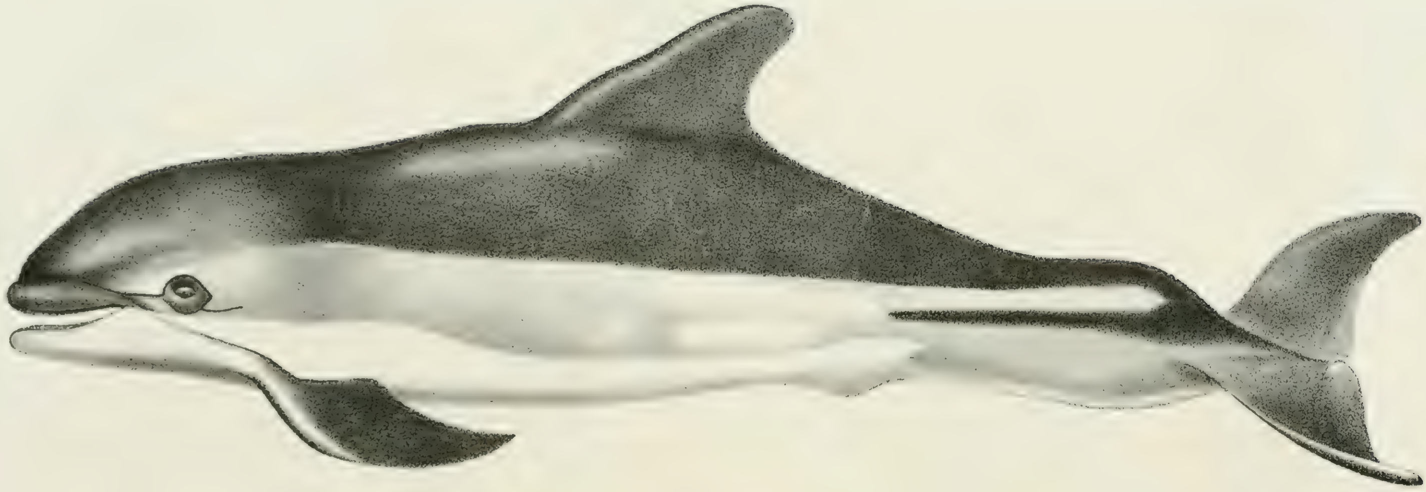
Von Martens (Albers' Heliceen, p. 116) places the species in the sub-genus Turricula, Beck, giving as the habitat, "Italy and Southern France." I have never heard of its occurrence elsewhere until its discovery in Charleston, where it exists, as far as I can ascertain, only in St. Peter's churchyard, accompanied by *Helix aspersa*, Müller, *H. Hopetonensis*, Shuttlw., *Zonites minusculus*, Binney, *Pupa marginata*, Say, and *Stenogyra decollata*, Linnæus, which latter is exceedingly abundant throughout the city.

St. Peter's Church was burnt in the great fire of December 12, 1861, at which time the greater portion of the shrubbery of the graveyard was also destroyed. The ruins of the building were removed about two years ago, and, the shrubbery not having been renewed, there is but little shade, a circumstance which has, doubtless, greatly retarded the propagation of the species which has probably existed in small numbers for several years in this very restricted locality.

I am indebted to Mr. Thomas Bland for the determination of the specific name.

Specimens of the dead shells have been deposited in the Museum of Comparative Zoölogy, Cambridge, Mass., in the cabinets of Mr. W. G. Binney and Mr. Thos. Bland, and may be seen in my own collection.





[illegible] Cope.

FOURTH CONTRIBUTION TO THE HISTORY OF THE EXISTING CETACEA.

BY E. D. COPE.

Grampus griseus, Cuvier. Pl. III.

A specimen apparently belonging to this species was taken by the United States Commission of Fisheries off the coast of Massachusetts. Its appearance may be learned from the accompanying plate, which is copied from a drawing made on the spot by the artist of the Commission. Its length is five feet five inches; the length of the pectoral fin, measured along its median line, is nine inches.

Globicephalus brachypterus, sp. nov.

Globicephalus? sp. nov., Cope, Proceedings Academy Philadelphia, 1866, p. 8.

A female of this genus was taken by fishermen, in February of the present year, on the east coast of Delaware Bay, at the mouth of Maurice River, and was sent to this city, where it fell under my observation. Its uninjured condition offered an opportunity of making a description of its external proportions and appearance. This had been a desideratum, since the examination of a cranium several years ago had led me to suspect that the blackfish of the middle and southern Atlantic coasts of the United States is a different species from the *Globicephalus melas* of the northern coasts of both continents.

The measurements of this specimen are as follows:—

	Feet.	In.
Total length, measured along the side	12	6.5
Length to base of dorsal fin		37
Length of base of dorsal fin		24
Elevation of the dorsal fin		9
Length of the pectoral fin		25.5
Greatest width of pectoral fin		7
Width of thorax between pectoral fins		18
Depth at middle of dorsal fin		35
Length from vent to end of tail (on convexity)		52
Depth of caudal peduncle half way between anus and end of tail		22
Expanse of flukes		43

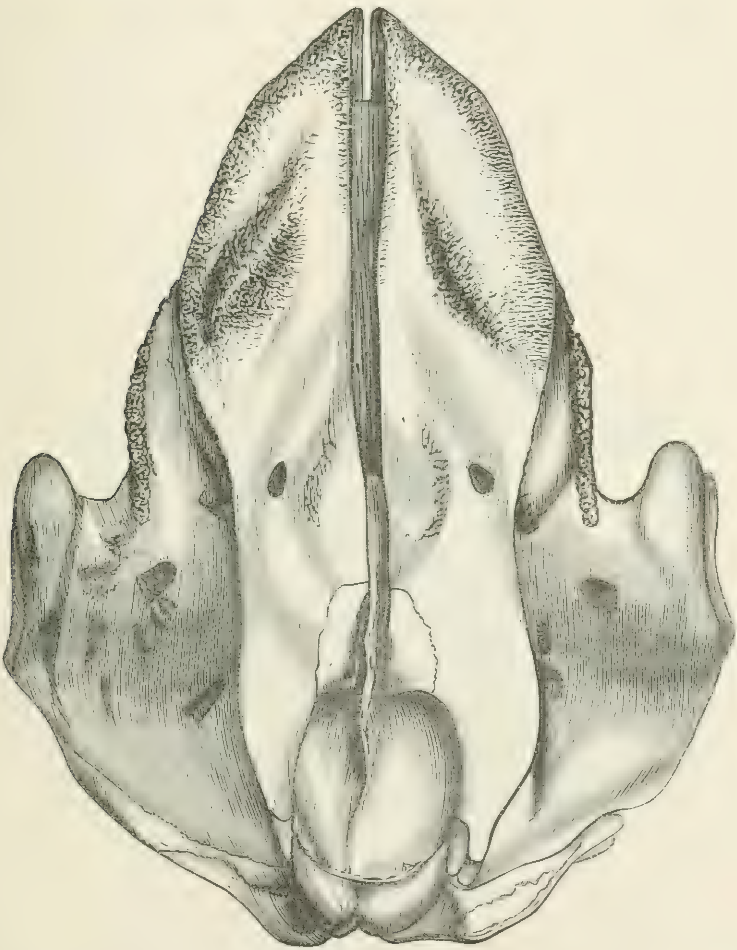
The color is a uniform black, without any markings whatever.

The profile of the head has the protuberant convexity of the other *Globicephali*, with a very narrow projecting lip. The general form of the body is elongate, more so than in the *G. melas;* and the dorsal fin has a more anterior position. Instead of standing near the middle of the length, it rises at the end of the anterior fourth of the length. Its base is unusually long, and its elevation not great. Its superior border is convex, and the apex decurved behind so as to be slightly descending. The posterior or caudal part of the body is much compressed, and maintains its depth with a very gradual diminution until near the flukes, where it contracts more rapidly. The blow-hole is situated at a point less than half way between the points opposite the eye and front base of pectoral fin; it forms a fissure, which presents a shallow concavity forwards. The anterior base of the pectoral fin is situated at the anterior third of the distance between the blow-hole and the front border of the dorsal fin. It is characterized by its relatively small size, and offers one of the distinguishing features of the species. It enters the total length six times, while in the *G. melas*, according to Van Beneden, it enters the total 4.5 times in a fully grown fœtus, and the length increases with age, according to Flower, so that its proper length would be about one-fourth of the total. This measurement nearly agrees with that given by Dr. Jackson, as obtained by him from a specimen from the New England coast, which I suppose to belong to the *G. melas.* In a specimen taken by the U. S. Fish Commission, the length of the pectoral fin is nearly as in the *G. brachypterus.* This probably represents the *G. intermedius*, Harl., and has a white abdominal band, and light gular areas.

The teeth in the specimen from Maurice River are small, and number five in the upper jaw and six in the lower. There is a mammary fissure on one side of the vulva, and a fissure with an additional fold on the other side.

The skeleton of this specimen presents several interesting characteristics. The cranium differs from that of *G. melas* in the anterior lateral expansion of the premaxillary bones, so that they entirely conceal the maxillaries when viewed from above. This character is not seen in numerous specimens of the *G. melas* from Cape Cod. The front teeth are less firmly implanted in alveoli than those of the *G. melas;* thus on one side of the maxillary bone, four alveoli are filled with osseous deposit; and on the other side, one. The cervical vertebræ are all coössified, and they present no parapophyses, and but one diapophysis on each side (the seventh). Three segments of the sternum are preserved, which are longer than broad, the anterior two coössified. The first

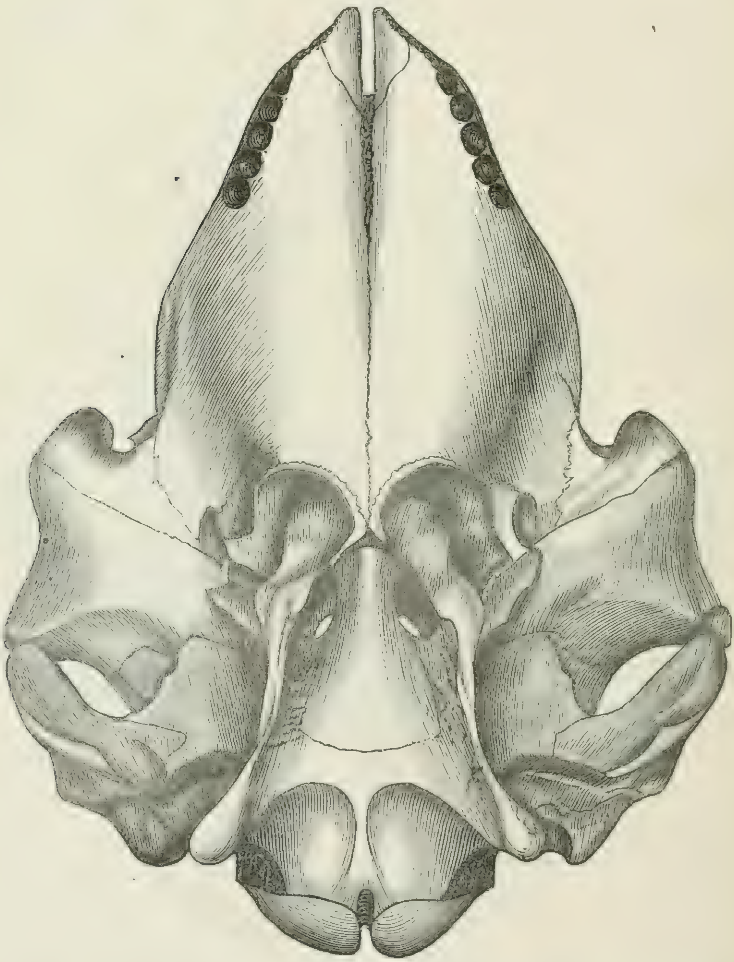
Fig. 1.



one is furnished with recurved antero-lateral processes, and is divided in front by an oval foramen. The scapula is as wide as high; it presents a rather long, truncate, coracoid process, and a prominence of the proximal part of the spine, which represents the acromion.

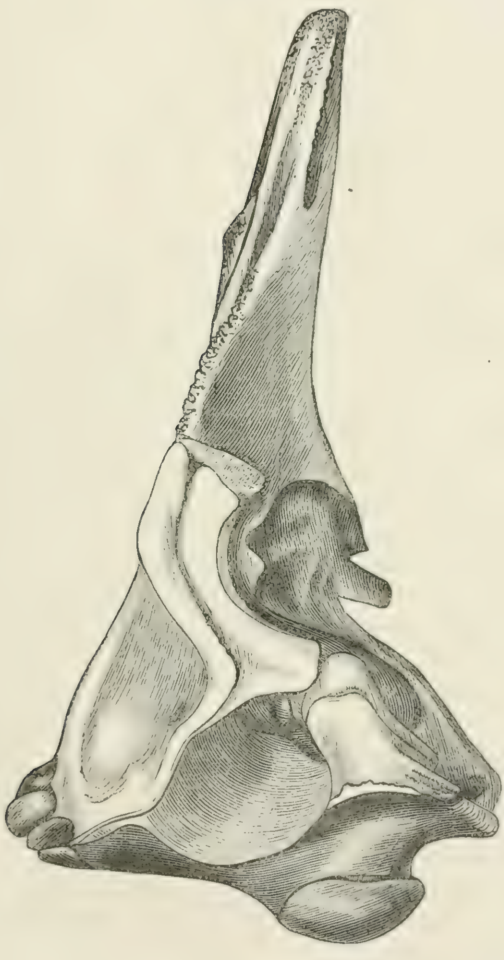
The cranium which I formerly described (Proceedings Academy Philada., 1866, p. 8) is that of an adult of full size. I remarked

Fig. 2.



at that time that it differed from the crania of the *G. melas* from the European and New England coasts in the greater width of the premaxillary bones, which extend to the lateral borders of the basal two-fifths of the maxillaries; and also in the small number of maxillary teeth, there being only five alveoli in the upper jaw. The existence of the same number of teeth in the

Fig. 3.



specimen now described proves that this small number in the adult is not due to shedding, or connected with age, and it is probably a constant character of this species. In the *G. melas* there are ten teeth in the maxillary bone, as I have observed on numerous specimens from the New England coast.

In review, the *Globicephalus brachypterus* is characterized by the short pectoral fins, the few teeth, the wide premaxillary bones, and the absence of white band along the median line of the lower surfaces. The anterior position of the dorsal fin is also probably characteristic. In the two characters first enumerated, it approaches the genus *Grampus* more nearly than does any other well-known *Globicephalus*.

The cuts represent the profile and superior and inferior surfaces of the skull of the larger individual above mentioned.

Phocæna lineata, sp. nov.

This new porpoise is represented by a single specimen, which was taken in the harbor of New York not many months ago, and sent to the Smithsonian Institution, where the skeleton is now preserved. Under direction of Professor Baird, a plaster cast of the animal was made and colored directly from the specimen, with the excellent result of offering a means of study more reliable than the dried skin, where the form is likely to be distorted from various causes, and the color changed by the action of the oil. A large number of skeletons and two plaster casts of the common porpoise of our coast (*Phocæna brachycium*) having also been prepared under the direction of Prof. Baird, ample means for the comparison of the two species exist. The Smithsonian collection embraces also two crania of the *P. communis* from the Norwegian coast, and two of the *P. vomerina*, Gill, from Puget Sound, Washington Territory.

A comparison of these crania develops the following distinctive characters of three species. I may premise that a second cranium in the Smithsonian collection, and one in the museum of the Philadelphia Academy, agree in characters with that of the *P. lineata.*

Phocæna communis, Brookes (Nos. 3507–8).

Vomer not at all or very little exposed behind posterior border of palatine bones, which are not separated from the pterygoids by deep entrant notches.

Phocæna brachycium, Cope (*P. americana*, Agass., fide Verrill; not described), Proceed. Acad. Philada., 1865, p. 279.

Vomer with a narrow transverse protuberance behind the palatines, which are separated from the pterygoids by a deep notch.

Phocæna lineata, Cope, sp. nov.

Vomer with an extensive development behind the posterior margin of the palatine bones, forming an inverted table; the pterygo-vomerine outline forming an M.

The skull of the *P. vomerina*, Gill, differs in no appreciable degree from that of *P. brachycium*, and it remains to ascertain in what respect other parts of its structure present distinctive characters.

The *Phocæna lineata* presents various features which distinguish it from the *P. brachycium*. The body is relatively larger and longer, the length of the cranium entering the total six times; while that of *P. brachycium* is only one-fifth the total length. The base of the pectoral fin is situated more than half way between the end of the muzzle and the line of the anterior base of the dorsal fin. The dorsal region and border of the dorsal fin are entirely smooth, in the cast as in life, according to my friend, G. Brown Goode, of the U. S. Fish Commission, who examined the skin. There are twenty-four teeth of the typical form in each ramus of the mandible.

The color of this porpoise is quite characteristic. The upper surface to the middle line of each side is black. This color is bounded below from a point behind and below the eye to a foot in front of the end of the tail by a rosy-brown. The lower surfaces are whitish. The pectoral fin is black, the color being isolated from the black of the sides by the white and rosy colors described. Its black color is continued forwards and upwards as a narrow band to a point about three inches below the eye.

In the following measurements some comparisons are made with the *P. brachycium*.

	Inches *P. brachycium*.	Inches. *P. lineata*.
Total length	47	68
Length of skull	9.3	11
Length to base of dorsal fin	21	30
Length to posterior base pectoral	12	17
Width of skull at notch		3
Width of skull above orbits		5.6
Elevation of cranium		5
Length of head to below blow-hole . . .		6
Length of head to eye (inclusive)		7.6
Length of posterior edge of pectoral fin . . .		6.6
Elevation of dorsal fin		4

In further comparison with the *P. brachycium* I may add, that the casts preserved in the Smithsonian collection show that the colors of that species are widely different from those of *P. lineata*. They are black above, and the belly has a narrow yellow longitudinal band, which fades into a lead-color on the sides which commences at the axilla, and is marked with numerous brown spots. The sides of the throat are black, and this color continues posteriorly and involves the entire pectoral fin and parts immediately above it on the side. This specimen with numerous crania is from Eastport, Maine.

This, or a nearly allied species, is stated by F. Cuvier (Cetacea, p. 171) to be found on the European coast. The relative length of the head to the body is as in *Phocæna lineata*, and his fig. 1, pl. xii., represents a coloration nearly similar to the individual from New York Harbor. He does not distinguish it from the *P. communis*, although it differs entirely from the descriptions of that species.

Lagenorhynchus perspicillatus, sp. nov.

This species is represented in the collections of the Smithsonian Institution by numerous crania, some skeletons and a colored cast of the natural size, taken by the United States Commission of Fisheries, near Portland, Maine. Professor Baird, Chief of the Commission, states, that it is an abundant cetacean, and the fact that it has been hitherto unrecorded is doubtless due to the absence of facilities for obtaining these creatures, within reach of naturalists.

The species belongs to the *Delphinidæ* without palatal grooves (*Lagenorhynchus*, Gray), and to the section with flat muzzle of the cranium, and short beak of the integuments of the head.

The muzzle is longer than the brain case, measured internally, and a little longer than the cranium posterior to the maxillary notch. The occiput is convex, and the basal premaxillary triangle is an oblique plane a little elevated above the maxillaries at the sides. The anterior part of the triangle is rugose, and extends to the end of the basal fifth of the muzzle, measuring from the notch. In this portion the muzzle is flat with slightly recurved edges; in the remaining part, the section is depressed roof-shaped. Teeth $\frac{30}{30}$ acute, curved, directed outwards, and of medium size. The palate between the pterygoid bones is concave. The last tooth reaches to within an inch of the fundus of maxillary notch, and at that point the sides of the palate slope obliquely upwards and outwards. The measurements of the cranium are as follows:—

	Inches.	Lines.
Total length	16	
Length of brain case (internal)	4	6
Length of muzzle to notch	8	9
Length to blow-hole	11	
Width of muzzle at notch	4	6
Width of cranium above orbits	8	2
Width of muzzle at distal fourth	2	3
Length of a tooth beyond alveolus		5

The general outline of this species is fusiform. The beak is well marked, and separated from the front by a groove. The front does not rise abruptly, but slopes gently backwards in continuation of the dorsal line. The dorsal fin is higher than long, and its apex is not decurved. The caudal peduncle is compressed and descends rather abruptly to the flukes. The typical specimen is about six feet in length.

The dorsal region is black to a line which begins in front of the eye, extends along the sides above their middle, and descending includes the entire caudal fluke. From the latter it sends forwards a narrow horizontal bar to a point half way to the dorsal fin, and which does not reach the abdomen. In front the black includes the entire upper lip, and sends posteriorly a short bar which includes the eye. The edge of the lower lip and the pectoral fin, with a line from the latter nearly to the former, are also black. The sides are a lead color as far as a line which leaves the lower-lip border at the middle, extends above the pectoral fin, descending by a Z-shaped border below the posterior edge of the dorsal fin, and extends to the black longitudinal bar of the caudal peduncle. Below this the surface is white.

The typical specimen is six feet in length.

This dolphin is, according to the descriptions, allied to the *L. acutus* of Gray (*D. eschrichtii*, Schleg.), especially in the characters of the cranium. The descriptions of the coloration of that species are quite different from that of the *L. perspicillatus*. A figure given by M. Poelman (Bulletin Acad. Royal Belgique, xvii. p. 608) represents the black longitudinal band of the caudal peduncle of *L. perspicillatus* to be extended forwards so as to unite with the black of the dorsal region on the side, thus inclosing above it a longitudinal white and pink area. The black of the upper surfaces also involves the eye, which is, therefore, not surrounded by the spectacle-like mark of the *L. perspicillatus*. Other material differences in the coloration are also apparent. The colors of the *L. leucopleurus* are more like those of the present animal; but here also the black line of the side extends far forwards, and there is a short black line through the eye instead of the spectacle-like figure. The measurements of the skull differ from those of this species, and agree with those of the *L. acutus*, as given by Dr. Gray. (See Annals and Magaz. Nat. Hist., 1864, 133, pl. 3.)

Lagenorhynchus gubernator, sp. nov. Pl. IV.

This delphinoid was taken by the U. S. Fish Commission at near the same locality as the last. Two plaster casts were made and colored from the fresh specimens. These display differences from those of the *L. perspicillatus*, which are doubtless specific, although the two are nearly allied.

The typical specimens are about half the bulk of those of *L. perspicillatus*, measuring forty-seven inches in length. The muzzle is neither elongate nor very short, and is well marked off from the front, which rises more abruptly and is more convex than in the larger animal. The dorsal fin is longer than high, and the anterior border becomes horizontal above, so that the apex is directed posteriorly. The post-dorsal region is strongly compressed, and maintains its width more nearly to the base of the flukes, making a more abrupt contraction than in *L. perspicillatus*.

The description of the coloration of the *L. perspicillatus* applies to that of *L. bombifrons* with the following important exceptions: The white of the belly extends upwards to the dorsal coloration, entirely excluding the lead color so prominent in the *L. perspicillatus*. The black bar, which extends forwards from the flukes, reaches to below the posterior base of the dorsal fin, and extends also to the belly at its base, neither of which characters is observed in *L. perspicillatus*.

The measurements of this species are as follows:—

	Inches.
Total length	47
Length to the eye	6
Length to posterior basis of pectoral fin	11
Length to anterior basis of dorsal fin	18
Depth of caudal peduncle just anterior to the contraction	5

It is not necessary to compare this species with the *L. acutus* and *L. leucopleurus*, since, in those respects in which it differs from *L. perspicillatus*, it is the more widely distinct from them.

EXPLANATION OF PLATES.

Plate III. Fig. I. Grampus griseus.
Figs. 2 and 3. Heads of two individuals.

Plate IV. Lagenorhynchus perspicillatus.

JULY 4.

The President, Dr. RUSCHENBERGER, in the chair.

Seven members present.

A paper entitled "Description of a New Species of Ægiale, and Notes on some other Species of North American Lepidoptera," by Herman Strecker, was presented for publication.

JULY 11.

The President, Dr. RUSCHENBERGER, in the chair.

Thirteen members present.

JULY 18.

The President, Dr. RUSCHENBERGER, in the chair.

Twenty-one members present.

Halloysite from Indiana.—Mr. E. GOLDSMITH remarked that a considerable deposit of a clay-like mineral has been observed near Huron, Lawrence County, Indiana. He had been informed that the deposit is nine feet thick; this, however, seems to be exaggerated, since Prof. E. T. Cox, in the 6th Annual Report of the Geological Survey of Indiana, makes it but four to six feet. It occurs in the carboniferous formation, 103 feet below the surface. Its roof is the millstone grit.[1] The floor is reported to be iron ore four feet thick. In regard to the breadth and length nothing seems known. In the Main Exhibition Building, also in the Mineral Annex of the International Centennial Exhibition, an *exposé* of this fine porcelain ore is made. Having been informed that Prof. Cox had called it Indianite, he had made an investigation of its physical and chemical properties before seeing any notice of the mineral in print.

The substance is amorphous; fracture subconchoidal; thick pieces are perfectly opaque; on the edges some light passes through; it is, therefore, subtranslucent, but the material becomes transparent if lying in water, of which it absorbs much. At the same time it cracks into small sharp-edged fragments. These, when taken out of the water and dried, lose the transparency, and become subtranslucent again. Lustre waxy, in some

[1] The stratification is illustrated by a diagram in the same volume.

places dull; the lustre increases if the substance is rubbed with a smooth harder material. He had noticed irregular cracks which traverse the specimens. Streak colorless; its cohesion is weak; H = 2.5; S. G. = 2.16. It is odorless, and adheres somewhat to the tongue. Color, white. The blowpipe reactions indicated the presence of water, alumina, and silica, and nothing else could be detected in the qualitative analysis in the wet way.

The "air-dry" substance, having been very finely pulverized, was heated in a platinum crucible at a white heat over a Bunsen-burner until two consecutive weighings were equal. It lost, thus treated, 24.15 per cent. of water. Through the above-described properties, it is easy to determine the name of the species, for Pholerite contains 15 per cent. of water; Kaolinite about 13 per cent.; Halloysite about 26 per cent.; and Samoite 30 per cent. The species is Halloysite; but, in order to be positive as regards the ratios of the other elements, he had requested Mr. W. H. Dougherty to make the quantitative determinations of the constituents. This analyst found, by experiment, that boiling sulphuric acid is the best decomposer of this mineral, and having worked repeatedly with other decomposers without satisfactory results, the sulphuric acid plan was adopted. The samples analyzed were "air-dry," the normal condition of the mineral in nature.

The result of the quantitative analysis is as follows:—

Silica . . .	38.30	per cent.,	which	contains	20.425	per cent.	of oxygen.
Alumina . .	35.20	"	"	"	16.408	"	"
Water . . .	25.74	"	"	"	22.880	"	"

The oxygen ratios of the three oxides—

$$\dddot{\mathrm{Si}} : \ddot{\mathrm{Al}} : \dot{\mathrm{H}} = 4 : 3 : 4$$

nearly, which affords the formula—

$$\ddot{\mathrm{Al}}\,\dddot{\mathrm{Si}}^2 + 4\dot{\mathrm{H}}.$$

This formulated expression requires—

$\dddot{\mathrm{Si}}$ = 40.6 per cent.; $\ddot{\mathrm{Al}}$ = 34.9 per cent.; $\dot{\mathrm{H}}$ = 24.4 per cent.

In the list of analyses of Halloysite, reprinted in Dana's Descriptive Mineralogy, we find that the amount of water observed by the authors varies between 16 per cent. and 26 per cent., the former number having been obtained on drying the substance at 100° C. prior to the determination of the water. That Mr. Dougherty found more water than he had obtained is due to the fact that the former gentleman used the blast for removing the water.

Prof. E. T. Cox states in his report that this mineral had been analyzed by J. Lawrence Smith, M.D., with this result:—

$\dddot{\mathrm{Si}}$ = 45.90 per cent.; $\ddot{\mathrm{Al}}$ = 40.34 per cent.; $\dot{\mathrm{H}}$ = 13.26 per cent.;

which is the composition of Kaolinite; but how this analysis had been performed, and especially why only 13.26 per cent. of $\dot{\mathrm{H}}$ had been obtained, the reader is left uninformed. He presumed that the mineral sample must have been prepared previous to ignition, or, in other words, the sample was dried strongly, and no account taken of the loss sustained. Under such conditions the quantity of $\dot{H}$ is less, whilst the other constituents become more.

The reason why this mineral is a new species, and not Kaolinite, Prof. E. T. Cox endeavors to explain in this way: "Kaolin is entirely derived from feldspar and feldspatic rocks, such as granite and porphyry, etc.; but the porcelain clay of Lawrence County has resulted from the decomposition, by chemical water, of a bed of limestone and the mutual interchange of molecules in solution, brought about by chemical precipitation and affinity."

The proofs, however, have been omitted, and, therefore, the view cannot be accepted, since Bischof (in his Chemische Geology, B. II., p. 428) has shown that the various clays are derived from the decomposition of feldspar.

Retardation of Bloom in an Herbaceous Plant.—Mr. THOMAS MEEHAN made note of a plant of *Senecio Jacobæa*, which in his garden did not bloom till fifteen years old, in this respect somewhat rivalling the Century plant, *Agave Mexicana*, which sometimes flowered at that age.

Mr. Martindale reported the *Senecio* as being found among the ballast plants at Kaighn's Point, and had seen plants at least two years old that had not bloomed.

Cross Fertilization in Campanula.—Mr. MEEHAN remarked that when the subject of insect cross-fertilization was before the Academy a few evenings since, he admitted that some plants seemed to require the aid of insects, and he had conceded *Campanula* as being of this small list of exceptions. Since then, having had reason to suspect this conclusion, he had confined flowers of *C. pulcherrima* in fine gauze bags, and they had seeded perfectly. He had no hesitation in saying that those who had claimed *Campanula* as illustrating the necessity for cross-fertilization by insect agency were wrong. He admitted that it was difficult to understand from the structure alone how self-fertilization was effected, but that it was so effected was certain, and careful study would no doubt explain it. Composites were claimed as proving cross-fertilization—it might explain the *Campanula* case to note how self-fertilization in chicory was effected. He had recently been able to discover this. The chicory has blue pistils as well as blue corollas, and as the rather large pollen grains are of a pure white, they afford an excellent chance for observation. The whole growth and fertilization is over in about a couple of hours, so that one need not spend much time in the study. About 6 o'clock in the morning the pistil with the closed lobes elongates, pushing through the mass of pollen, and carrying quantities with it, all over its whole surface. About an hour after, the lobes expand, and the pollen falls into the cleft and on to the stigmatic surface. The flowers close entirely by nine or ten o'clock of the same day, the work of fertilization being wholly finished. Pollen-eating insects visit the flowers, but these can be kept away during the few hours of observation required, and it would be found that all the flowers had pollen on the stigmatic surfaces nevertheless.

Variation in the Sensitive Fern, Onoclea sensibilis.—Referring to some specimens on the table presented by Mr. Martindale, Mr. MEEHAN remarked that it was the variety *O. s. obtusilobata* of Gray's Manual, and afforded morphologists a rare and excellent opportunity to study the transitional stages by which the male became the fertile frond.

The resignation of Mr. Geo. W. Tryon, Jr., as Curator, was read and accepted, and the following minute ordered to be recorded :—

The Academy, in accepting the resignation of Mr. Tryon as Curator, desires to express its gratitude for the services he has long and faithfully rendered, and its sincere regret that he is unable to continue his official relations in the position which he has so efficiently filled.

JULY 25.

The President, Dr. RUSCHENBERGER, in the chair.

Twenty-five members present.

The following papers were presented for publication :—

"Report on the Hydroids collected on the Coast of Alaska and the Aleutian Islands by Wm. H. Dall, U.S. Coast Survey and party, from 1871 to 1874 inclusive." By S. F. Clarke. With an Introduction by W. H. Dall.

"Description of a Collection of Fossils made by Dr. Raimondi in Peru." By Wm. M. Gabb.

"The Rocks known as Mexican Onyx." By Mariano Barcena.

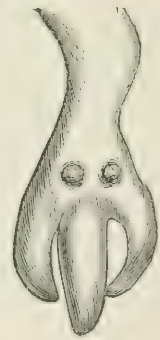
Supernumerary Anterior Extremity in a Brahmin Bull.—Dr. ALLEN presented drawings of a supernumerary anterior extremity in a Brahmin bull recently on exhibition in Philadelphia.

The deformation consists of a limb exserted from the body at the left shoulder. The extremity is apparently complete, possessing the shoulder, leg, and remaining portions of the limb.

The foot presents its palmar aspect forwards, and bears three distinct digits. The hoof upon each digit is long, compressed laterally, and slightly curved from before backwards. The central digit is the broadest, is slightly longer than either of the others, and presents a shallow groove upon its convex surface at its base.

Fig. 1.

Fig. 2.



At the surface answering to posterior aspect of carpus of a normal foot (but here in front) are two symmetrical corneous embossements, which may be compared to "cleets." The position of the limb, with its palmar face directed forwards, may be due to erratic rotation of the parts in embryo. Dissection would be essential to determine this point.

On a New Genus of Camelidæ.—Prof. Cope remarked that the dental formula of *Procamelus* is I. $\frac{1}{3}$; C. $\frac{1}{1}$; Pm. $\frac{4}{4}$; M. $\frac{3}{3}$. The number of teeth of the superior series anterior to the true molars being left uncertain by Dr. Leidy, he, Prof. Cope, was able to complete our knowledge of it after an examination of Colorado specimens. He ascribed three superior incisors to this genus at that time, as they are possessed by the species which he named *Procamelus heterodontus*. Having obtained in New Mexico the nearly entire cranium of the *P. occidentalis*, he found that the single lateral incisor in the existing *Camelidæ* is the only one that can be properly assigned to this genus. In this specimen, it is true, a small alveolus on one side contains a small crown of a second incisor; but on the opposite side the corresponding one is shallow and empty. As the last molar it not fully protruded, it would appear that this incisor is a temporary tooth, being shed before the maturity of the animal. It thus differs from the existing camels only in the longer persistence of these transitory incisors. The position of the first incisor in the specimen in question is marked by a roughness of the surface which indicates the still earlier shedding of a tooth, and filling up of the alveolus. In the *P. heterodontus*, of which the superior dentition of an adult was in his possession, the alveoli of the three superior incisors are large and deep, showing that the dental formula is, I. $\frac{3}{3}$; C. $\frac{1}{1}$; Pm. $\frac{4}{4}$; M. $\frac{4}{4}$. The alveoli are empty in the specimen, but this is doubtless due to their regular funnel shape, which gives little hold for the conic, though elongate fangs. This animal, then, represents a genus distinct from *Procamelus*, defined by the dental formula just given, for which he proposed the name of *Protolabis*. The typical and only known species is *Protolabis heterodontus*, Cope, from the Loup Fork beds of Northeast Colorado.

A new species of *Procamelus* was described under the name of

Procamelus fissidens, Cope? *P. occidentalis*, "Leidy."
Cope, Annual Report U. S. Geol. Survey Territories, 1873, p. 531.

This species is distinguished by the shortening of the series of true molar teeth as compared with the premolars, for while the second, third, and fourth premolars are similar in dimensions to those of the *P. occidentalis*, the true molars are considerably smaller. The crowns of the latter are stout, and not narrowed nor furnished with an antero-external ridge as in *P. angustidens*, and the anterior external crescent projects free posteriorly an oblique angular rib on the external face of the crown, being separated from the second crescent by a deep fissure. The last inferior molar is not very elongate, and the fifth lobe a crescentic section, *i. e.*, is concave on the external face, as in the *P. angus tidens.*

The inferior border of the ramus is straight from the first true molar posteriorly. The anterior face of the coronoid process is oblique outwards. The edge of the masseteric insertion forms a low ridge concentric with the convex posterior border of the jaw; like the inner face of the same portion of the jaw, the surface is flat.

Measurements.

	M. P. fissidens.	P. occidentalis.
Length of entire molar series	.112	.126
Length of premolars	.0385	.042
" second true molar	.023	.0275
Width of " "	.015	.0165
Length of third "	.033	.036
Width of " "	.014	.014
Depth of ramus at first true molar	.035	
" at middle of last molar	.040	.051
" at apex of coronoid process	.140	
" at condyle	.108	.118
" at post condylar angle	.069	.085

One ramus nearly entire, and the molars of the other (excepting the last) were obtained near the Pawnee Buttes of N. E. Colorado.

The evolution of the existing types of Camelidæ is a good illustration of the operation of the laws of acceleration and retardation. In evidence of this we may follow the growth of the foot, and dentition of the most specialized, and therefore the terminal genus of the series, the American *Auchenia*. It is well known that the animals of this genus, in common with other ruminants, have the constituent metapodials of the cannon bone distinct during a longer or shorter portion of fœtal life. As these elements are permanently distinct in the oldest or Miocene genus *Poëbrotherium*, it is evident that acceleration of the process of ossification has caused their union at successively early periods in the genera of later ages. This is indicated by the long duration of their separation in the Loup Fork genus *Procamelus*. It is also well known since the time of Goodsir, that the embryos of ruminants exhibit a series of superior incisor teeth, which disappear early. It is probable, but not certain, that in the Miocene genus *Poëbrotherium*, as in various contemporary selenodont *Artiodactyla*, that the superior incisors persisted. He had, however, discovered that these teeth persisted in the Loup Fork genus *Protolabis* during adult life. He had also found that one, the second of these teeth in *Procamelus occidentalis*, persisted without being protruded from the alveolus until nearly adult age. In genera (*e. g.*, the bunodont *Artiodactyla*) where the incisors are normally developed, they appear at about the same time with the other teeth, and continue to develop to functional completeness. This development is retarded in *Protolabis*, since they are not so matured as to remain fixed throughout life in their alveoli. In *Procamelus* the retardation is still greater, since the first incisor reaches very small dimensions, and is, with its alveolus, early removed, while the second incisor only grows large enough and for a sufficient time to occupy a shallow alveolus, without extending beyond it. In the first incisor the process of retardation has reached its necessary termination, *i. e.*, atrophy[1] or extinction; while in the existing *Camelidæ* the second incisor also has disappeared in the same way. In ruminants other than *Camelidæ*, the third or external incisor has undergone the same process; while, in the *Bovidæ*, the canines also have been retarded in development, down to atrophy.

In the genus *Auchenia*, as has been pointed out, the premolar teeth are two in number; in *Poëbrotherium* of the lower Miocene, they number four, the first and second of the normal mammalian series being present. The first premolar is present in *Poëbrotherium*, *Protolabis*, *Procamelus*, *Pliauchenia*, and *Camelus;* it is

[1] See Proceedings Academy, Philadelphia, 1876, p. 17, for an explanation of these terms.

wanting in *Auchenia* and other *Ruminantia*. In the latter it is present in the fœtus, but soon disappears; in *Auchenia*, according to Owen, it is retained for a somewhat longer time.[1] Thus retardation of the growth of this tooth is first seen in the latter genus so far as known, and is more pronounced in the other *Ruminantia*. The second premolar is present in *Poëbrotherium*, *Protolabis*, and *Procamelus;* it is absent in *Pliauchenia*, *Camelus*, and *Auchenia*. In the last two genera it is a transitional character of immaturity, and we may infer that this is also the case with *Pliauchenia*. It is thus evident that retardation in the supply of nutritive material to this tooth has caused its reduced size, and terminated the duration of its existence. This has not occurred in the other lines of *Ruminantia*, where it remains as in *Poëbrotherium*. From these and many analogous cases, the general law may be deduced, that *identical modifications of structure, constituting evolution of types, have supervened on distinct lines of descent.*

E. O. Thompson and A. E. Foote, M.D., were elected members.

Dom Pedro II., Emperor of Brazil; Capt. Luiz de Saldanha da Gama, of the Brazilian Navy, and Dr. José de Saldanha da Gama, of Rio Janeiro, Brazil, were elected correspondents.

The following paper was ordered to be published:—

[1] Odontography, p. 530.

DESCRIPTION OF A NEW SPECIES OF ÆGIALE AND NOTES ON SOME OTHER SPECIES OF NORTH AMERICAN LEPIDOPTERA.

BY HERMAN STRECKER.

Ægiale Cofaqui, nov. sp.

♀. $2\frac{1}{6}$ inches in expanse. Head dark brown; palpi whitish; thorax brown, mixed with hoary, posterior half, above, clothed with yellowish hair; abdomen brown; antennæ black above, white beneath, terminations black.

Upper surface of wings blackish-brown. Primaries with an exceedingly irregular, bright, deep yellow band, extending from vein 1 to the subcostal nervure; the outer edge of this band is rather regular from veins 1 to 4, though further removed from the exterior margin at the latter than at the former; from veins 1 to 2 it is narrow, from veins 2 to 4 it is nearly three times as broad extending to where vein 3 joins the median vein, the balance of it is within the discoidal cell and is narrow, of about the same width as it is between veins 1 and 2; the portion of this nearest the costa is paler in color than the rest. Between veins 4 and 6, exterior to this band, is a mark composed of two small almost connected yellow spots. Interior to these, between veins 6 and 9, is a narrow yellowish-white mark. Midway between the inner edge of the large yellow band and the base of wing, and between veins 1 and 2, nearest to the latter, is a roundish yellow spot. Inner half of base covered with rich yellow hair. Fringe yellowish-white, alternated with dark brown at terminations of veins.

Secondaries. Basal third, especially in inner part, heavily clothed with rich yellow hair and scales. A band of four yellow spots, separated only by the veins, cross the wing beyond the middle; from this band towards the costa, opposite the apex, is another quite small yellow spot, which is succeeded by a larger one near to the costa, nearly midway between the apex and base of wing. Outer margin between the veins yellow, forming patches more or less triangular, with the points inwards. Fringe yellowish-white.

Under surface. Primaries brown, not as dark as above, and shaded at outer margin and apex with hoary; no yellow at base of wings. Markings as above, excepting that the yellow band is continued from its lower end to, and connected with, the yellow spot between it and the base, and between veins 1 and 2.

Secondaries. Hoary or whitish-gray, dark-brown along costa, especially towards the base. Towards anal angle, a pure white spot, corresponding in position with the first of the series of four that compose the yellow band of upper side; each of the remaining yellow spots of upper surface, and the next one of the two, between them and the costa, is represented by a small dark-brown spot, or rather row of continuous spots; the last towards costa is replaced by one of pure white; half way between this latter spot and the base is another white spot, and also one in discoidal cell, from which a dark-brown line extends to near abdominal margin. Fringes white and brown.

In markings of upper surface, this species resembles somewhat closely the lowermost of Boisduval's figures on plate 70, in the Lep. Am. Sept., but the outline of the wings is entirely different. In the present species the primaries are much produced at veins 2 and 3, and from veins 3 to 7 they are hollowed, making the wing most decidedly fulcate, though the apex is very slightly rounded. The inferiors are narrow, even between the apex and abdominal angle, and the wing at the former is not rounded, but the costa and exterior margins meet at almost a right angle. As far as outline goes this species has no possible resemblance to Boisduval's figures, or to the species he purports to represent, the history of which has been given in full detail by Prof. Riley, in Trans. St. Louis Acad. Sc. That species, *Æ. yuccæ*, has much longer and comparatively narrower fore wings, and the shape of exterior margin of these is just the reverse of the present described species, the hind wings are also as entirely different in shape as can be in two insects generically the same. The under surface of inferiors in *yuccæ* is brown, broadly bordered with whitish-gray, especially at the costa, and with a large triangular white spot below costal vein about one-third the distance (from base), between base and apex. The present species has under surface of secondaries grayish, with dark-brown costa, and four conspicuous white spots on various parts of the wing. Boisduval's lower figure may have been intended to represent this insect, but his upper two figures show the upper and under surface of *yuccæ*, though none are correct as regards shape of wings, especially of the inferiors. All three figures on his plate were either drawn from three different examples, or the artist was most culpably careless, as none are of same size, or agree in outline, though the presumption would naturally be, that the middle figure with wings erect, was intended to represent the under surface of one of the others. What leads me further to suppose that two species are figured on Boisduval's plate, is that the lowermost figure has the small spot on inner half of primaries, of which Prof. Riley says, that of the ten specimens of *yuccæ* he had examined, "none of them have the spot on primaries, indicated in one of Boisduval's figures, just within the middle of the wing and below vein 2."

I have placed this insect in Ægiale, where, with *yuccæ*, I think it belongs; Scudder's *Megathymus* I consider but a synonym of Felder's genus.

The example from which the foregoing description was made was captured in Georgia.

Papilio Indra, Reakirt. ♀.[1]

Same size as ♂. Primaries somewhat falcate, broader and less produced apically. Secondaries more rounded exteriorly; the rudimentary tail even less conspicuous than in the other sex; macular bands on all wings nearly twice the breadth, on secondaries covering part of the discoidal cell. The discal bar of primaries better defined, and at two lines distance inwardly succeeded by another parallel bar, which on the under surface is widened into an ovate spot. In other particulars same as ♂.

Two ♀ examples taken by Mr. Duncan Putnam, July 1st, 1872, in Clear Creek Cañon, between Golden City and the Forks of the Creek, Colorado.

The example above described, through the courtesy of Mr. Putnam, has passed into my keeping, the other, which is still in that gentlemen's collection, differs mainly in the mesial band of secondaries being entirely exterior to the discoidal cell.

These are the only females that I have yet heard of, and no males were seen by Mr. Putnam, nor have any been taken, to my knowledge, since the original types, captured by Mr. Ridings in 1864, on Pike's Peak, Colorado.

[1] ♂ described in Proc. Ent. Soc., Phil. VI. p. 123 (1866), and figured by myself in T. II. Lep. Rhop. et Het.

Cossus nanus, nov. sp.

Expands $1\frac{1}{8}$ inches. Has the appearance of a miniature *Cossus ligniperda*, is gray, of lighter and darker shades, and reticulated with black lines which are most noticeable across the disk and on the terminal part of wing. Secondaries uniform grayish. Beneath grayish, faintly reticulated.

Hab. Colorado.

Arctia cervinoides, nov. sp.

Expands $\frac{7}{8}$ inch. Head black, white above the eyes. Collar white, with two black bars. Thorax white, with three black bands as in *Nais*, and others. Abdomen black above; at sides and beneath, each segment is broadly edged with white.

Upper surface. Primaries white, marked with black almost exactly as in *Phyllira*, Drury. Secondaries with obscured grayish, ill-defined marks almost semi-diaphanous, resembling those of *Quenselii*, Payk.

Under surface marked as above, but paler on primaries.

Entirely distinct from all known North American species, nearer to *Quenselii*, from Labr., and *Cervini*, Fall., from summit of Alps, than any others I wot of. It is from Colorado.

Cymatophora magnifica, nov. sp.

♂. Expands $1\frac{1}{2}$ inches. Head and collar chestnut-brown; antennæ pectinated and brownish; thorax ashen-white, with a few scattered brown atoms; abdomen brown; legs clothed heavily with whitish-gray hair.

Upper surface. Primaries lustrous brownish-gray or ashen; the outer space, forming a large oval spot extending from apex to inner angle, is brownish-yellow of a somewhat golden tint; this space, as well as the whole upper wing, reminds one strongly of *Phalera Bucephala*, Lin.; on the outer edge of this terminal space, midway between the apex and inner angle, is a parallelogramic brown spot; the inner margin also of this terminal space is edged irregularly with brown marks; the part of the wing adjoining this is paler than the rest; at base of wing is also a pale patch same color as thorax; the whole surface of wing, except the yellow terminal space, is more or less reticulated or flecked with dark brown; none of these reticulations are very conspicuous, except a few which form an abbreviated slight transverse band, which extends neither to costa nor inner margin, and is distant from thorax about one-third of the length of the wing. Secondaries brown, with paler fringes; they are remarkably produced at the outer angle.

Under surface brown, with indistinct reticulations; the square mark on outer margin, midway between apex and inner angle, is repeated.

Hab. Florida, captured by Mr. J. Doll.

It is doubtful if this is by any means a true Cymatophora, though it undoubtedly belongs to the Cymatophoridæ, HS.; the pectinated antennæ would seem to indicate a position near the insect described as *Dicopis muralis*, Grote, but there is plenty of room for any one who has the inclination to make a new genus for its reception. For my part, I would take infinitely more pleasure in doing away with many of the genera erected of late on trifling grounds, than in adding to the confusion by creating new ones.

Cosmia perophoroides, nov. sp.

Expands $1\frac{3}{8}$ inches. Head and thorax pale brownish, insensibly fading into yellowish-white as it nears the abdomen, which latter is also yellowish-white; tarsi dull crimson.

Upper surface. Primaries, same yellowish or tawny-white as in the Bombycid *Perophora Melsheimerii*, which the whole insect superficially resembles in color and ornamentation; the costa, outer and inner margins, edged with a dull crimson line; the whole surface of wing powdered with minute crimson scales; a narrow crimson transverse anterior line, elbowed outwards almost at a right angle in its middle, crosses the wing from costa to inner margin, as also does a transverse posterior line of same color; this latter is rather straight, making but a slight curve a short distance from the costa. Secondaries white, powdered, not heavily, with red at outer margin; fringes white.

Under surface. Primaries, basal third, white, rest reddish, paler towards outer margin, which is edged with a narrow red line, as is also costa and inner margin. Secondaries white, bordered with a few minute red scales on costa and at apex.

Taken in Florida by Mr. J. Doll.

Phrygionis argentistriata, nov. sp.

Expands $1\frac{3}{8}$ inches. Much the same silky gray or dove-color as in *P. cultaria*, Geyer, to which it is closely allied; but differs in the gray being a little more inclined to brownish, less bluish, in the inner edge of band that crosses all wings being very much less silvered, and in veins of hind wings being yellow, narrowly edged with black, from inner edge of this band to past the middle of wing, the yellowish veins being continued or shot off from the yellow of cross band; the sub-basal band of primaries is irregular and strongly elbowed in middle; whilst in *cultaria* it is straight from inner margin to costa. Near the angle produced at middle of exterior margin of secondaries, is a rather large oblong dark red spot, tipped at its outer end with silver; near this, on side towards abdominal margin, is a smaller triangular spot of same color, also with a little silver at outer end; between this and anal angle are two more spots of red and silver, but quite small. The band common to both wings is not nearly so strongly elbowed outwardly in its middle as it is in *cultaria*, and the space between this band and outer edge of secondaries in that, is not nearly so broad as in the species at present described.

Florida, from Mr. J. Doll.

Euclea pænulata, Clemens, Proc. Acad. Nat. Sci. Phila., p. 159 (1860), is the insect lately redescribed under the name of *Parasa incisa* by Dr. Leon Harvey in Can. Ent., p. 5, vol. viii, 1876. His type he received from Belfrage in Texas, who also sent me examples of it, which, as above stated, turned out to be Clemens' species.

AUGUST 1.

The President, Dr. RUSCHENBERGER, in the chair.

Twenty-four members present.

Diurnal Motion in Liatris pycnostachya.—Mr. MEEHAN called attention to a peculiar diurnal motion he had observed in *Liatris pycnostachya.* When throwing up its flower stems the top was always curved over towards the east in the early morning, nearly erect at midday, and towards the west at sundown. For commercial purposes he had thousands of plants growing, and the habit was uniform in all. The motion was evidently vertical, and not in a horizontal direction, and this still left it open to ascertain how the point turned towards the east for its early morning start. As soon as the flower spike approached its full growth the motion ceases.

Fasciated Branches.—In reference to a broadly flattened branch of a sweet potato on the table, to which attention had been directed by a member, Mr. MEEHAN said these branches were found on numerous plants, and there was no reason why all plants may not be found to produce them. They were species of fasciations, which took different forms at times. In trees they often appeared as "crow's nests." The old theory referred them to over-luxuriousness; but in a paper published in the Troy Proceedings of the American Association it was shown to be just the reverse. In union there is strength, in vegetable as in other bodies. Any tendency to a multiplicity of small branches on a tree instead of making a few large ones, all other things being equal, is an evidence of lower vitality. And this was proved by these fasciations. In severe winters fasciated branches were the first to die. Often they were the only branches that were destroyed.

Again, it had been shown in his papers before the American Association and before the Academy of Natural Sciences of Philadelphia, that only when a flowering portion of a plant was in the best conditions to maintain its hold on life, in other words in the highest conditions of vitality, did it produce pistils, or female flowers. With a lowered or depreciated vitality the male organs of the flower or male conditions were favored, and it was a singular fact that whenever these fasciations flowered, the female organs were nearly always abortive, and stamens and petals increased at their expense. These were some of the facts which had proved the old notion that over-luxuriousness, in the sense of high vital power, had nothing to do with fasciations, but rather the reverse.

The final cause of this defective vitality was imperfect nutrition in that immediate part. This was as near to the full explanation as science could get as yet.

The facts were not as new as he liked to bring before the Academy, devoted as it is to original research; but the conclusions of the Troy paper are rather recent, and not yet well known, and this might excuse his remarks.

Mineralogical Notes.—Dr. GEORGE A. KŒNIG spoke about the coloring matter of the *amazon stone* from Pike's Peak. This beautiful mineral has lately been obtained in large specimens and in considerable quantity through the exertions of Dr. Foote, who furnished the author with the material for this investigation. The color of the amazon stone from Pike's Peak varies between a light bluish-green and a dark emerald-green. On many specimens the faces of modification, as prisms and domes, are without color, or yellowish, or flesh-colored. The interior of very large crystals is likewise of a much lighter color generally than the outside.

Assuming the coloring principle to be a compound of iron, the following experiments were made to test the value of this hypothesis:—

1. Fragments were exposed to the action of boiling hydrochloric acid and aqua regia for several days, until the liquid was free from iron. Under this treatment the intensity of color was increased, the coloring substance withstands, therefore, the action of the above agents.

2. Fragments, prepared by the treatment described, were placed in a glass tube, and hydrogen passed through the latter at a red heat. After cooling, the mineral was found possessed of an evenly spread *gray color*.

3. The same pieces were now treated with oxygen at a red heat, and exhibited, after cooling, an even *rose* color, the intensity of which was proportional to the intensity of the green.

4. Green fragments were heated in an atmosphere of dry chlorine, at increasing temperatures. No change occurred until at a red heat, when the mineral became perfectly white, and a slight sublimation of ferric chloride was noticed.

5. The rose-colored pieces become white when boiled in strong hydrochloric acid.

6. Thin fragments do not show at any place a concentration of the green color, when examined under the microscope.

7. Heated in the outer flame of a Bunsen burner, the same effect is caused as in the current of oxygen, but with a less brilliant color.

These experiments prove—

First. That the basis of the coloring substance is *iron*.

Second. That the iron is present as a very stable compound, probably as an organic salt.

Third. That the coloring substance is not in molecular combination with the feldspar; because, if it were so, the iron could not be extracted completely by hydrochloric acid from a solid piece after oxidation; but that the color is of later date, and caused by infiltration into the numberless capillary cleavage fissures of the mineral.

Investigation into the composition of the organic acid is reserved for a future communication.

Dr. KŒNIG also mentioned his discovery of *Zircon* in the amazon stone from Pike's Peak. Dr. Foote had observed brownish spots in the feldspar, with an apparent cleavage. The speaker was able to extract complete crystals, showing a tetragonal habitus: $P + \infty P \infty$. The largest crystal measures $\frac{1}{4}$ inch in length by $\frac{1}{8}$ inch square. The angle of the pyramidal faces was found 122°, which is near the zircon angle. The prismatic faces are uneven by the preponderance of a step-like structure; there is a prismatic cleavage. Lustre, greasy vitreous; color, dark grayish-brown; fracture, straight. $H = 6.5$, spec. gr. $= 4.065$. Every crystal is associated with columbite in well-defined prismatic needles, which pierce the zircon. The powder has a cinnamon color. Owing to the deficiency of material, only an approximate analysis can be given for the present.

$$
\begin{aligned}
SiO_2 &= 28.00 \\
MgO &= 8.93 \\
(Fe_2O_3)ZrO_2 &= 60.00 \\
H_2O &= 3.47 \\
\hline
&\quad 100.40
\end{aligned}
$$

Besides the large percentage of magnesia, there is a very anomalous behavior in the zirconia. It is easily soluble in oxalic acid, and the oxalate dissolves in a very small quantity of water, and is not decomposed by boiling in a dilute solution. He had since established the same behavior in the earth from the Clay County, N. C., zircons, and was still engaged in the study of this matter.

Dr. KŒNIG mentioned further the occurrence of *earthy barite* on the calcite from the city quarries of St. Louis, Mo.

This mineral is found in very friable clusters between the large crystals of calcite. Color perfectly white. Under the microscope the powder resolves into transparent prismatic crystals. They are small enough to pass through the meshes of a hair sieve.

The analysis gave—

$$
\begin{aligned}
BaSO_4 &= 98.8 \\
Fe_2O_3 &= 0.5 \\
\text{Ignition} &= 0.14 \\
\hline
&\quad 99.44
\end{aligned}
$$

This is one of the purest varieties of barite on record.

On Frost-Drift in North Carolina.—Prof. W. C. KERR remarked that there are some peculiar features in the surface geology of North Carolina which have not hitherto been accounted for. We have no true glacial drift, or at least none well characterized. But besides the ordinary quaternary gravels which overlie a large section of the coastward half of the State, there are found, chiefly on the flanks and among the foothills of the Blue Ridge, and over a considerable portion of the Piedmont region, beds of earth and stones which are characterized by a peculiar arrangement of their materials, explicable neither on the theory of their being morainal nor modified drift. Reference was made to the subject in the North Carolina Report of last year, and a theory suggested; but as illustrations were wanting, it was not practicable to do more, and he should require the blackboard now to make the matter intelligible. He represented, in a diagram, the succession of different arrangements of the detrital materials as they may be seen in descending the slopes on which these accumulations are found. All our gold gravels come under this description of quaternary deposit. In one part of the diagram the arrangement which obtains in the higher portions of the deposits, nearest the source of the materials, was represented. The lower part, perhaps one-half or one-third of the vertical depth, is filled with angular and little worn fragments of quartz and other hard rocks; the upper part being simply unstratified earth. As we descend the slope, the angular blocks have become more rounded, and are accumulated in a successively lower and more crowded stratum, at last hugging closely the surface of the underlying rock. In the case of the auriferous gravels, the gold is found, of course, only on the upper slopes, and near the sources of the materials, its greater specific gravity insuring its speedy descent to the bottom of the moving mass. It is perfectly obvious, both from the position of these beds on the slopes of hills and mountains, up to 1500 feet above the sea, and from their arrangement, that they have not been deposited under water. And it is equally evident that they are not true glacial drift; and, indeed, they are readily traced, in many cases, to their sources, distant only a few rods, or even feet. But he had not hit upon the solution of the question of the origin and mode of accumulation of these beds until he had accidentally found in a railroad cut near Morganton, the structure indicated in the second diagram, where a small quartz vein was represented rising up, undisturbed, through the underlying strata of rock, in a nearly vertical direction, until it reaches the lower surface of the deposit in question, where it is seen to be suddenly interrupted, and its materials—angular fragments—strewn along the surface of the rock, down the slope a distance of several yards. A close study of this phenomenon at last suggested the theory which he had proposed of *frost drift*. It is obvious that in subglacial regions (and in glacial regions in subglacial times) the annual frosts of winter would penetrate to a great depth; and likewise the summer thaws, aided by the enormous precipitation which characterized those regions and times. And it is equally obvious that a mass of water-saturated earth, in freezing and thawing, must be subject to the same laws of movement as a true glacier, the rate of motion being proportioned to the quantity of water. The depth of some of these deposits at first presented a difficulty, this depth rising in some cases to twenty and even thirty feet, although they are for the most part less than half that depth. But after learning that in Vermont, in the winter of 1874–5, the frost penetrated to a depth of eight feet, and that in Siberia and other subarctic regions the ground is annually frozen and thawed to a much greater depth, there seemed to remain no part of the phenomena presented by these beds which is not satisfactorily accounted for by the theory.

The occasion of his bringing this subject to the attention of the Academy was this: In passing an excavation on Market Street, above Forty-Fourth Street, he had observed a new and striking confirmation of the view just presented. In an accumulation quite like those already described as occurring in North Carolina, this additional feature was observed: several banded seams of decomposed mica schist, standing nearly vertical in the undisturbed rock below, on reaching the lower edge of the drift were bent at a sharp angle, in the direction of the movement of the mass, down the slope, and were traceable many feet, diminishing with a gradual and regular taper in a horizontal direction, until lost in the homogeneous mass of earth which formed the body of the bed. How this happened is obvious enough on the theory given, but on no other known to him.

AUGUST 8.

The President, Dr. RUSCHENBERGER, in the chair.

Twenty-seven members present.

On the Diurnal Opening of Flowers.—Mr. THOS. MEEHAN referred to observations he had made this season on the nocturnal and diurnal expansion of flowers, and said that, contrary to the popular impression, it was not probable that light or its absence alone determined the opening of the blossoms. There were some plants, as, for instance, *Œnothera biennis*, the evening Primrose; *Anagallis arvensis*, the "Pimpernel," and others, which remained open or otherwise longer when the weather was humid or cloudy, and were looked on in consequence as kinds of floral barometers; but from other facts it was clear that it was not the weather merely, but some other incident accompanying the weather that governed the case.

For instance, though *Œnothera biennis*, and other Œnotheras, opened at evening, and, if the atmosphere be moist, continue open the greater part of next day, many species opened only in the daytime; and this they did regularly, quite regardless of meteorological conditions. *Œ. serrata* of Colorado was one of these. It was regular in opening about noon; the blossoms were all closed long before sundown.

In other allied families we saw similar divergence. In the Cactus family, *Opuntia* and *Mammillaria* opened only about midday; while most of the *Cereus* opened at night. The night-blooming Cactus was a familiar example. But the chief interest was in the fact that many had their special hours of day or night for the expansion. The *Portulaca oleracea*, common Purslane, opened about eight A. M., and by nine had performed all its functions; while a closely allied plant, the *Talinum teretifolium*, from the serpentine rocks of Chester County, opened at one P. M., and was closed by three. The conditions of the weather did not seem to influence them.

There was the same attention to daily periods in the growth of the parts of plants, as well as in the expansion of the petals. In composite plants the floral growth was generally in the morning, and was usually all over by nine or ten o'clock A. M. The elongation and expansion of the corolla was usually completed in an hour after sunrise, but the stamens grew for an hour more, and the pistil continued for still another. There was little if any growth in the floral parts after nine o'clock in a very large portion of this order of plants.

In grasses, *Cyperaceæ*, and some rushes also, the floral parts were very exact in their time of opening. In the plantains (*Plantago*) the pistils appeared a day or more in advance of the stamens; and these last appeared at about a regular time in each day. In *Luzula campestris*, the wood rush, he had by a series of observations timed it exactly. Before nine the anthers were perfect, but by ten the pollen has been all committed to the winds, and only dried membranous matter remained. So far as he could ascertain, meteorological conditions did not influence the time in the least in this case.

The popular impression of light and moisture as agents in this behavior, had seemed to receive a tacit scientific assent. It was clear, he thought, there was a more powerful agency underlying these; and it was, perhaps, a gain to science to be able to see this, though in so dim a light.

Dr. Henry C. Chapman was elected curator in the place of Mr. Tryon, resigned.

AUGUST 15.

The President, Dr. RUSCHENBERGER, in the chair.

Twenty-three members present.

On Hexagonite, a New Mineral.—Mr. E. GOLDSMITH remarked that Mr. John C. Trautwine, of Philadelphia, had been kind enough to present to him a mineral from near Edwards, St. Lawrence County, N. Y. As it was not comparable with any of the known species that occur in said locality, it was presumed by Mr. T. to be new.

The mineral is crystallized hexagonally, the forms noticed being the infinite pyramid (110), and the basal plane (111). The crystals are small, from about 3 mm. in length and 1 mm. in thickness, although some are 5 mm. thick. Two distinct cleavage planes were observed, which could be easily produced by striking the specimen with the hammer. It was found that these planes intersected at 120° ; there is a third cleavage plane parallel to (111), but less smooth than the former.

Fracture uneven. The small crystals and fragments are transparent, while the thicker ones are semi-transparent.

Lustre subvitreous, somewhat glimmering on the cleavage (110); on the basal plane the lustre is dull.

A basal cleavage fragment was introduced between two Nicol prisms transmitting no light, in such a way that its principal axis formed a continuous line with that of the prism, and, no change in the light being observed, the crystal was pronounced uniaxial. The color is pale violet, but not equally distributed; the mineral in spots is colorless, and it is thought that if the substance was absolutely pure it would have no color. The coloring principle, which is a small quantity of manganese, is so finely distributed through the mass that it is impossible to separate it mechanically.

The streak is colorless, and so is a large bulk of the powder.

The substance is brittle.

Its hardness is between apatite and orthoclase; that is, 5.5. S.G = 3.011.

If the substance, in the form of a thin splinter, is heated to redness in the Bunsen burner flame, no change is produced ; the same is the case if the oxidizing flame with the blowpipe is directed upon it; but a rounding of the sharp edge of the splinter is effected by treating it in the reducing flame ; the transparent substance then becomes opaque and white, enamel-like. On moistening this rounded spot with cobalt solution, and strongly reheating, a violet coloration is produced. In the glass tube there is no change whatever. The flame reaction indicates the presence of soda.

From the above observation he pronounced the mineral to be infusible.

Fused with microcosmic salt, it shows a skeleton of silica; and if heated with borax in the oxidizing flame, the reaction of manganese is observed; the same if heated with carbonate of soda in the oxidizing flame.

On coal heated with cobalt solution a violet mass is produced, which is due to the presence of a small quantity of alumina and a larger of magnesia.

In regard to its solubility in acids, it was observed that it yielded only to hydrofluoric acid, the others having no effect. The fine powder was fused with carb. soda, in order to find all the elements contained in it by the processes in qualitative chemical analysis in the wet way; by this means were found silica, alumina, and manganese, lime and magnesia.

The quantitative analysis gave these results:—

Silica . . .	57.92	per ct.	contains	oxygen	27.91	
Alumina and manganese	2.39	"				
Lime . . .	11.98	"	"	"	3.42	= 14.45
Magnesia . .	26.23	"	"	"	10.49	
Soda . . .	2.10	"	"	"	0.54	
	100.62					

The alumina and manganese amounting to 2.39 per cent. are considered as an impurity, and for this reason they are excluded from the consideration of the ratio. The oxygen ratio of the bases and the silica is as $14.45 : 27.91 = 1 : 1.9$, or adopting 2 for the latter will give the general expression $(\dot{R})\,i_2\ddot{S}$, in which $(\dot{R})$ stands for the monoxyds $(\dot{C}a, \dot{M}g, \dot{N}a)$. The new mineral species hexagonite is formulated thus: $(\dot{C}a, \dot{M}g, \dot{N}a)\,\ddot{S}i_2$.

As this described bisilicate is anhydrous, and is crystallized in hexagonal form, it consequently belongs to the beryl group, of which it will be the third species.

On Opuntia Rafinesquii and O. vulgaris.—Mr. MARTINDALE remarked that the large natural order of plants, the *Cactaceæ*, comprises about 800 species chiefly natives of tropical countries, and the western part of the United States, where many grow to an immense size. The only representative of this large order in the northern United States, east of the Mississippi, is the genus *Opuntia*. The only species of that genus described in the older works on the flora of that section, is the so-called *O. vulgaris*, "from Massachusetts, southward, mostly near the coast." In the new edition of Gray's Manual, the *O. Missouriensis*, a western species having dry prickly fruit, is admitted as occurring in Wisconsin, and *O. Rafinesquii*, with smooth pulpy fruit, somewhat like the *O. vulgaris*, also in the western section from Wisconsin to Kentucky. Dr. George Engelmann, of St. Louis, in a recent examination of the genus, after comparing specimens from Massachusetts, New York, Pennsylvania, and New Jersey, heretofore classed as *O. vulgaris*, determines them to be identical with *O. Rafenesquii* from the west. In a recent note from him he says, "I have specimens growing here from Massachusetts, New York, Pennsylvania, and New Jersey, and they are all *O. Rafinesquii;* the *vulgaris* I have only from the falls of the Potomac and South Carolina."

In June last Mr. Martindale collected near Haddonfield, N. J., some specimens of *Opuntia* in flower, which on examination, and comparison with the species as figured in the fourth volume of the Pacific Railroad Reports, he had determined to be the *O. vulgaris*. In the latter part of July he again examined the plant, then in full fruit, and his former conclusion was sustained. He also sent a fully developed specimen to Dr. Engelmann, who pronounced it to be the true *O. vulgaris*, which he had not before seen north of the falls of the Potomac, and asked if it is a real native in New Jersey. On that point he thought there could be no doubt, as the owner of the land, John Gill, informed him it had been there to his knowledge at least twenty-five years; and while it does not incline to spread any, shows no signs of disappearing.

On comparing this plant with specimens growing near the coast, and which appears to be the *O. Rafinesquii*, the following characters appear. The *O. vulgaris* has a pale green appearance, the flat joints obovate, with small ovate subulate leaves, stout and tapering from a broadish base, mostly less than one-fourth of an inch in length, and appressed to the joint, with a fascicle of minutely barbed bristles, and occasionally a spine in their axils. The flowers are sulphur-yellow; the fruit smoothish, about an inch in length, and half an inch in thickness, somewhat ventricose, or largest just above the middle, and tapering to the base, with a depression at the top where the flower had fallen off, from one-eighth to one-quarter of an inch in depth. The *O. Rafinesquii* has rather larger flowers, occasionally with a reddish centre; more numerous petals; the fruit fully one and a half inches in length, with an elongated tapering base; the depression in the top of the specimens examined is rather shallower than in the *vulgaris;* the older joints have a darker green appearance, the leaves more slender, longer, from one-quarter to three-eighths of an inch in length, and spreading, and more frequently with the large spine, particularly about the top of the joint.

He had examined specimens from Woodbury, New Jersey, about twelve miles from the Haddonfield locality, which are *O. Rafinesquii*, and which have fusiform tubers on the extremities of the roots, similar in this respect to a western form of *Rafinesquii* described in the Pacific Railroad Reports as *O. fusiformis*. He had not been able to find tubers on the vulgaris, and the published description of that species made no mention of any.

There is growing in the Meehan nurseries, near Germantown, Pa., a specimen of *O. Rafinesquii* from New Jersey, which is identical with one from Illinois, also a specimen of *O. vulgaris*, from Harper's Ferry, Virginia, which is identical with the one collected near Haddonfield, N. J. These two species are somewhat closely allied; yet the form and position of the leaves are manifestly different, and being early deciduous is possibly the cause of their being so long confounded. Certain it is, if the two species as described are distinct, we have both of them in New Jersey.

Supernumerary Anterior Extremity in a Domestic Cow.—Dr. Allen exhibited a drawing of a malformation somewhat similar to that recorded in the Proceedings of July 25.

In this instance, however, the digits were reduced to two. These were of unequal size and one only was terminal. The remaining digit was appended to the side of the metacarpus, but was not articulated with it. It was indeed a dwarfed digit held in position to the metacarpus by fibrous tissue and integument. When at rest it lay nearly parallel to the main digit. Each digit possessed a well-developed hoof-like covering, the larger mass being curved and compressed from side to side, while the smaller one was styliform.

Above the smaller digit was a small conical appendage, which may be considered a localized hypertrophy in the normal position of the "cleet."

August 22.

The President, Dr. Ruschenberger, in the chair.

Twenty members present.

August 29.

The President, Dr. Ruschenberger, in the chair.

Twelve members present.

A paper entitled "Note on the Discovery of Representatives of Two Orders of Fossils new to the Cretaceous Formation of North America," by Wm. M. Gabb, was presented for publication.

On the Coal and Iron Resources of Alabama.—Mr. William Gesner remarked that a number of applied and interesting scientific facts had developed themselves in connection with the construction of geological sections in miniature of the Warrior and Cahaba Coal Measures in Alabama for exhibition at the Centennial. The frequent inquiry for information concerning them had induced him to believe that a description of these measures would prove interesting to the Academy of Natural Sciences.

The three coal fields of Alabama, comprising an area exceeding seven thousand square miles, and separated by narrow silurian valleys, are just now being brought into prominent notice by the superior character of the coals and coke they afford, and the economy incidental to the manufacture of iron by their means.

The valleys which separate these fields being stored with inexhaustible supplies of the best grades of hematite and brown ores, even to that variety best adapted to the manufacture of ferromanganese, it seems surprising that both of these resources should have been allowed to lie dormant for such a length of time, while others of less extent, richness, and economy of working have been given their fullest development.

It is now ascertained that the coal measures of the Warrior and Cahaba coal fields consist severally of 172 and 173 strata, embracing respectively forty-six and fifty-one coal-seams of all dimensions, from one inch up to six feet six inches in thickness, constituting a grand aggregate of one hundred and eighty-eight feet of bituminous coal.

In the Warrior field there are many localities where the beds of coal lie horizontally, while in the Cahaba they are more frequently inclined; but all of those being worked in either are reached by slope or tunnel.

Two beds of black band characterize the Warrior measures, one of them showing a richness of 43 per cent. metallic iron; clay iron-stone is abundant, and is found in all of the coal fields in Alabama. In one instance it constitutes the roof of a twenty-eight-inch bed of coal in the Warrior measures.

The fossil fauna and flora of these beds are found to be similar. Immediately beneath the mountain limestone of the carboniferous formation in the upper silurian, a bed of fossiliferous hematite occurs as one of its members. It extends in a northeastern direction, a distance exceeding 120 miles, and into the State of Tennessee, where it may be seen outcropping, interstratified with ferruginous limestone seven feet thick, under Mitchell's Point, Walden's Ridge.

In Jefferson County, Alabama, its thickness is found to be twenty-eight feet, gradually becoming thinner toward its northeastern prolongation. Wherever it outcrops on the top, from the sides, and in the valleys of Red Mountain, it is noted for affording the most fertile soils.

It is conceded by all who see and examine this immense bed of ore, that it is to become the great base from whence in the future our principal supplies of iron will be produced.

In the neighborhood of from two to three miles east and west of this ore bed lie the coal fields before mentioned. For its entire extent through the State, and immediately under it, lie the limestones of the silurian formation, among which are many of the purest and those best adapted for fluxing iron from its ores.

Geologically, in descending order, next occur the immense beds of brown ore, comprising the varieties manganiferous and fibrous limonite, mamillary and crystallized hematite, belonging to Talladega, Coosa, Cahaba, Roop's and Murphy's valleys, from which heretofore nearly all of the Alabama iron has been produced—charcoal being used for fuel.

At the present time, by a practical application of all of these advantages, great progress has been made by the Eureka Company, under the able superintendence of Mr. James Thomas.

After remodelling the plant of the former Red Mountain Iron and Coal Company at Oxmoor Station, on the South and North Alabama R. R., he has put in hot blast one furnace, on coke produced on the spot by ovens, with attached combustion chambers of his own devising. The ore charges are made to consist of the mixture—three-quarters fossiliferous hematite and one-quarter brown ore, which is yielding from the furnace 56 per cent. good pig metal, costing under twelve dollars per ton in its manufacture. In view of these facts it becomes evident that Alabama will soon attain pre-eminence in the production of iron; and, as steel supersedes its use for railroad and all other mechanical appliances (our next great stride in the march of civilization), she must become most populous and prosperous, for her climate is equable and her soils rank among the most fertile.

Dr. S. H. Linn, of St. Petersburg, Prof. Paul Groth, of Strasburg, and Dr. James Hector, of New Zealand, were elected correspondents.

The following papers were ordered to be published:—

THE ROCKS KNOWN AS MEXICAN ONYX.

BY MARIANO BÀRCENA.

I have the honor to present before this Academy a report upon the calcareous rocks of Mexico, which so deservingly are occupying the attention of the public in the present International Exhibition.

These rocks are known in Mexico by the names of "Tecalli," "Mexican Onyx," and "Mexican Marble." The first of these names refers to the place where they are found, as the principal beds are located in the neighborhood of the town of Tecalli, in the State of Puebla. The word Tecalli is a compound one, and, in my judgment, is derived from two Aztec words: *Tetl* (mountain) and *Calli* (house), the meaning in this case being "House of the Mountain." The origin of the word might be supposed as well to be *Teocalli* (God's Mansion), name given by the Indians to their temples.

The names Onyx and Mexican Marble are due: the first, to the fact that, like the true onyx, the Mexican rock shows stains and parallel stripes; and the second, to their chemical composition, which, in point of fact, is the same as that of the common marble.

I have read in some of the latest European journals that Mr. D'Amour informed the Academy of Sciences of Paris, that the Mexican onyx was nothing but a *calcareous alabaster*. This same opinion was expressed by myself, more than two years ago, in the "Mexican Society of Natural History." It was published in the first number of the third volume of "La Naturaleza," and I have been most happy to learn that the classification of that celebrated chemist agrees with mine.

The rocks of Tecalli offer a great many varieties in their different grades of transparency, in the diversity of their colors, and in their physical properties. In order to make a close examination of these rocks, I selected a white specimen, as I considered this to be the purer variety. The characteristics were as follows:—

Irregular form. H = 4.90 (Breithaupt's scale), G = 2.90. Lustre vitreous—resinous. Color white, slightly tinged with green. Transparent in thin slices, and translucent in pieces of some thickness. Fracture splitting in the oblique section and fibrous, with a somewhat silky appearance in the vertical section. Streak white.

B. B. infusible, becoming opaque and with a light reddish color.

In two analyses made I found the following composition:—

Lime	55.00
Magnesia	1.25
Water and oxide of iron and manganese	0.10
Carbonic acid	42.40
Sulphuric acid	1.25
	100.00

This composition shows that the rocks are essentially formed by carbonate of lime, and that the other substances may be considered as accidentally mixed, because of their existing in different proportions in the red, green, and yellow colors, as observed in the block.

The small proportion of sulphuric acid discovered was probably in combination with the lime, as the quantity of this base exceeded that which is required for combination with 42.40 of carbonic acid; for this proportion of the acid are required 93.96 of lime. The excess of this base is 1.04, which would take 1.48 of sulphuric acid to form the hydrous sulphate (Anhydrite), being this amount of acid very similar to that found in the analysis.

The oxides of iron and manganese, as well as the selenite, were mixed only with the carbonate of lime, which alone formed the bulk of the analyzed specimen.

Prof. W. J. Ward lately presented to the Royal School of Mines in London a qualitative analysis of the same rock, having found exactly the same substances that I did myself on my examinations; but, I understand he selected one of the most colored varieties, as he found the iron in large proportions, and partly combined with the carbonic acid. He found the sulphuric acid, and also the oxides of iron and manganese, which latter he considers to be the only coloring matters.

The capricious variegation of colors produced by those oxides, as well as the different grades of transparency and opacity in the polished slabs, give them that magnificent aspect which constitutes their indescribable beauty. When the blocks are cut in the direction of their planes of stratification, the shades appear in the form of clouds, flames, and stains of all dimensions. The clouds at times appear simulating somewhat the form of *cumuli*, or that of *cirrus*. The combination of those extreme grades, and of other intermediaries, added to the difference of opacity in some portions of the same slab, produce the most beautiful and inimitable effects. In some we find the figures of mountains, ruins, and several other objects which look very much like landscape sketches. The colors vary from the dark-green to the apple-green, and from the intense red to the lightest rose tint. There are also varieties of yellow and blue which intermingle with the former. The metallic oxides which produce this coloration are found in greater proportions towards the borders of the veins of some of the rocks, and through which was effected the infiltration of the waters which contained the coloring materials.

The rocks of Tecalli admit of a higher polish than the common marble. This can be seen in the many specimens now on exhibition in the Mexican Department of the Main Building, and which, by their brilliant surfaces, colors, and transparency, admirably imitate the agates and the true onyx.

By the foregoing peculiarities we find that the Mexican marble belongs to the group of the *calcite*, and from its physical properties to the variety designated as *Travertine*, under which head is classified the *calcareous alabaster* or *onyxite*.

The good reception of these rocks in the markets, the extent of their deposit, unequalled perhaps in this respect, give them sufficient interest to deserve the names of *Onyx* and *Mexican Marble*, a name which probably will be always adopted in commercial language. The beds of the rock are situated in the neighborhood of the town of Tecalli in the State of Puebla.

In a report which the Mexican Engineer, Mr. Patricio Murphy, made two years ago, he mentioned three principal deposits which bear the names of "La Pedrera," "Tlahualco," and "Aratleta." The most important of these is the first named, located at twenty miles from the city of Puebla. According to Mr. Murphy, the mountain where the Mexican marble is found is alternately formed of beds of this rock, argilleous calcareous rocks, and marls and sands. The quantity in which those rocks are found is very extensive, and warrants the expectation of an almost unlimited supply. It is to be hoped that the use of these rocks will be soon extended, because, as they are far more beautiful than marble, and resemble so much the true onyx and agate, they are appropriate for the richest and most splendid decorations.

ON PHOTOGRAPHS OF TASMANIANS AT THE CENTENNIAL EXPOSITION.

BY CHARLES PICKERING, M.D.

During my visit to Australia, in or about 1840, every one at Sydney spoke of the Australians as a distinct people from the natives of Tasmania or Van Diemen's Land; the Australians, it was said, are "straight-haired blacks," and the Tasmanians are "woolly-haired blacks;" but, not meeting with a Tasmanian, I did not feel authorized to make a distinction on my Map.

Recently, at the Centennial Exposition, photographs of Tasmanians, and especially of the last male survivor, have enabled me to form an opinion, and refer the originals to the *Papuan Race* or large New Guinea negro.

Among the varieties of man, the Papuan is remarkable for his harsh skin; and it is on record in books of travel, that the skin of Tasmanians is not soft to the touch like that of Australians; also, that the Tasmanians fill their hair with mud (a characteristic trait of Papuans).

New Zealand was peopled by Polynesians from the tropics. The emigrants, leaving behind all tropical plants, yet carried along old familiar names, some of which they transferred to the productions of the colder climate; one instance I will quote from memory:—

The *Barringtonia* of the tropics bears a large husky fruit, which is used by the natives to float their seines or nets; the Polynesian name of the tropical tree has been transferred in New Zealand to a tree of the pine kind; its wood, however, is very light, and made by the New Zealanders into seine-floats.

Tasmania in a similar manner was peopled by Papuans from the tropics, by emigrants probably acquainted with agriculture, but who did not bring esculents suitable for cultivation in the cold climate of the new country.

Two other important corrections have come to light since the publication of my Map:—

One is the discovery by Schweinfurth, in Central Africa, of a country under the equator inhabited by the *Hottentot* race, identified by him with the pigmy nation that, according to Homer, suffered from attacks by cranes; the true location even pointed out by Herodotus.

The third correction is derived from photographs, showing that the Aino of Northern Japan, Yeddo, Saghalien, and the neighboring islands belong to the *White* or Caucasian Race. The most eastern island bears the name of "Yurup," as though given by a land party journeying east in search of Europe, precisely as Columbus by sea journeyed west in search of Asia. The geographical position of the Aino, and their maritime expeditions to the Aleutian Islands, accord with Mexican and South American tradition of an ancient intercourse with long-bearded white men from the west (see Humboldt).

SEPTEMBER 5.

The President, Dr. RUSCHENBERGER, in the chair.

Twenty-nine members present.

A paper entitled "Hexagonite, *Goldsmith*, a variety of Tremolite," by Geo. A. Koenig, was presented for publication.

Morphology of the Pear.—Dr. McGRATH placed on the table abnormal fruit of the pear, in appearance resembling huge acorns. Mr. THOMAS MEEHAN took occasion to note the recent advances of morphological knowledge as explaining such phenomena. Even recent text-books taught that a fruit was but modified leaves. The exact truth is that a fruit is leaves *and branch.* When a bud is being formed in the apple, pear, or similar fruits, it may finally be either a flower-bud or a bud producing a new branch. Varying phases of nutrition decide this question. Exactly the nature of this variation we do not know; but we do know that the growth-force in the bud is arrested by some law of nutrition, and, instead of an elongated branch, what would be its series of spirals are drawn together closely, and the whole modified and made to form a flower. Thus, in the pear, it takes five buds to form one full cycle on a pear branch. When growth is arrested to form a flower this first cycle is transformed into a five-lobed calyx, and generally this becomes much enlarged and fleshy, and covers all the other cycles of buds which go to make up the inner layer of flesh terminating in the petals, carpels or core, and so on. Now, in the case before the Academy, the arresting force was imperfect. It had succeeded in forming the outer or calycine verticillate series of buds into a fleshy matter, giving what here might be called the cup of the "acorn," when the accelerating or branch-producing force gained a temporary advantage and pushed on, forming the acorn-like centre, but only to be soon again arrested. This abnormal pear was indeed nothing more than an effort of the tree to produce a branch after a fruit had been decided on; a struggle which was finally decided in favor of the fruit, if we might speak metaphorically in explaining the case.

Natural Hybrids.—Mr. MEEHAN said that modern naturalists were mostly convinced that new forms were evolved from old ones, but how much the new form had been influenced in its creation by a thus far mysterious law of change inherent in the old form, impelling it to bring forth the new one when nature's own good time had come: or how far external influences acted in bringing about these changes, was still a matter for science to solve. He thought the innate power of change was much greater than many of our best naturalists were willing to grant. In illustration, he held a letter from a leading botanist inclosing what he contended was a hybrid between *Verbena stricta* and *V. urticæfolia*. Mr. M. described the structure of Verbena. The tube of the corolla was half an inch in length, and narrow, and only insects of a large size and long trunks could reach to the bottom for honey. The anthers were curved just above the stigma, and both organs matured near together. Above all, and completely closing the entrance to the tube, was a dense mass of hair. Supposing, on prevailing theories of cross fertilization by insect agency, that an insect should visit the verbena flower for honey, and the trunk get covered with pollen, the rather large trunk would get stripped clean of its pollen in wiping against the mass of hair on withdrawal; or, if a little did remain in spite of the brushing, would most likely get thoroughly cleaned on the visit to the next flower. Hybridization by this agency, and there appeared to be no other in this case in nature, was well nigh impossible. He had always regarded the dangers of hybridization, and consequent confusion of species, as an *à priori* argument against the prevalent theories of cross fertilization by insect agency being any part of a great plan for the development of the races of plants. At any rate in *Verbena*, the mass of hair in the throat could not by any interpretation be regarded as an arrangement in the aid of cross breeding. It was an obstruction, and, in his opinion, an insurmountable one.

The striking form of Verbena between *V. stricta* and *V. urticæfolia*, sent to him by his distinguished correspondent, he should regard as no hybrid, but as a form evolved in the due course of an inherent guidance from the former species, a power continuously at work, and which "external circumstances" tended as often to repress as to aid.

SEPTEMBER 12.

The President, Dr. RUSCHENBERGER, in the chair.

Thirty-two members present.

A paper entitled "On the Lingual Dentition, Jaw and Genitalia of Carelia, Onchidella, and other Pulmonata," by Wm. G. Binney, was presented for publication.

Welwitschia mirabilis.—Mr. THOMAS MEEHAN called attention to a specimen of *Welwitschia mirabilis*, exhibited in the Portuguese African section of the Centennial Exhibition, as well worthy of the examination of members of the Academy. The trunk in this specimen is vase form, and about two feet across, and stands about two feet from the ground.

Nocturnal flowering of Mentzelia ornata.—Mr. THOMAS MEEHAN said this old species had only just found its way into cultivation, and afforded an opportunity to note its distinctive habits. His nephew, Mr. Joseph T. Meehan, had kindly watched for him, and found that the same flower opened on four successive nights; on the fifth it made a weak attempt to open, but soon faded away. The flower commenced to open soon after sundown (6 P.M.), very rapidly the first day, and commenced closing again in about three hours, becoming entirely closed by midnight. The second night they opened more slowly, and commenced to close earlier, so that the final closing was again about midnight. The last two nights the motion was slower, but occupied about the same time on the whole. Mr. Redfield had noted, Mr. M. observed, that some Mentzelias opened by day and some by night, but he knew of no attempts to time the opening exactly.

In order to tell whether these openings and closings by night had anything to do with fertilization by insect agency, he had inclosed one flower in a gauze bag, and found it to have a seed vessel apparently as perfectly developed as the rest. The seed might possibly be imperfect when the seed vessel was mature, but this was hardly likely, as the instances where plants developed their capsules in the absence of fertilization were uncommon.

SEPTEMBER 19.

The President, Dr. RUSCHENBERGER, in the chair.

Twenty-eight members present.

Notes on the Coniferæ.—Dr. ENGELMANN, of St. Louis, spoke about *Abies Fraseri*, the very local species of the highest mountains of North Carolina, which he had just visited, together with several botanical friends, members of this society. This is the tree which caused these mountains to be designated as the Black Mountains; giving their summits that sombre hue for which they are known. They seem to grow nowhere but on these mountains, and only on those that reach up to or above 6000 feet altitude. The northern localities claimed for the species, rest on confusion with forms of *Abies balsamea*, the common northern balsam, of which our tree may be claimed to be the southern representative. *A. balsamea* does not seem to extend southward further than the Virginian mountain region; and it would be interesting to ascertain how near both species approach each other.

Besides the well-known characters of the cones and their cusps, excellent distinctions are found in the structure of the leaves of both species. It may not be generally known, though it is a fact to which, since several years, some European botanists have called attention, that the anatomical structure of the leaves of these species, as well as of *conifers* in general, are extremely various, and that this structure well characterizes many species, and is one of the safest means to arrange them in natural groups. *Abies Fraseri* and *balsamea* are so nearly allied, that without fruit they are constantly confounded; but the structure of the leaves will always distinguish them so well, that a single leaf, or even a fragment of one, will invariably solve all difficulty. The leaves of *Abies* have under the epidermis, and between it and the cells of the parenchyma, which are full of chlorophyll, an arrangement of cells of thick walls, elongate form, and destitute of chlorophyll, analogous to bast cells, which have been called *hypodermic* cells; we find them in all species of *Abies* on the edges and on the keel, where they strengthen the leaf; but their distribution under the epidermis of the upper side of the leaf is very different in different species—they may be wanting there altogether or may be differently grouped, or may extend over the whole upper surface. Now in all forms of *A. balsamea* they are there almost entirely absent, even in those of the highest New England mountains; while *Fraseri* exhibits under the microscope a continuous hypodermic stratum of them.

These differences may seem minute and perhaps unimportant, but they remind us of similar structural differences in the higher or vascular cryptogams, in which on differences in variation and cell-structure much stress is laid, and justly so; while in higher developed plants the anatomical structure of the leaves is much more uniform.

This leads to another and much more important question, the position of the conifers in the vegetable world.

Conifers are usually placed at the bottom of the dicotyledonous plants, and Cycadeæ with the highest monocotyledons, near the Palms. Now, Robert Brown, more than fifty years ago, has shown that both differ from all other flowering plants, by bearing on open leaf-organs naked ovules; nor are their seeds inclosed in regular fruits, a peculiarity which has procured for them the name of gymnosperms. It must be admitted, however, that to this day the question, though diligently ventilated, is not entirely settled, or, to express it more correctly, gymnospermy is not yet acknowledged by every botanist.

Calling to our aid the investigations in another field of natural science, Palæontology teaches us that the lowest forms appear in the oldest epochs of our globe's history, and that only in the later periods the higher developed forms are found. Now, the fact is, that ages and ages before other flowering plants, angiospermous plants are found, and almost coëtaneous with the earliest cryptogamic land plants—in the Carboniferous and even in the Devonian periods conifers already made their appearance.

As in the development of the mammals, the prototypes of many of the orders are found anterior in their geological age, as well as lower in grade of development; so the conifers, with their exogenous trunk and their often numerous cotyledons, will have to be considered the prototypes of the exogens, while the cycadeæ with endogenous trunk, and unequal or almost single cotyledons, are those of the endogens. Both together, comprised under the general term of gymnosperms, will eventually be acknowledged as a link intermediate between the vascular cryptogams and the flowering plants.

Naturalization of Plants.—Mr. MARTINDALE spoke of the various agencies by which foreign plants have been introduced into the country, also of the manner of their distribution, instancing the case of *Rudbeckia hirta*, L., now very abundant in the eastern section, having been introduced in grass seed from the west. He also mentioned a number of plants that are common on the coast of Virginia and southward, which have been collected in the lower counties of New Jersey, evidently from seed carried by birds in their migrations coastwise.

Within a few years large quantities of ballast have been deposited in the neighborhood of Philadelphia, on which have been collected a large number of plants not found elsewhere in the vicinity. Some of the species occur every year, and in some instances spread into the waste grounds; others have not appeared the second season, although their seeds became fully matured. He stated that this subject of introduction and establishment of foreign plants was becoming of more and more importance, as the geographical distribution of species was being investigated, and where reasons could be assigned, as to the manner of introduction, they give it an additional interest. He had, within a few days, collected, near the mouth of Wissahickon Creek, a plant which had been determined to be *Leonurus glaucescens.* A large number of luxuriant specimens were growing in the locality mentioned, and it appeared to be fully established. The plant is an entire stranger in this part of the country, and he could assign no way by which its introduction might have been effected at this time. It might possibly have been introduced from Siberia, by way of Japan, in some of the materials intended for the Centennial Exhibition.

SEPTEMBER 26.

Mr. EDW. S. WHELEN in the chair.

Thirty-four members present.

A paper entitled "Remarks on Ptiloris Wilsonii, Ogden," by Jas. A. Ogden, M.D., was presented for publication.

On Sphenes from Delaware County, Penna.—Dr. Wm. H. Forwood, U. S. A., communicated the fact that a number of sphenes of very large size and beautiful yellowish-green color have been taken from a quarry on the property of Jno. Mullin, near Bridgewater Station, Chester Creek R. R., Del. Co., Penna. The rock formation at this point consists for the most part of a hard, curled, garnetiferous gneiss, with here and there a narrow vein of quartz or feldspar.

Iron pyrites, hornblende, black mica, and a few staurolites have been noticed there. Near the eastern end of what is known as the middle quarry, there is a stratum of loose, dark-brown mica schist, permeated with a spring of water; and in the wettest portion of this, about ten feet from the surface, the sphenes were found in a small space in disseminated crystals, associated with loose crystals of quartz.

Unfortunately, the greater number of them were broken in blasting, and several are known to have been lost or destroyed; but he had collected pieces representing over thirty (30) distinct crystals from this one place. They vary from *one to three inches* in length, and all, without exception, present a twinned formation. Only three crystals escaped being broken. The largest is two and three-quarters inches long by an inch and a half across, and weighs eight hundred and sixty-four grains troy. The next in size is two inches long, and weighs five hundred and ten grains; and the smallest is an inch and five-eighths long, and weighs one hundred and ninety grains. He had prepared a plaster cast of each of these, which were presented, together with the fragment of a still larger crystal, being the largest one found, and weighing ten hundred and thirty grains. This is a new locality for sphenes, and these appear to constitute a new variety of that mineral in this State.

The Harmony of Antagonism of Teeth.—Dr. McQuillen directed attention to a human skull in which, owing to the loss of the bicuspids and molars in the left side of the lower jaw, an upper molar, failing to meet with the antagonizing teeth, protruded from the alveolus twice its original length. In addition to this, and from the same cause, the left superior maxilla had fallen considerably below the level of right superior maxilla, and, carrying with it the malar bone, had lowered the orbit to such an extent that the face must have been quite disfigured during life. There was a marked contrast between this and another skull shown, in which the thirty-two teeth were all in good condition, symmetrical in their arrangement, and illustrating in a marked degree the harmony of antagonism. During life the upper and lower teeth articulate with each other, so that when the jaws are closed they maintain each other in their positions. The incisors and canines of the upper jaw overlap those of the lower so as to conceal the upper third. The external cusps of the lower bicuspids and molars are received into depressions between the external and internal cusps of similar teeth of the upper jaw. No two teeth oppose each other only, but each tooth in closing the jaws impinges upon two, so that, should a tooth be lost, or even two alternate teeth, still the corresponding teeth of the opposite jaw are to some extent opposed, and thus remain useful. When a tooth is wholly unopposed, a process is set up in the jaw by which the useless organ is gradually extruded from the socket, as shown in the first skull.

Dr. Isaac T. Coates was elected a member.

Don Alvaro de la Gándara, of Madrid, Spain, Col. Juan J. Marin, of Barcelona, Spain, and Sig. Alessandro Castellani, of Rome, Italy, were elected correspondents.

The committees to which they had been referred recommended the following papers to be published:—

NOTE ON THE DISCOVERY OF REPRESENTATIVES OF THREE ORDERS OF FOSSILS NEW TO THE CRETACEOUS FORMATION OF NORTH AMERICA.

BY W. M. GABB.

It is not often, in a subject so long and so thoroughly worked over as has been the palæontology of the American cretaceous formation, that a student has the good fortune to discover at the same time the first representatives of three orders previously unknown. In a little lot of fossils from the "Timber Creek" or yellow limestone beds of the neighborhood of Vincenttown, New Jersey, recently found by Miss Frances H. Bryan, and presented by her through her father, Col. T. M. Bryan, to the Academy, I find the stem of an undescribed *Pentacrinite*, the first crinoid of the formation in the United States, and a number of plates of the first American cretaceous star-fish. In view of the unusual interest attached to these discoveries, I shall depart from the rule I have followed for several years, of abstaining from the description of isolated species and from imperfect material, and give the following brief diagnoses, in the hope of stimulating the search for these objects, thereby rendering our knowledge of them more complete:—

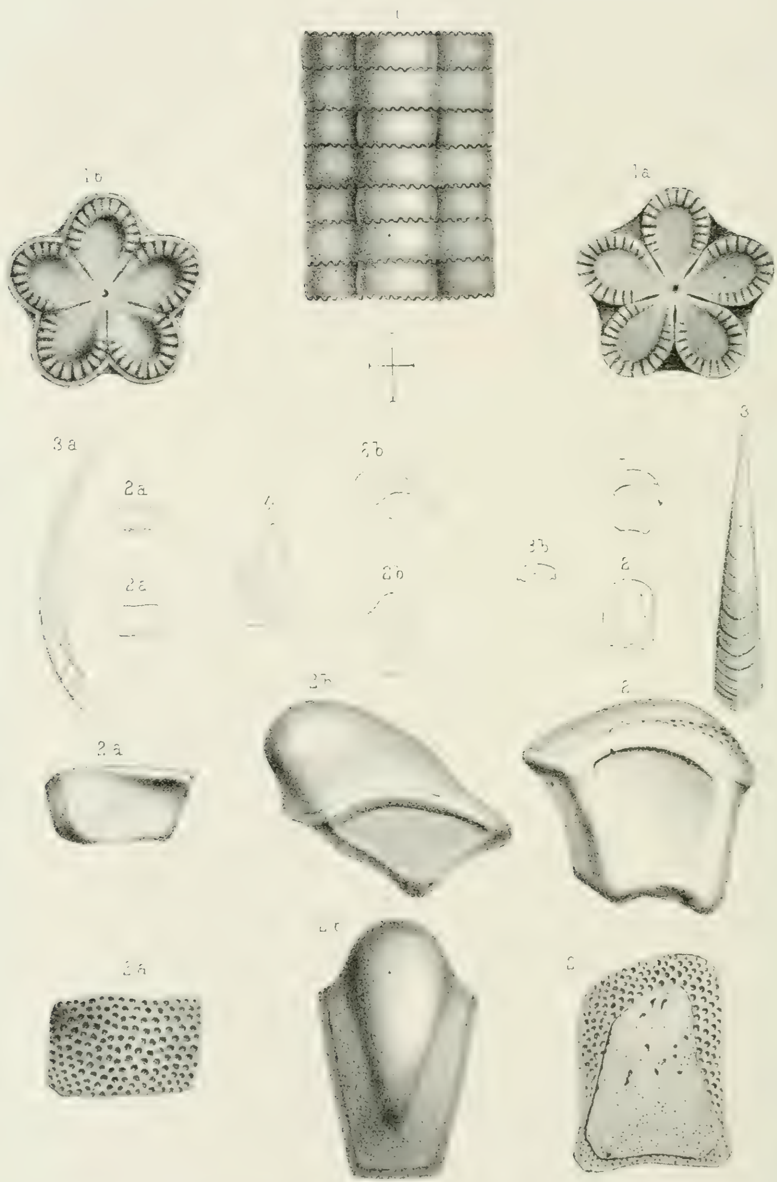
Pentacrinus Bryani, n. s. Pl. 5, figs. 1, 1*a*, 1*b*.

Known only from two fragments of the stem, one consisting of seven joints, the other of eight or nine. Stem distinctly pentangular, angles rounded; segments alternating, each alternate one more and less constricted in the longitudinal grooves. The less constricted segments are concavely rounded on the sides, while their alternates are cut on each side by a deep, acute indentation, giving them the appearance, as seen from above, of flowers with five rounded petals. Lateral surface of the segments convex and smooth; articular face slightly raised on the margin and radiately denticulate.

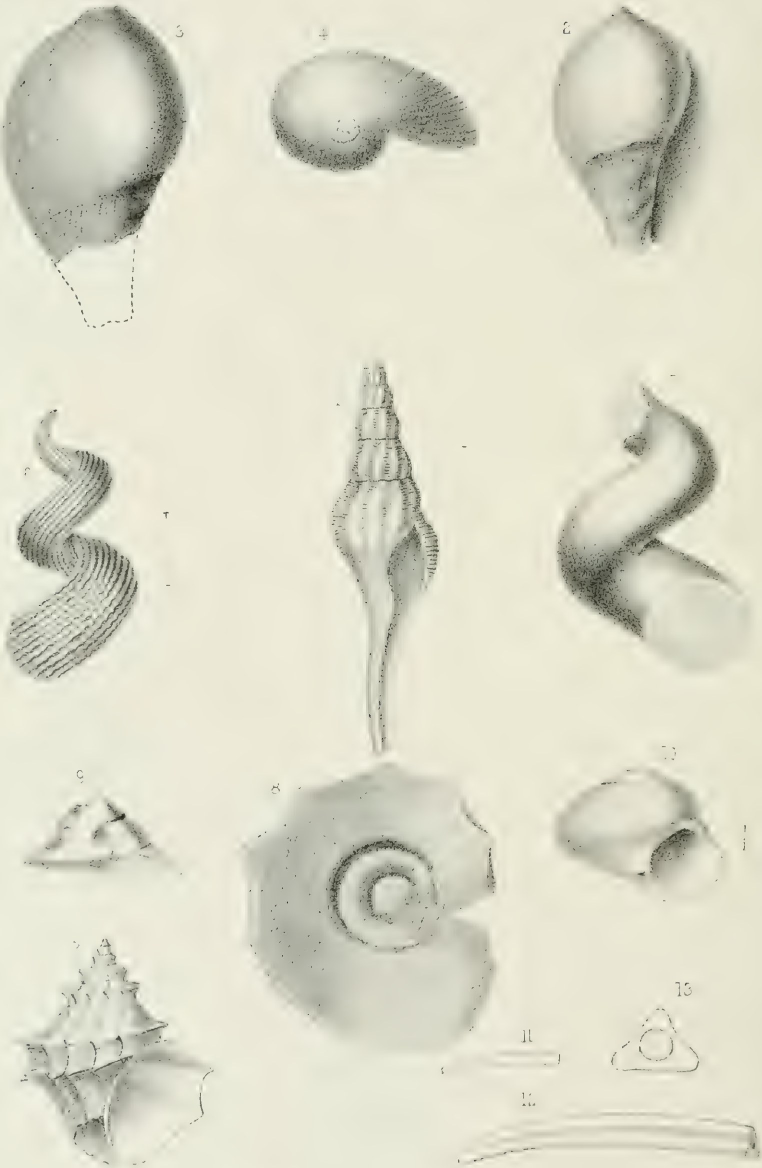
In style, this stem is nearest to *P. scalaris*, Goldf., from the Oxford, especially that form figured in Petr. Germ. Pl. 52, f. 3, b; but the angles are more rounded, and the flower-like appearance of the articular face of the segment is more marked.

Goniaster mammillata, n. s. Pl. 5, figs. 2, 2*a*, 2*b*.

About thirty marginal plates occur in the collection, some of which resemble in form those of *G.* (*Ast.*) *quinqueloba*, Goldf.,



Illustrated by the Barton Fund.



Illustrated by the Barton Fund.

Gabb on American Cretaceous Fossils.

Petr. Germ. Pl. 63, f. 5, b, c, d, except that they are somewhat shorter and thicker, and the pointed extremity is replaced by one truncated nearly straight across. But the most marked peculiarity of the present species lies in several marginal plates in the collection, corresponding with Goldfuss's fig. *e*. These are longer and narrower in form, and each bears on the end of the plate, which is acute in the European species, an elongated rounded protuberance, projecting beyond the end of the plate and overhanging it. Other smaller plates, about one-half longer than wide, are thinner, but retain the superficial outline of the first mentioned.

From the size of the plates, our species seems to be nearly of the same size as that with which I have compared it; but the difference in form, and the great rounded protuberance on the long plates, reversing the relative thickness of the two ends, will at once distinguish them.

Since writing the above, I have received from Col. Bryan another little fossil, so akin to the present subject that I add it. No Cirripedes have been reported from the American cretaceous, and his fossil is the carinal plate of a *Scalpellum*. On showing it to Mr. Conrad, he recognized it as being similar to a fragment in his possession from New Jersey, also from the white limestone, but of which the exact locality is unknown. Through the kindness of these two gentlemen, therefore, I have the means of making known the species, the more especially since Mr. Conrad's carina is accompanied also by a scutal valve of the same animal. The carina (figs. 3 and 3*a*) is large, indicating a size of about an inch and a half in length of the animal, without the stem. It has nearly straight sides, is very gently curved; external surface nearly flat at the upper part and rounded subangular below in the median line. Upper end acute, base rounded; inner face deeply concave; sides bearing a prominent linear rib which marks the three parts of surface into which Darwin divides this plate. This will be better understood by a reference to the cross-section, Pl. 5, fig. 3*b*, made across the middle of the plate. The scutal plate (fig. 4) is nearly straight on its occludent margin; the tergal margin is strongly sloping and a little concave at the apical portion; the base is straight or very slightly convex. The surface is slightly angulated, and marked by strong lines of growth. I propose for this rare fossil the name of *S. Conradi*, in recognition of the donor of the greater part of the material from which the description is drawn.

HEXAGONITE, GOLDSMITH, A VARIETY OF TREMOLITE.

BY GEORGE A. KOENIG, PH.D.

In a paper read by Mr. Goldsmith before the Academy (August 15, 1876), he described a new mineral occurring at Edwards, St. Lawrence Co., N. Y., for which he proposed the name hexagonite. According to his description the mineral is hexagonal in form, is optically uniaxial, and in composition is a bisilicate of magnesium, calcium, and sodium. Mr. Goldsmith assigns it a place in the *beryl* group. Upon inspection of the mineral, the habitus of the crystals struck me as being very little like that of a hexagonal mineral. Some of the crystals, especially the larger ones, have a decided tabular habitus, such as we often find in minerals of the rhombic, monoclinic and triclinic systems. The appearance of the mineral is altogether novel and striking; the fine light amethystine color, and a peculiar lustre, together with the aggregative entwining of the crystals, render it very attractive to the eye. My doubts as to the accuracy of Mr. Goldsmith's determination being roused, I resolved to examine the mineral myself, having been furnished with plentiful material, through Mr. Clarence C. Bement's kindness, who was the first in this city to obtain it.

System of Crystallization, *Monoclinic.* The crystals form rhombic prisms, showing the faces of a prism and of a pinakoid, the excessive development of the latter producing the tabular shape of the larger crystals. The section of the prism is, of course, a hexagon, but the peculiar mode of aggregation prevented the definite formation of the terminal faces. However, this want is partially supplied by a basal cleavage at such an angle that no doubt can exist as to the monoclinic character of the mineral.

The larger crystals cleave very perfectly according to the prism, and one face with greater perfection than the other, which speaks also for the monoclinic form of the mineral. The angle of cleavage was found 124° 35′.

From a large number of measurements, I select the results obtained from one crystal, which was quite small, but had even and splendent faces.

Readings.	Calculated angles.	Mean.
0° 00′ 62° 30′	117° 30′	117° 38′
117° 43′	124° 47′	
242° 15′	117° 43′	124° 39′
297° 40′	124° 30′	
360° 00′	117° 40′	

The prismatic angle is therefore 124° 39′, corresponding very closely to that of tremolite, 124° 30′. *Color* pink, violet, amethystine; *lustre*, strongly vitreous; cleavage, basal, uneven and prismatic.

H = 6.5. Sp. gr. = 2.996, B. B.

Fuses to a white enamel in a strong flame. The white powder remains unchanged. With borax gives a pure amethyst glass in O. Fl., with sodium carbonate fuses to a glass, which is sky-blue when cold. These reactions indicate manganese. With cobalt solution reacts like an earthy silicate.

Composition.		Oxygen.	
SiO_2	= 58.20	31.021	
MgO	= 24.14	9.649	13.932
CaO	= 12.20	3.485	
Na_2O	= 1.90	0.490	
MnO	= 1.37	0.308	
$(Al_2O_3 + Fe_2O_3)$	= 1.40		
	99.21		

The oxygen ratio is therefore $\dot{R} : \ddot{Si} = 1 : 1.23$, and the simplest expression is

$$(MgO, CaO)\ SiO_2.$$

Now, if we compare with this the composition of tremolite from Gouverneur N. Y., a white variety, analyzed by Rammelsberg (Pogg. ciii. 299)—

SiO_2	= 57.40
MgO	= 24.69
CaO	= 13.89
$(Al_2O_3 + Fe_2O_3)$	= 1.74
$H_2O + F$	= 0.40
	98.12

we see that the new mineral differs from this only by having replaced a small percentage of magnesium and calcium by manganese and sodium. The manganese produces the distinguishing color.

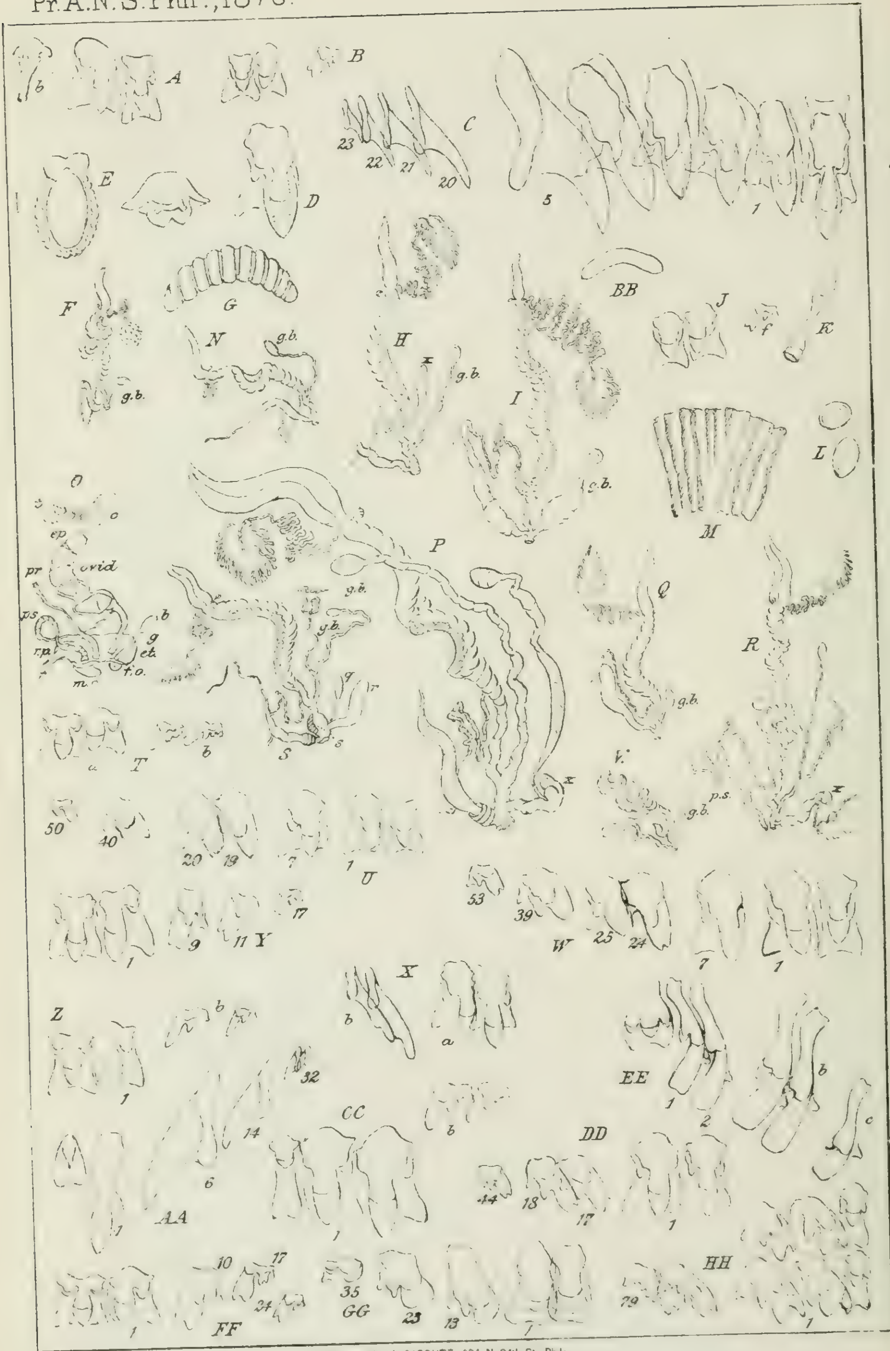
REMARKS ON PTILORIS WILSONII, OGDEN.

BY J. A. OGDEN, M.D.

In my description of *Ptiloris Wilsonii* (Proc. Acad. Nat. Sci., p. 451, 1875), two important characters were considered as being sufficient upon which to establish the species; but, since the publication of the article, it has been observed that the legs and feet are those of another bird.

This specimen was presented to the Academy by Dr. T. B. Wilson as coming from the Rivoli Collection, and no doubt the present legs and feet were substituted for the absent ones so as to complete the mounting of the bird. This was not noticed at the time the bird was described, and credit is due to Mr. D. G. Elliot for directing my attention to it.

Reliance, however, may be placed upon the other characters—the extent of the metallic-colored feathers of the neck and breast, which differ from *Ptiloris magnificus* in that they are not confined to the centre of the throat, but extend around beneath the eyes, covering the sides of the neck, as well as in front. Now, whether this difference be due to the manner in which the specimen has been prepared, or not, remains yet to be fully determined, and cannot be without further investigation; if it is, then *Ptiloris Wilsonii* will have to stand as a synonym of *Ptiloris magnificus*.



W.G.B. del.

Photo-Lith. by J. CARBUTT, 624 N. 24th St, Phila

Binney on Dentition &c. of Pulmonata.

ON THE LINGUAL DENTITION, JAW, AND GENITALIA OF CARELIA, ONCHIDELLA, AND OTHER PULMONATA.

BY W. G. BINNEY.

Macrocyclis sportella, Gld.

Oregon. Mr. O. B. Johnson.

Jaw and lingual membrane as usual in the genus. (See Proc. Acad. Nat. Sci. Phila., 1875.)

Teeth 22—1—22. The 6th tooth is the largest. The peculiar side spur noticed on the inner laterals of *Macr. Vancouverensis* is present in this species also. The central tooth is of same type as that of the last-named species, to which *sportella* is most nearly allied by its shell. Pl. VI., fig. AA.

Zonites inornatus, Say.

Pl. VI., fig. C, represents the dentition of this species, showing both planes of the cusps and cutting points. The dotted lines show the lower plane, *i. e.*, the part which rests on the base of attachment. This is what I have hitherto shown in my plates. From this lower plane the cusp and cutting point bulge out laterally as they round upwards. The most outward margin is the other plane shown, giving the widest extension of the cutting point.

Zonites fuliginosus, Griff.

On pl. VI., fig. D, is a lateral tooth of this species showing the two planes described under *Z. inornatus*.

Zonites(?) Bermudensis, Pfr.

Bermuda. Mr. J. Matthew Jones to Mr. Bland.

The specimens were living, enabling me to study advantageously the external characters of the animal. There is a distinct locomotive disk to the foot, but no caudal mucus pore, and no longitudinal furrows above the margin of the foot, so that the species cannot be placed in *Zonites*, which has the last two characters. The external orifice of generation is quite under the mantle, not behind the right eye-peduncle.

The jaw and dentition I have already described. (Ann. Lyc. Nat. Hist. of N. Y., X., 221.)

The genitalia present the following peculiarities. The genital bladder is small, globular, on a long duct. The penis sac is long, tapering to its apex, where it receives the vas deferens and the retractor muscle. There is a long, stout, dart sac, containing a delicate, arrow-like dart of the same form as figured by Leidy for *Zonites ligerus* (Terr. Moll., U. S. I.).

The absence of the caudal mucuspore removes the species from *Zonites*, nor can it be placed in any recognized genus.

Limax Hewstoni, J. G. Coop.

California. Dr. Cooper.

Pl. VI., fig. F, represents the genitalia of this species, which I have recently drawn from specimens kindly furnished by Dr. Cooper. For description, see Ann. Lyc. Nat. Hist. of N. Y., XI., p. 22.

Limax campestris, Binney, var. **occidentalis**.

California. Dr. J. G. Cooper. (See Proc. Acad. Nat. Sci. of Phila., 1872, 146, pl. III., fig. c.)

In outward appearance, in genitalia and in jaw, this form cannot be distinguished from the eastern form. Its lingual membrane has 35—1—35 teeth, 13 being laterals. On some of both the inner and outer marginals I can detect the side spur which in the eastern form I have only observed in the outer marginals. In this particular, *occidentalis* is more nearly allied to *L. montanus*, Ingersoll,[1] but when the value of differences in such slight details becomes known, I believe all three species will be found identical.

Pl. VI., fig. X, *b*, gives two inner marginals.

Onchidella borealis, Dall.

Alaska. Dr. W. H. Dall.

In three specimens examined I found a jaw (pl. VI., fig. BB), low, wide, slightly arcuate, ends scarcely attenuated, blunt, anterior surface ribless.

Lingual membrane (pl. VI., fig. EE) long and wide. Teeth about 61—1—61, arranged strongly en chevron. The central tooth is large, longer than wide, truncated above, expanded below its middle, and incurved at the basal margin. The reflection is large, tricuspid, each cusp bearing a decided cutting point. The side teeth have a long, narrow base of attachment, a small portion of its upper portion thrown outwards, the balance curving inwards, giving an irregular bow-shape to the whole base of attachment—

[1] This is the species indicated by me as *L. Ingersolli*, in Proc. Acad. Nat. Sci. Phila., 1875, 176.

whose upper and lower edges are abruptly truncated. The reflection is near the base, and consists of a very small, inner cusp, bearing a small conical cutting point, and another, outer, larger cusp, bearing an extraordinarily developed, wide, expanding, bluntly truncated cutting point. As the teeth pass outwards towards the outer margin of the membrane, they at first increase and then decrease in size, but retain the same shape quite to the edge.

An outer lateral tooth is figured in *c*, an inner lateral in *b*.

Fig. E, of plate VI., gives a view of the lower surface of the animal and also one of the head, showing the short, stout eye peduncles and curious oral appendages.

The *Onchidiidæ* are described as agnathous, but I am confident of having observed the jaw figured.

Ariolimax Columbianus, Gld.

From Mr. O. B. Johnson, of Forest Grove, Oregon, I have received specimens of this species. On examining the genitalia, I find them to agree perfectly with what I have already figured in Proc. Acad. Nat. Sci. of Phila., 1874, pl. XI., fig. C. I am convinced, therefore, of the identity of the specimens there figured, of which some doubt then existed.

Binneya notabilis, W. G. B.

Sta. Barbara Island, California, Mr. Henry Hemphill.

Pl. VI., fig. V, represents almost the whole of the genital system. The penis sac is long, narrow, tapering at its apex, where it receives the vas deferens: the retractor muscle is inserted below the entrance of the latter. The genital bladder is oval, on a long, narrow duct. There is a small, saclike, accessory organ, probably a dart sac.

Carelia bicolor, Jay.

Dr. W. H. Dall.

Through the kindness of Dr. Dall, I have been able to examine this species, formerly known as *Achatina bicolor*. Thus I have increased the list of subgenera or groups of *Achatinella* of Gulick's arrangement, whose jaw and lingual dentition is known, leaving still to be examined *Newcombia* only of the same arrangement.

It will be seen from my description, that while Carelia (or at least this species) differs utterly in jaw and dentition from Gulick's Achatinella s. s., Bulimella, Apex, Partulina, Auriculella, it agrees in dentition with his Laminella, Amastra, Leptachatina, but differs in having a costate jaw. Carelia, therefore, must stand distinct from any of the other groups of Achatinella.

My description and figures should be studied in connection with my former papers on Achatinella in Annals of Lyceum of Natural History of New York, Vol. X., p. 331, pl. xv., and Vol. XI., p. 190, pl. xiv., in the preparation of which I was assisted by Mr. Bland.

The animal is obtuse before, pointed behind. The mantle appears subcentral in the single individual examined, which is preserved in alcohol. The orifice of respiration and anal orifice are as usual in the heliciform genera. The genital orifice as far as I can judge is somewhat removed from behind the right eye peduncle, rather under the mantle edge, but it is difficult to say what is its position in the living animal. There is no sign of a distinct locomotive disk or of a caudal mucus pore.

The jaw (pl. VI., fig. G) is low, slightly arcuate, with but little attenuated, blunt ends: anterior surface with ten stout ribs, denticulating either margin.

Lingual membrane (pl. VI., fig. CC) long and narrow. Teeth 37—1—37 of same type as I have formerly described (l. c.) for species of Laminella, Amastra, and Leptachatina, the marginals being irregularly and obliquely pectinate as in Achlla. obesa (l. c.).

The digestive system, as would be anticipated from the shape of the shell, is characterized by the extreme length of the œsophagus. The salivary ducts are comparatively short. The salivary glands are small and in a globular mass around the œsophagus. The buccal mass with its pouch of the lingual membrane is as usual: its retractor muscle is attached to the retractor of the head.

The genitalia are here figured (pl. VI., fig. O). It will be seen that there is in the specimen examined a decided external swelling of both male and female (the former, female (*f. o.*), large and horn-shaped, the latter, male (*m. o.*), small and globular) organs; owing, perhaps, to the sudden immersion of the individuals in alcohol. The gravid state of the uterus precludes the possibility of these swellings being preparatory to accouplement This condition of the external orifices accounts for the wide separation of the genital bladder from the vagina, and of the accessory organ (*pr.*) from the penis sac. The figure is of life size, all the organs having been accurately measured. The testicle (*t.*) is composed of short cœca grouped in a globular mass. The epididymis (*ep.*) is short and greatly convoluted. The ovary (*o.*) is obtusely tongue-shaped and lobate. The oviduct is sacciform and contained two well-developed embryonic shells, showing the species to be viviparous, as well as four masses, probably consisting of less mature embryos. The genital bladder is small, suboval, on a short duct. The penis sac (*p. s.*) is long, cylindrical, with a developed, extended median constriction. The vas deferens (*v. d.*) enters the apex of the penis sac: the retractor muscle (*r. p.*) of the penis is inserted just above the entrance. There is a long, narrow, accessory organ (*pr.*) with an extended median constriction to the penis sac, perhaps a dart sac or prostate gland. There is a stout retractor muscle (*r.*) to the external horn-shaped swelling of the male orifice.

Microphysa incrustata, Poey.

Corpus Christi, Texas. A dried specimen collected over thirty years ago by Mr. Bartlett.

Jaw low, wide, slightly arcuate, ends blunt, but little attenuated: anterior surface with numerous, crowded ribs, bluntly denticulating the lower margin.

Lingual membrane (pl. VI., fig. T) with 13—1—13 teeth, 5 perfect laterals. The teeth are of same type as in other species of *Microphysa*, as *Ingersolli* (Ann. Lyc. of N. H. of N. Y., XI., pl. xviii., fig. C). The jaw also resembles that of *Microphysa* rather than *Patula*, to which I formerly referred the species. Von Martens places it in *Microphysa*. Fig. *b* shows marginal teeth.

Triodopsis inflecta, Say.

Indiana. Mr. F. Stein.

Genitalia as in *T. Rugeli*. See Ann. Lyc. Nat. Hist. of N. Y., XI., pl. xvi., fig. 18.

Turricula tuberculosa, Conr.

Palestine. A dried specimen in Mr. Bland's collection.

Lingual membrane (pl. VI., fig. J) long and narrow. Teeth 28—1—28. Centrals and laterals without decided side cusps or cutting points, but the central cutting point has a decided lateral bulge. Marginals low, wide, with one inner, oblique, large bifid cutting point, and two outer smaller cutting points. A marginal is shown in *f*.

Jaw with numerous, crowded, broad, flat ribs, denticulating either margin.

Helix monodon, Rackett.

Indiana. Mr. F. Stein.

Genitalia (pl. VI., fig. Q) characterized especially by a very unproportionally large penis sac, which is long, club-shaped, greatly enlarged above, where it receives the vas deferens and retractor muscle. The genital bladder is elongate-oval, small, on a short, delicate duct. The epididymis is convoluted throughout its length.

Polygyra Postelliana, Bland.

Charleston, S. C. Mr. W. G. Mazyck.

Genitalia as in *P. auriculata.* (See Leidy in Binney's Terr. Moll. U. S. I.)

Jaw as usual in the genus: over 12 ribs. Lingual membrane (pl. VI., fig. Z) as in *P. Hazardi.* (See Proc. Acad. Nat. Sci. Phila., 1875, pl. viii., fig. 5.) The change from laterals to marginals is very gradual, and formed without the splitting of the inner cutting point. There are 21—1—21 teeth with about 7 laterals. Extreme marginals are shown in *b*.

Polygyra Dorfeuilleana, Lea.

A dried specimen long preserved in my cabinet furnished the lingual membrane here described.

Teeth (pl. VI., fig. U) 20—1—20, with 9 laterals, the tenth tooth having its inner cutting point bifid. Base of attachment subequilateral of central and lateral teeth. All the teeth of same type as in *P. auriculata.* (See Ann. Lyc. of Nat. of N. Y., XI., pl. xviii., fig. E.)

Polygyra avara, Say.

Banks of St. John's River, Florida. Mr. Chas. Dury.

It is with peculiar satisfaction that I give these details, as it is one of our rarest species.

Jaw as usual in the genus, with over 12 ribs. (See Proc. Acad. Nat. Sci. Phila., 1875, p. 201.)

Lingual membrane as usual in the genus (see same, p. 202). The change from laterals into marginals is shown in the 9th tooth, which is the first having a bifid inner cutting point. There are 17—1—17 teeth. Pl. VI., fig. Y.

Caracolus sagemon, Beck.

Gonave Island. Prof. Linden to Mr. Bland.

On pl. B, fig. GG, I figure the dentition of the specimens described in full by Mr. Bland in Ann. Lyc. Nat. Hist. of N. Y., XI., 197 (1875).

Mesodon major, Binn.

This species (or form of albolabris) was found by me near Aiken, S. C., but still larger specimens, at Macon, Ga., in the City Cemetery, by Mr. H. S. Crooke. The form seems to inhabit a narrow strip of territory east of the mountains from Abbeville, S. C., to the Gulf of Mexico. The largest specimen I have ever seen is 48 mill. in its greater diameter.

The jaw, lingual dentition, and genitalia agree with those of *albolabris*. Fig. I, of plate VI., represents the genital system of one individual examined, in which the ovary is very small, and the genital bladder unequally divided, both points differing from those of other individuals examined. This shows us we should allow some latitude of variation in the details of the genital system of any given species.

Aglaja fidelis, Gray.

Oregon. Mr. O. B. Johnson.

On pl. VI., fig. P, I give a more satisfactory figure of the genitalia of this species than formerly published by me. The organ x in the specimens recently examined was greatly developed. The organ is a dart sac, which contained a dart of the type described below under *Arionta Mormonum*.

Arionta Mormonum, Pfr.

Tulumne Co., California. Mr. A. W. Crawford.

Pl. VI., fig. S, represents the genitalia. The general appearance is that of *A. fidelis*, as formerly described by me (see below), but there is an additional accessory organ (*q*.), of use unknown to me. The organ, *r*, is a dart sac. The dart is short, stout, straight, swollen at its base, and with an enlarged acutely pointed apex (pl. VI., fig. K). Upon the vagina, above the insertion of the penis sac, is a ridge-like process (*s*.) containing in three individuals examined one round, and one oblong calcareous nodule (pl. VI., fig. J). I suspect the organ 14, noticed in *fidelis* (Proc. Acad. Nat. Sci. Phila., 1873, pl. I., fig. 5) corresponds with this process.

Jaw as usual in Arionta: 7 ribs.

Lingual membrane (pl. VI., fig. B) as usual in Arionta. Teeth 50—1—50, with 15 laterals, the 16th tooth having its inner cutting point bifid.

Arionta sequoicola, J. G. Coop.

Santa Cruz, California. Mr. H. Hemphill.

The genital system (pl. VI., fig. R) is like that of Arionta Traski.

(See Ann. Lyc. of Nat. Hist. of N. Y., XI., pl. VI., fig. IV.) The accessory bulb upon the vaginal prostate is somewhat differently situated in this species. The extreme length of the genital system is eighty-seven millimetres.

Jaw and lingual membrane already described. (See Proc. Acad. Nat. Sci. Phila., 1874, pl. XIV., fig. 5.)

Arionta Californiensis, Lea.

Monterey. Mr. H. Hemphill.

Jaw already described.

Lingual membrane with 53—1—53. Teeth as usual in the genus (see above). The side cusp and cutting point appears on the 9th tooth. The inner cutting point of the 25th is bifid, so that there are about 24 laterals (pl. VI., fig. W).

The genitalia are as in *A. Nickliniana* already described.

Arionta Dupetithouarsi, Desh.

Monterey. Mr. H. Hemphill.

Jaw as usual in the genus, with four, separated, stout ribs.

Lingual membrane with 50—1—50 teeth. There are no distinct side cusps or cutting points on the centrals or first laterals, though there is a lateral bulge on the large cutting point. The distinct side cusp and cutting point appears on the ninth tooth. There are about nineteen laterals, the twentieth tooth having its inner cutting point bifid. The marginals are as usual in the genus (pl. VI., fig. U).

Genitalia as in *A. Traski* (l. c.). The penis sac is more slender and has no retractor muscle in the single individual examined by me. The oviduct is greatly convoluted.

Glyptostoma Newberryanum, W. G. B.

San Diego, Cal. Henry Hemphill.

Genitalia (pl. VI., fig. H). *x* is a dart sac or prostate gland.

Bulimulus Dormani, W. G. B.

Port Orange, Florida. Mr. Chas. Dury.

Jaw (pl. VI., fig. M, the central portion only) as usual in the genus, arcuate, thin, transparent, ends acuminated, anterior surface with about 54 plait-like ribs. The figure gives only a portion of the jaw. The upper median ribs are very oblique.

Lingual membrane as in *B. laticinctus*, *primularis*, *papyraceus*, etc. Teeth 79—1—79. Pl. VI., fig. HH. This is the first species of

Bulimulus noticed within the United States having this peculiar type of dentition.

Genitalia figured on pl. VI., fig. N. Penis sac very long and narrow, ending in a flagellum: vas deferens entering at about the anterior fourth of its length. Genital bladder oval, on a long, narrow duct. No accessory organs.

Bulimulus Edwardsi, Mor.

Lake Titicaca. Prof. Alex. Agassiz.

Jaw low, arcuate, ends rapidly acuminated, blunt: anterior surface with over ten distant ribs, some of the usual *Helix* type, others like the plait-like processes, common in *Cylindrella*, *Bulimulus*, *Gæotis*, *Amphibulima*, etc.

Lingual membrane (pl. VI., fig. DD) with 44—1—44 teeth. Centrals of the usual *Helicinæ* type, tricuspid: laterals like centrals, unsymmetrical, and consequently bicuspid. The change to marginals very gradual, and formed by the simple modification of the laterals, without any splitting of the inner cutting point.

Succinea ovalis, Gould, not Say.

Burlington, New Jersey.

Teeth over 60—1—60. Fig. *b* represents extreme marginals (pl. VI., fig. A).

Jaw with smooth anterior surface and prominent median projection to the cutting edge.

EXPLANATION OF PLATE VI.

Fig. A. Lingual dentition of Succinea ovalis.
Fig. B. " " Arionta Mormonum.
Fig. C. " " Zonites inornatus.
Fig. D. " " " fuliginosus.
Fig. E. Onchidella borealis.
Fig. F. Genitalia of Limax Hewstoni.
Fig. G. Jaw of Carelia bicolor.
Fig. H. Genitalia of Glyptostoma Newberryanum.
Fig. I. " Mesodon major.
Fig. J. Lingual dentition of Turricula tuberculosa.
Fig. K. Dart of B.
Fig. L. Calcareous concretions of B.
Fig. M. Jaw of Bulimulus Dormani, central portion.

Fig. N. Genitalia of M.
Fig. O. " Carelia bicolor.
t. Testicle.
ep. Epididymis.
o. Ovary.
ovid. Oviduct.
g. b. Genital bladder.
p. s. Penis sac.
r. p. Retractor penis.
r. Retractor.
pr. Prostate gland?.
v. d. Vas deferens.
m. o. Male orifice.
f. o. Female orifice.
e. t. External tegument.
Fig. P. Genitalia of Aglaja fidelis.
Fig. Q. " Stenotrema monodon.
Fig. R. " Arionta sequoicola.
Fig. S. " B.
Fig. T. Lingual dentition of Microphysa incrustata.
b. Marginals.
Fig. U. Lingual dentition of Arionta Dupetithouarsi.
Fig. V. Genitalia of Binneya notabilis.
Fig. W. " Arionta Californiensis.
Fig. X. " Limax occidentalis.
b. Inner marginals.
Fig. Y. Lingual dentition of Polygyra avara.
Fig. Z. " " " Postelliana.
Fig. AA. " " Macrocyclis sportella.
Fig. BB. Jaw of E.
Fig. CC. Lingual dentition of G.
Fig. DD. " " Bulimulus Edwardsi.
Fig. EE. " " E.
b. Inner marginals.
c. Outer marginals.
Fig. FF. Lingual dentition of Polygyra Derfeuilleana.
Fig. GG. " " Caracolus sagemon.
Fig. HH. " " M.

October 3.

The President, Dr. Ruschenberger, in the chair.

Thirty-six members present.

A paper entitled "On the Extrusion of the Seminal Products in Limpets, with some Remarks on the Phyllogeny of Docoglossa," by W. H. Dall, was presented for publication.

Bituminous Sediment of the Schuylkill River.—Prof. Leidy remarked that he had been recently invited by Dr. Josua Lindahl, Secretary of the Swedish Commission, who had at his command a small steamer, to make the experiment of dredging in the Schuylkill River. He had accepted the invitation in the expectation of finding abundance of the smaller aquatic animals, such as he had sparingly detected on stones near shore below low-water mark, just below Fairmount dam. The dredging was tried near the mouth of the Schuylkill, but no living thing whatever was drawn up, as the mud and sand were black and saturated with bituminous oil. This latter fact was unexpected, and would appear to illustrate the mode of formation of more ancient bituminous shales. The refuse of the city gas-works, and probably of some coal-oil refineries, run into the river. The oils appear to have an affinity for the particles of clay carried down the river, and, precipitating, become bituminous sediments at the bottom. In the same manner oils, from a profusion of decomposing animals, and probably also plants, supplied the sedimentary muds of ancient shales. Many even of the lowest plants contain abundance of oil, and it may be observed in such forms as Vaucheria, Diatomes, etc.

Fertilization in Beans.—Mr. Meehan observed that in all the discussions on the injurious effect of close breeding in flowers, and the consequent theories of cross fertilization, nearly all the arguments were drawn from structure. We are asked to note certain arrangements, and then to believe that certain results must follow. He preferred to watch the plants in their actions, and in the results of their actions when excluded from external agencies, believing it the more practical way and preferable to the theoretical one. One of his friends who thought he was wrong in limiting insect agency to a few plants, and in questioning the injury from vegetable close breeding, had been giving for some months past a series of articles in proof of his side, which was the generally accepted view. Of course the position of his friend was entitled to all the benefit to be derived from structural arrangement; but when he referred to actual behavior in plants, it came within the province he had marked out for himself. In the last paper there was an instance of this kind. After noting how the flowers of

Phaseolus, the common bean, were formed; and the supposed impossibility of fertilization by its own pollen, the paragraph concludes as follows: "The *machinery* tells its own story plainly. The confirmation is familiar to all who know beans and their facility of mixing when different varieties are grown together." Mr. M. said he claimed to "know beans" for thirty years past; and had grown large numbers of varieties side by side, saving seed from them and re-sowing, and had never known a single case of admixture from this close proximity. The various kinds of both Beans and Peas in cultivation were in all cases evolutions, or, as would be commonly said, "sports or accidents," or were the results of actual manipulations by skilful seed raisers. He had no hesitation in saying that his friend was utterly wrong in his impression of the facts; that he did not "know beans;" and the fact that beans would not mix, though so close together, and so freely visited by bees, was an excellent argument against instead of for the generally received theories of insect cross fertilization.

Fruit of Akebia quinata.—Mr. Thomas Meehan exhibited a fruit from a plant grown by Mr. W. Canby, of Wilmington, Del., who had three fruits from two old plants, and they were the first fruits he had heard of, after twenty years of extensive cultivation in America. In China and Japan, where it is a native, it is regarded as an edible fruit, and, inferring from its having a vernacular name, *Fugi-Kadsura-Akebi*, the fruit is probably common there. Attempts had been made to induce fruitfulness here by cross fertilization, but they had failed. It was not, therefore, a question of fertilization, but one of nutrition. The fruit is as large and of the appearance of a papaw (*Asimina triloba*), but opens on one side as in a follicle of *Asclepias*, disclosing the long column of parietal seeds. Mr. M. pointed out by it the difference between the Lardizabilaceous and Menispermaceous orders.

Note on Phallus fœtidus.—Mr. Meehan exhibited specimens of what he supposed to be a variety of this fungus. It was very rare with him, the last time it had appeared on his grounds was seven years ago. Its brilliant scarlet color and strong fetid odor would have attracted attention had it been in existence during that time. It was doubtful if any existed in the vicinity, and it was an interesting question whether the spores or mycelium had been in the ground all that while, or whether it had been recently brought as a spore in the atmosphere. But the main point he wished to draw attention to was the attraction the fetid plant had for meat flies. They abounded on the plants. The common toad plant of greenhouses (*Stapelia variegata*) attracted these in the same way, and it was said to be a scheme to aid the plant in cross fertilization, the stench attracting the flies, and inducing them to deposit eggs under the impression it was rotten meat; though what benefit it was to the fly to be thus fooled had never been made clear to him. In the case of this fungus, however, it would hardly be contended that the flies had been deceived for the purposes of fertilization, nor could he understand why "in-and-in breeding," if bad for phænogams, should not be injurious to a fungus as well.

OCTOBER 10.

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

Thirty-two members present.

Destructive Coleoptera.—Dr. LE CONTE mentioned that a small Coleopterous insect had recently proved quite destructive to carpets in houses in Albany and neighboring towns in New York. Mr. J. A. Lintner had sent him some specimens of the larvæ a few weeks ago, which proved to belong to some species of Dermestidæ, of unfamiliar form. Recently Mr. Lintner succeeded in rearing one of the larvæ, and sent the imago for examination. It was immediately recognized as *Anthrenus scrophulariæ*, a very common European species, not before reported as occurring in the United States. Herbst, Käfer, vii. 328, mentions that the larvæ destroy natural history collections, clothes, furs, leather, and edibles (Esswaaren).

Remarks on the Structure of Precious Opal.—Prof. LEIDY stated that Signor A. G. Arevalo, proprietor of one of the opal mines in Queretaro, Mexico, had recently called upon him, and exhibited a large collection of cut opals of various kinds, comprising the milk-white opal with a rich harlequin display of colors, the less valued transparent glassy variety with rich hues, and the red fire opal of different shades, also displaying the play of colors of the spectrum. From among them he had selected several which he exhibited to the Academy as illustrating in an unusually distinct manner the structure of the precious opal.

One of the specimens is white opal, emiting on one side from the free surface a brilliant display of colors. These are reflected from facets ranging from $\frac{1}{4}$ to 1 mm. in breadth, and of irregular polyhedral form, as represented in figure 1. The facets are distinctly separated by fissures, which, in the polishing of the stone, have become more or less filled with dirt, and they appear to form the surface of a mosaic pavement laid on a basis of amorphous opal, of which the other side of the specimen consists. The facets are distinctly striate; the striæ being parallel on the same facet, but changing in direction on the different ones, though pursuing the same general course over comparatively large areas, as represented in the same

Fig. 1.

figure. The striæ, or tubes as Sir David Brewster considered them to be, vary in degree of fineness; some apparently being double or more the thickness of others. He had not attempted to measure them accurately, but they appear to be about the size of the lines in the ordinary micrometer eye-piece of the microscope. There appeared usually to be about 4 or 5 striæ in the space of $\frac{1}{10}$th of a mm.

Another specimen is a dark carnelian-hued fire-opal, which exhibits in directly looking upon it, just beneath the surface, a patch of round or oval spots of a deeper hue. The spots range from $\frac{1}{4}$th to 1 mm. in breadth, and are separated by interspaces from $\frac{1}{8}$th to $\frac{3}{8}$th of a mm. The appearance of a portion of the specimen magnified is represented in figure 2. The spots appear as lenticular disks with finely striated surfaces; the striæ being parallel, and on the different spots pursuing nearly the same course. Viewed at a certain angle, they mainly emit a rich golden-green hue.

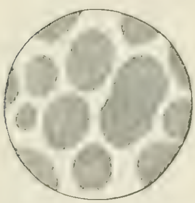


Fig. 2.

In another opaque white specimen, emitting rich hues, the striated facets are more or less isolated by amorphous opal, and vary much in size, as represented in the magnified figure 3. The smaller facets are generally irregularly oval; the larger ones appear to be made up of an aggregate of the smaller kind. Over comparatively large areas, the striæ of the different facets pursue nearly the same direction, but in contiguous areas they even pursue quite opposite directions, as represented in figure 3. On the larger patches, also, as I have attempted to represent them, the striæ are not perfectly continuous, but appear to be rather interrupted in bands. On another part of the same opal the brilliant patches would appear to pertain to cylindroid or fusiform rods of the striated opal imbedded in amorphous opal, as represented in figure 4.

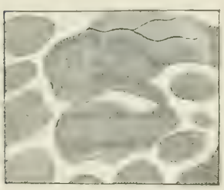


Fig. 3.

The striæ in these rods appear to be arranged in regular parallel layers, so that either longitudinal or transverse sections give rise to the appearance of parallel striæ.

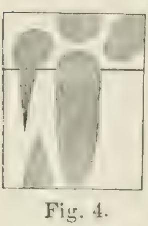
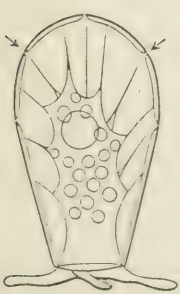


Fig. 4.

From these specimens precious opals would appear to be constituted of an aggregation of particles of a striated or finely tubular structure which may be imbedded in a basis of more amorphous opal. When isolated by the latter, the particles may appear as lenticular disks, round or oval balls, or cylindrical rods with rounded ends and of variable length. When closely aggregated, these particles become more or less polyhedral. The particles in section in any direction present a striated appearance, and, according to the varying fineness of the striæ, and their inclination, emit the varied hues for which the precious opal is so much admired.

Observations on Rhizopods.—Prof. LEIDY stated that last July, in the sphagnum swamps of Tobyhanna, Pocono Mt., Monroe Co., Pa., he noticed an abundance of a Rhizopod which he thought he had not previously seen, and which he at first supposed to be an undescribed species, but which he now viewed as a variety of *Hyalosphenia ligata.* From this, as previously described, it differs in the test being of a pale sienna color, and perhaps of greater thickness, but otherwise is like it. The test is compressed pyriform, with the length and breadth nearly or about equal, and the thickness one-half. The lateral borders are obtusely rounded. The mouth is transversely oval. The sarcode is colorless, and attached to the inside of the test by diverging threads. The pseudopods are usually from two to three. Measurements, .08 mm. long and broad, and .036 thick, with the mouth .02 broad and .008 wide. Others varied from .06 long and .08 broad, to .092 long by .064 broad.

In observing the Pocono variety of *Hyalosphenia ligata*, and the beautiful and well-marked species *Hyalosphenia papilio*, he detected an important point of structure which previously had escaped his notice. In the active condition of these, and other Difflugians, they are seen with one or more pseudopods extended from the mouth of the test, to the margin of which the sarcode is attached, as well as by diverging threads to various points of the interior of the test. The interval between the body of the sarcode and the interior of the test is occupied with water. The extent of the interval increases with the increase in number and extent of protrusion of the pseudopods, and also varies according to the degree of emptiness or repletion with food of the sarcode body. When the pseudopods are withdrawn into the mouth of the test, the mass of the sarcode expands in a corresponding ratio, and the threads of attachment to the inside of the test contract in length. The intervening water appears to be displaced through small apertures of the lateral borders and fundus of the test, which exist in numbers usually from two to half a dozen or more, as represented in the figure.



Hyalosphenia papilio. The arrows are directed to two of the apertures through which the water escapes when the animal retracts its pseudopods.

While speaking of Rhizopods, he would ask the indulgence of the Academy to listen to some remarks on recent observations on the habits of several species of Amœba.

One of the species of Amœba which he had most commonly seen, he took to be the

Amœba verrucosa of Ehrenberg, with which the *A. natans* of Perty, and the *A. terricola* of Greef, appeared to him to be synonymous. This species he had found in many places: in the crevices of the brick pavement in the yard attached to his residence, in brick ponds, in the ooze of the rocky shores of the Schuylkill River, in sphagnum swamps, in marsh mud, etc. It is remarkable for its sluggish character; and in appearance reminds one of a little pile of epithelial scales, or fragment of dandruff from the head. Appearing quadrately oval or rounded, transparent, and more or less wrinkled, or marked with delicate wavy lines; the pseudopods rise in short obtuse mammillary eminences or wave-like ridges, the summits of which are composed of transparent ectosarc, while the central portion of the body is occupied by a thin, pale, diffused, and finely granular entosarc. This contains one or more vesicles, usually one, which very slowly enlarges, and then less slowly collapses. In addition, as part of the structure, an oval granular nucleus is sometimes visible. The food contents generally appear not to be abundant, and often the creature appears to be empty of food altogether. The character of its food is the same as with other species of Amœba. It not unfrequently feeds on Difflugians. In a specimen from sphagnum water, from Vineland, N. J., last August, he observed an individual, about the $\frac{1}{10}$ of a millimetre, containing a Difflugia and a Trinema together. As observed by him, the species ranges from $\frac{1}{25}$ to $\frac{1}{6}$ of a millimetre in diameter.

On the morning of August 27, from some mud adhering to the roots of *Sparganium*, obtained the day previously in a nearly dried-up marsh, at Bristol, Pa., he obtained a drop of material for examination with the microscope. After a few moments he observed an *Amœba verrucosa*, nearly motionless, empty of food, with a large central contractile vesicle, and measuring $\frac{1}{25}$ of a millimetre in diameter. Within a short distance of it, and moving directly towards it, was another and more active Amœba, the species of which he was not positive. It was, perhaps, the one described by Dujardin as *A. limax*, by which name, for the present purpose, it may be called. As first noticed, this Amœba was limaciform, $\frac{1}{8}$ of a millimetre long, with a number of conical pseudopods projecting from the front broader end, which was $\frac{1}{16}$ of a mm. wide. The creature contained a number of spherical food vacuoles with sienna-colored contents, a large diatome filled with endochrome, besides several clear vacuoles, a posterior contractile vesicle, and the usual granular entosarc. The *A. limax* approached and came into contact with the motionless *A. verrucosa*. Moving to the right, it left a long finger-like pseudopod curved around its lower half, and then extended a similar one around the upper half until it met the first pseudopod. After a few moments the ends of the two pseudopods actually became connate (the second time he had observed this phenomenon), and the *A. verrucosa* was inclosed in the embrace of the *A. limax*. The latter assumed a perfectly circular outline, and after awhile a uniformly smooth surface; but the central contractile vesicle remained in the same condition, nor did he once observe it enlarge or collapse. The *A. limax* now moved away with its new capture, and after a short time what had been the head end contracted, became wrinkled and villous in appearance, while from what had been the tail end a number (ten) of conical pseudopods projected. The *A. verrucosa* assumed an oval form, and the contractile vesicle became indistinct, without collapsing. Moving on, the *A. limax* became more slug-like in shape, measuring about $\frac{1}{7}$ m. long, by $\frac{1}{28}$ m. broad. The *A. verrucosa* now appeared inclosed in a large oval clear vacuole, was constricted so as to be gourd-shaped, and had lost all traces of its contractile vesicle. Subsequently, the *A. verrucosa* was doubled upon itself; and at this period, the *A. limax* discharged from one side of the tail end, the siliceous case of the diatome, which now contained only a shrivelled cord of endochrome. Later the *A. verrucosa* was broken up into five spherical granular balls, and these gradually became obscured and apparently diffused among the granular contents of the entosarc of the *A. limax*. At one moment the five granular balls derived from the *A. verrucosa* appeared to be contained in three vacuoles, and the *A. limax* had a more contracted and radiate form, and then measured $\frac{1}{12}$ m. in diameter.

The observation, from the time of the seizure of the *A. verrucosa* to its digestion, or disappearance among the granular matter of the entosarc of the *A. limax*, occupied seven hours.

From naked Amœbæ, the test protected rhizopods were no doubt evolved, and it is a curious sight to observe them swallowed, home and all, to be digested out of their home, just as the contents of diatomes are digested. It was also interesting to observe the cannibal Amœba swallowing another, and appropriating its structure to its own, just as we might do a piece of flesh, completely, without there being any excrementitious matter to be voided.

Habits of Formica rufa.—Mr. McCook, speaking of the habits of *Formica rufa*, stated that the ants descending the tree-paths, with abdomens swollen with honey-dew (called by him *Repletes*), were arrested at the foot of the trees by workers from the hill seeking food. Galleries communicating with the hill, opened at these points, around and in which numbers of ants were huddled engaged in drawing or bestowing rations of honey-dew. Similar commissary stations were found under the stones near by. The replete reared upon her hind legs, and placed her mouth to the mouth of the pensioner, who assumed the same rampant posture. Frequently two, sometimes three pensioners were thus fed at once by one replete. Apparently the workers engaged in building at the hill and galleries had thus resorted to these feeding places to obtain ordinary food, in the same manner that queens, males, and young ants receive it, viz., by disgorgement from the abdomens of repletes. The latter commonly yielded the honey-dew complacently, but sometimes were seized and arrested by the pensioners, occasionally with great vigor.

A number of experiments were described leading to the conclusion that there was complete amity between the ants of a large portion of the field, embracing some 1600 hills and countless millions of creatures. Insects from hills widely separated always fraternized completely when transferred. A number of ants collected from various hills fraternized in an artificial nest, harmoniously building galleries and caring for the cocoons.

It was found that ants immersed in water when replaced upon the hills were invariably attacked as enemies; the assailants, being immersed, were themselves in turn assaulted. A number of experiments were made which indicated that the bath had temporarily destroyed the peculiar odor or other property by which the insects recognized their fellows.

The variety of *F. rufa* which had colonized in vast numbers on the cliff at Rockland opposite the steamboat landing, as observed for the last three summers, were found that morning to have abandoned the place. No trace of them could be seen in the vicinity. The crowds of human beings who occupied the spot during the late International regatta had evidently dispersed the republic.

OCTOBER 17.

The President, Dr. RUSCHENBERGER, in the chair.

Thirty-six members present.

A paper entitled "Descriptions of some Vertebrate Remains from the Fort Union Beds of Montana," by Edward D. Cope, was presented for publication.

OCTOBER 24.

The President, Dr. RUSCHENBERGER, in the chair.

Thirty-seven members present.

On Webs of New Species of Spiders.—Mr. McCOOK called attention to several new species of spiders, with the view to illustrate the existence of mixed habits in construction of the web. The first of the two great groups of the Araneæ, viz., the

Sedentary Spiders, consists of the four sub-orders, (1) orb-weavers (*Orbitelariæ*), (2) line-weavers (*Retitelariæ*), (3) tube-weavers (*Tubitelariæ*), and (4) tunnel-weavers (*Territelariæ*). The first web, that of *Epeira triaranea*, n. sp., exhibits quite distinctly the characteristics of the first three of the above sub-orders. The orb, which is the primary characteristic of the snare of this arachnid, is partially inclosed by a web having quite as distinctly the characteristics of the line-weavers. This secondary snare extends several inches above the orb. At the top is a tertiary snare characteristic of the third sub-order. It is a mortar-shaped tube, of white, close textured silk, opening downward. Within this the spider dwells, clasping with its fore-claws a thick thread or free radius which is attached to the centre of the orb. He had not been able to determine whether the secondary snare is used, as with the line-weavers, in taking prey, or is possibly a simple protection against hymenopterous enemies. The tube or tent is quite frequent in connection with the orb-weaver's snare, but the mixture of the line-weaver's habit is rare, having been observed in but one other Epeiroid, *Epeira labyrinthea* of Hentz, the architecture of which was described. A possible exception was noted in the web of *Argiope fasciata*, one of the most beautiful and interesting of our indigenous spiders. In three instances the orb-shaped web of *A. fasciata* was found protected on either side by a cone-shaped mass of right lines. In all other webs of the same species observed, this mixed habit was not indicated. Possibly it may be in the course of development. It was suggested that the use of this auxiliary web might be to protect the snare from destruction, or to save the animal from enemies. A like tendency to mixed webs was observed in a new species of tube-weaver named provisionally *Tegenaria philoteichos*. It is found in vast numbers upon the brick walls and fences of our city. Its web shows distinctly the characteristics of the orb-weaver's snare in the radial lines issuing from the opening or openings of the central tube. These lines are overlaid upon each other, and with the adhering street dust, present the appearance of rude lace-work. The outside of the wall seems curiously to be preferred. The apparent affinity of this spider to *Ergatis benigna* of Europe, and *Theridion morologum* Hentz, was shown by photograph and description. The latter named spider much resembles *T. philoteichos* in appearance, although uniformly of a far lighter hue. Its web, cocoon, and general habits greatly differ. The one appears to be a creature of the city, the other of the fields.

October 31.

The President, Dr. Ruschenberger, in the chair.

Thirty-five members present.

A paper entitled "Descriptions of Vertebrate Remains chiefly from the Ashley Phosphate Beds of North Carolina," by Jos. Leidy, M.D., was presented for publication.

Self-fertilization in Mentzelia ornata.—Mr. Thomas Meehan referred to an o   made during his remarks on this plant some weeks ag   flower which had produced a perfect capsule under a gau   to exclude insects, might yet not produce perfect seeds. The   sule was now ripe, and the seed perfect.

Direct Growth Force in Roots.—Mr. Meehan spoke of the direct growth-force in roots, as illustrated by some specimens of the White Hickory (*Carya tomentosa*) exhibited. The Hickories during the first few years of their growth developed far more beneath than above the surface. He had seen Pecan Nuts (*Carya olivæformis*), with weak stems not two feet high, have tap roots six feet long. In the one year hickory now exhibited, the tap root was three times the length of the stem. In one plant, however, the young radicle, instead of pushing through the cleft made by the separated shell, had been directed into the shell, and in its fruitless effort to penetrate the wall, had lingered so long, that the upper portion had grown so large as to prevent egress. The root, therefore, instead of making a slender growth of eighteen inches long, had simply made a bulb of about three quarters of an inch in diameter with the shell of the nut attached to it.

Interpretation of varying Forms.—Mr. Thos. Meehan said that William Bartram, in the last century, had found forms of *Liriodendron tulipifera* on the Schuylkill River, as he had been informed by his son-in-law, with entire leaves, but only this year had he succeeded in discovering them. Some of these leaves he exhibited. He observed that years ago, such discoveries had an interest in themselves. Now the botanist expected to find entire leaved forms among kinds usually lobed, or lobed ones among the entire leaved class; the only value now in these discoveries is in any lesson they might teach. As a rule, he hesitated to refer to the unpublished observations of others, preferring that the discoverers should in their own good time and way, report what they had found; but hoped to be pardoned on this occasion, for saying that on a recent visit to the Academy, the distinguished botanist Dr. Engelmann had pointed out that some oaks had lobed leaves even in early infancy, while others had entire leaves, but that those which had the early lobed leaves assumed more entire leaves when mature, and those which had entire leaves when young, had lobed leaves when fully grown. In many oaks which he had examined he found Dr. Engelmann's observation correct, and that it extended to many other plants. The mulberries generally had lobed leaves in their younger years, but when mature the leaves were uniformly entire; and this was especially well known in the case of the *Broussonetia*. In young Japan Honeysuckles the leaves were querciform or variously lobed, while at maturity the tendency to union was often remarkable. In the common ivy the halbert-shaped leaves of youth, always gave place to lobeless forms when of fruiting age. But it was in cruciferous plants, that the differences were best seen. Here lyrate or pinnatifid leaves in infancy often gave place to entire ones as the plant grew, while there were numberless instances in which entire juvenescent leaves gave place to pinnatifid ones in adolescence. However, the point for the present evening was, that there was often a vast difference between the leaves of a plant's early life, and their form in advanced age. In Coniferæ he said this was well known. During the first few months from seed, the different species in their several subdivisions were so nearly alike, that it was almost impossible to tell any one apart till a little age had brought divergence from the original type. He exhibited some young Thujas to illustrate this. The early Thujas all had ericoid leaves. In the forms which we knew as Arbor Vitæs, the condition which we were familiar with was the secondary form. In these the leaves, which in juvenescence were free and heath-like, had become almost wholly united with the branches. But there were cases where the young Arbor Vitæs had never had power to leave their early condition. They were the analogues of what we know in human nature as imbeciles or feeble minded; and of this class were many so-called "*Retinesporas*," *Biota Meldensis*, and many Junipers and Thujas. He had known the *Thuja ericoides* of gardens remain fifteen years in this infantile state, and then only one of thousands to regain the pure adolescent or fan-like arbor vitæ form. In all these cases it is important to notice that a comparative feebleness of growth, and an absence more or less total of all disposition to produce flowers, go with these continuously juvenescent characters. With the appearance of sexual characters, there is a change of form; and, in proportion as this change is the more marked, is the relative productiveness. The White Oak (*Quercus alba*) which, during its first year, has entire leaves, has them lobed at maturity; and the trees which have them the most deeply lobed are the most productive in acorns.

He found these observations to hold good in the entire leaved *Liriodendron*. During the first year all tulip trees had entire leaves, or at least more or less so in comparison with those which they afterwards assume. These large trees with entire leaves had merely retained their juvenescent form. The other attendant characters of juvenescence were also present. The tree from which the large entire leaf exhibited was taken had no signs of ever having borne seeds. In one place he found two trees which, from surrounding circumstances, he should judge were probably about the same age, and in every circumstance relating to nutrition equally favored, one with very deeply cut leaves even to the most feeble branch was covered with seed cones, and was thirteen feet in circumference. The other had leaves almost entire, with but few fruit, and a trunk of only eight feet round.

The danger was that in discussing laws of variation in connection with the origin of species we may overlook these sexual and physiological changes. If one never having seen a Baltimore oriole should notice particularly the brilliant plumage of the male bird, and, without noticing the sex, compare it with the very different looking female bird, he would be very apt to think he had found a "missing link" in a grand evolutionary chain. There were many differences in animals which were recognized as having their origin in obscure sexual laws, as well as many more unrecognized but probable; and he believed these cases were far more numerous in vegetation, and they would have to be carefully eliminated from consideration in any study on the origin of species or the evolution of form in relation thereto.

Edwin A. Barber, H. F. Whitman, and Dr. W. Forwood, U. S. A., were elected members.

Col. W. L. Ludlow was elected a correspondent.

The following papers were ordered to be printed :—

ON THE MARINE FAUNAL REGIONS OF THE NORTH PACIFIC; AN INTRODUCTORY NOTE TO THE REPORT ON ALASKAN HYDROIDS, BY MR. CLARK.

BY W. H. DALL, U. S. COAST SURVEY.

Mr. Clark's paper is the first of what is hoped will form a series, by different specialists, on the collections of marine invertebrates, obtained by me, with the co-operation of my party and other persons interested, during a period extending over nearly ten years. The first explorations in that region were begun in 1865, under the direction of the late lamented Robert Kennicott, and by the courteous co-operation of the officers of the Western Union Telegraph Company. Since the death of Mr. Kennicott the direction of the work has devolved upon me. By far the richest portion of the invertebrate collections has been obtained between 1871 and 1875, while engaged on hydrographic work for the U. S. Coast Survey. During the whole period mentioned the work has been aided by the earnest co-operation of the Smithsonian Institution, a circumstance to which is due a large part of our success.

Among those persons to whom we owe thanks for assistance in forming the collections, and to whom I beg to express my sense of indebtedness, are particularly to be mentioned Capt. E. E. Smith, of San Francisco, whose energetic dredgings in the Arctic Ocean have furnished nearly all our material from that region; Mr. Bernhard Bendel, formerly stationed at Unalashka; and Messrs. W. G. Hall, E. P. Herendeen, A. R. Hodgkins, Sylvanus Bailey, Mark W. Harrington, Marcus Baker, and Wm. M. Noyes, attached for shorter or longer periods to the Coast Survey party under my charge. To the officers directing the U. S. Coast Survey I have been indebted for hearty co-operation.

In April, 1873, I gave a short notice of the principal faunal regions into which the information gained in the field seemed to permit the division of the coast of Alaska. Mr. Clark's independent reasoning from a study of the hydroids alone, confirms in every particular the opinions then expressed, and information gained since 1873, seems to offer only additional confirmation of the views held by me at that time, with some interesting additions.

A brief statement of these views will be in place here.

The coast of Alaska and northwest America from Monterey, California, north and west may be divided into three faunæ.

I. *The Oregonian Fauna.*

This extends from Monterey to the Shumagin Islands.

II. *The Aleutian Fauna.*

The range of this province is from the Shumagins westward throughout the Aleutian chain, and northward to the winter line of floating ice in Bering Sea; a line extending westward from Cape Newenham toward and grazing the Pribiloff group, and thence to the western termination of the Aleutian chain, bounded by the depth of the water in Bering Sea, extending probably to no greater depth than five hundred fathoms, and entirely cut off from the adjacent coasts of Asia.

III. *The Arctic Fauna.*

This well-recognized fauna passes in water over five hundred fathoms in depth indefinitely southward on the ocean bottom. By the shores it is limited by the winter line of floating ice, or water of the temperature of thirty-two Fahrenheit at the surface, for a certain proportion of the year.

The species belonging to this fauna creep southward along the shores to the northernmost islands of Japan on the west coast and Cape Newenham on the east coast of the ocean of this region. Many of them extend even further south; as the species of Arctic habitat have a greater facility of adaptation to other than their normal conditions than those of any other existing fauna.

The material derived from the coasts of N. W. America, from Cook's Inlet south and east, indicate a series of Arctic colonies in favored localities, the future exploration of which offers a labor of the highest interest. These colonies are situated where the depth of water, the drippings of glaciers, and the high and adjacent shores of the Great Archipelago, combine to reduce the temperature of the water below its apparently normal isotherm. Cook's Inlet affords one of them, one exists in the Gulf of Georgia, and others only await further exploration.

In these colonies we find strictly Arctic species, such as normally abound in the vicinity of Icy Cape; islands of polar life surrounded by shoaler water; forms altogether alien to them. In the absence of information as to depth and temperatures, collections made at such localities would indicate to the student only inextricable confusion of different faunæ.

The species of each fauna are not, of course, rigidly bound within the limits above set forth. According to their various degrees of adaptability to the surroundings, they creep south or north from their own proper region, until their limit of temperature is reached.

Nevertheless the course of currents, the changes in depth and the variation in temperature, are so far co-ordinate that the limits herein mentioned may be taken as approximately exact for the mass of species.

I would here reiterate the view published by me in 1868, that temperature, and temperature alone, is the great factor in determining the limits of marine faunæ. Depth, salinity, specific gravity, motion or quietness in the water, and geological character of the shores and sea bottom have their influence in determining the distribution and individual characters of particular species or small groups of species; but for marine faunæ, all my field observations lead to but one conclusion, that they are absolutely dependent on the water temperatures. It is hardly necessary to point out, in view of recent deep sea researches, that the ocean valleys which so sharply separate adjacent faunæ, are in such cases valleys of depressed temperature as well as depressed sea-bottom. Leaving out strictly littoral or shore forms, restricted by the nature of their food to very moderate depths, no case is known to me in which a deep sea valley, not containing colder water than that on either side of it, separates two great marine faunal provinces. Local subfaunæ are not here considered.

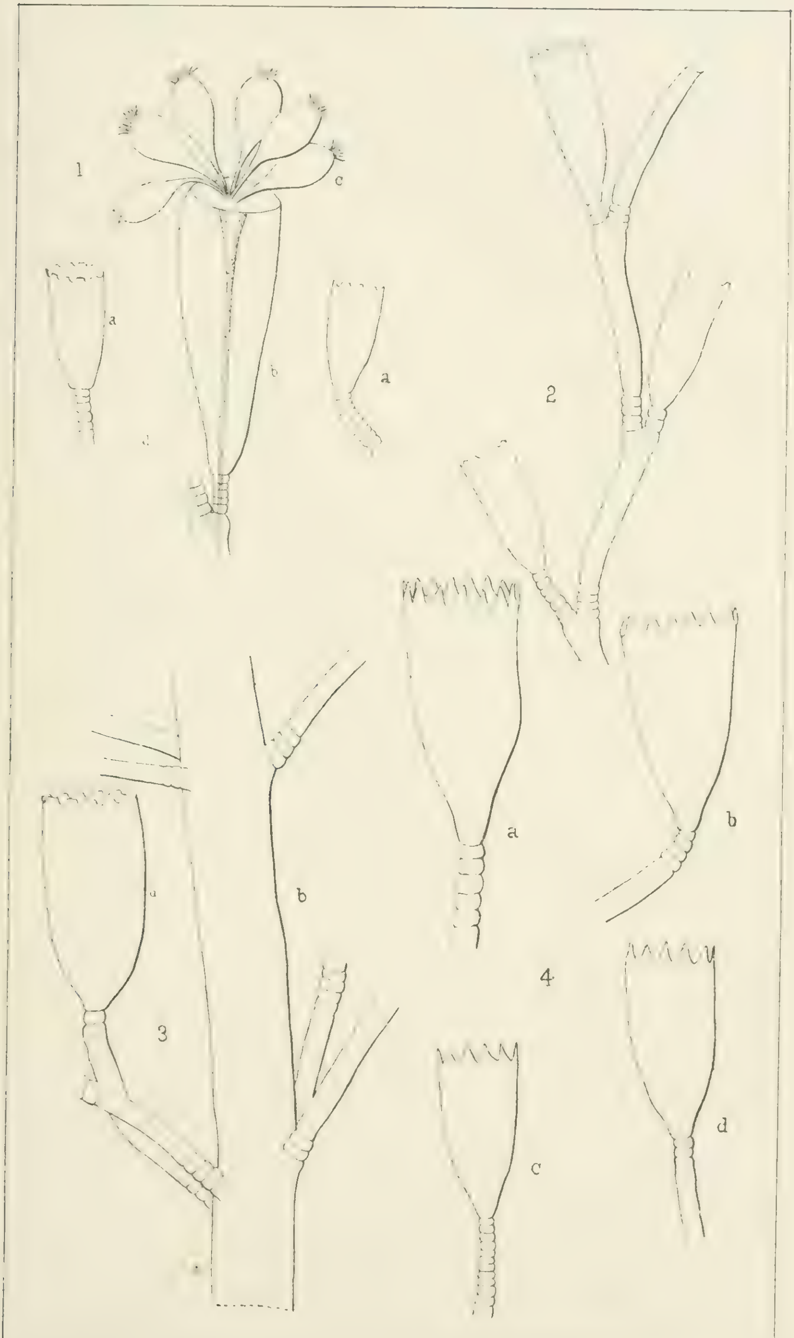
The geological formation supplies the elements of plant life; the phytophagous mollusks are distributed where they can obtain their favorite food. All formations supply some algæ, and the zoöphagous mollusks can find some food almost anywhere. They are therefore the best indices of faunal provinces in their own subkingdom. Something similar is probably true of other groups of marine animals. The mollusks are here referred to as the group with which I have the greatest familiarity. A striking instance of this local distribution is afforded by granitic areas. On the Alaskan coast these appear to afford special opportunities for the growth of the red or chlorospermous algæ. In granitic districts they are quite abundant compared with what we know of their occurrence in sandstone or basaltic regions. Here also we find a number of species which prefer red algæ as food, and a notable tendency to rosiness in the coloring of shells and annelids.

Other details of a similar nature are reserved for future publication.

In regard to the collection of hydroids it may be remarked that the collection illustrating the Arctic province was very small, and by no means sufficient to represent it fairly.

The Oregonian province is also less fully represented than is desirable. For the Aleutian region the collection is tolerably full, though it cannot be doubted that many of the more minute or delicate forms were overlooked. However, Mr. Clark's paper forms a desirable contribution to our knowledge of a little known region, and must be regarded as a considerable advance on our previous information. It is to be expected that a fuller investigation of the Arctic province will reveal many more circumpolar species, and in the Oregonian fauna a fuller representation of those already known from the Californian coast.

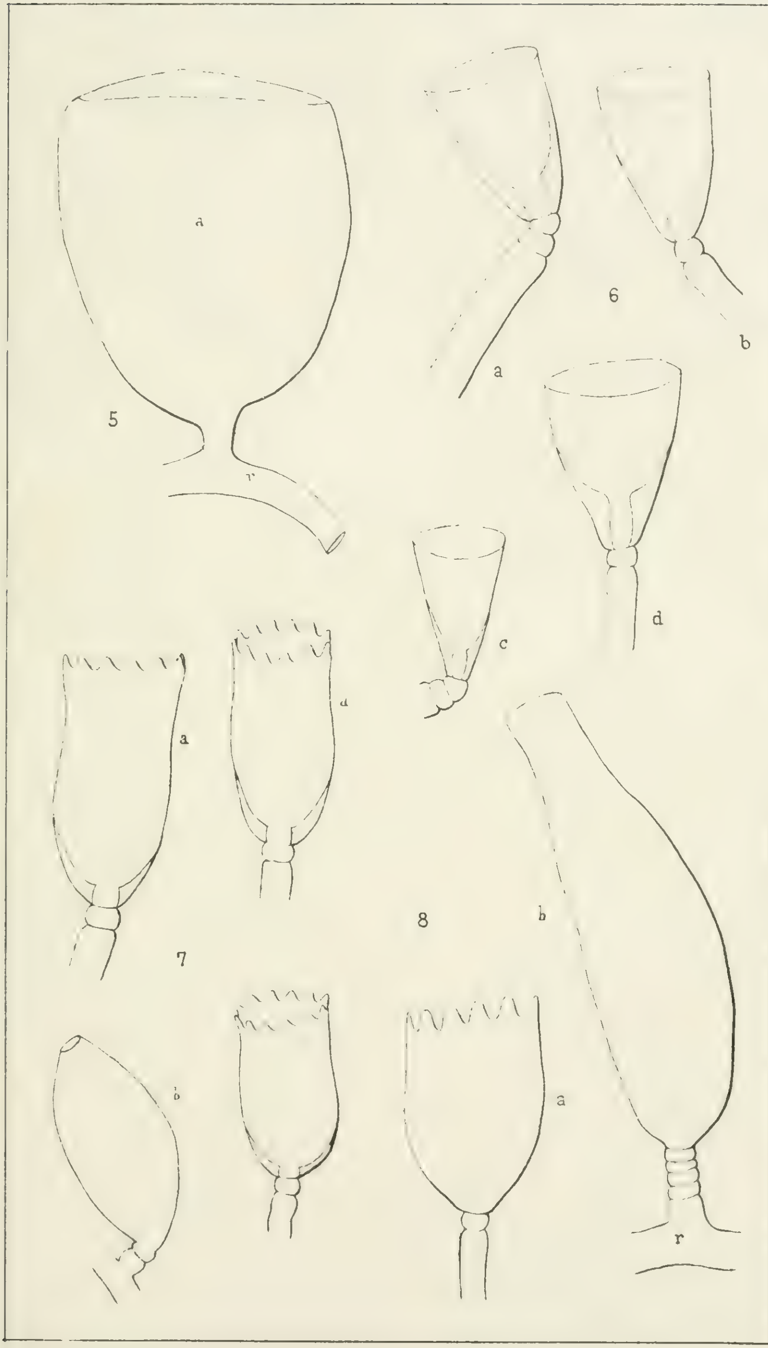
The types of the species mentioned are deposited in the National Museum in charge of the Smithsonian Institution at Washington; a series has also been placed in the Peabody Museum of Yale College, and in the Museum of the University of Michigan.



S. F. Clark, del.

Sinclair & Son, Photo-lith.

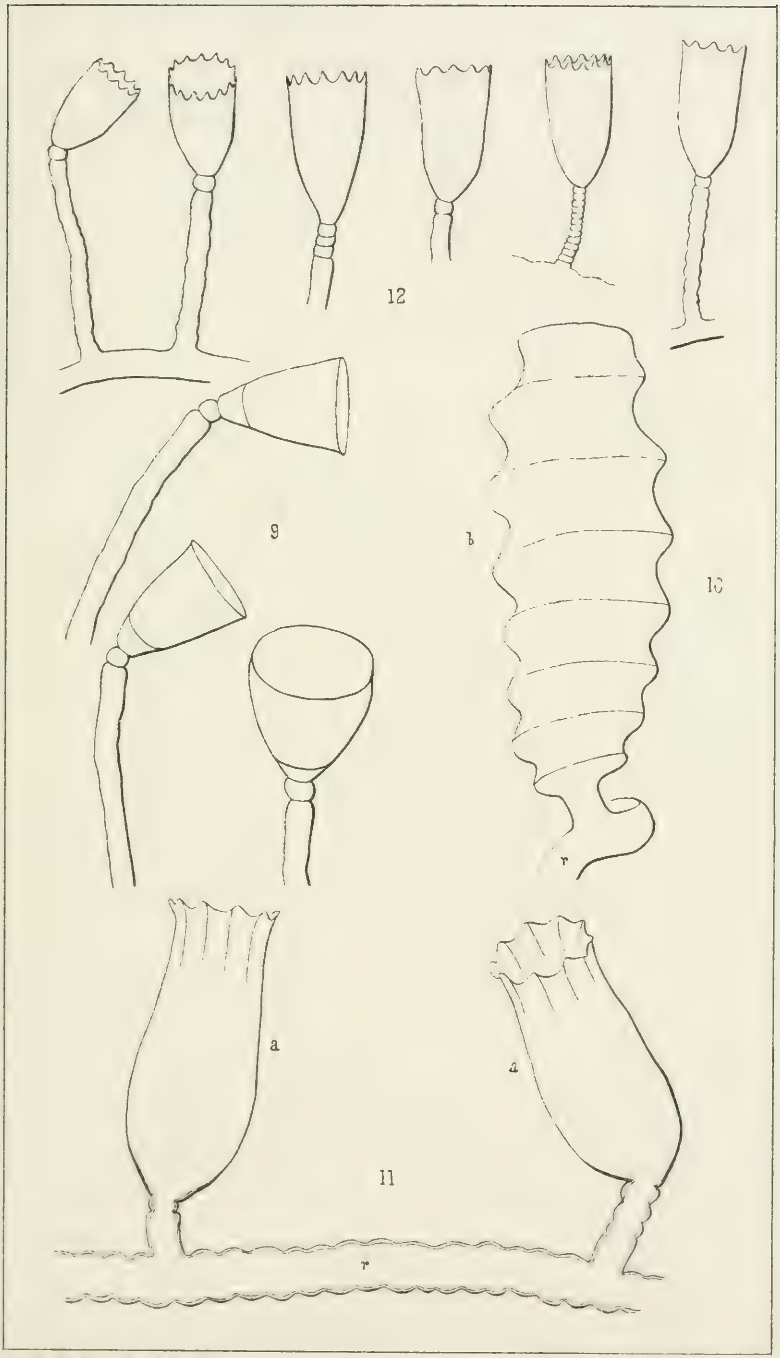
Clark on Alaskan Hydroids.



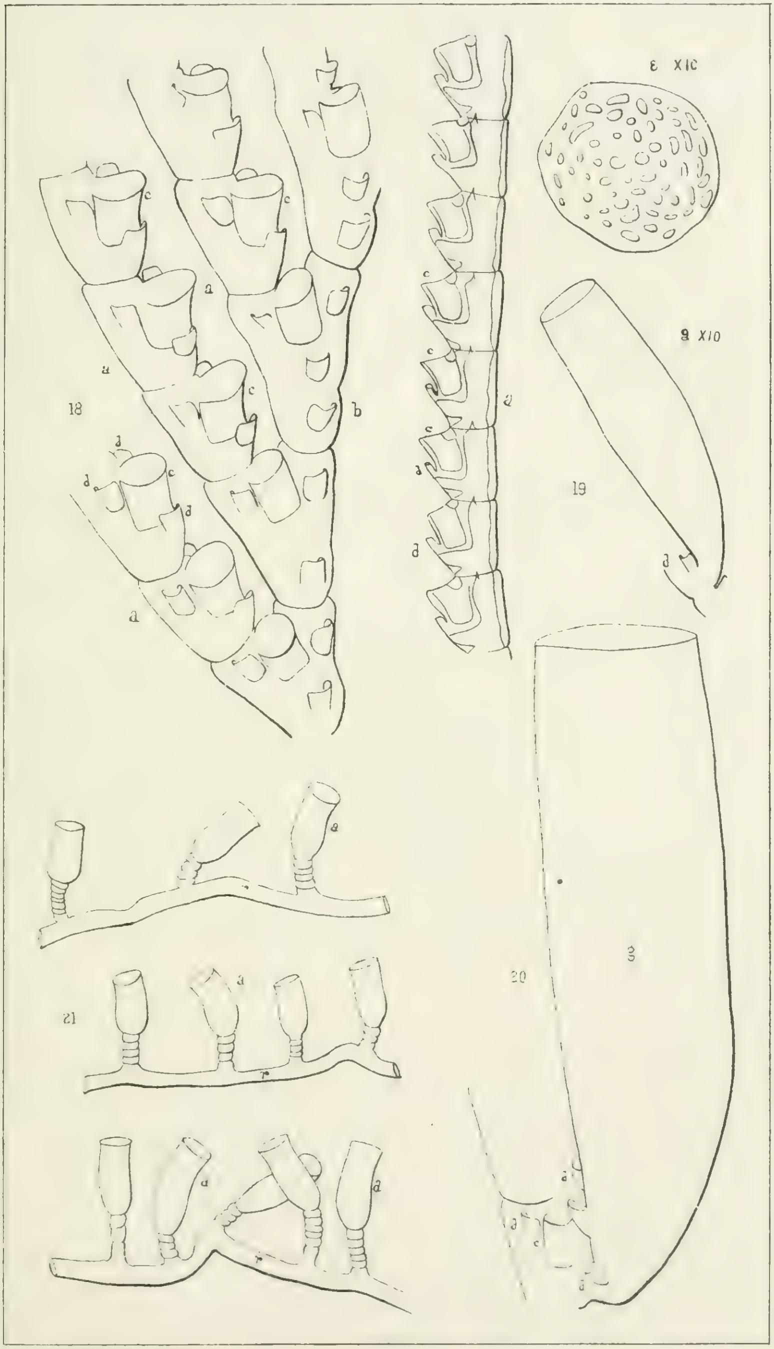
S. F. Clark, del.

Sinclair & Son, Photo-lith.

Clark on Alaskan Hydroids.



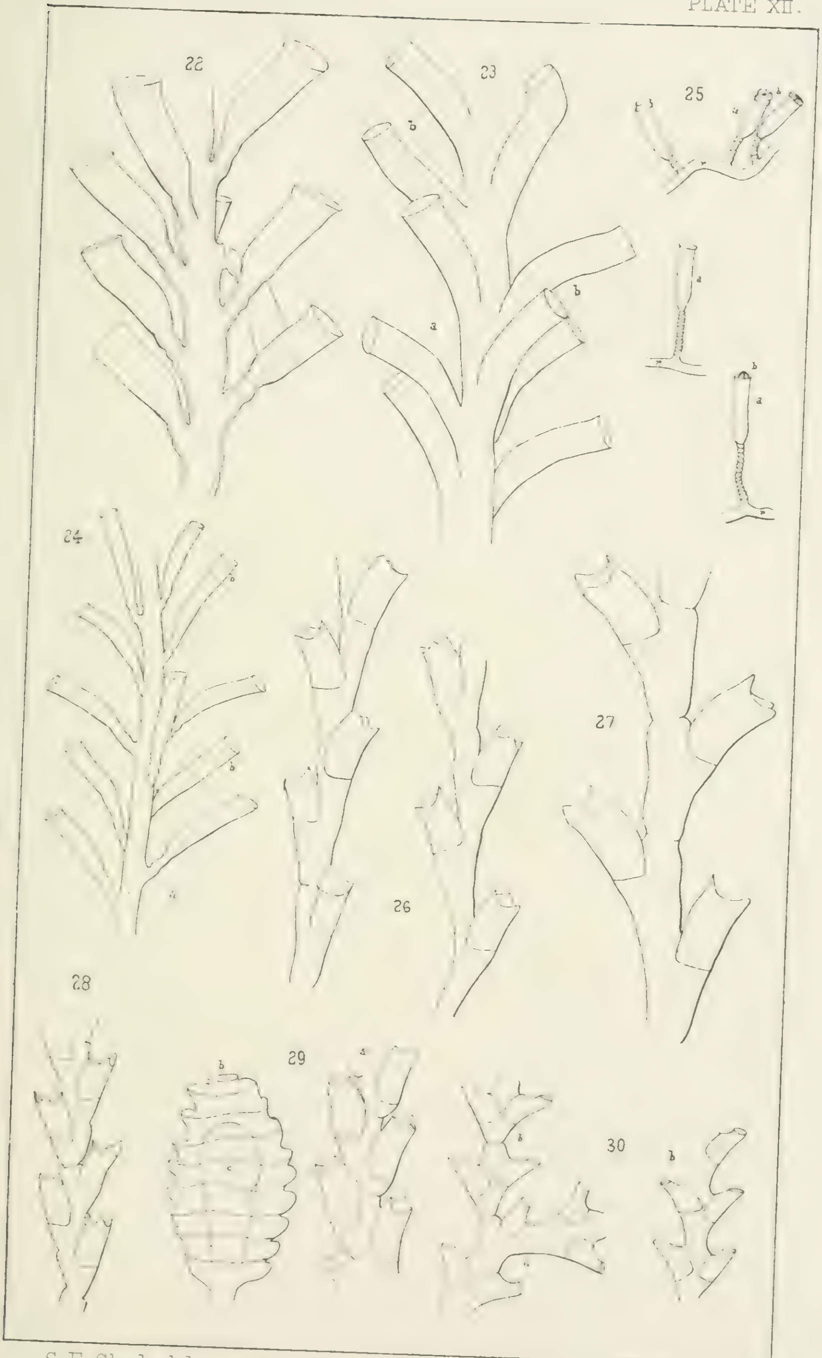
Clark on Alaskan Hydroids.



S. F. Clark, del.

Sinclair & Son, Photo-lith.

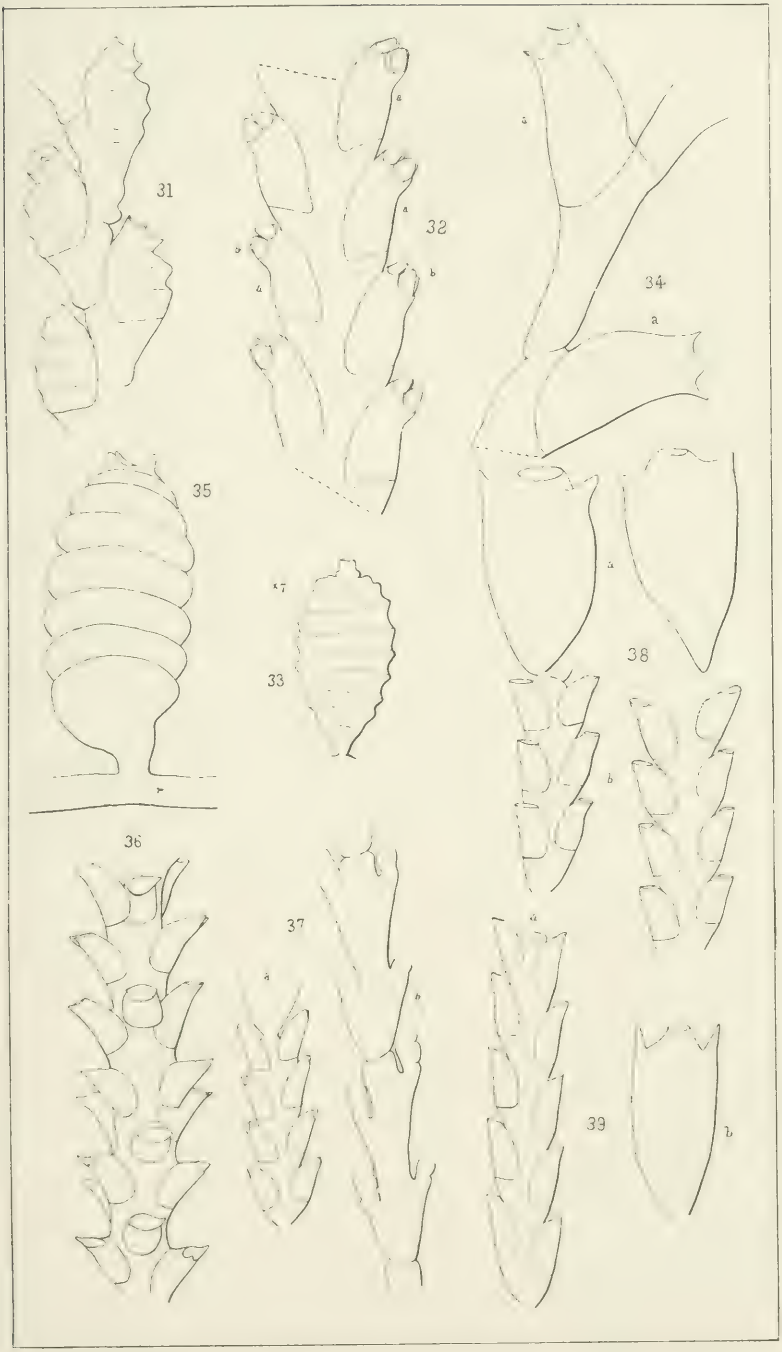
Clark on Alaskan Hydroids.



S. F. Clark, del.

Sinclair & Son, Photo-lith.

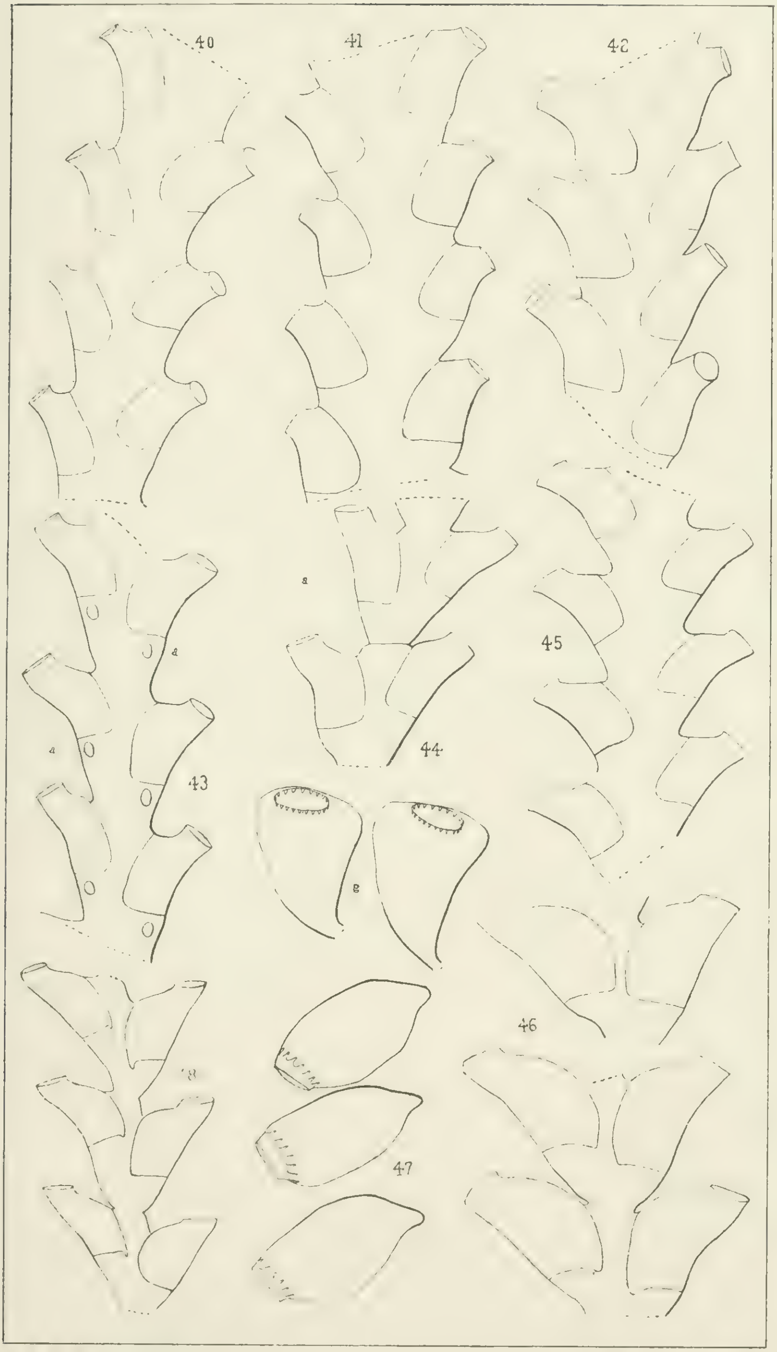
Clark on Alaskan Hydroids.



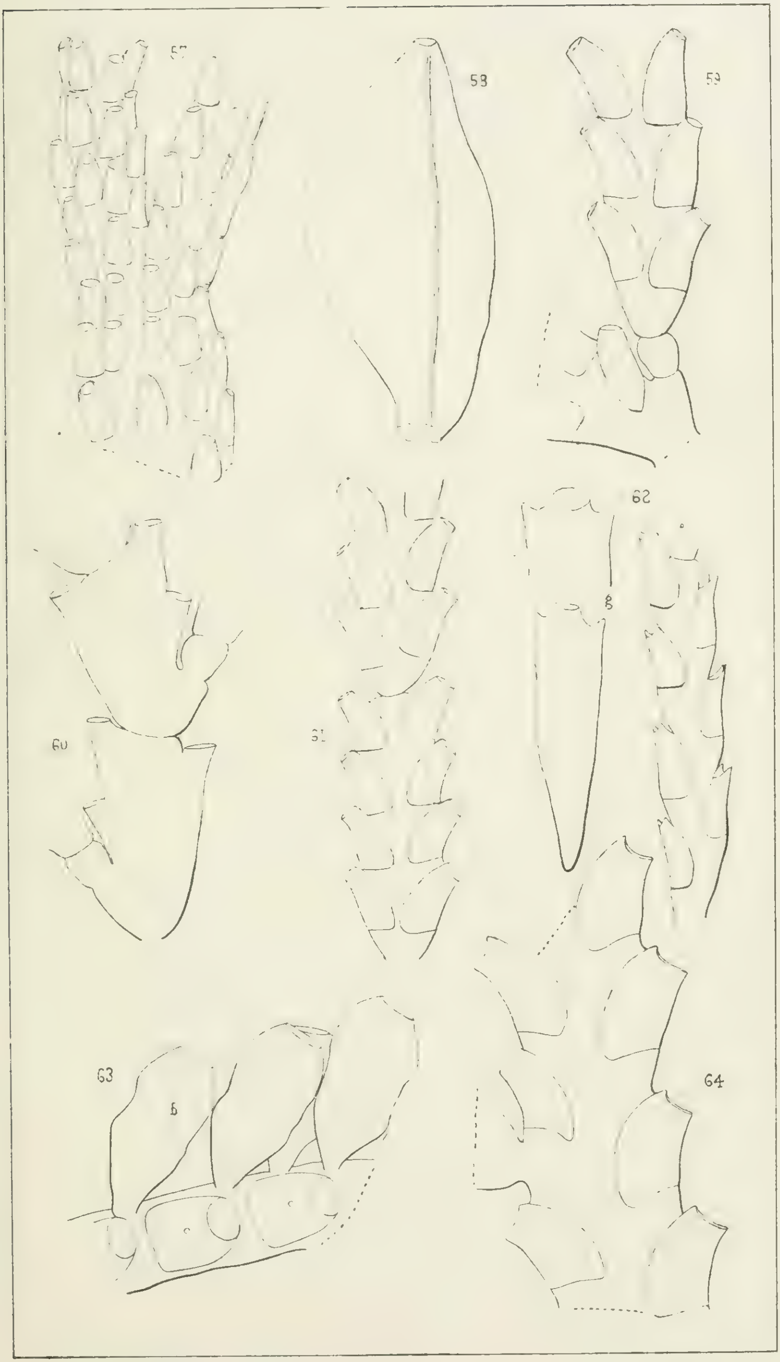
S.F. Clark, del.

Sinclair & Son, Photo-lith

Clark on Alaskan Hydroids.



Clark on Alaskan Hydroids.



S. F. Clark, del. Sinclair & Son, Photo-lith.

Clark on Alaskan Hydroids.

REPORT ON THE HYDROIDS COLLECTED ON THE COAST OF ALASKA AND THE ALEUTIAN ISLANDS, BY W. H. DALL, U. S. COAST SURVEY, AND PARTY, FROM 1871 TO 1874 INCLUSIVE.

BY S. F. CLARK, YALE COLLEGE, NEW HAVEN.

The Hydroids collected on the Alaskan coast by Mr. Dall, represent the fauna more or less completely from the Sea Horse Islands southwest of Point Barrow in latitude about 71° north, to Kyska Harbor 52° north, and from St. Paul Island, Pribiloff group, longitude 170° west, and Kyska Harbor 182° west to Sitka in longitude 135° west. This region includes a coast line of about 4000 miles naturally divided into three great divisions. The Arctic region, extending from Point Barrow to Cape Prince of Wales, washed by the Arctic Ocean; the western region, including all of the western coast of Alaska from Cape Prince of Wales to the Aleutian Islands, borders on Bering Sea, and the southern region, extending from the Aleutian Islands to Sitka, washed by the North Pacific. As the northern region is only represented by two species, one from the Sea Horse Islands and Cape Prince of Wales, and one from Icy Cape, we have no opportunity of comparing the Hydroid-fauna of that region with those of the other two. The region most abundantly represented in the collection is the southern, and it is here also that we find the most strongly marked fauna; for of the forty-two species in the collection, twenty-four are from the southern coast east of the Shumagin Islands, and of these twenty-four, fourteen are peculiar to this southern region. From the shores of the Aleutian Islands, from Unimak to Kyska, there are fifteen species represented, six of which are not found elsewhere, and four are found both to the northward in Bering Sea, and to the eastward in the Northern Pacific. The collections from these two regions (the Aleutian Islands, and the southern Alaskan coast, from the Shumagin Islands east to Sitka) contain thirty species, or fully three-fourths of the known species from Alaska. While this result is in part due to the fact that the greater amount of collecting has been done in these regions, it also indicates a richer fauna, for some important genera of the southern fauna are not represented north of the Aleutian Islands.

The most strongly marked barrier on the coast, as indicated by the hydroids, is the Shumagin Islands on the southern shore, which is apparently the dividing line between the northern and southern forms. As in all the divisions of nature, there is, of course, no sharp line of demarcation, but a number of the species of each group have a range extending into the region of the other.

Of the forty-two species represented, sixteen have been recorded from the English coast, and of this latter number, all but two are found on the shores of New England; of the remaining twenty-six, one is identical with a New England form and the rest are new. The great majority belong to the group *Thecaphora* of Hincks, there being but four representatives of the *Athecata*.

The following table contains a list of all the Hydroids in the collection, and gives their range upon the Alaskan coast:—

THECAPHORA.

Obelia longissima Hincks (Pallas).	Iliuliuk Harbor, Unalashka.
Clytia Johnstoni Hincks (Alder).	Lituya Bay to Popoff Straits.
Campanularia denticulata, sp. nov.	Port Etches.
" circula, sp. nov.	Port Etches.
" turgida, sp. nov.	Port Etches.
" compressa, sp. nov.	Shumagin Islands.
" speciosus, sp. nov.	Shumagin Islands.
" urceolata, sp. nov.	Lituya Bay.
" integra Macgillivray.	Lituya Bay to Semidi Islands.
Gonothyrea hyalina Hincks.	Semidi Islands to Nunivak Island.
Lafoëa pocillum ? Hincks.	Nunivak Island.
" gracillima Sars.	Sitka Harbor to Shumagin Islands.
" dumosa Sars.	Port Etches.
" fruticosa Sars.	Shumagin Islands to Kyska Island.
Calycella syringa Hincks (Linn.).	Shumagin Islands.
Coppinia arcta Hincks (Dalyell).	Shumagin Islands.
Halecium muricatum Johnst.	Unalashka.
" ? plumularioides, sp. nov.	Nunivak Island.
" scutum, sp. nov.	Semidi Islands to Unalashka.
Diphasia mirabilis Verrill.	Port Möller to Shumagin Islands.
Sertularia filicula E. and S.	Shumagin Islands to St. Paul Island.
" similis, sp. nov.	Hagmeister Island.
" cupressoides, sp. nov.	Shumagin Islands to Hagmeister Id.
" variabilis, sp. nov.	San Miguel Id., Cal., to Nunivak Id.
" inconstans, sp. nov.	Unalashka.
" thuiarioides, sp. nov.	Chignik Bay to Nunivak Island.
Sertularella tricuspidata Hincks.	Port Etches to Kyska Harbor.
" rugosa Gray (Linn.).	Shumagin Islands to Nunivak Island.
" polyzonias Gray.	Port Etches to Nunivak Island.

Sertularella robusta, sp. nov.	Shumagin Islands.
" pinnata, sp. nov.	Lituya Bay to Unalashka.
Thuiaria cylindrica, sp. nov.	Port Möller to Hagmeister Island.
" robusta, sp. nov.	Hagmeister Island to Seahorse Ids.
" plumosa, sp. nov.	Nunivak Id. to Icy Cape, Arctic Sea.
" turgida, sp. nov.	Lituya Bay to Kyska Island and Hagmeister Island.
" gigantea, sp. nov.	Kyska Island to Hagmeister Island.
Macrorhynchia Dallii, sp. nov.	Akutan Pass.

ATHECATA.

Rhizonema carnea, sp. nov.	St. Michael's, Norton Sound.
Tubularia indivisa (Linn.).	St. Michael's.
Tubularia borealis, sp. nov.	Hagmeister Island.
Eudendrium pygmæum, sp. nov.	Akutan Pass.

It is interesting to note that of the ten species of *Campanulariidæ* represented, one only occurs to the northward of the Aleutian Islands; and as this one, viz. *Gonothyrea hyalina*, is recorded by Hincks from the Shetland Islands, by Sars from Lofoten, and by Professor Verrill from Eastport and St. George's Bank, it is apparently a northern or cold-water form. Both the species from the Arctic Sea belong to the genus *Thuiaria*, and of the five species of this genus in the collection, but one of them occurs south of Bering Sea. The genus is essentially a northern cold-water one. Hincks says of *T. thuia*, " it is a prevalent northern form, ranging to the North Cape," and Allman describes some species from very deep water, that were taken on the Porcupine expedition. The thickness of the perisarc seems to protect them from the dangers incident to living in cold deep waters.

A very noticeable feature, and a very general one, is the remarkable stoutness and large size of the specimens, especially in the *Sertulariidæ*.

The main points of interest then derived from the study of this collection are—the strong indication of a faunal limit at the Shumagin Islands; the Hydroid-fauna to the south of that point being chiefly characterized by the large number of *Campanulariidæ*, while the fauna to the northward is almost entirely destitute of that family and contains a larger number of *Thuiariæ;* the luxuriant growth and the robustness of nearly every species; the specimens of those species that are also found upon the New England shores being of larger size and stouter form than the eastern specimens; thirdly, that while the fauna is quite distinct, as is indicated by the twenty-three new species, it has yet some similarities with the New England and British faunæ, which are shown in the fifteen species that are common to those three regions; fourthly, the small number of Athecata, which may be partly accounted for by the possibility of their having been overlooked, owing to the small size and obscure places of growth common to so many of the species of this group. And, lastly, the small number of species that are common to the Alaskan coast and the western shores of the United States from Vancouver Island southward. Of the twenty-three species recorded from the latter region one only, *Lafoëa dumosa*, is known from the coast of Alaska.

Descriptions of the Species.

THECAPHORA.

Obelia longissima, Hincks (Pallas).

This species is the most abundant member of the family in the collection, but, although some of the specimens are 150 mm. in length, and have a very luxuriant growth, a diligent search has failed to reveal any gonangia. It is possible that these forms may prove to be different from *O. longissima*, but the trophosomes agree so closely in every particular, that I think it quite safe to credit them to this species.

Hab. Iliuliuk, Unalashka; 3 fathoms, shingly bottom. Unalashka; 6 fathoms, November 11th, among sticks and beach-refuse, washed along the bottom. Unalashka; 80 fathoms, sand, and shells. Unalashka; 9 to 15 fathoms, September 10th. Unalashka; 15 fathoms, gray sand.

Clytia Johnstoni ? Hincks (Alder). Plate ix., fig. 12.

The collection contains specimens of a creeping campanularian from three localities which I have decided to call *C. Johnstoni*, for the present, at least. The gonangia are not present upon any of the specimens, and when known will enable us to decide whether these trophosomes have been placed in the right genus. The specimens from Lituya Bay correspond very closely with the New England forms of this species, while those from the other localities are more deeply campanulate, and some of them are much less tapering; the pedicels vary greatly in length and in the amount of annulation which they bear. The character of the denticulation varies but little, if any, and the hydrothecæ, which show the greatest variation in size and shape, are connected by intermediate forms.

Hab. Lituya Bay; 9 fathoms, sandy-mud. Port Etches; 5 to 8 fathoms, gravel and stones, May 30th. Shumagin Islands, Popoff Straits; 6 fathoms, rocky, July.

Campanularia denticulata, sp. nov. Plate vii., fig. 4.

Trophosome. Hydrocaulus simple, creeping, giving origin to the pedicels at irregular intervals; pedicels of very variable length, from five to ten annulations at the base, and from three to eight at the base of the hydrothecæ, usually bearing but one hydrotheca, occasionally branched and bearing two. Hydrothecæ deeply campanulate, tapering from the distal end, quite slender near the base, rim ornamented with about fifteen large, acutely-pointed teeth. *Gonosome.* Gonangia unknown.

Hab. Port Etches, Alaska; 10 to 18 fathoms, clayey mud.

Campanularia circula, sp. nov. Plate vii., fig. 3.

Trophosome. Hydrocaulus erect, compound, composed of a number of slender united tubes, unbranched. Hydrothecæ large, deeply campanulate, rounded at the base, rim ornamented with from ten to twelve large denticulations, some of which are square-cut, others have slightly rounded edges, and are very shallow; the pedicels supporting the hydrothecæ are long and slender, a single distinct annulation at the base of the hydrothecæ, the remainder of the pedicel more or less twisted, arranged in verticils of four to six pedicels, at regular intervals on the stem. *Gonosome.* Gonangia unknown.

Hab. Port Etches, Alaska; 12 to 18 fathoms, clayey mud.

This well-marked form is represented by a single small specimen, which, unfortunately, is destitute of gonangia. Its nearest ally is *C. verticillata*, Lamk, from which it may be distinguished by the size and form of the hydrothecæ, and by the ornamentation of the rim.

Campanularia turgida, sp. nov. Plate viii., fig. 8.

Trophosome. Hydrocaulus simple, creeping, giving rise, at short intervals, to long pedicels bearing the hydrothecæ. Hydrothecæ large, turgid, rounded at the base, the rim ornamented with from twelve to sixteen roundly pointed or sometimes squaretopped teeth, borne on long, slender pedicels with a wavy outline, or occasionally a slight twist in them, a single well-marked annulation at the base of each hydrotheca, and from three to six annulations at the base of each pedicel. *Gonosome.* Gonangia borne on short pedicels consisting of five or six annulations springing from the creeping stem, flask-shaped, largest in the middle, tapering but slightly to the rounded base, produced into a neck distally, aperture terminal, discoidal.

Hab. Port Etches, Alaska; 12 to 18 fathoms, mud.

Campanulari compressa, sp. nov. Plate viii., figs. 5, 6.

Trophosome. Hydrocaulus creeping, simple, giving origin to the pedicels at irregular intervals. Hydrothecæ large, deeply campanulate, tapering to the base, the walls very thick, especially at the base, where they project inwards, forming a sort of diaphragm, upon which the polyp rests, rim entire; pedicels of medium length, with a single well-marked annulation at the base of the hydrothecæ, and usually two or three constrictions just beneath the annulation, not annulated at the base. *Gonosome.* Gonangia turgid, sessile, or with a very short pedicel, largest at the distal end, rounded at the base, very much compressed laterally.

Hab. Yukon Harbor, Shumagin Islands; 6 to 20 fathoms, sand and rocks, July 7th. Growing on a piece of Laminaria.

This form belongs in the same group with *C. calyculata*, Hincks, from which it may be distinguished by the gonangia, and by the base of the hydrothecæ.

Campanularia speciosa, sp. nov. Plate ix., fig. 11.

Trophosome. Hydrocaulus simple, creeping, twisted, bearing the pedicels at irregular intervals; pedicels short, more or less annulated, bearing each a single hydrotheca. Hydrothecæ very large, deeply campanulate, urceolate, the rim ornamented with about ten shallow teeth, and with an internal ridge extending from each tooth for about one-fourth the distance, to the base of the hydrotheca. *Gonosome.* Gonangia unknown.

Hab. Yukon Harbor, Big Koniushi, Shumagin Islands; 6 to 20 fathoms, gravel, July 7th.

This is the largest creeping Campanularian known, and is as noticeable for its beauty as for its size. The intrathecal ridges and the character of the denticulations make it a well-marked form, readily distinguishable, without the gonangia, from any known species on the American coast.

Campanularia urceolata, sp. nov. Plate viii., fig. 7.

Trophosome. Hydrocaulus simple, creeping, rather stout, with a wavy outline, giving origin to the pedicels at irregular intervals; pedicels short, never more than twice the length of the hydrothecæ, usually annulated or twisted throughout, and always one annulation at the base of each hydrotheca more distinctly marked than the rest. Hydrothecæ large, deep, urceolate, rounded or slightly tapering at the base, with an internal support in the base of the hydrotheca upon which the polyp rests, rim ornamented with from thirteen to eighteen large rounded teeth. *Gonosome.* Gonangia small, fusiform, occasionally a trifle obovate, orifice small, terminal, discoidal, supported on very short pedicels consisting of but two or three annulations.

Hab. Lituya Bay, Alaska; 9 fathoms, sandy mud.

Campanularia integra, Macgillivray. Plate ix., figs. 9, 10.

This species is represented by two fine specimens, which are in an excellent state of preservation, and have three or four fully developed gonangia. The latter are a little larger than usual.

Hab. Semidi Islands; 15 to 25 fathoms, gravel, June 10th. Lituya Bay; 9 fathoms, sandy mud.

The specimen from the Semidi Islands was growing upon a stem of *Sertularella tricuspidata.*

Gonothyrea hyalina, Hincks. Plate vii., figs. 1, 2.

This is apparently one of the most common species of the family *Campanulariidæ* on the Alaskan coast. Very good specimens were obtained from five different localities; those from the Semidi Islands being of especial value, as they bear extra-capsular medusoids at the distal ends of the gonangia. The medusoids vary in number from two to six, are slender and pyriform, which is probably, in part, owing to the contraction due to the alcohol.

Hab. Semidi Islands, Alaska; 15 to 25 fathoms, gravel, June 10th. Port Möller, Aliaska Peninsula; 13 fathoms, gravel; 17 fathoms, sand; August. Five miles southwest of the west cape of Nunivak Island; 30 fathoms, sand.

Lafoëa pocillum? Hincks. Plate xi., fig. 21.

There are two specimens of creeping forms of *Lafoëa* in the collection, to the examination of which I have given considerable time. Number 1 has short, stout hydrothecæ of variable shape, borne upon short pedicels of from three to six annulations, the latter showing a good deal of difference in the stoutness, some being half as wide as the hydrothecæ, others not more than a third; most of the hydrothecæ are urceolate, like Hincks's figures of *L. pocillum;* others are regularly cylindrical, like Hincks's figure of *L. parvula*, and between these two are forms which make a connecting series between the urceolate and cylindrical types. Number 2 has the hydrothecæ of about the same width, but longer, the pedicels average a little longer, and it agrees more closely with *L. pocillum* than the more variable form of number 1. The perisarc of both these forms is very thick, and dark-brown colored.

Hab. Number 1 is from Cape Etolin, Nunivak Island, Alaska; 8 to 10 fathoms, stony. Number 2 is from Bering Sea, 5 miles west of west cape of Nunivak; 30 fathoms, sand.

Lafoëa gracillima, Sars. Plate xii., fig. 24.

Very fine specimens of this delicate form were collected, which show no variations from the specimens found on the eastern shores of North America. Gonangia unknown.

Hab. Coal Harbor, Shumagin Islands, beach; July 15th. Sitka Harbor; gravel and mud, 15 fathoms, May 1st.

Lafoëa dumosa, Sars. Plate xii., fig. 23.

This widely distributed species is also a member of the Alaskan Hydroid Fauna. The specimens are larger and more robust than those from the eastern shores of North America, and the hydrothecæ are more deeply merged in the stem. It is very singular that we are still obliged to record, for this common and widely distributed species, gonangia unknown.

Hab. Port Etches; 12 to 18 fathoms, clayey mud.

Lafoëa fruticosa, Sars. Plate xii., fig. 22.

This appears to be the most common of the four species of this genus in the collection. It differs only from the New England specimens in being more robust. Gonangia unknown.

Hab. Kyska Harbor; 10 fathoms, rocky, July 15th. Popoff Straits, Shumagin Islands; near edge of reef, 6 fathoms. Yukon Harbor, Big Koniushi, Shumagin Islands; 6 to 20 fathoms, sand and rocks, July 7th.

Calycella syringa, Hincks (Linn.). Plate xii., fig. 25.

A very fine specimen of this species occurs on a colony of *Lafoëa gracillima*. It is in very fine condition, and has the gonangia with extracapsular pouches in considerable abundance.

Hab. Coal Harbor, Shumagin Islands; beach, July, about the 15th.

Coppinia arcta, Hincks (Dalyell).

A very fine specimen of this peculiar form was collected at the Shumagin Islands. The hydrothecæ are very long, and most of them curved near the distal end. Growing on the stem of a colony of *Lafoëa gracillima*. The largest hydrothecæ are 2 mm. long.

Hab. Coal Harbor, Shumagin Islands; beach, July 15th.

Halecium muricatum, Johnston (E. and S.). Plate x., fig. 15.

A single specimen of this species with the characteristic gonangia, was collected on Unalashka beach. The trophosome is about 50 mm. in height, but is in very poor condition, none of the hydrothecæ being present. The gonangia, however, are very abundant, are irregularly arranged on the basal half of the compound stem, and are in a good state of preservation.

Halecium (?) plumularioides, sp. nov. Plate x., figs. 16, 17.

Trophosome. Hydrocaulus erect, simple, straight, divided by transverse joints into internodes of considerable length, regularly branched, and with a few annulations at the base; branches arranged alternately on opposite sides of the stem, one to each internode, having their origin in a small shoulder-like process just below each joint, divided usually into regular internodes, though, in some cases, short internodes occur between the longer ones. Hydrothecæ arranged uniserially, usually one to each internode, partly adherent to the stem, or entirely free, shallow, tapering slightly to the base, with an entire rim.

Gonosome. Gonangia unknown.

Hab. Cape Etolin, Nunivak Island; 8 to 10 fathoms.

Height of largest specimen 20 mm.

I refer this species to the genus *Halecium* provisionally, for, the gonangia being absent, and the hydrothecæ having a different arrangement from any known *Halecium*, make it quite doubtful whether it belongs in this genus. It is the most delicate species in the collection. It closely resembles, in many particulars, the

Plumulariæ, from which it is separated on account of the absence of nematophores.

Halecium scutum, sp. nov. Plate x., figs. 13, 14.

Trophosome. Hydrocaulus erect, compound, exceedingly stout, rough, with an irregular outline, attached by a thick mass of interlaced stolons, much and irregularly branched; branches of two kinds, the larger ones stout, black, and like the main stem undivided by joints, the smaller are light horn-color, sub-erect, short, divided into long internodes, each giving origin to a single branchlet; branchlets divided by oblique joints into short, stout, wedge-shaped internodes, each of which bears at least one hydrotheca, often two. Hydrothecæ tubular, margin everted, arranged alternately, and occasionally a second one is borne in the axil of the first. *Gonosome.* Gonangia very large, obovate, with the orifice on one side; the latter varies much in position, occurring anywhere from the middle to near the distal end; it has an irregular outline, and is made very ornamental by the thickening of the perisarc around it; there is a thickened border around the upper edge, and below the orifice is a shield-shaped thickening in which are two ellipsoidal markings, where the chitin is only of the usual thickness.

Height of largest specimen 150 mm.

Hab. Unalashka; beach, low water, after gale, September. Coal Harbor, Shumagin Islands; low water, April; Gonangia abundant. Coal Harbor, Shumagin Islands; Gonangia abundant. Unalashka; beach, May 1st; Gonangia abundant. Semidi Islands, Alaska; 15 to 25 fathoms, gravel, June 10; Gonangia. Sanborn Harbor, Shumagin Islands; Gonangia abundant

The specimen from which the above description is taken is a remarkably stout, coarse form, more closely resembling Hinck's figure of *Eudendrium rameum*, Pallas (*vide* frontispiece to Hinck's *British Hydroid Zoöphytes*, vol. i.), than any hydroid that I am acquainted with. The diameter of the mass of stolons at the base is from 15 mm. to 25 mm. The largest stem is 6 mm. thick at the base, and tapers very gradually to the distal end.

The variation which this species shows in the mode of growth is so remarkable that I will mention some of the most divergent forms. The specimens from Sanborn Harbor, Shumagin Islands, consist of tufts of light horn-colored stems about 50 mm. in height, rather slender and compound only for a very short distance at the base, branches very short. Gonangia present, and exactly like those of the typical form. Another style is from 20 mm. to 60 mm. high, from dark horn-color to black, stem stout, coarse, branches numerous and short. Gonangia very abundant; has a crowded look; specimens of this form are from Unalashka; beach. Semidi Islands; 15 to 25 fathoms, gravel. Coal Harbor, Shumagin Islands; beach, low water, after a gale in September.

Diphasia mirabilis, Verrill. Plate xiii., fig. 36.

American Journal of Science, iii., vol. v. p. 9, December, 1872.
Connecticut Academy of Arts and Sciences, vol. iii., Part I., p. 53.

Two specimens of this remarkable form are the only representatives of this genus in the collection. The specimens are in very good condition, and show no variation from Professor Verrill's type specimen from Le Have Bank, with which I have compared them. Gonangia unknown.

Hab. Hagmeister Island, Bering Sea; beach. Popoff Straits, Shumagin Islands.

Sertularia filicula, E. and S. Plate xii., fig. 30.

This species grows very luxuriantly, and is apparently quite common on the beaches. There is a good supply of it in the collection, mostly from Unalashka beach. It grows there in very dense masses from 50 to 80 mm. in height, is usually of a dark horn-color, and attached to algæ or sponge. The gonangia vary somewhat from the figure given by Hincks, but not enough to warrant a separation of this form from the British. The Alaskan form has the gonangia sessile, largest at the distal end, tapering to the base, aperture terminal, small, discoidal. In the British form they are more fusiform or are pear-shaped, largest near the middle, with a short tubular aperture. The trophosomes agree perfectly.

Hab. Unalashka; beach after gale, September. Coal Harbor; Popoff Straits, Shumagin Islands. St. Paul Island (Pribiloff group); 9 fathoms, sand, July 24. Hagmeister Island; beach. San Miguel Island, California. Nunivak Island; 8 to 10 fathoms. Constantine Harbor, Amchitka Island; 6 to 10 fathoms, sand and stones, July 20. Chirikoff Island; beach.

Sertularia similis, sp. nov. Plate xv., fig. 56.

Trophosome. Hydrocaulus erect, simple, slender, straight, jointed, pinnately branched, internodes of equal length and bearing three hydrothecæ and a branch; branches short, slender, divided by transverse joints into short internodes, bearing two, sometimes three pairs of hydrothecæ, occasionally bearing one or two branchlets, constricted at the base; branchlets jointed like the branches, and like them constricted at the base, diverging at a wide angle from the branches. Hydrothecæ opposite, tubular, curved strongly outwards with a bilabiate orifice, the broad side being turned towards the stem; on the main stem there are three on each internode, a pair placed opposite to each other, and one in the axil of the branch; on the branches and branchlets they are arranged oppositely. *Gonosome.* Gonangia unknown.

Height of largest specimen, 85 mm.

Hab. Hagmeister Island; 8 to 15 fathoms, gravel.

This is a very interesting species, as it combines some of the characters of three other species of the genus. In mode of growth it approaches *S. cupressina*, in the shape of the hydrothecæ it is similar to *S. argentea*, and in the arrangement of the latter it is like *S. pumila.* Considerable variation is shown in the extent to which the hydrothecæ curve outwards; upon some of the branches the mouth opens at right angles to the stem, while upon others they open upwards.

Sertularia cupressoides, sp. nov. Plate xiii., fig. 37.

Trophosome. Hydrocaulus simple, erect, slender, two or three annulations at the base, divided by oblique joints into internodes of variable length, pinnately branched; branches arranged alternately, an even number to an internode, attached to the stem by quite a prominent process, annulated and slender at the base, the broader side facing the stem; the basal portion is sharply curved outward, the distal portion is nearly straight, and lies about at right angles with the stem, bearing but very few branchlets; branchlets short and diverging at a wide angle from the branches. Hydrothecæ tubular, deeply immersed in the stem, curving slightly outwards; orifice bilabiate, with the broader side facing the stem, arranged sub-alternately upon the branches and branchlets, none upon the main stem. *Gonosome.* Gonangia unknown.

Height of finest specimen, 80 mm.

Hab. Shumagin Islands, Popoff Straits; 6 fathoms, rocky bottom, July. Port Möller, Aliaska Peninsula; 13 fathoms, sand, August.

This species is quite similar to *S. cupressina* in some respects, but may be distinguished by the entire absence of hydrothecæ upon the main stem, and by having an even number of branches to an internode; the branches are also usually stouter.

Sertularia variabilis, sp. nov. Plate xiv., figs. 40 to 48. Plate xv., figs. 49, 50.

Trophosome. Hydrocaulus erect, simple, stout, flexuous, divided by transverse joints into short internodes, usually bearing a pair of hydrothecæ, those giving origin to a branch bearing one hydrotheca on one side and two hydrothecæ and the branch on the other, regularly branched; branches arranged alternately on opposite sides of the stem, short, stout, suberect, occasionally bearing a few short branchlets; the latter usually divided into regular internodes, bearing each a pair of hydrothecæ, sometimes occurring undivided. Hydrothecæ large, subalternate, the widest portion, the lower two-thirds, is immersed in the stem, the upper portion is narrower and curved strongly outwards and upwards; aperture large, discoidal, rim entire. *Gonosome.* Gonangia of two forms; No. 1 is pyriform, tapering rapidly to the base, sessile; orifice large, terminal, discoidal, ornamented with a number of chitinous teeth which project downwards into the gonangia; No. 2 is obovate, sessile, aperture terminal, large, provided with an internal collar, the latter ornamented with a number of acute teeth, which project downwards; borne in two rows on the upper sides of the branches.

Height of largest specimen, 100 mm.

Hab. Unalashka; beach. Lituya Bay; 112 fathoms. Hagmeister Island, Bering Sea. Sanborn Harbor, Shumagin Islands; beach. Captain's Harbor, Unalashka; 60 to 80 fathoms, sand, September 13. Port Etches, Alaska; 12 to 18 fathoms, clayey-mud. Five miles southwest of the west cape of Nunivak, Bering Sea; 30 fathoms sand. Popoff Straits. Semidi Islands; 15 to 28 fathoms, gravel, June 10. Unalashka; 6 fathoms, Nov. 11th. St. Paul Island, Pribiloff group; 9 fathoms, sand, Kelp ground, July 24th. Akutan Pass, near Unalashka; beach. Big Koniushi, Shumagin Islands; 6 to 20 fathoms, sand and rocks in Yukon Harbor, July 7th. San Miguel Island, California; W. H. Dall.

This is the most variable form of hydroid that I am acquainted with. Besides the great variation which is shown within the ordinary limits of specific differences, there are two extreme forms which, without as complete a series of connecting forms as there is in Mr. Dall's collection, would undoubtedly be called distinct species. One of these two varieties is represented by only two specimens, one of which is somewhat worn and mutilated, while the other is in good condition, and bears a number of gonangia. This variety is much more robust than any of the normal forms, the branches being an eighth of an inch wide; the hydrothecæ are very large and swollen in the middle portion; the gonangia are of the kind given as No. 2 in the description. The other variety has slender hydrothecæ which are free for more than half their length, are not swollen in the middle, and the outline from the aperture of the hydrotheca to the stem forms a curve which projects into the hydrotheca, while in the robust form it projects outward; most of the hydrothecæ also have a projection in the shape of a small horn at the inner, inferior angle; some of those on the distal ends of the branches have a well-defined notch in the rim, on the opposite side from the stem, forming a blunt tooth on each outer corner, and between each tooth and the inner margin of the rim there is a slight sinuosity. This character of the rim decreases towards the lower portion of the stems and branches to such an extent, that many of the hydrothecæ have a rim that is entire, or nearly so.

This is not only the most variable, but apparently the most abundant form on the Alaskan coast. In some of its variations it is quite similar to *S. abietina* of the New England shores, Greenland, and the North Cape, which also shows considerable specific variation.

Sertularia inconstans, sp. nov. Plate xv., figs. 51, 52.

Trophosome. Hydrocaulus erect, simple, constricted at the base, jointed obliquely, internodes of uniform size, densely branched; branches mostly short, arranged alternately, one to each internode, erect, lying close to each other, a few of the larger shoots bear one or two large branches similar to the main stem, divided by transverse joints into internodes of very variable length, constricted at the base, attached to the stem by quite a prominent process, but little branched; branchlets few, short, erect. Hydrothecæ large, swollen at base, a constriction near the distal end, aperture discoidal, rim entire, arranged alternately upon the branches and branchlets; on the lower part of the stem, below the branches, there are two to each internode; on the upper portion of the stem there are usually three to each internode, one on one side and two on the other; one of the latter being in the axil of the branch.

Gonosome. Gonangia sessile, large, orifice terminal, small, discoidal; outline very irregular, tapering usually at the base; borne in two close-set rows on the distal portion of the main stem.

Height of specimen 45 mm.

Hab. Unalashka; beach.

From the character of the trophosome, this species evidently belongs in the same group wlth *S. abietina* and *S. filicula*, the hydrothecæ agreeing very well in form and arrangement. The mode of growth, however, is quite different, the number and closeness of the branches and branchlets giving to the colony a very dense, plumose appearance.

The gonangia show the greatest amount of variation of any species that I know of; it is impossible to describe their form, for there is not one of them which seems to agree with any other.

Sertularia thuiarioides, sp. nov. Plate xiii., figs. 38, 39.

Trophosome. Hydrocaulus erect, simple, very slender at the base, largest at the distal end, the middle portion slender and of uniform size, jointed transversely, internodes of variable length, regularly branched; branches sub-erect, short, springing from opposite sides of the stem, but spirally arranged owing to the stem being twisted, much branched, on some of the largest specimens two or three large branches occur, which resemble the main stem in every particular; branchlets short, spreading widely, bearing a few small subdivisions. Hydrothecæ tubular, deeply immersed, with a constriction on the inner side of the distal end, aperture semilunar shape, arranged alternately upon the branches and branchlets, and basal part of the stem; on the upper branched portion the internodes usually bear one hydrotheca on one side, and two hydrothecæ and a branch on the other.

Gonosome. Gonangia large, sessile, tapering at the base, ornamented with two pointed horns placed opposite to each other, near the distal end; aperture terminal, discoidal, ornamented with a row of teeth projecting into the gonotheca, borne in single rows on the upper sides of the branches and branchlets.

Height of largest specimen 180 mm.

Hab. Bering Sea, 5 miles west of the West Cape of Nunivak Id.; 24 fathoms, sand. Chignik Bay, Aliaska; 11 to 16 fathoms, sand.

I have not been able to make out any distinct opercula, but in one or two instances have noticed a minute piece of membrane, with a ragged edge, hanging from the rim of a hydrotheca. The hydrocaulus is very characteristic, the distal part being often twice the size of the basal portion.

Sertularella tricuspidata, Hincks. Plate xii., figs. 26, 27.

There are specimens of a *Sertularella*, collected at four or five different localities, which I at first thought to be a new species, and closely allied to *S. tricuspidata*, but upon examining them more closely, I find them to be robust forms of the above-named species.

The gonangia are very abundant, and are borne in rows on the upper side of the branches.

Hab. Semidi Islands, Alaska; 15 to 25 fathoms, gravel, June 10th; gonangia abundant. Popoff Straits, Shumagin Islands. Unalashka; beach. Port Etches, Alaska; 12 to 18 fathoms, clayey mud. Yukon Harbor, Big Koniushi, Shumagin Islands; 6 to 20 fathoms, gravel, July 7th. Kyska Harbor; 10 fathoms, rocky, July 15th. Iliuliuk, Unalashka; 13 fathoms, stony.

There is one specimen which is much more delicate than any of the others, but differs in no essential characters. The gonangia are not present.

Hab. Semidi Islands, Alaska; 15 to 25 fathoms, gravel, June 10th.

Sertularella rugosa, Gray. Plate xiii., fig. 31.

This species, which has only been found upon the New England coast at low water, is represented on the shores of Alaska by a stout form, which was found in from six to twenty fathoms. Although the gonangia are not present, the trophosomes are so characteristic that I do not hesitate to refer them to this species.

Height of the largest shoot 30 mm.

Hab. Iliuliuk, Unalashka; on kelp, Oct. 23, 1871. Yukon Harbor, Big Koniushi, Shumagin Islands; 6 to 20 fathoms, sand and rocks, July 17th. St. Paul Island (Pribiloff group); 9 fathoms, sand, on kelp ground. Cape Etolin, Nunivak Island; 8 fathoms, stony.

Sertularella polyzonias, Gray. Plate xiii., figs. 34, 35.

A number of very fine specimens of this widely distributed species are in the Alaskan collection. They vary but very slightly from the New England specimens, the hydrothecæ and gonangia being on the average a trifle stouter, and the whole colony has a more luxuriant growth.

The gonangia are very abundant, and are borne on the sides of the stems, midway between two hydrothecæ. Our specimens are all from two localities.

Height of largest specimen 70 mm.

Port Etches, Alaska; 12 to 18 fathoms, clayey mud. Five miles southwest of the West Cape of Nunivak Id.; 30 fathoms, sand.

Sertularella robusta, sp. nov. Plate xiii., figs. 32, 33.

Trophosome. Hydrocaulus simple, erect, stout, flexuous, four or five annulations at the base, divided by transverse joints into internodes of variable length, sparingly and regularly branched; branches erect, varying greatly in length, those near the base of the hydrocaulus being longest, and like the upper and shorter ones extending to the distal end of the stem, flexuous, constricted at the base, the larger ones bearing a few branchlets. Hydrothecæ very large, operculated, deeply immersed in the stem, only enough of the distal end to include the teeth being free, curving slightly outward, the inner angle of the base somewhat produced downwards toward the centre of the stem, the rim armed with four stout teeth; operculum consists of four segments.

Gonosome. Gonangia axillary, very large, sessile, ovate, marked with about eight very prominent transverse bands; orifice terminal at the extremity of a short tube, with an entire rim.

Hab. Yukon Harbor, Big Koniushi, Shumagin Islands; 6 to 20 fathoms, sand and rocks, July 7th.

This is one of the stoutest forms of all the numerous *Sertulariidæ* from the Alaskan coast; and the large size and conspicuous position of the gonangia contribute to make it the most imposing of all the known members of the family. It has a very rigid, angulated habit, more like some of the stouter species of *Sertularia*, e. g., *S. abietina*, than the graceful curved mode of growth usually found in *Sertularella.* The shape and arrangement of the hydrothecæ is also similar to that usually found in the genus *Sertularia*, and the deep immersion of the hydrothecæ in the stem remind one of the forms belonging to the genus *Thuiaria.*

The stem, branches, and branchlets are all of about the same width, 1 mm. Height of largest colony 50 mm. Length of gonangia 5 mm., width 2 mm.

It is quite interesting to note that while this species is undoubtedly a good *Sertularella*, as is indicated by the form and structure of the gonangia and the operculated hydrothecæ, it also possesses some of the characteristics of the genera *Sertularia* and *Thuiaria*, thus still more closely connecting these different members of the family *Sertulariidæ*.

Sertularella pinnata, sp. nov. Plate xii., figs. 28, 29.

Trophosome. Hydrocaulus simple, erect, straight, much and pinnately branched, divided by transverse joints into short internodes, each of which bears a single branch; shoots occurring in dense clusters; each shoot widest in the middle and tapering more rapidly towards the base than to the distal extremity; branches short, sub-erect, not all in the same plane, inclining towards each other on the upper side of the stem, divided into short internodes, but little subdivided, occasionally a long branch occurs near the base, which is similar to the main stem in all respects. Hydrothecæ short, tubular, wide-mouthed, rim ornamented with three large teeth, two of which are usually on the outer side, not all in the same plane, but inclining towards each other, so that in a general view they appear to be arranged uniserially; hydrothecæ on the pinnæ arranged alternately, one to each internode and on the main stem one in each axil. Gonangia ovate, sessile, axillary. marked with about eight very strong transverse ridges, which, in most of the specimens, have an irregular, wavy outline, orifice terminal, central, discoidal; borne in two rows, in the axils, on the basal half of the stems.

Height of finest specimens 35 mm.

Hab. Unalashka; beach, low water, after gale, September; growing in dense tufts on sea-weeds, gonangia abundant. Coal Harbor, Shumagin Islands; low water, attached to fuci and sponges, gonangia abundant. Lituya Bay; 9 fathoms, sandy mud; gonangia present. Lituya Bay; 112 fathoms.

This is a very distinct form, well characterized by the pinnate arrangement of the branches, the arrangement of the hydrothecæ, and by the structure and arrangement of the gonangia.

Thuiaria cylindrica, sp. nov. Plate xvi., fig. 57.

Trophosome. Hydrocaulus erect, simple, stout, gradually tapering from the distal end to the base, divided by oblique joints into internodes of very variable length, three or four annulations at the base, regularly branched; branches cylindrical or polygonal, arranged alternately, bearing from one to three branchlets near the base which are of equal size and nearly equal length with the branches, or unbranched; constricted at the base; occasionally a large branch occurs which resembles the main stem in every particular. Hydrothecæ tubular, entirely immersed, tapering at the distal end, curved slightly outwards, aperture oval, those upon the stem are arranged in two opposite rows on the same sides with the branches, three between each two branches; those upon the branches and branchlets are in regular rows of from four to six in number. *Gonosome.* Gonangia unknown.

Height of largest specimen 130 mm.

Hab. Port Möller, Aliaska Peninsula; 5 to 17 fathoms, sand, August. Hagmeister Island, Bering Sea; beach. Chirikoff Island; beach. Chiachi Islands; 8 to 15 fathoms, gravel.

There is considerable variation in the mode of growth of this species. The largest specimen has a straight stem with short pinnate branches, not over half an inch (13 mm.) long, and bearing but few very short branchlets. Another specimen has a twisted stem, giving a very graceful, spiral form to the colony; and four or five of the specimens in which the branches bear long spreading branchlets have a stout plumose form as if the branches orignated from all sides of the stem.

Thuiaria robusta, sp. nov. Plate xv., figs. 53, 54, 55.

Trophosome. Hydrocaulus simple, erect, slender at the base, gradually increasing in size to the distal end, divided by transverse joints into internodes of uniform size, a few annulations at the base, regularly branched; branches short, spreading, curving outwards and downwards, springing from all sides of the stem, one to each internode, bearing four or five branchlets, internodes of unequal size; branchlets few, short and diverging at a wide angle. Hydrothecæ vary greatly in form, those upon the branchlets and extremities of the branches curve quite strongly outwards, may be immersed up to the aperture in the stem, or the distal third may be free, aperture large, bi-labiate, with the broad side towards the stem; those upon the median portions of the branches are long, completely immersed, aperture smaller and not as distinctly bi-labiate as those upon the branchlets; those upon the proximal portion of the branches are shorter than the others, much smaller, aperture large, slightly bi-labiate with a singular process of the perisarc in the shape of a two-pointed pyramid at the base of each hydrotheca; all the hydrothecæ upon the branches and branchlets are arranged sub-alternately; those upon the main stem are similar to those of the proximal portions of the branches, usually two to each internode which are placed about opposite to each other, occasionally a third one occurs in the axil of the branch. The perisarc is unusually thick, and especially so in the basal third of the hydrocaulus where the diameter of the cavity of the cœnosarc is not more than a third of that of the stem.

Gonosome. Gonangia largest at distal end tapering to the base, sessile, about twice the length of the hydrothecæ, not including the horns, armed with two stout, cylindrical, truncate horns placed on opposite sides of the aperture near the distal end, aperture terminal, discoidal.

Hab. Sea Horse Islands, Arctic Ocean; 23 fathoms, mud and gravel. Hagmeister Island, Bering Sea; beach. Cape Prince of Wales, Arctic Ocean; mud. Bering Sea, 12 miles east of King's Island; 17 fathoms, mud.

Thuiaria plumosa, sp. nov. Plate xvi., fig. 62.

Trophosome. Hydrocaulus simple, erect, very slender at the base, increasing in size to the distal end, somewhat twisted, jointed transversely, internodes of the proximal portion of very unequal length, some being three times the length of others, those of the upper portion are quite uniform, regularly branched; branches short, arranged alternately, one to each internode, but owing to the twist in the stem take on a spiral form, the uppermost erect, lying close to the stem, the lower ones curve outwards, attached to the stem by a very prominent process, bearing a few branchlets, regularly jointed; branchlets do not extend beyond the ends of the branches, and lie close to the latter. Hydrothecæ largest at the base, tapering slightly outwards, entirely immersed, aperture towards the stem, the outer side produced, rim ornamented with two large teeth placed on the outer side, two tooth-like processes of the perisarc also occur in the base of each hydrotheca, arranged subalternately upon the branches and branchlets; upon the stem there are three to each internode, two placed opposite to each other, and one in the axil of the branch. *Gonosome.* Gonangia sessile, very long and narrow, tapering gradually to the base, ornamented with two short horns placed on opposite sides of the orifice near the distal end, orifice terminal large; borne in single rows on the upper side of the branches and branchlets.

Height of largest specimen, 40 mm.

Hab. Bering Sea, 5 miles southwest of the west cape of Nunivak Island; 30 fathoms, sand. Icy Cape, Arctic Ocean; 15 fathoms, sand.

In general appearance this species cannot be distinguished from *Sertularia thuiarioides*, and even in some of the details of structure they bear a very close resemblance to each other; the best distinguishing characteristic in the trophosomes is the form of the aperture in the hydrothecæ, and in the gonosome the size and relative proportions of the gonangia. The twist in the stem and the erect position of the branches give to this species a very graceful mode of growth, which bears a striking resemblance to a feather.

Thuiaria turgida, sp. nov. Plate xvi., figs. 58 to 61.

Trophosome. Hydrocaulus simple, erect, stout, straight or slightly flexuous, of nearly uniform size throughout, joints oblique, internodes short, of equal size, annulated at the base, the lower portion without branches, the upper or distal part regularly branched; branches broad, short, arranged alternately, one to each internode, constricted at the base, attached to quite a prominent process from the stem, with one annulation, divided by transverse joints into internodes of variable length, sparingly branched; branchlets diverging from the branches at a wide angle, usually curving towards each other. Hydrothecæ large, tubular, deeply immersed in the stem, curving slightly outwards, aperture large, rim entire, arranged oppositely on the branches and branchlets; on the upper portion of the stem there are three to each internode, a pair opposite to each other, and one odd one in the axil of the branch; on the lower part of the stem there are two to each internode. *Gonosome.* Gonangia large, swollen, sessile, with three to five stout, longitudinal ridges, orifice terminal, small, discoidal; arranged in two closely set rows on the upper portion of the main stem.

Height of largest specimen, 140 mm.

Hab. Port Etches; 5 to 8 fathoms, gravel and stones, May 30. Popoff Straits, Shumagin Islands; near edge of reef in 6 fathoms, July. Semidi Islands; 15 to 28 fathoms, gravel, June 10. Coal

Harbor, Shumagin Islands; beach. Eider village, Unalashka; 25 to 30 fathoms, sandy mud, June 4. Hagmeister Island, beach. Unalashka; 6 fathoms, Nov. 11. Kyska Harbor, Aleutian Islands. Lituya Bay; 9 fathoms, sandy mud. Akutan Pass, near Unalashka. St. Paul Island (Pribiloff group); 9 fathoms, in kelp, July 24. Middleton Island; 12 fathoms, gravel, June 2.

This species is one of the most abundant in the collection. It is a showy form, and has quite a stout appearance, owing to the width of the branches and stem throughout, and the large gonothecæ forming a double, close-set row along the distal third of the stem add not a little to its showiness.

Thuiaria gigantea, sp. nov. Plate xvi., figs. 63, 64.

Trophosome. Hydrocaulus simple, erect, rooted by a creeping stolon, stout, straight, divided by transverse joints into internodes of variable length, much and quite regularly branched; branches suberect, short, stout, usually unjointed, seldom branched all in one plane, arranged alternately on opposite sides of the stem from within an inch of the base to the very tip, constricted at the base. Hydrothecæ large, deeply immersed, curving outwards, orifice large, somewhat elliptical, arranged subalternately upon the stems and branches. *Gonosome.* Gonangia borne in two rows on the upper sides of the branches and branchlets, usually occurring towards the distal ends of the stems, sessile, obovate, with an irregular outline, orifice terminal, large, discoidal.

Height of largest specimen, 165 mm.

Hab. St. Paul Island, Bering Sea. Hagmeister Island; beach. Akutan Pass, near Unalashka. Kyska Harbor; 10 fathoms, rocky, July 15.

The finest specimens consist of a dense cluster of about 350 shoots, averaging six inches in length, attached to a large barnacle; it is much the largest single specimen in the collection, containing just about one million individuals, exclusive of the reproductive zooids, and it can just be crowded into a two-quart jar. The conditions for the existence of life must be very favorable where such a luxuriant growth as this is obtained from a rootstock that covers only a piece of an old barnacle shell.

Macrorhynchia Dallii, sp. nov. Plate xi., figs. 18, 19, 20.

Trophosome. Hydrocaulus erect, compound, very stout, black, straight or gracefully curved at the distal end, not divided by joints, the lower portion sometimes as much as the lower third, bearing no pinnæ, but give origin to two or three branches which often equal the main stem in size, and resemble the latter in every particular, the upper portion bears a double row of closely set pinnæ. Pinnæ arranged alternately on opposite sides of the stem and branches, gracefully curved, more or less, towards each other, giving off near their origin from one to three branches, which are exact copies of the main pinnæ, equal the latter in length, and lie so closely upon each other, that they are not noticed in a casual glance; both the pinnæ and their branches are divided by transverse joints into short internodes. Hydrothecæ arranged uniserially upon the pinnæ and their branches, one to each internode, narrowest at the base, rim entire and slightly flaring. Nematophores simple, very large, the distal portion free, semicylindrical, very broad, one on either side and at the upper edge of the hydrothecæ, facing inwards, one just below each hydrotheca, and on the main pinnæ, sometimes two, one directly below the other, there are also two or three near the base of the gonangia irregularly arranged.

Gonosome. Gonangia very large, quite regularly cylindrical, tapering at the base, sessile, mouth discoidal and the full size of the gonangia, rim entire; scattered over the pinnæ and their branches.

Height of finest specimen 225 mm. Width of largest hydrocaulus at base 5 mm. Length of largest gonangium 4 mm.

Hab. Unalashka; beach. Akutan Pass, near Unalashka; beach.

This is one of the largest, stoutest, and by far the showiest and most elegant species in the collection, and I take pleasure in naming it after Mr. Dall, through whose untiring labor and skilful care this fine collection has been made, and kept in a good state of preservation.

In the mode of growth and external characters this species has all the appearances of a true *Aglaophenia*, and the large cylindrical gonangia partially hidden by the dark-colored pinnæ are readily mistaken for corbutæ.

ATHECATA.

Tubularia borealis, sp. nov.

Trophosome. Hydrocaulus simple, erect, slightly annulated or twisted at the base, largest at the distal end and tapering gradually to the base, smooth, not forming a collar-like expansion below the hydranth, light straw-color. Hydranths large, drooping; proximal tentacles thirty to thirty-two in number, arranged in a single verticil; when expanded forming a circle with a diameter of twenty to twenty-four mm.; distal tentacles fifty to sixty, arranged in a double row so closely as to form a single verticil. *Gonosome.* Gonophores oviform with four crest-shaped, laterally compressed, tentaculiform processes, arranged in pendant racemes of six to nine in number, which, when mature, are twice the length of the hydranth, and bear from thirty to seventy sporosacs each. No radiating canals are discernible in these alcoholic specimens, yet they may exist.

Length of stem 60 mm.

Hab. Hagmeister Island; beach, low-water.

In general appearance this species bears quite a close resemblance to *Tubularia indivisa;* the light-yellow, stout stems, and the large heads of both would hardly fail to mislead one at a casual glance. If there really are no gastrovascular canals in the sporosacs this form belongs in the sub-genus *Parypha* of Agassiz, but if the canals are present it makes it a still more interesting form, it then being intermediate between the sub-genera *Tubularia* proper of Agassiz, and *Parypha* of Agassiz.

Tubularia indivisa, Linne.

A number of very characteristic specimens of this widely-distributed species have been received from Alaska. The stems are very much interlaced, and many younger ones have attached themselves to older stems, thereby producing a branched appearance. Where the young stems have become closely twined about the older ones, it gives to the latter an appearance like that of the large confluent stem of *Halecium muricatum.*

Hab. St. Michael's, Norton Sound; collected by Mr. L. M. Turner, who describes them as very abundant in small pools left by extreme low tides.

Eudendrium pygmæum, sp. nov.

Trophosome. Hydrocaulus simple, erect, stout, rooted by a creeping stolon, annulated throughout, irregularly branched; branches erect, and bearing but few branchlets. Hydranths large, the stout tentacles, which vary in number from sixteen to twenty, are arranged in a single verticil. *Gonosome.* Sporosacs arranged in crowded rows beneath the tentacles, nearly spherical or pointed at the distal end, and from thirty to forty-five or even fifty in a cluster.

Height of specimen 20 mm.

Hab. Akutan Pass, near Unalashka.

This is a short, stout form, of a blackish-brown color at the base, becoming lighter towards the distal ends of the branches. It resembles the dried stems of a Eudendrium that occurs at Santa Cruz, California, in being annulated throughout, and may prove to be identical.

Nov. Fam. (?) RHIZONEMIDÆ, S. F. Clark.

Polypites attached by numerous thread-like fibres. Tentaculæ apparently of two kinds; the inner verticil of aboral tentacles branched.

Nov. Genus **RHIZONEMA**, Clark.

Polypes solitary, unconnected. Basal portion of the polypite swollen, mammillate, with the thread-like processes for attachment developed therefrom.

Type **Rhizonema carnea**, sp. nov.

Stems stout, unbranched, smallest at the distal end; of a nearly uniform size for two-thirds of the distance toward the base, at which point they begin to increase in diameter rapidly to twice the diameter of the distal end, then taper rapidly to quite a sharp point like an acorn. The processes for attachment are developed in large numbers (hundreds) from the basal surface of the enlarged portion of the stem. They are of a light-brown color, and form a matted mass which extends beyond the sharp-pointed base. The polype is large and turgid; its length much greater than its width. The aboral tentacles are about forty in number, very slender and delicate, reaching a trifle beyond the end of the proboscis. Just within these tentacles is situated another circle of processes, the exact nature of which can be determined only from fresh specimens.

The proboscis is very large and swollen, and bears around its distal end the proboscidial tentacles, which are as delicate as the finest thread, very numerous, and so matted together in the specimen before me that it is impossible to form any correct estimate of their number. The mouth, situated at the extremity of the proboscis, is very large. Length of head, 13 mm. Length of swollen basal portion, 21 mm. Total length of perfect specimen, 68 mm.

The specimens from which the above description was written were collected at St. Michael's, Norton Sound, Alaska, Oct. 17, 1875, by Mr. Lucien M. Turner, U. S. Signal Service, who appends the following note: "These specimens were of a deep coral red when found. They are not common. From the sea."

They are two in number, one of which is perfect—the other is without a head, but bears at the distal end a thin chitinous membrane surrounding the stem; its edges recurved and marked with a few faint radiating lines.

From the appearance of the individual, I am of the opinion that the head had been thrown off, and that another was about to be developed.

The matted masses of delicate fibres about the basal portion present a very peculiar appearance.

When cleared away so as to expose the pointed basal end of the stem, that part has a close resemblance in miniature to a beet-root with an unusual number of fibrous rootlets.

Under the microscope, each fibrous process appears to be developed from a small rounded papilla; some papillæ which bore no fibres exhibited an opaque milk-white nucleus. The nature and development of these processes is a matter of considerable interest, but I think that little could be done even with a large supply of only alcoholic specimens. The nature of the inner verticil of aboral tentacles (?) is also a very interesting question. From their position, and from their compound appearance, they would naturally appear to be clusters of reproductive bodies. On the other hand, the alcoholic specimens under the microscope do not show the structure characteristic of such bodies. They appear to be thin, flattened, branched tentacles, and have no swelled or thickened portions such as would indicate anything like reproductive organs. It is, of course, impossible to determine their nature positively without further material.

This is certainly a very peculiar and very interesting form, on account of its peculiarly shaped base, its apparently compound tentaculæ, and the thread-like processes for attachment, which seem, on account of the pointed base, to be necessary for its secure anchorage.

Order LUCERNARIÆ.

Family ELEUTHEROCARPIDÆ, H. J. Clark.

Halyclystus auricula, H. J. Clark.

Twenty or thirty good specimens of this interesting form have been collected at St. Michael's. They are in good preservation, and represent various stages of development. In some of the larger specimens the ovaries are very far advanced, much enlarged, nearly filling the entire cavity, and greatly distending the body walls. In others the ovaries show no enlargement, and between these two conditions all intermediate stages are represented.

The color is light brown, with a bluish tinge, which becomes darker with the development of the ovaries. Three of the specimens have ten arms and three have twelve, showing a marked tendency to variation in this respect.

Geographical distribution: St. Michael's, Norton Sound, Alaska; Mr. L. M. Turner, Oct. 17, 1875. Vardöe Islands, Norway; Rathke. Faröe Islands; Steenstrup. English coast; Montague, Fleming, Johnston, and others. South coast of Greenland; Steenstrup. Anticosti; Hyatt, Verrill, and Shaler. Massachusetts Bay; H. J. Clark.

EXPLANATION OF PLATES.

The figures on plates vii. to xi., inclusive, are enlarged 30 diameters, with the exception of Nos. 16, 19*e* and 19*g*; the extent to which the latter are magnified is indicated on the plates.

The figures on plates xii. to xvi., inclusive, are magnified 20 diameters, with the exception of No. 33, which is enlarged 7 diameters.

Plate VII.

Fig. 1. *Gonothyrea hyalina; a*, hydrothecæ; *b*, gonangium; *c*, extra-capsular medusoids with tentacles; *d*, cœnosarc, or fleshy axis.

Fig. 2. The same; portion of a branch, showing the arrangement of the hydrothecæ.

Fig. 3. *Campanularia circula;* showing, *a*, hydrotheca; *b*, main stem, and the verticillate arrangement of the pedicels around the stem.

Fig. 4. *Campanularia denticulata;* the hydrothecæ, showing the variation in shape and size. Specimen from Port Etches; creeping on Lafoëa.

Plate VIII.

Fig. 5. *Campanularia compressa;* *a*, gonangium; *r*, rootstock or creeping stem.

Fig. 6. The same; showing the variation in size and form of the hydrothecæ.

Fig. 7. *Campanularia urceolata;* *a*, hydrothecæ; *b*, gonangium.

Fig. 8. *Campanularia turgida;* *a*, hydrotheca; *b*, gonangium; *r*, rootstock.

Plate IX.

Fig. 9. *Campanularia integra;* showing the variation in the hydrothecæ.

Fig. 10. The same; *b*, gonangium; *r*, rootstock.

Fig. 11. *Campanularia speciosa;* *a*, hydrothecæ; *r*, rootstock, or creeping stem.

Fig. 12. *Clytia Johnstoni;* showing the variations in the stems and hydrothecæ.

Plate X.

Fig. 13. *Halecium scutum;* *a*, hydrothecæ; *b*, gonangia; *c*, ova; *d*, aperture of gonangia.

Fig. 14. The same; *a*, portion of a branch; *b*, portion of main stem.

Fig. 15. *Halecium muricatum;* gonangium.

Fig. 16. *Halecium plumularioides;* *a*, portion of a branch; *b*, portion of main stem; *c*, hydrothecæ.

Fig. 17. The same; *a*, branch; *b*, main stem; *r*, rootstock.

Plate XI.

Fig. 18. *Macrorhynchia Dallii;* *b*, main stem; *a*, pinnæ; *c*, hydrothecæ; *d*, nematophores.

Fig. 19. The same; *e*, a cross section of main stem near the base; *g*, gonangium; the other letters as in fig. 18.

Fig. 20. The same; the letters as before.

Fig. 21. *Lafoëa pocillum ?; a*, hydrothecæ; *r*, rootstock.

Plate XII.

Fig. 22. *Lafoëa fruticosa;* a branch with hydrothecæ. Shumagin Islands, 6 to 20 fathoms.

Fig. 23. *Lafoëa dumosa; a*, main stem; *b*, hydrothecæ.

Fig. 24. *Lafoëa gracillima; a*, main stem; *b*, hydrothecæ.

Fig. 25. *Calycella syringa; a*, hydrothecæ; *b*, opercula; *r*, rootstock.

Fig. 26. *Sertularella tricuspidata;* slender variety, from the Semidi Islands.

Fig. 27. The same; stout variety, also from the Semidi Islands.

Fig. 28. *Sertularella pinnata;* portion of a branch.

Fig. 29. The same; *a*, portion of a branch; *b*, gonangium; *c*, internal chamber.

Fig. 30. *Sertularia filicula; a*, main stem; *b*, branches.

Plate XIII.

Fig. 31. *Sertularella rugosa;* portion of a branch with hydrothecæ, from the Shumagin Islands.

Fig. 32. *Sertularella robusta:* portion of a branch; *a*, hydrothecæ; *b*, opercula.

Fig. 33. The same; gonangium.

Fig. 34. *Sertularella polyzonias; a*, hydrothecæ.

Fig. 35. The same; gonangium; *r*, rootstock.

Fig. 36. *Diphasia mirabilis:* portion of a branch.

Fig. 37. *Sertularia cupressoides; a*, portion of a branch; *b*, portion of main stem.

Fig. 38. *Sertularia thuiarioides; a*, gonangia; *b*, portions of branches.

Fig. 39. The same; *a*, portion of a branch; *b*, gonangium.

Plate XIV.

Fig. 40. *Sertularia variabilis;* portion of a branch.

Fig. 41. The same; a stouter form.

Fig. 42. The same; a form in which the hydrothecæ are more elongated.

Fig. 43. The same; a slender form in which the hydrothecæ are arranged more in pairs; *a*, the apertures where the gonangia were attached.

Fig. 44. The same; *a*, portion of a branch; *g*, gonangia from same colony.

Fig. 45. The same; a stouter form, in which the hydrothecæ are quite divergent.

Fig. 46. The same; the stoutest of the many varieties; the three pairs of hydrothecæ are all from the same branch.

Fig. 47. The same; gonangia.

Fig. 48. The same; still another form, the divergent characters of which are not constant; not even in different portions of the same colony.

Plate XV.

Fig. 49. *Sertularia variabilis;* the three pairs of hydrothecæ are all from the same stem.

Fig. 50. The same; the most extreme of the many forms.

Fig. 51. *Sertularia inconstans;* three gonangia which grew next to each other, showing how variable they are.

Fig. 52. The same; portion of a branch.

Fig. 53. *Thuiaria robusta;* *a*, portion of main stem, showing the thickness of the perisarc or chitinous walls; *b*, side view of basal portion of a branch; *c*, side view of portion of stem.

Fig. 54. The same; *d* and *e*, portions of branches.

Fig. 55. The same; gonangia.

Fig. 56. *Sertularia similis;* portion of a branch.

Plate XVI.

Fig. 57. *Thuiaria cylindrica;* showing the unusual arrangement of the hydrothecæ and the mode of branching.

Fig. 58. *Thuiaria turgida;* gonangium.

Fig. 59. The same; portion of a branch and branchlet.

Fig. 60. The same; portion of main stem.

Fig. 61. The same; portion of a branch.

Fig. 62. *Thuiaria plumosa;* *b*, portion of a branch; *g*, gonangia.

Fig. 63. *Thuiaria gigantea;* a side view of main stem; *b*, gonangia; *c*, hydrothecæ.

Fig. 64. The same; portion of a branch.

ON THE EXTRUSION OF THE SEMINAL PRODUCTS IN LIMPETS, WITH SOME REMARKS ON THE PHYLLOGENY OF THE DOCOGLOSSA.

BY W. H. DALL, SMITHSONIAN INSTITUTION.

In a paper published in the American Journal of Conchology, Part III., 1871, I brought together a summary of the various details published from time to time by various naturalists, upon the anatomy and physiology of this group. In that paper it was shown that the manner in which the seminal products were freed from the ovary and testis, and the passage by which they reached the exterior, was unknown, and from the investigations of Lankester and myself, that the existence of the oviduct figured by Cuvier (Mém. sur les Moll., 15, 1817), if not actually disproved, was at least a matter of grave doubt, and had not been confirmed by any subsequent examination. Lankester (Ann. Mag., N. H., xx. p. 334, 1867) had suggested that the passage of the ova to the exterior was made through two orifices first described by him and termed "capitopedal orifices." These were said to open, "one on each side of the head in the angle formed by its junction with the muscular foot, and (internally) opening into the blood sinus surrounding the pharyngeal viscera." He also described an opening communicating between the "pericardium and the supra-anal articulated sac," or accessory renal organ. The latter I have never been able to demonstrate to my own satisfaction, but I do not assume to dispute its possible existence. In the brief notice of his work published by Mr. Lankester, which has not been followed by any more detailed communication, the terms used were somewhat misleading, or at least not clear. Instead of opening externally in the angle formed by the head and the foot, the "capitopedal orifices," if I have correctly identified them, are situated on the back of the neck, so to speak, or more properly on the transverse portion of the integument above the head and in front of the main pericardial chamber in the angle formed by the neck and the inferior surface of the mantle over the head. Mr. Lankester found them in *Patella vulgata*, but I have never been able to detect them in the few alcoholic specimens of that species which I have been able to examine. In fresh specimens of *Acmæa patina* and *testudinalis*, I have generally been able to find them, and in the living animal they are of an orange color. In *Ancistromesus mexicanus*, they are quite prominent in some cases and almost imperceptible in others. They also differ in character. In *Ancistromesus* (one of the *Patellidæ*), they appear as true orifices, in the acmæas they present the appearance of an elongate, narrow, glandular mass, from which, internally, a duct is not always traceable. In some individuals they appear entirely absent or abortive. My own opinion of their function is, that they are aquiferous pores, such as are common to many mollusks, through which water passes into the circulation directly in the *Patellidæ* and by a process of straining through the glandular mass in the *Acmæidæ*. Whatever their office, it can hardly be of fundamental importance, or they would not be so frequently found in an abortive condition. Whether in some cases they may be indirectly in communication with the renal sac is of little consequence, as, in the paper alluded to, I have shown that in some genera the pericardium is so situated that there can hardly be any such communication, and in so homogeneous a group as the limpets it is unlikely that such an anatomical character, if important, should be inconstant.

Moreover, through the intricate channels alluded to, the ova which are of considerable size could hardly be propelled without some special muscular arrangement which does not seem to be present in any case examined. Anxious to set at rest a question of so much interest, and which for so many years had puzzled anatomists, I have lost no opportunity of dissecting animals of this group, especially the large species in which the characters might be supposed to be more evident. The opacity of the shell and the impossibility of getting at even the external orifices of the viscera without destroying the life of the individual, proved effectual obstacles to the study of these functions in the living animal. While in the field, from 1871 to 1874 inclusive, I made dissections of many hundreds of acmæas with no definite result, except that of finding that the sexual products appeared ripe in only a small portion of the ovary at any one time, and in the acmæas the portion most usually in that condition was the extreme right hand part of the anterior end, immediately below the floor of the larger renal sac. No oviduct or opening was in any case demonstrated.

Somewhat discouraged by repeated failure, on leaving the field-work in which I had been engaged, the matter was deferred until a better opportunity should arise. Some time since, a large number of specimens of the giant limpet of Central America, *Ancistromesus mexicanus*, were obtained by the Museum of Comparative Zoology from the naturalists of the Hassler Expedition. By the courtesy of Prof. Alex. Agassiz a number of these were turned over to me for dissection.

In this species the right supra-renal sac is quite large, covering the entire superior surface of the animal between the muscular attachments. The viscera are coiled below it in the usual manner, except that in ripe individuals the upper outer edge of the ovary or testis extends rather more beyond the peripheral coil of the intestine than in most species. A section then discloses the membranes in the following order from above.

First, the external delicate layer of the mantle covering everything else, and very intimately bound together by tough connective tissue with,

Second, the superior wall of the right hand (and only fully developed) renal sac. By means of delicate, but tough columnar walls of tissue, forming connected cellular cavities, overlaid with semi-glandular tissue for the elimination of the renal secretions, the upper wall of this sac is connected with,

Third, the floor of the sac, of similar constitution and toughness. The two are readily separated owing to the greater delicacy of the connecting tissues, but the upper wall and the mantle, and the lower wall and the tissues below it, are very intimately connected by membranous fibres of such toughness as to render their separation without injury very difficult.

A muscular band or mesentery of considerable strength, having, in the specimens of *Ancistromesus* examined, a width equal to nearly one-twenty-fifth of its length; extends completely around the internal viscera which are compactly bound together by similar tissue.

From the floor of the renal sac similar but short mesenteric bands extend downward to the peripheral band, radiating from the apex of the shell, and having, when in their natural position, a somewhat triangular form; the short sides of the triangles corresponding to the distal ends of the radii, and their plane surfaces being nearly vertical to the horizontal plane of the visceral mass. In the specimen under consideration there were one posterior and ten lateral bands of this nature, five on each side. In details of form and dimensions these vary in different individuals. They widen at their junction with the tissues above and below, and send off numerous fibres in all directions, and especially to the peripheral band. We thus have as it were the entire visceral mass suspended in the perivisceral cavity, free of the floor and sides of the latter (except a delicate anchoring membrane, lying vertically in the median line and connecting the median line of the visceral mass with that of the muscles of the foot), but in contact or close connection with its roof which is composed of the floor of the larger renal sac. This sac opens externally by a prominent papilla to the right of the anal papilla, while the smaller (and usually almost abortive) left renal sac, opens by a proportionally smaller papilla to the left of the anal.

The specimens were examined by cutting away the solid muscular foot, and thus exposing the perivisceral cavity without in any way lacerating its contents, sides, or upper surface. A number of individuals were dissected without coming any nearer to the object in view. At last, however, a specimen was taken up which appeared to solve the difficulties and afford the long sought for explanation. It was a male. The surface of the viscera with one exception was perfectly normal. On the right-hand posterior portion of the periphery of the testis, covered with its usual delicate investing membrane, for the space of an inch from the posterior end of the median line, forward, the ducts were swollen and enlarged. They projected in a marked manner from the smooth and evenly rounded normal surface, like "varicose veins," except that the ducts are nearly parallel. In the ripest portions the delicate investing membrane of the testis had become ruptured or perforated, and the seminal matter exuding from these punctures had been solidified by the alcohol in little rounded grains or particles, which had not been disturbed by the careful manipulation of dissection.

At those points where the congested or enlarged ducts were in mechanical contact with the roof of the perivisceral cavity, that is to say, the floor of the renal sac, numerous minute, but plainly visible, oval perforations appeared. These were oblique to the general plane of the membrane, the opening on the side adjacent to the testis being usually directed somewhat backward instead of vertically downward. They had also something of a funnel shape, being larger on the side toward the testis, and some of them were twice as large as others. The largest had a diameter of .015 in., and would admit the passage of a fine bristle into the renal sac. On applying slight pressure from above, the fluids contained in the renal sac passed through in a minute jet. They were irregularly distributed, corresponding in locality to the ripeness of the ducts of the testis. Except where the testis in its ripe condition was in immediate proximity or actual contact with the membranes of the renal sac, *no such orifices or pores were to be found.* In the other specimens in which the testis or ovary showed none of these signs of maturity, no such orifices could be detected. The membranes in such cases presented a smooth and practically impervious surface in every part.

It would seem as if these facts gave a final solution to the difficulty as follows:—

When the ovary or testis is ready to discharge its products, that portion of it which is ripe evinces its condition by an enlargement of the ducts, continuing until dehiscence takes place. Coincidently, the superincumbent membranes of the renal sac (whether by sympathy with the congestion of the seminal organ or otherwise) become lax and perforations make their appearance immediately adjacent to the dehiscent ducts. Through these orifices the seminal products make their way. A contraction of the pedal muscles would be sufficient to cause the ejection. After reaching the renal sac, the question of the extrusion of the ova or semen presents no difficulties. The same agency which empties the sac of its secretions through the renal papilla would suffice to eject the seminal products, which floating in the water would cause the fertilization of the ova as in the case of *Chiton.*

The rarity of individuals in a ripe condition in collections may be due to their repairing below tide marks at such times, and hence avoiding the collector.

The method above suggested is paralleled in numerous other invertebrates, and even some fishes, with non-essential differences of detail. The specimen referred to has been submitted to several naturalists who agree as to the facts.

While additional evidence is desirable in corroboration, I feel tolerably confident of the correctness of the inferences drawn from the above facts, which furnish an explanation at once simple and in accordance with experience in other cases, of a very puzzling question.

I may add, that the localized turgidity or swelling of the ripe seminal ducts had been previously observed by me on other occasions among specimens of *Acmæa patina;* but having dissected them in most cases from above, removing the membranes not connected by tissue with the ovary, and looking more particularly for a permanent duct or passage, the perforations of the renal membranes were likely to, and did, entirely escape my notice.

Additional notes on the genera of Limpets.—In the paper before referred to, I was unable, for want of material, to obtain data in relation to the dentition of the typical species of *Helcion* and *Scurria.* The former I have lately obtained from a dry specimen kindly communicated by Dr. Carpenter, and Mr. S. A. L. Brannan, of San Francisco presented me with an alcoholic specimen of *Scurria scurra* obtained by him at Valparaiso.

The result of an examination of the two forms shows that *Helcion* has the dentition of the typical *Patellæ* such as *P. vulgata*, except that the third or outer cusp of the third lateral tooth is obsolete. The gills are interrupted over the head as in *Helcioniscus*, from which it is sufficiently distinguished by the dentition.

Scurria scurra agrees in all essentials of branchiæ and dentition with *Scurria mesoleuca* described by me as above, so that no change of the arrangement I then adopted is necessary. A careful examination of the soft parts and dentition of some of the typical scutellinas is still a desideratum.

Having now nearly complete data in regard to the principal groups of the *Docoglossa*, a few observations may be permitted on the relations of the different subordinate groups. I will premise, that, for reasons which I hope in a short period to publish *in extenso*, I have come to the conclusion that the northwest coast of America has been a great centre of distribution for molluscan species; or of forms which, as they migrated south or east from their original habitat, changed or added to their original characters, until at present they are termed nearly related rather than identical forms. In many cases their paths have become dry land, and the track must be followed rather by organic relations than contiguity in distribution. Were the foregoing views correct, we should look to find in this region—1st, a maximum development of the lower or parent forms of *Docoglossa;* 2d, a local abundance and radiating distribution of the next higher genera; and lastly, in the nearest region where conditions of temperature, food, and station were most favorable (and the migrating organisms might be supposed to have been longer exposed to these favorable conditions than those subjected to the vicissitudes of more distant migration), we should expect to find instances where the group had reached its highest form of specialization.

This is exactly the real state of the case.

Whether we consider the dentition, the mechanism of respiration, or the development of special organs, or the total bulk of the organism, the *Abranchiata* are unquestionably the lowest forms of the order. Without eyes, branchiæ, or lateral teeth, sluggish in their motions; relying on buccal tentaculæ and the cuticular nervous system for outward impressions, and protected by the uniform conditions of their deep water station, they stand at the foot of the genealogical tree.

In the Alaskan region they are represented by two or three species, which reach a larger size than any of their congeners.

Pilidium and *Lepeta* have reached the east coast of America and the Hebrides; the latter only has penetrated to the Mediterranean if identifications of Italian naturalists are to be accepted.

The rhachidian tooth, representing the type of a radula, and disproportionately developed when compared with the uncini in this group, may by natural selection have given place to the strong subequal ranks of laterals characteristic of the *Acmæidæ*, and the buccal tentacles, rendered unnecessary by the presence of eyes, disappeared, or are only represented by the smooth frill of the muzzle of *Acmæa* drawn down to a corner, while in the remainder of the family they are totally absent.

The development of the radula, of a cervical branchia, of eyes, and of general bulk, marks the progress of the group in the *Acmæidæ*. From uselessness the uncini become abortive.

In the northwest American region, more than in all the world beside, is this group developed in species, in size, and in individuals. Strong in the possession of their new organs, they have invaded the littoral zone, and only the smaller and weaker forms tarry in deep water.

On the west they have, through favorable conditions, reached Japan, China, and south to Amboyna. On the south, their unbroken ranks stud the beaches from California to Tierra del Fuego, and thence north on the east coast of South America to Rio de Janeiro. The eastern barriers at the north are not so easily overcome, and *Acmæa testudinalis* and *virginea* have alone reached northern Europe.

In the present state of our knowledge, it is easy to trace the steps of development. Greater knowledge would doubtless increase the complications.

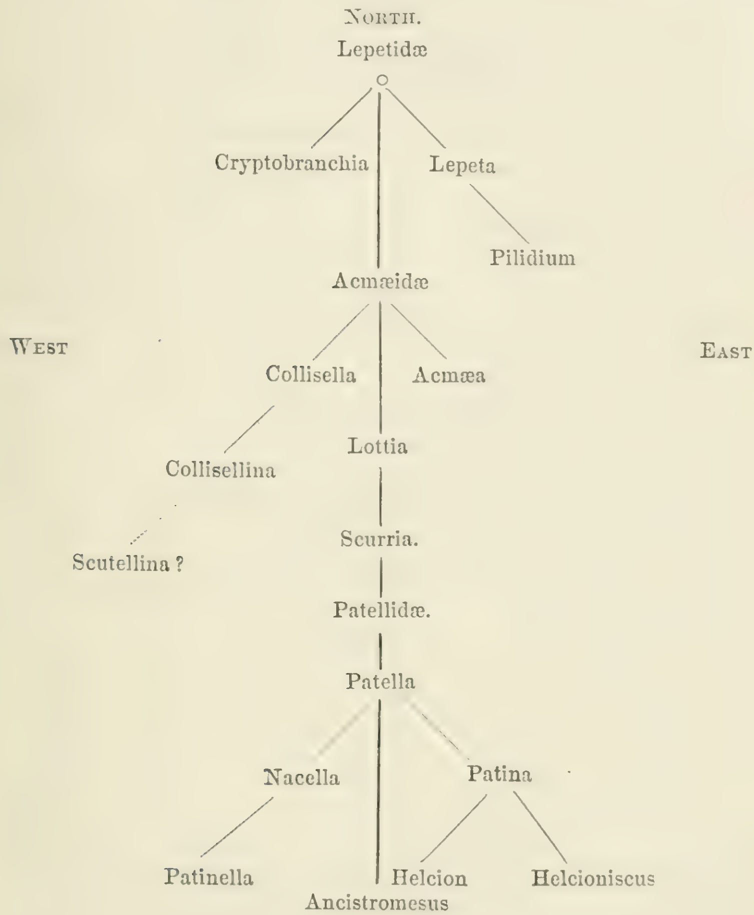
In the warm waters of California *Lottia grandis*, having reached an enormous size, is also enabled to develop an incomplete branchial cordon in addition to its cervical plume.

Further south *Scurria* completes the cordon and apparently reaches the highest stage of development short of a rejection of useless parts. This soon occurs in the disappearance of the cervical plume, whose office is abundantly filled by the development of the cordon. This brings us to the *Patellidæ*. Here the development of the radula has so far progressed that its median line, in the highest type of the family, is now supplied with a rhachidian tooth of properly proportioned size, and the abortive uncini of the *Acmæidæ* have given place to teeth which are capable of fulfilling a useful purpose. At the same time, the plain muzzle frill of *Acmæa* is replaced by a crop of arborescent tactile papillæ, and in *Ancistromesus*, the highest development of total bulk known to the order, is added to the greatest known specialization of the other characters.

This occurs on the Mexican coast in the direct line of migration from the northwest coast. So far as we yet know, the representatives of this family in more distant regions have not yet rivalled it in development. All want the median tooth; the other characters, but with much smaller bulk, are developed in *Patella vulgata* of Europe and some Indian species. *Patina* cannot complete its cordon, inhabiting the British Isles. *Nacella*, an equally distant traveller, in Patagonia, barely completes its cordon, while its associate, *Patinella*, is more successful, and both sport a frill around the foot.

Helcion and *Helcioniscus* of the African coasts, have the cordon interrupted, and the dentition is less uniform and effective than in *Ancistromesus*, which, however, they resemble in dispensing with the foot frill. In the rich Indo-Pacific region it seems probable that the higher types prevail more abundantly, and there is reason to believe that *Scutellina* is a weakly offshoot from the acmean stem.

Without verging greatly on the speculative, we may construct a genealogical tree, which cannot greatly differ from the following scheme:—


North.
Lepetidæ
Cryptobranchia
Lepeta
Pilidium
Acmæidæ
West
East
Collisella
Acmæa
Lottia
Collisellina
Scurria.
Scutellina ?
Patellidæ.
Patella
Nacella
Patina
Patinella
Helcion
Helcioniscus
Ancistromesus

DESCRIPTIONS OF SOME VERTEBRATE REMAINS FROM THE FORT UNION BEDS OF MONTANA.

BY E. D. COPE.

Aublysodon lateralis, sp. nov.

Established on some teeth, one of which is of the size of those of the *A. horridus*, and which differ in some important particulars. The posterior crenate ridge is as in that species, lateral in position, separating a posterior face from the lateral at a right angle. The posterior face is separated from that of the other side by a very obtuse angle. The anterior aspect of the crown is without crenate cutting edge, but the latter is present as a border to the front, passing along the front of the side opposite to that which bears the posterior angle. It is directed laterally, and projects beyond an open groove which follows its posterior base. The base of the crown is broad elliptic in section. Enamel smooth.

A much smaller tooth was found with the preceding, and presented similar characters, excepting that the posterior face is not so strongly truncate.

Measurements.	M.
Length of crown preserved	.025
Diameter of base of crown { long	.018
Diameter of base of crown { short	.010
Width of posterior face	.006
Length of smaller crown	.011
Long diameter of base of do.	.006

The apices of both crowns are considerably worn by use. Both were found by Charles H. Sternberg of my exploring party.

Lælaps incrassatus, sp. nov.

Represented by two teeth, a larger and a smaller, which were found near each other, but not sufficiently so as to warrant the belief that they pertain to the same individual.

The characteristic feature of these teeth is, that the transverse diameter of the base of the crown exceeds its anteroposterior, a point in which it differs from all the other carnivorous dinosaurians yet known from the formation. Nevertheless, the posterior cutting edge is median, and is denticulated. The anterior cutting edge, which is also denticulated, is nearly median at the apex, but continues along one side of the widening anterior face to the base of the crown. The posterior cutting edge is nearly straight, while the anterior is rather abrubtly curved at the apex.

The anterior and posterior edges are not lateral in position as in *Aublysodon lateralis*.

Measurements.

		M. No. 1.	M. No. 2.
Length of crown		.025	.014
Diameter at base	antero-posterior	.012	.006
	transverse	.0135	.008

A large species. Discovered by Jno. C. Isaac.

Lælaps explanatus, sp. nov.

An abundant species, but as yet represented only by teeth which are about the size of those of the largest of living *Varanidæ*.

The crowns are strongly compressed and curved; one side is flat, the other gently convex; the posterior cutting edge is median and concave. The anterior edge is not continued to the base of the crown, and disappears before attaining the apex; it is feebly denticulate, and only at its convex curvature towards the apex; its course is median. The flat face has a slight bevel to the posterior edge. Surface smooth, without transverse undulations.

Measurements.

		M.
Length of crown		.0110
Diameter crown at base	antero-posterior	.0066
	transverse	.0028

Lælaps falculus, sp. nov.

Represented by several teeth of about half the size of those of the last described reptile. They differ in form in several respects, being relatively shorter and stouter, and less sectorial in character. The lateral surfaces are about equally convex, while the anterior face is narrowly obtuse, and without cutting edge. The posterior edge is concave and furnished with a serration of smaller denticles than in the *L. explanatus;* it is median in position.

Measurements.

		M.
Length of crown		.0090
Diameter of base of crown	antero-posterior	.0056
	transverse	.0040

Found by Jno. C. Isaac.

Dysganus encaustus, gen. et sp. nov.

Char. Gen.—A large number of teeth exhibit the characters of this genus, which is a peculiar form of herbivorous *Dinosauria*. The crowns are compressed, so that the fore and aft diameter much exceeds the transverse. The body of the crown is a flattened shaft of dentine, one face of which is the denser, and produces the cutting edge. This face is flat or weakly keeled, while there are two other faces uniting at an open angle, thus giving a subtriangular section. On each of these faces is adherent a shaft of cementum-like material of a dense character, whose external face is longitudinally concave. These inclose between them on the median line a deep groove, which expands below into a wide concavity, which appears to be enlarged as the age of the tooth increases preparatory to shedding. The other parts of the base of the crown below the cutting face, are inclosed in a rather thick deposit of rugose cementum, which rises a distance on the sides of the tooth.

The method of replacement of the teeth in this genus appears to resemble that of *Cionodon*, except that there is no indication of the existence of as many series in the transverse direction. The longitudinal grooves in the anterior and posterior cement columns are probably occupied by the borders of the apices of successional teeth. The presence of these columns, etc., distinguishes this genus from that and other allied genera.

Char. Specif.—The cutting face is more or less concave, and is impressed or sunken, its lateral borders, and the cement of the basis, projecting beyond it. The inferior border is also usually oblique, that of one of the sides rising diagonally. In the same proportion, a weak keel is also unsymmetrically placed, lying close to the opposite border, and dividing the face into a wide and a narrow concavity. The oblique border is also incurved, the edge of the posterior cement column curving round the cutting face of the dentine. The latter is delicately rugose in unworn specimens. The external basal cementum rises highest on the incurved border of the crown; its surface is minutely rugose, the rugosity being generally punctiform. It is also of a different color from the dentine in the specimens as preserved, and is occasionally found nearly worn away. The edge of unworn teeth is not serrate.

Measurements.

		M.
Length of basis of tooth		.012
Diameter of crown	antero-posterior	.009
	transverse	.004
Transverse diameter below crown		.008

The teeth are rather smaller than those of *Hadrosaurus foulkei.* The borders present no indication of the crenation seen in that and other species, either in worn or unworn specimens.

Dysganus haydenianus, nov. sp.

Represented by a number of teeth found in such relation that they are supposed to belong to two individuals.

They differ materially in form from those of the *D. encaustus*, and exceed any of them in size.

The base of the tooth possesses the thick investment of rough cementum, and has a slope away from the base of the crown. The form of the crown is peculiar in possessing a lateral face placed at a strong angle to the usual face, and separated from it by a strong protuberant angular ridge. This angular cutting face would resemble that of the *Diclonii* were it not that the body of dentine of which it is composed is a flat plate instead of a triangular segment of a subquadrate prism. Each face has a separate plate, which is separated from the other by a suture. A solid mass fills the angle between them, which is divided by a groove produced by the pressure of the angle of the face of the succeeding tooth which fits it. The wider of the "front" faces is divided by a low longitudinal ridge. Both of the faces are bounded by an external incurved ridge which cause them to have a concave surface.

A tooth of a size equal to that of the one just described was found with it, has a form more nearly like that of *D. encaustus*, in the less degree of prominence of the lateral angle. It displays but a single posterior cementum-like mass, which presents considerable lateral faces as well as a posterior one, as in the first described tooth.

Measurements.

		M.
Length of base of crown		.010
Elevation of remaining part of crown		.006
Diameter of crown	antero-posterior	.015
	transverse, total	.010
	" dentine	.004

Dedicated to Doctor F. V. Hayden, U. S. Geologist.

Dysganus bicarinatus, sp. nov.

This dinosaurian is represented in the collections by some of the teeth of three individuals. Two of the teeth represent immature stages, while the others are worn by continued use. They all present characters not found in the *D. encaustus*, from which they differ in a direction the opposite of that which characterizes the *D. haydenianus.*

The crowns present a nearly flat face without incurved lateral angles, nor prominent median keel. The basis is wide, projects in a rim beyond the face, and is invested with rough cementum. The face is peculiar in being divided into three planes by two low angular ridges, and its surface is smooth. The dentinal column is triangular, and there are two posterior columns separated by a fissure, in mature teeth.

The absence of the lateral incurved angle, and the presence of the two median ones distinguish this species from the *D. encaustus.*

Measurements.		M.
Length of basis		.009
Width "		.011
Length of worn face		.006
Diameter of crown	antero-posterior	.011
	transverse	.007

Dysganus peiganus, sp. nov.

In the typical tooth of this species the form approaches the genus *Palæoscincus*, Leidy, in the compression of the crown, and the contraction of the base; it is a limital species of *Dysganus* if really properly placed in that genus.

The widest portion of the crown is above the base; from this expansion it contracts in both directions, and in the unworn tooth forms an angular median apex. This is not the case in *D. encaustus*, which is regularly rounded. The margin of the crown is narrowed, expanding but little towards the expansion, and is quite rugose. From these rugosities low ridges descend on the face of the tooth, whose surface is also minutely rugose. The face is divided by a prominent median rib, which extends to the apex. No cementum is visible on the basis, in the only specimen in which this part is preserved.

Measurements.			M.
Length of crown			.008
Diameter of crown	transverse		.005
	antero-posterior	at base	.008
		greatest	.011

Diclonius pentagonus, gen. et sp. nov.

Char. Gen.—Herbivorous dinosaurians, in which the teeth are elongate and without distinct root, and present dense material only on one side of the crown (the "front"), whose section produces a cutting edge. The other face of the tooth (the "back") is coated with cementum, and is absorbed during the protrusion of the successional tooth from below, which thus rises from "behind." In the antero-posterior direction the teeth are protruded alternately, and the lower parts of the crowns are contracted to give space for the apices of the adjacent young teeth. In the type of the genus there is but a single series of teeth.

In the known species of this genus, the dense face ("front") of the crown presents a longitudinal keel, but this is not necessarily a generic character. The terms "front" and "back" are not intended to be accurate, as the faces so termed are either external or internal, the direction being probably reversed in the two jaws.

This genus is allied to *Hadrosaurus* and *Cionodon*. From the former it differs in the mode of succession of the teeth, which, as determined by Prof. Leidy in that genus, is from the "front" of the base of the tooth, whereas, in *Diclonius*, the succession is as in *Cionodon*, from the "posterior" base of the tooth. This arrangement allows of a more continuous use of the dense face than in *Hadrosaurus*, where that face terminates as the young crown rises into functional position. A species from the Fort Union bad lands of the Judith River was described by Dr. Leidy as *Trachodon mirabilis*. Specimens of this species from the locality furnishing those of *Diclonius*, present the mode of succession ascribed by that author to *Hadrosaurus*, to which genus he afterwards referred the species under the name of *H. mirabilis*.

The dentition of species of this genus shows that but one tooth in mature functional use existed in a line transverse to the axis of the jaw at one time, and that alternating with these, one partially protruded crown, and one stump of a crown, present masticating surfaces in transverse relation. The formula for this genus should then be written 2—1, while in *Cionodon* it is 3—3—2.

The type of this genus exhibits a mode of nutrition of the young teeth similar to that seen in the genus *Saurocephalus* among fishes. The bone is perforated by a series of foramina, each of which conveyed an artery directly into the base of the growing crown.

Char. Specif.—The front of the crown is divided longitudinally by a prominent median keel and the borders are not serrate. The keel is only moderately prominent at the lower part of the crown. The back of the crown is divided into three faces by two straight longitudinal parallel solid angles, and the crown is contracted near the base by the lateral bevels for the adjacent growing teeth. All these faces are covered by cementum, whose roughness is granular in character. The external surface of the jaw-bone has precisely the same character, so that the apices of the teeth only appear as prominences of its border.

The typical specimen is that of an individual of moderate dimensions; measurements of a tooth of a gigantic individual are given below.

Measurements.		M.
Length of a series of five teeth		.023
Protrusion of crown of largest tooth		.006
Diameter " " "		.006
Length of crown above lateral apical facets of larger animal		.013
Diameter of crown at same point	antero-posterior	.011
	transverse	.009
Width of median face of "back"		.005

Diclonius perangulatus, sp. nov.

This abundant species of herbivorous dinosaur has left its shed teeth in many localities of the Fort Union horizon, in company with those of the *Trachodon mirabilis*, *Palæoscincus costatus*, and other large reptiles. Teeth with complete apices are rare. The marked character of the species is seen in the prominence of the median angular ridge which divides equally the cutting face of the crown from apex to base. The prominence increases downwards so that the transverse diameter becomes greater than the antero-posterior, in some cases being diamond-shaped in the transverse direction. Its position is symmetrical, or nearly so. The lateral borders are smooth, one specimen displaying a faint trace of crenation near the apex. There is no shank or root in any of the teeth preserved, and the basis is excavated on the side away from the cutting edge for the apex of the successional tooth. A band of roughened cementum extends round the base, and is continued upwards on each side opposite the cutting face. This side presents three faces, a narrow median, and two wider lateral. The latter are slightly concave, and are probably adapted to the apices of the successional teeth; the former is often slightly concave, and is the seat of most rapid attrition. The lateral facets disappear at a distance below the apex, where the non-cutting side is strongly convex, and covered with a coarsely rugose cementum; the rugosity including pits.

Measurements.		M.
Length of a shed tooth		.011
Diameter of crown	antero-posterior	.010
	transverse	.012
Width of facet for successional crown		.006
Width of posterior facet		.005
Width of cutting face of another near apex		.008
Antero-posterior diameter of do. at do.		.010

The prominence of the median angle with other points distinguishes this species from the *Cionodon arctatus*. The size is larger than that of the known specimens of that species, equalling that of the largest of the order. (See Report of U. S. Geological Surv. Terrs. II., 4to, for description of genus *Cionodon*.)

Specimens of this species have been referred by Dr. Leidy to his *Trachodon mirabilis*.

Diclonius calamarius, sp. nov.

This species, as represented by teeth, is the smallest of the genus, but the adult size is a point, however, not easily determined among extinct reptiles. The teeth are slender, and the front has parallel borders and a median keel. The borders are entire, and, in two of the crowns, twisted slightly round the long axis of the tooth. The keel is thus twisted also, and towards the base, when it becomes quite low, is nearer one border than the other. The back of the tooth displays two lateral facets, separated by a narrow median facet. The former have a thin, delicateiy rugose, cement investment, with a minute rugosity; the latter is smooth in the specimens, apparently from friction. The characters of this saurian readily distinguish it from its congeners.

Measurements.		M.
Length of portion of crown		.012
Diameter of crown	antero-posterior	.004
	transverse	.C04

Monoclonius crassus, gen. et sp. nov.

Char. Gen.—Teeth with obliquely truncate face and distinct root, which is grooved for the successional tooth on the front.

No external cementum layer, caudal vertebræ biconcave, and brim narrow. Fore limbs large and massive.

The teeth of this genus resemble those of *Hadrosaurus*, and like them, are replaced from the "front," an arrangement which precludes the possibility of more than one series of teeth being in functional use at one time. The robust fore limbs and elongate ilium distinguish *Diclonius* from *Hadrosaurus*. From *Trachodon* it differs in the absence of the rough cementum layer on the back of the tooth.

Char. Specif.—The faces of the teeth are acuminate oval in form, and are divided by an elevated keel, which is median above, but turns to one side at the base. Margin crenate, the grooves extending more or less on the convex "back," which is otherwise smooth.

Sacrum with ten vertebræ, the last centrum much compressed, the diapophyses extending horizontally from the neural arch above, and connected by a vertical lamina with the iliac supports; length 27.33 inches. The bones of the limbs are robust, the hinder the longer, but not so much so as in some other genera. Length of femur 22 inches; width, proximally, 7.4 inches; distally 6 inches. Length of tibia 20 inches; greatest diameter, proximally, 8 inches; distally 7.25 inches. The three anterior dorsal vertebræ are coossified, and the first exhibits a deep cup for articulation with the preceding vertebra. The episternum is a T-shaped bone, thin and keeled on the median line below. Length of transverse portion 21 inches.

Paronychodon lacustris, gen. et sp. nov.

Char. Gen.—The teeth which characterize this genus have the general character of those of *Plesiosaurus*, *Elasmosaurus*, etc. The crowns are subconic, and the enamel is thrown into longitudinal plicæ. The special characters of the genus are seen in the form of the crown, one side of which is convex, and the other side plane, so that the section instead of being circular is semicircular. It is also strongly curved in the direction of its plane face.

Char. Specif.—Both anterior and posterior edges are curved, and are not acute nor denticulate. There are four plicæ on the flat face, only two of which approach the apex. There are six keels on the convex face, all of which approach the apex. All the carinæ are rather obtuse, and the enamel is otherwise smooth. The apex is very acute.

Measurements.		M.
Length of tooth		.0130
Diameter at base	antero-posterior	.0040
	transverse	.0024
Length of crown		.0100

It is probable that portions of skeleton of this reptile are in my possession, but the means of positive identification are yet wanting.

Compsemys imbricarius, sp. nov.

This species, like the others of the genus, has the scutal sutures well defined, and the superficial surface of the carapace sculptured. The character of this sculpture distinguishes the species, and in the present instance in a special manner. It consists, in the *C. imbricarius*, of excavations bounded on the sides by a short ridge each, which alternate with each other. Thus each bounding ridge terminates abruptly at the fundus of one of the fossæ, while the other end of the fossa rises and contracts to another ridge. The result is precisely that seen in the interior sculpture of Saracenic domes or niches, and is one which is quite unique among tortoises. The direction of the ridges is at right angles to the costal dermal sutures. This species was about as large as the snapping tortoise (*Chelydra serpentina*).

Measurements.		M.
Thickness of a costal bone		.0050
Three fossæ measure	lengthwise	.0065
	crosswise	.0050

Compsemys variolosus, sp. nov.

One of the most abundant, and the largest species of the Fort Union beds. The carapace is convex and the plastron flat; the marginal bones are heavy and strongly convex on the inferior side. The margin of the plastron is thickened and heavy, characters which also belong to all parts of the carapace. The sutures of the dermal scuta are deeply impressed, and the surface of the bone is strongly sculptured above and below, and even on the superior face of the thickened margins of the free lobes of the plastron. The sculpture consists of round fossæ, which are deeply impressed and are arranged quincuncially, so that their borders never form straight lines. The latter are also more or less angulate on the edge, so that the surface has a more than usually rugose character.

The typical specimen equals those of the large land tortoises of the Eocene in dimensions.

Discovered by C. H. Sternberg.

Polythorax missuriensis, gen. et sp. nov.

Char. Gen.—Plastron with contracted fixed lobes and wide bridge; carapace with well-developed marginal bones; mandibular ramus narrow; alveolar face with acute external margin; the symphysis neither produced nor recurved. Dermal scuta everywhere distinct, those of the plastron the usual ones, with the addition of the two marginal intergulars, and two large interhumerals. The latter scuta are separated from the humerals by sutures running parallel with the humeral margin of the anterior lobe between the gular and pectoral scuta.

In the possession of interhumeral scuta, *Polythorax* differs from any known genus of *Testudinata*. The general structure is much like that of *Adocus* and *Baëna*, with nearer resemblance to the latter in its double intergular scuta. It is impossible to ascertain whether there are intersternal bones, as the plastron is coössified throughout. The presence or absence of intermarginal scuta cannot yet be determined, although it is clear, that if existing, their position is quite external.

This genus is interesting as connecting in its stratigraphical position allied types of Cretaceous No. 5 (*Adocus*), with those of the Wahsatch and Bridger Eocenes (*Baëna*).

Char. Specif.—Carapace with openly dentate posterior border. The surface is irregularly swollen, especially on the median line near the margins of the vertebral scuta. The vertebral scuta are wide, the costals short, and the marginals narrow. The anterior lobe of the plastron is a little shorter and more contracted than the posterior; its base is narrower than the antero-posterior extent of the bridge. Its extremity is rounded, while that of the posterior lobe is truncate with rounded angles. The gular and intergular scuta are each wider than long, while the interhumerals are much longer than wide. The humerals are narrow, while the pectorals are wide from the anterior position of the pectoro-humeral suture. Each anal scutum is longer than wide.

The surface of the plastron is obsoletely but coarsely rugose; the roughness greatest anteriorly, where it consists of short raised lines irregularly disposed.

Measurements.	M.
Length of plastron	.183
Length of anterior lobe	.049
Length of bridge	.076
Width of bridge	.076
Width of extremity of posterior lobe	.035
Thickness at inguinal region	.010

Hedronchus sternbergii, gen. et sp. nov.

Char. Gen.—The bone on which this genus reposes has the appearance of the crown of a young tooth. Its central cavity is large and expands to the margin of the basis; its apex is unworn. It appears to be too protuberant for the position of a dermal tubercle. It may be distinguished as a short crown on a shorter slightly constricted portion or neck. The crown culminates in three crests, which together form a letter T, and which descend towards the neck. There is no investment of enamel or cement, and the material of which it is composed resembles dense bone.

Char. Specif.—The faces on each side of the stem of the T, are concave and divided by an oblique crest, which descends from the common apex. The other face is gently convex, and the inferior part of each of its bounding crests projects ear-like. The base is an oval.

Measurements.		M.
Elevation of crown		.006
Diameter of base	longitudinal	.005
	transverse	.004

Discovered by Charles H. Sternberg.

Ceratodus eruciferus, sp. nov.

A basal lamina separable from the dentigerous lamina. The latter supports ribs which diverge from a single marginal rib which extends along one side. The marginal rib is separated by a deep groove from the radiating ribs, which is continuous with the grooves between the latter. The ribs are of irregular diameter and not perfectly straight; they are interrupted by weak transverse ridges which project beyond the margins. The ridges rises abruptly from their common base and are separated distally by notches of the margin.

Measurements.	M.
Long diameter of dental surface	.011
Short diameter of dental surface	.007
Thickness of plate	.003

There are six ridges in the length.

Ceratodus hieroglyphus, sp nov.

This species is materially different from the last, and was more abundant, judging from the occurrence of its remains.

The dentigerous plate is thin and dense, and has the appearance of a short toothed comb with a handle. The tooth-like points are the extremities of low ridges, which are arranged nearly at right angles to a wide longitudinal elevated half of the osseous base. They are separated by shallow grooves from each other, and are not continuous with the basis just mentioned, which rises abruptly above them. They are smooth. The "handle" above alluded to is triangular in section having two bevels on the side supporting the tooth ridges. The lower face of the bone is smooth.

Measurements.	M.
Total length	.013
Length of dentigerous portion	.010
Total width	.0045
Width of dentigerous portion	.0020

There are thirteen teeth in the length.

Myledaphus bipartitus, gen. et sp. nov.

Char. Gen.—Crowns of the teeth molar in character, truncate, wider than long, standing table-like on the root. The latter partaking of the shape of the crown, short, straight, split equally and at right angles to the greatest diameter of the tooth. The crowns form a pavement having a regularly hexagonal outline. Their composition is different in the halves on each side of a line which divides the crown equally, running in the long direction. On one side the dentine is striate at right angles to the long diameter; the structure is not distinguishable by the hand lens on the opposite side of the line.

The affinities of this genus cannot now be stated, but the form of the root recalls the *Elosmobranchii*, and that of the crown, some of the rays.

Char. Specif.—The staining on opposite sides of the line that divides the crown, is different, on the one paler than on the other.

The face of the crown is nearly plane, and its border is vertical and overhangs the root all round in a narrow ledge; it is vertically striate, as is also the root. The antero-posterior diameter exceeds the transverse, and the facets are subequal, and are continued less perfectly on the root. The fissure of the latter does not reach the base of the crown.

Measurements.		M.
Length of tooth		.0053
Diameter of crown	antero-posterior	.0060
	transverse	.0045
Long diameter of root		.0050
Length of root		.0030

Discovered by Charles H. Sternberg.

November 7.

The President, Dr. Ruschenberger, in the chair.

Twenty-five members present.

A paper entitled "Notes on American Cretaceous Fossils, with descriptions of some New Species," by Wm. M. Gabb, was presented for publication.

On Conglomerate No. XII.—Mr. Young described the Conglomerate No. XII. as it appears upon the New River in West Virginia.

The formation consists of alternate members of shale and sandstone; the latter numbering five, which are massive, but not conglomeritic, and form cliffs upon the sides of the hills which flank the river.

The shaly members of the group contain workable coal-beds. There are four beds, ranging in thickness from three to five feet. Small seams are also present.

The total thickness of the formation is about one thousand feet, half of which is represented in the sandstone cliffs.

The formation as above described extends from Hinton to Hawk's Nest, the latter point being a bold cliff formed of one of the sandstone layers of the formation.

The New River at Hinton falls over a barrier made by one of the sandstone members.

The falls of the Kanawha are made by the upper plate of the conglomerate.

The Australians.—Dr. Pickering, having recently made a communication to the Academy on the sources of the native population of New Zealand and Tasmania, now proposed to speak of Australia.

The zoological character of Australia precludes the origin there of a member of the human family, and the Australians are intruding strangers; but where they come from is a mystery.

The most prominent photographs at the Centennial Exposition are unsatisfactory, with the exception of two life-sized heads of clearly pure-blooded natives; while the many excellent small photographs require closer inspection than is usually afforded to visitors.

At the Fiji Islands, he had been informed by a chief of the existence of "long-haired" people in the interior of the main island; similar accounts are given of other large islands westward, and there are inland people in the Malayan archipelago about whom very little is known; yet it does not seem probable that any island in the whole series in question contains straight-haired blacks resembling Australians.

Though unprepared to cancel the Australian as a distinct physical race, he admits that affinity may possibly be found in the Telingan or Black Hindu; and, notwithstanding the general Caucasian features of Telingans, and the broad, flat nose and darker complexion of Australians, a match could probably be found of individuals not very dissimilar in personal appearance.

From eastern Hindustan, Telingans continue migrating by thousands to the Malayan archipelago, but, being all males, make very little impression on the resident population. He did not, while among them, apply the Caucasian test of the divided cartilage at the nasal extremity.

On Sonomaite.—Mr. E. GOLDSMITH stated that he had found among other undetermined minerals collected by Prof. F. V. Hayden in Sonoma County, Cal., near the geysers, one for which he proposed the name Sonomaite.

This is the composition of the first specimen—

$\dddot{\mathrm{Al}}$	= 7.66	per cent.	= 3.56	per cent.	oxygen.
$\dot{\mathrm{Fe}}$	= 2.01	"	= 0.46	"	"
$\dot{\mathrm{Mg}}$	= 7.14	"	= 3.21	"	"
$\dddot{\mathrm{S}}$	= 38.78	"	= 23.26	"	"
$\dot{\mathrm{H}}$	= 44.41	"	= 39.55	"	"

A second specimen from another spot probably, but from the same locality, gave but a slightly different result, as the analysis showed—

$\dddot{\mathrm{Al}}$	= 8.36	per cent.	= 3.89	per cent	oxygen.
$\dot{\mathrm{Fe}}$	= 1.56	"	= 0.34	"	"
$\dot{\mathrm{Mg}}$	= 7.51	"	= 3.00	"	"
$\dddot{\mathrm{S}}$	= 38.30	"	= 22.98	"	"
$\dot{\mathrm{H}}$	= 44.27	"	= 39.35	"	"

The oxygen ratios of both analyses are—

$$\begin{array}{ccccccc} \dddot{\mathrm{Al}} & : & \dot{\mathrm{Mg}}\,(\dot{\mathrm{Fe}}) & : & \dddot{\mathrm{S}} & : & \dot{\mathrm{H}}. \\ 3 & : & 3 & : & 18 & : & 33. \end{array}$$

which result may be expressed in the formula—

$$\dddot{\mathrm{Al}}\,\dddot{\mathrm{S}}_3,\ 3\dot{\mathrm{Mg}}\,\dddot{\mathrm{S}} + 33\dot{\mathrm{H}}.$$

The alumina was in these analyses precipitated twice in order to effect a complete separation of the magnesia. The water was found by the difference.

In regard to the oxidation of the iron, he ascertained that, if the watery solution of the salt was tested with a solution of sulphocyanide of potassium and well mixed, no red coloration appeared, but, on adding a few drops of diluted sulphuric acid, a reddish coloration became visible. It seems reasonable to assume that a small quantity of the iron was oxidized to sesquioxide, but had no acid with which to form the sesquisalt. The truth of this view becomes apparent if a few hundred milligrammes are dissolved in much water, in which case a small quantity of sesquioxide of iron drops to the bottom of the vessel; if, however, the solution of the salt is concentrated, the separation of this oxide seems not to take place. The iron in this mineral varies in quantity, and he thought it might at times be entirely wanting, for magnesia and protoxide of iron may substitute each other, and for this reason he did not introduce it into the formula.

When he first determined the mineral, it was supposed to be Pickeringite, because the general appearance, the reactions with the blowpipe, its solubility, and all the elements contained in it are the same; only the quantitative analysis showed the differences in the ratios of the constituents.

Sonomaite occurs in silky, colorless crystals.

Specific gravity in alcohol of 95 per cent. = 1.982; in water it would therefore be = 1.604.

Klauer described (Gmelin's Handbuch der Chemie, 2, 315) a salt which differs from this only in having 3 æq. of water more.

Explorations in South America.—Prof. COPE stated that an expedition had been planned in this city for the exploration of the sources of the Madeira River, and of the eastern slopes of the Andes in Bolivia. Prof. James Orton had taken charge of the party, which included a corps of scientific assistants. As the region in question is the least known in South America, important results are anticipated. It was hoped that the Academy would be able to avail itself of these in the increase of its collections, etc. The expedition sailed on the 25th of October last.

NOVEMBER 14.

The President, Dr. RUSCHENBERGER, in the chair.

Thirty-six members present.

A paper entitled "Note on a Cirripede of the Californian Miocene, with remarks on Fossil Shells," by T. A. Conrad, was presented for publication.

On Boussingaultite and other Minerals from Sonoma County, California.—Mr. E. GOLDSMITH stated that among the minerals brought by Dr. F. V. Hayden from Sonoma County, Cal., was one which he thought proper to call Boussingaultite. Although he had not been able to find in the current literature an analysis of the mineral to which Bechi had given this name in 1864, still he presumed that it might be that. It is stated, however, in Dana's Descriptive Min., p. 635, that Boussingaultite is mascagnite with some sulphate magnesia; whereas the mineral which Mr. G. analyzed seems to be sulphate magnesia ammonia. The mineral occurs in irregular granular masses, is soft, and easily rubbed to a perfectly white powder.

If heated in the tube, closed at one end, it affords water and a white sublimate, which latter is sulphate ammonia; in the bottom remained a white residue. On coal it gave, with solution of cobalt and strong ignition, the reddish coloration indicating the presence of magnesia. It is soluble in water. The solution showed the presence of sulphuric acid, magnesia, and ammonia.

The quantitative determination of the sulphuric acid and the magnesia was done with the air-dry substance; the amount of ammonium-oxide and water were calculated by means of those obtained data stöchiometrically.

$\dddot{S}$	=	38.86	per cent.	=	23.31	oxygen.
$\dot{Mg}$	=	15.56	"	=	6.22	"
AmO	=	5.03	"	=	1.54	"
$\dot{H}$	=	40.55	"	=	36.04	"

The oxygen ratios of the acid and bases are—

$$\dddot{S} : \dot{Mg} : AmO : \dot{H}.$$
$$15.13 : 4.03 : 1 : 24.$$

Here are evidently five equivalents of sulphuric acid, and also the same number of equivalents of bases, hence the formulated expression—

$$4\dot{Mg}\,\dddot{S},\ AmO\,\dddot{S} + 24\dot{H}$$

may be proposed.

The substance is nearly insoluble in alcohol of .818 specific gravity, at 70° F., it was therefore weighed in it, and its specific gravity found to be = 2.037; in water it would have the specific gravity = 1.666.

Mr. Goldsmith further called attention to the following minerals, which were all collected by Prof. Hayden in the same locality as those described above:—

Geyserite intermixed with a basic sulphate of iron and an oil, which is probably petroleum.

Epsomite or native sulphate magnesia occurs there, sometimes pure, occasionally mixed with geyserite.

Geyserite containing some sonomaite.

Mascagnite or native sulphate ammonia in white, irregular-shaped fragments.

Nodular geyserite seems to have been ground by the action of the motion of the geyser. Some of the nodules are nearly spherical; others spheroidal; a few in the collection are flattened, but always smoothly rounded; color white. They are nearly pure silica.

Sulphur is also a product of the geyser region. This element was noticed to be in very small crystals, which, when burned away, left at first a black carbonaceous matter; on heating to a high temperature, the carbon disappeared and a white ash remained.

Iron ochre containing a small quantity of arsenic. The reddish-brown powder has a peculiar disagreeable odor.

Kaolinite in the form of a pale blue, soft powder; on heating, the blue color disappears; if this substance is heated in the glass-tube, closed at one end, water is expelled which reacts alkaline; but on heating strongly, that is, to near redness, the reaction on litmus-paper indicates the presence of an acid.

Earthy geyserite containing some gypsum, and, at least, the flame-reaction of the presence of a minute quantity of potassa.

Although Mr. G. searched for chlorine or soluble chlorides, which as usual are widely distributed over the globe, in these cases, however, they seem to be absent. Whether in Sonoma County no chloride of sodium is found cannot be said at present with certainty; it is singular that none was noticed among those minerals which he had the opportunity to determine.

Cretaceous Vertebrates of the Upper Missouri.—Prof. COPE stated that he had recently returned from an exploration of the Judith River beds of the Upper Missouri, which were discovered by Dr. Hayden in 1855. Attention was given to the relation of this formation to the underlying marine cretaceous beds, and to the respective faunæ of the two as compared with that of the early eocene period. The fauna was found to be terrestrial and lacustrine, including great numbers of *Unionidæ*, *Lepidosteus*, *Myledophus* (a form probably of rays); of tailed *Batrachia*, crocodiles, fresh-water turtles, *Rhynchocephalia*, and Dinosaurian reptiles. The *Dinosauria* constitute the most abundant and characteristic form of life, eighteen species having been found, of which eight were of the carnivorous (*Goniopodous*) and ten of the herbivorous (*Orthopodous*) type. The predominant genus of the former is *Lælaps*, and of the latter *Dysganus*, of both of which several species were found.

The facies of this fauna is thus plainly mesozoic and cretaceous, adding weight to the arguments already adduced to this effect. But the change from the fauna of the underlying cretaceous numbers four and five is very striking, the genera and often higher groups being quite different. The types of the marine beds were found to be *Pythonomorpha*, *Elasmosaurus*, a genus allied to *Polycotylus*, *Enchodus*, chimærids, and sharks, with marine *Cephalopoda*, etc. Nevertheless, the physical transition between the marine and lacustrine formations appears to be complete, as indicated by Prof. Hayden.

Dr. Le Conte read the following report from the committee appointed, at the request of the Centennial Commission, to investigate and report upon the introduction of noxious insects and plants through the medium of the foreign exhibits in the exhibition:—

REPORT ON INSECTS INTRODUCED BY MEANS OF THE INTERNATIONAL EXHIBITION.

On behalf of the Committee appointed by the Academy of Natural Sciences of Philadelphia, at the meeting held October 10, 1876, "to investigate and report upon the introduction of new species of insects and plants through the medium of foreign exhibits at the Centennial Exhibition," I have the honor to present the following report, with the desire that it may be forwarded to the proper authorities of the Centennial Commission, at whose instance the Committee was appointed.

The Committee is composed of the following members of the Academy:—

Dr. Joseph Leidy, Dr. George H. Horn, Mr. Thomas Meehan, Dr. J. Gibbons Hunt, and Dr. John L. Le Conte, Chairman.

It was apparent that while the labors of the botanists of the Committee could not properly commence until next spring, when careful observation will recognize any new introductions of plants, the entomological investigations should be made as speedily as possible. Accordingly, Dr. Horn and myself, availing ourselves of the admission cards which had, with great liberality, been sent to the members of the Committee, went frequently to the exhibits in the Main Building and Agricultural Hall, and made collections in all the agricultural products from foreign countries, which were found to be infected.

Most of the species which we obtained have been already distributed over the globe by the ordinary channels of trade, and nothing is to be apprehended from the addition of a few hundred thousand specimens, to the incalculable millions of individuals of the same kind, that we have now domiciled amongst us.

I am happy to add that the species found, which have not been previously observed in the United States, will be innocuous; they are dependent for their support upon plants which do not grow here, and which would be of no commercial value to us if they were cultivated.

I may therefore announce, with moderate certainty, that no evil result will occur to our agricultural interests, from any introduction of foreign insects, by means of the Centennial Exhibits.

Before concluding this report, by a list of the insects collected in the buildings, it is our duty to notice some remarkable differences between the exhibits from different countries, indicating the care with which the specimens had been prepared, and the means taken to prevent depredation by insects.

All those exhibits which had been moist when packed, or had become moist or mouldy on the voyage or during the Exhibition, abounded in *Bruchus*, *Calandra*, and *Tineidæ;* while those which were protected against moisture were unattacked. It stands to reason, in fact, that insects dependent on a circulating fluid for their vitality, and having, during their early stages as larvæ, a very soft and moist body, cannot obtain in properly dried grains the requisite amount of moisture for their sustenance, and the egg, if previously deposited, will remain, like an ungerminating seed, for a favorable moment to develop, or if hatched, the larva will die at an early stage.

It was, therefore, with great pleasure that we recognized the appreciation of this almost self-evident proposition by the Department of Agriculture of Portugal. The exhibits in bottles were entirely free from all mould and infection, and in each bottle was a small quantity of caustic lime,[1] wrapped in paper, which, by its hygrometric power, had kept the specimens perfectly dry.

We do not intend to have it inferred, from what is above stated, that all the other exhibits were in a condition inferior to that of Portugal; on the contrary, many of them, as well as many from our own States, were in most admirable order; but, so far as we could learn, this good condition had been produced by great personal care, and the removal from time to time of the infected parts; not by the use of a preventive agent.

While investigating the occurrence of a small species of *Tineidæ* in the Italian exhibit of Leghorn straw, I learned that some importations of straw goods, by Messrs. Albinola and Bailey, of New York, had been attacked by insects. I immediately wrote to those gentlemen, who, with great courtesy, sent me two collections of the insects infesting a recent importation which had become mouldy from being packed in a moist condition. The names of the species contained in this set are appended; they are all either carnivorous or fungivorous, and can therefore do no harm; some of them have

[1] The nature of the powder was suspected by the Committee, but the determination was made through the analysis of Mr. Edward Goldsmith.

not been before observed in the United States, or their habits have not been noted. What is more important, however, is that none of the straw goods were attacked by moths either on this or previous occasions. It is therefore to be inferred that the moth in the Italian exhibit was the grain-moth of the seed of the grass which produced the straw used in the manufacture of the Italian goods. What confirms this inference is that the moths occurred in but one case, in which were exhibited several bunches of the straw with the heads of grain still remaining.

Prof. C. V. Riley, in the Proceedings of the Academy of Science of St. Louis, Oct. 2, 1876, has given a list of the species which he collected at the Centennial Exhibition, with very useful and suggestive remarks. We have obtained specimens of all the species mentioned by him except one Crambide Lepidopteron, from the Egyptian exhibit, for which we sought without success. At an earlier period in the season, and with smaller attendance of visitors, the number of species in our list would perhaps have been larger, but no additional advantage would have been obtained therefrom. The species, with the few exceptions noted, are either innocuous or previously introduced.

J. L. Le Conte, *Chairman*,
Geo. H. Horn,
Joseph Leidy.

List of Species collected in the Centennial Buildings in Foreign Exhibits.

COLEOPTERA.

Silvanus surinamensis.

Argentine Confederation and Brazil, in various materials.

Læmophlœus ferrugineus.

In beans, Brazil. These two species lived upon the debris of *Bruchus*, and were accompanied by a species of *Psocus*.

Bruchus picturatus, *Fahræus.*

Argentine Confederation; in seeds of two Leguminous plants, one of which produces a screw bean, resembling *Strombocarpus* of Arizona.

Bruchus, sp.

Allied to *B. prosopis*, of Arizona and New Mexico. Argentine Confederation; also in the screw bean. These two *Bruchi* are depredated upon by three small species of Ichneumonidæ.

Bruchus, sp.

Of larger size and more uniform color. Argentine Confederation, in the seeds of another Leguminous plant, allied to *Prosopis*.

Bruchus, sp.

Of larger size and more mottled color; in the seeds of three other Leguminous plants of the Argentine Confederation.

Bruchus scutellaris.

Venezuela, in beans.

Bruchus obsoletus.

In beans from various countries of both continents.

Bruchus pisi.

In peas; Spain and Portugal.

Bruchus, sp.

A small broad species, with transverse prothorax; ♂ rather uniformly clothed with gray-brown pubescence; antennæ as long as the body; ♀ black, with a grayish-brown broad dorsal stripe on the prothorax, and a small transverse white band on each elytron, extending from the side margin nearly to the suture, a little in front of the middle; thighs not toothed. Length .09 inch.

Brazil, in a bluish-gray variety of bean. I cannot identify this species among those described in Schönherr's work; it is of the same form, and belongs to the same division as *B. pisi*, but is much smaller, and quite different in other characters. It is the only one of the species here mentioned which is capable of being introduced; and I have, therefore, given such a description as will enable it to be recognized. The antennæ are only feebly serrate. This species is mentioned by Mr. Riley as *B. granarius*, but it does not agree with the figure of Olivier.

Rhizopertha pusilla.

Victoria, Australia; in wheat. This insect has been previously introduced into the United States in Persian wheat, distributed by the Patent office. (*Vide* Lec. Class, Col. N. Am. p. 208.)

Calandra oryzæ.

This destructive insect abounded in exhibits of corn (maize), wheat, and rice from every part of the globe. I also observed it in arrowroot from Brazil.

Aræocerus coffeæ.

Eating the thin shell of cacao-nuts from Brazil, but apparently not attacking the interior of the nut. Previously introduced both in the Atlantic and Pacific States.

LEPIDOPTERA.

The ordinary and well-known *Tineidæ*, which affect wheat and corn (maize) (*Butalis cerealella*, *Ephestia Zeæ*), abounded in exhibits from various countries. There was a smaller form which is mentioned above, as coming from the grass seeds of the Leghorn straw. Specimens have been identified by Prof. C. V. Riley as the common grain moth, *B. cerealella.*

HYMENOPTERA.

Besides the three *Ichneumonidæ* parasitic on the *Bruchi* in the Argentine Confederation exhibit, I observed a small species of *Pteromalus* parasitic on the *Tinea*, *Bruchus obsoletus*, or *Calandra oryzæ* which infested a small bag of Brazilian wheat.

List of the Species found in Mouldy Specimens of Straw Goods from Italy.

These species were collected by Messrs. Albinola and Bailey, in New York. They are either carnivorous or fungivorous; those of the latter kind live upon the mould, which, as determined by Dr. J. G. Hunt, is a species of *Aspergillus*, previously known in this country.

Lathridius filiformis.

Lathridius striatus.

Corticaria, sp.

(Not identified.)

Holoparamecus singularis.

Has not been previously observed in the United States.

Silvanus surinamensis.

Silvanus advena.

Læmophlœus ferrugineus.

Murmidius ovalis.

Habits not previously observed in the United States, though its occurrence was known.

Tribolium ferrugineum.

November 21.

The President, Dr. Ruschenberger, in the chair.

Thirty-six members present.

November 28.

The President, Dr. Ruschenberger, in the chair.

Fifty-three members present.

A paper entitled "Notes on Fishes from the Isthmus of Panama, collected by Dr. J. F. Bransford, U. S. N.," by Theodore Gill, was presented for publication.

Louis F. Benson and Walter H. Ashmead were elected members.

Dr. A. S. Packard, of Salem, Mass., W. H. Holmes, U. S. Geol. Surv., and Laurenço Malheiro, of Lisbon, were elected correspondents.

The following papers were ordered to be printed:—

NOTE ON A CIRRIPEDE OF THE CALIFORNIA MIOCENE, WITH REMARKS ON FOSSIL SHELLS.

BY T. A. CONRAD.

BALANUS.

H. Estrellanus, Con.

This fossil of the Californian Miocene, *Tamiosma gregaria*, Conrad, I supposed at one time to be a member of the *Rudistæ*, and I also described it as *Balanus estrallanus;* but not satisfied that, as one of the *Rudistæ*, it should be in the Miocene formation, I have further studied its characters, and now conclusively refer it to the *Balanidæ*. The only difference I can find to distinguish it, except specifically, from other species of the genus *Balanus* is that its basis is filled the entire length with septa. These septa do not essentially differ from those of *Balanus lævis*, Brug. In the only specimens found, the opercular valves are wanting, but a portion of the basis on which they rested is well preserved, and shows the same kind of surface as in other *Balani*.

HELIX.

H. Strangulata, Adams.

A very perfect specimen of this species is in the collection of the Academy of Natural Sciences, which I obtained at Yorktown, Virginia, while collecting Miocene fossils at that locality, although I do not recollect whether I found it in the marl or on the surface, probably the latter. It cannot be proved to be a Miocene fossil.

INOCERAMUS, Sow.

This genus is distinguished from *Haploscapha* (*Catillus*, Brong.) by a straight hinge line and the crenulations on the hinge, partly internal; while *Haploscapha* has an irregular or waved hinge, the right valve being alate about the beaks and having a sinus posteriorly, as represented in D'Orbigny's figure, pl. 412, of his "Paleon. Franc." The ligament is wholly external, situated in crenulations more numerous than in *Inoceramus*, and often in an irregular line. Pictet describes *Inoceramus* as "lamelleux," and says "La principale différence qui existe entre ces coquilles et celles des Inocérames consiste dans la structure du test, qui chez les Catillus est fibreux dans sa couche externe, repellant presque celui des TRICHITES." Mr. Meek adopts *Catillus* as a subgenus of *Inoceramus* without stating a distinguishing character, but I cannot find one species of *Catillus* among those he describes as species of it excepting *I. deformis*. One characteristic difference between the two genera is the extremely thin shell of *Catillus* over the middle portion of the disk and the gradual thickening towards the margin; indeed, the shell of the two species I have described is so thin that it has only been preserved entire by the adhesion of multitudes of *Ostrea congesta* on the back. This thinness is not in consequence of any loss of the original test, for the pearly layer is well preserved. Dr. C. A. White has given a figure of *I. deformis*, Meek, which is a true *Catillus*, as a section of the shell shows. "Report upon Geog. and Geolog. Explor., pl. xv., fig. 1." Catillus attains a far larger size than *Inoceramus*, and is known only in the chalk. Although the interior of the valves is well preserved, no trace of a muscular impression is seen. The laminated structure of *Inoceramus*, where the shell is preserved, will readily distinguish it from the coarsely fibrous structure of *Haploscapha* (*Catillus*).

The latter originated near the close of the chalk period, while the former is found in the lias as well as in the chalk.

APHRODINA, Conrad.

Mr. Meek makes this cretaceous genus a subgenus of *Callista*, which I think an error. *Callista* did not exist in the cretaceous period, nor *Dosiniopsis*.

IDONEARCA, Conrad.

I make the same objection to Mr. Meek's retaining this cretaceous genus as a subgenus of *Cucullæa*. It is a large group of fossil shells, which can be instantly known by the hinge character, and which disappeared entirely at the close of the cretaceous period.

MUTELIDÆ.

HAPLOTHÆRUS.

This extinct genus was the forerunner of *Columba*, Lea (*Leila*, Gray), to which it is nearly allied, the typical species having much resemblance in outline to *Columba Blainvilleana*, Lea, but wants the cardinal tooth of that genus. The hinge more nearly resembles that of *Columba* (*Leila*) *castelnaudi*, Hupé, but the anterior muscular impression is very different from that of *C. castelnaudi*. *Columba*, Lea, takes precedence of *Leila*, Gray, according to date of publication.

ANCHURA.

In the Geology of North Carolina, by Prof. Kerr, I have inadvertly referred *Anchura pennata*, Morton, to his *Rostellaria rostrata*, pl. 2, fig. 28. *Arene Carolinensis* of the same work is erroneously referred to plate 2, fig. 19. It should be pl. 1, fig. 19.

ETEA, Conrad.

To this genus must be transferred *Crassatella monmouthensis*, Gabb; *C. transversa*, Gabb; *C. Delawarensis*, Gabb; and *C. prora*, Con.; all of which were described from casts without knowledge of the hinge characters.

NOTES ON AMERICAN CRETACEOUS FOSSILS, WITH DESCRIPTIONS OF SOME NEW SPECIES.

BY W. M. GABB.

After fifteen years, during which I have been engaged constantly at other geological and palæontological labors, but have not lost sight of my first love—the Cretaceous fossils of the Atlantic region of the United States—I have spent much of the past summer in reinvestigating them. In this work I have been materially assisted by the constantly enriching collection of the Academy, and have received a large suite of fossils from Dr. Little, the State Geologist of Georgia. Besides these, Prof. Cook, of New Jersey, has loaned me all of the specimens from his survey collection that I required, so that I have it in my power, while describing a number of new forms, to correct many of my own juvenile errors, as well as similar ones of others, which must result during the publication of a large number of small, isolated papers. Many of the fossils of New Jersey are only known as internal casts in the marls, and, while very unsatisfactory, require names, if only provisional ones, to assist the field geologist in the identification of strata. Some of these have from time to time been rediscovered in the gray marl, commonly known as the "Ripley group," and we may reasonably hope that all will eventually be fully described. This Ripley marl is a deposit now known to extend from New Jersey around through the coast States to Tennessee. It has been found in all of these States except Delaware, Maryland, Virginia, and South Carolina, that is to say, it seems coextensive with the Atlantic Cretaceous. It is a fine-grained, gray material, in which, unlike most of the rest of the formation, the shell substance is preserved, and, although the shells are often distorted, their specific as well as generic characters are beautifully preserved. It is especially favorable for the study of the bivalves, since, in nearly all cases, the hinges can be exposed. The fossils are extremely fragile, alike from the softness of the inclosing material and from the fact that the animal matter seems to have totally disappeared, without being replaced by any other cementing substance. Still, with care, the greater part of the fossils can be extracted and afterwards hardened with gum, so as to fit them for study and preservation. In the following paper I have enumerated all the recognizable species sent me by Dr. Little, since very little is known of the fossils of Georgia, and in that sense this is a geographical list:—

NAUTILUS, Linn.

N. Bryani, n. s.

Shell discoidal, sides flattened, nearly parallel; dorsum regularly rounded; umbilicus small; aperture elongate, emarginate to about a third of its length by the preceding whorl; siphuncle central, small; septa slightly arched forwards, close to the umbilicus, and very gently backwards on the middle of the side of the whorl. Surface unknown.

Greatest diameter 3.5 inches; width of aperture 1.9 inch; height of mouth from umbilical margin 2 inches, from the dorsum of included whorl 1.4 inch.

From the yellow Cretaceous limestone of Vincenttown, New Jersey. Two fragments, one comprising half of a volution, well preserved, showing seven septa; the other, a smaller fragment of a larger specimen, useful only as confirming the specific determination.

This species is markedly distinct from *N. Dekayi*, the only other described species in New Jersey. Its flattened sides are entirely unlike the globose form of that species. It seems nearest to *N. Sowerbianus*, D'Orb., resembling that species in the size of its umbilicus and in the style of the septa, as well as in being compressed. But our species differs in having the sides more parallel, in the whorls increasing somewhat less rapidly in size, and in the septa being further apart and less sinuated throughout. I take great pleasure in dedicating it to my friend, Colonel T. M. Bryan, who has, by his assiduous collecting, added much to our knowledge of the New Jersey fossils.

N. sp. indet.

I have also received from Col. Bryan another form from the dark marls of New Jersey, near Vincenttown. This is distinct from either of the known species, having very sinuous septa. It is represented by fragments too imperfect for description.

N. Dekayi, Morton.

Synopsis Cret. p. 33, pl. 8, f. 4 ; pl. 13, f. 4.

A distorted specimen from Pataula Creek, Georgia, from Dr. Little.

N. elegans, Sby.

It is not improbable that the shell referred by me (in the Report of the Palæontology of California, vol. 1, p. 59, pl. 9, fig. 3) to *N. Texanus*, Shumard, may prove to be Sowerby's species. It seems to agree quite closely, not only in its outline and proportions, but in the shape of the septa and in the ornamentation. The only difference I can detect is that, in the Californian shell, the ribs are a trifle larger and less numerous—a very unreliable character in these shells. Dr. Shumard's species, only known to us by a description from imperfect specimens, may also have to be put down as a synonym.

Ammonites, Brug.

A. placenta, Dekay.

Ann. N. York Lyc. vol. 2, pl. 5, f. 2.

A large specimen from Pataula Creek, Georgia.

A. Trinitensis, Gabb.

A. Gibbonianus, Marcou, Geol. N. A. p. 35, pl. 2, fig. 2; *not id.*, Lea, Trans. Amer. Philos. Soc., 2 ser. vol. 7, p. 254, pl. 8, f. 3.

In my paper on the fossils of South America, now going through press (Journ. Acad. 1876), I have pointed out the differences between the Texan fossil and that from South America, and I now propose the above name. Marcou found his specimen on one of the tributaries of the Trinity River, Texas.

Hamites, Park.

H.? torquatus, Morton.

Syn. p. 45, pl. 15, fig. 4.

A straight fragment, with the *Ammonites placenta*, some three inches long. I have it also in my collection from Uniontown, Ala., showing part of the septum.

Fusus, Lam.

Exilifusus. New subgenus.

Shell very long, slender, fusiform, spire high; aperture produced into a long, slender, twisted canal.

This group differs from the true genus Fusus, as restricted, by its twisted, slender canal. In this character it approaches some of the *Neptuneæ*, but its high spire and strongly costate whorls show that it is more nearly allied to the true Fusus. *Exilia* of Conrad (Journ. Philada. Acad., 2 ser., vol. 4, p. 291) has a "beak perfectly straight," and may be only an extremely slender *Fusus*. The author does not describe the shape of the outer lip, and gives us no clue as to its family relations, whether it belongs with the *Fusinæ* or the *Pleurotomidæ*. The lines of growth on my shell are slightly sinuous on the upper part of the body whorl, though not enough to be called the notch or sinus of a *Surcula*, the genus which it most resembles in that family. I attribute their shape to the generally curved outline of all of the body whorl.

The figure of *Fusus Diaboli*, Pal. Cal. v. 1, pl. 18, fig. 35, is a very accurate reproduction of one specimen before me, the extremity of the canal being broken away. But I have another, nearly of the same size, with the same character of the spire, in which the aperture and canal are larger than the spire, the canal being twisted exactly as in the present described species. In the specimen figured, as above, the lines of growth are slightly sinuous also, so that further research may prove that this is really a member of the *Pleurotomidæ*.

F. (E.) Kerri, n. s. Pl. 17, f. 1.

Shell elongate, slender; spire high; whorls about six or seven, rounded on the sides and bordered on the upper margin by a rib adjoining the suture. Surface marked by about a dozen oblique heavy ribs, beginning on the top of the whorl adjoining the marginal thickening, most prominent on the upper angle of the whorl, and disappearing a little below the middle. In addition to these characters, their entire surface is covered by numerous closely placed, fine, revolving ribs. Upper part of the aperture subelliptical, continued below into the twisted canal, twice as long as the upper portion. Columella thickened and marked by a comparatively prominent angle, similar to that of *Busycon*, where the curved canal begins.

Length 1.25 inch; width 0.37 inch.

A single specimen in the Museum of the Academy, from the Cretaceous of North Carolina (Ripley group). Named in honor of Prof. W. C. Kerr, State Geologist of North Carolina.

SURCULA, H. and A. Ad.

S. strigosa, n. s.

Shell very long and slender; spire and aperture of nearly equal length; whorls broadly rounded, perhaps eight in number (apices broken), those of the spire marked by a peculiar revolving constriction just above the suture. Surface cancellated by numerous, small, longitudinal ribs, somewhat smaller than their interspaces, and crossed by still smaller revolving lines. These latter continue over the whole surface to the end of the canal.

Length 3 inches; width 0.6 inch.

From a light-colored Cretaceous marl from Holmdale, N. J., from the collection of the N. J. Geological Survey, kindly loaned to me by Prof. Cook.

This is the most slender species of the genus with which I am acquainted. The shell substance is entirely destroyed, but the surface characters are preserved, all except the lines of growth. I am consequently unable to describe the shape of the outer lip. The groove above the suture causes an appearance, at first sight, as if the top of the whorls was bordered by a thickening; but the separation of the volutions is still marked by a slight fissure in the suture, which is placed about a tenth of an inch below the groove. This seems to have died out on the body whorl.

S. (Surculites) Mathewsonii, Gabb.

Fusus, *id.*, G., Pal. Cal. v. 1, p. 83, pl. 18, f. 33.

S. (Surculites) io., Gabb.

? *Fasciolaria*, *id.*, G., Pal. Cal. v. 1, p. 101, pl. 28, f. 214.

Both of these species, as seen from better specimens than I had originally, have the broad, shallow sinus on the upper part of the whorl, characteristic of *Surcula*. The first certainly belongs to Mr. Conrad's subgenus; the latter, however, with its tuberculated volutions, may have to be separated, though there is no named division into which to remove it. Generically, or subgenerically, they only differ in this character.

Drillia, Gray.

D. Georgiana, n. s.

Shell elongate, fusiform; spire elevated, longer than the mouth; whorls seven or eight, flattened, bordered by a thickened rim adjoining the suture; below this is a groove followed by a series of heavy longitudinal ribs, about 12 or 13 to a volution. These ribs are not well defined beyond the middle of the body whorl. Crossing the entire surface are numerous revolving lines, appearing as small ribs on the upper whorls, and as narrow impressed grooves on the last whorl. Notch narrow and shallow (as determined from lines of growth), and corresponding to the groove below the thickened upper margin of the shell. Canal moderately long; details of it and of the mouth unknown.

Length 1.5 inch; width 0.4 inch.

From the Ripley group, Pataula Creek, Clay Co., Georgia; Dr. Little.

A pretty species, resembling *Turris Ripleyana*, Con. (Journ. Acad., 2 s., v. 3, pl. 35, f. 21), in ornament, but more slender, with a higher spire and shorter body whorl.

Tritonium, Linck.

Subgenus Lagena, H. and A. Ad.

T. (L.?) edentatum, n. s.

Shell thin, short, broadly subfusiform; spire moderately elevated; whorls seven; spire turriculated; whorls of spire subangulated and sloping above, terminated in a thickened, beaded margin adjoining the suture, and constricted below this margin; body whorl regularly rounded. Upper whorls marked by numerous longitudinal ribs, sometimes visible on the upper part of the body whorl, sometimes obsolete. These are crossed by revolving lines, always distinct on the spire and on the anterior part of the body whorl, but sometimes obsolete on the middle. Aperture broad, subelliptical; canal short, very slightly recurved. Outer lip simple; inner lip lightly encrusted. No tooth on the posterior part of the inner lip.

Length 1.4 inch; width 1 inch.

A smooth, rounded shell, with ornamented spire, rather plain body volution, and no varices. With the following species, to which it is closely allied, it seems to form a distinct group in the Tritons, nearest, however, to *Lagena*, to which I have referred it, but differing in the absence of the tooth.

Common on Pataula Creek, Georgia; Dr. Little.

T. (L.?) interruptum, Con. (sp.).

Chemnitzia, *id.*, Con., Journ. Acad., 2 ser., v. 3, p. 333, pl. 35, f. 15.

With the preceding. Mr. Conrad describes the species as having the "spire prominent;" but my specimen, as well as his figure, shows that it is not so long as the mouth.

Chemnitzia? gloriosa, Roem. Kried. von Texas, p. 40, pl. 4. f. 3. From the remarkable resemblance in the style of ornament of this shell to the two preceding, I have little doubt that it is subgenerically identical with them. Roemer's fanciful restoration of the anterior end of the mouth, of course, goes for nothing.

Nassa, Lam.

N. globosa, n. s.

Shell thin, subglobose; spire moderately elevated; whorls six or seven, the upper whorls costate, the ribs not reaching to the suture; above the ends of the ribs is a narrow concave space; suture bordered by a slight thickening of the margin of the succeeding volution; suture not impressed, although well marked—partly obliterated by irregular lines of growth. Body whorl not ribbed, but ornamented by small indistinct and sometimes almost obsolete revolving lines. Aperture oblique; outer lip simple; inner lip rather heavily encrusted by a narrow deposit, and terminating in front in a heavy rib, hardly visible externally; anterior notch narrow and deep.

Dimensions of a small specimen: length 1.0 inch; width 0.9 inch. Other specimens, too imperfect for measurement, indicate a size nearly twice that given.

From the Ripley group of North Carolina, Museum of the Academy, from Prof. Kerr, and from the same deposit on Pataula Creek, Georgia, from Dr. Little.

Fasciolaria, Lam.

F. Slackii, Gabb.

Proc. Acad. 1861, p. 322.

Described from a single internal cast from New Jersey. The longitudinal ribs are large, showing strongly on the cast. The revolving sculpture, if it existed, is unknown. From the shape and from the cast of the columellar fold it most probably belongs to Meek's subgenus *Piestochilus*.

Subgenus Cryptorhytis, Meek.

F. (C.) crassicosta, n. s.

Shell small, broadly fusiform; spire moderately elevated, number of volutions unknown, suture well marked and undulated; body whorl subangulated, flattened above, convex in the middle, and rapidly constricted in advance. Surface bearing about nine large rounded longitudinal ribs, beginning near the suture, strongly developed on the upper angle and disappearing with the convexity in advance; the entire surface to the end of the canal, is crossed by small but well-defined revolving elevated lines, showing a slight tendency to alternation in size. Aperture broad above, constricted into a moderately short twisted canal; inner lip encrusted terminating in advance in a single heavy oblique fold.

Length about 1.0 inch; width about .65 inch.

A single specimen from Pataula Creek, Georgia; Dr. Little.

It is somewhat distorted in shape by pressure, and has lost part of its apex; but its heavy ribs and strongly twisted columella will distinguish it.

F. (C.) Kerri, n. s.

Shell small, subfusiform, spire shorter than the aperture, whorls five, suture minutely channelled; upper whorls sloping convexly; body whorl regularly convex and gradually contracted in advance into a moderately long and somewhat curved canal; surface marked by a few large square revolving ribs, five on the convex part of the body whorl, and numerous smaller ones in advance; these are crossed by faint longitudinal ribs, more closely placed than the first. At the points of crossing, these two sets of ribs develop well-marked little nodes or tubercles. On the spire, the longitudinal ornaments do not appear, but each volution carries three revolving ribs, the upper of which is smallest Aperture gradually narrowed in front; inner lip somewhat encrusted and bearing a small oblique fold on the angle.

Length .75 inch; width .4 inch.

From the Ripley of N. Carolina; Prof. Kerr.

F. (C.) obliquicostata, n. s.

Shell small, fusiform, spire not quite as long as the aperture; whorls about five or six, upper surface rounded, subtruncated; body whorl widest above, top sloping, tapering in front. Surface marked by a few large oblique ribs with broad concave interspaces; these ribs begin at the suture, are most prominent on the angle of the whorl and disappear in front. The entire surface is also crossed by numerous fine revolving striæ. Aperture gradually narrowing in advance; inner lip sinuous, encrusted; fold small, very oblique; canal moderately twisted.

Length .9 inch; width .45 inch.

Locality; with the preceding.

From *F.* (*C.*) *crassicosta*, this shell differs in its much more slender form, its higher spire, less twisted canal, and in the longitudinal folds being much more compressed laterally and placed obliquely instead of direct.

PYROPSIS, Con.

P. Richardsonii, Tuomey, sp.

Pyrula. id., Tuomey, Proc. Acad. 1855, p. 169.

Perissolax? id., Gabb, Syn. Cret. p. 69.[1]

Tudicla (*Pyropsis*) *perlata*, Con., J. Acad. 2 s., v. 4, p. 288, pl. 46, f. 39.

This species is found in New Jersey, and is abundant in the white limestone of Prairie Bluff, Ala. Dr. Little has sent me one internal cast from Pataula Creek, showing that it grows to a diameter of nearly two inches.

P. Bairdi, M. & H. (sp.) Meek.

Pyrula Bairdi, M. & H.

With the additional information furnished by Mr. Meek's illustrations, especially by the wood-cut, p. 371 of his admirable memoir, I am convinced that there is no generic, or even subgeneric difference between his species, and that of Mr. Conrad's type, lying before me; unless it may be found in the end of the canal of the Eastern species, and which has never yet been found. *P. Richardsonii* has a slender canal, probably not umbilicated, but this is not ground enough for a separation. The characters of the inner lips of the two species are identical.

P. elevata, Gabb.

Rapa, *id.*, Gabb, Journ. Acad. 2 s., v. 4, p. 301, pl. 48, f. 12.

Tudicla, *id.*, Gabb, Syn. Cret. 1861, p. 85, *id.* Meek, Check List Cret. No. 750.

Described from the brown sandy marl of Burlington Co., N. J. But a single internal cast has ever been found and this corresponds so nearly in size and shape with *P. Bairdi*, that I suspect it of being identical. It is certainly not the same as *P. Richardsonii* (*perlata Con.*), as Mr. Conrad intimated in Journ. Conch., 1868, p. 248.

[1] This arose from an error, I having confounded Tuomey's two species, and transposed them in their genera. I intended to put this under *Tudicla*, and to put *trochiformis*, which is a round bodied shell, under *Perissolax*. Even this, however, would have been wrong, since, as will be seen below, on obtaining more material I am obliged to separate it.

? **P. trochiformis,** Tuomey (sp.).

Pyrula, id., Tuomey, Proc. Acad. Nat. Science, 1855, p. 169.

Tudicla, id., Gabb, Syn. Cret., p. 85.

Shell moderately large, spire somewhat elevated; body whorl convex on the sides, sloping above, canal long and straight; surface marked by prominent acute revolving ribs, about nine on the body whorl and others pretty regularly placed, to the end of the canal; between these are concave interspaces, and those on the body whorl are, in some specimens, crossed by faint longitudinal ribs. The inner lip is encrusted, and, just where the mouth contracts into the canal, bears a prominent bend like that in some of the *Fasciolarias*, but without folds; or better, resembling somewhat *Busycon*.

Length 3.75 inches; width 2.0 inches.

A fossil, common as casts in New Jersey, and in the white limestones of Alabama. The above description is from a specimen in the Museum of Yale College, from Uniontown, Ala. It is the only one showing the entire surface, that I have ever seen, and also the only one retaining its entire canal.

I have long had doubts as to the generic relations of this shell, and have referred it provisionally to *Pyropsis*, since that is the nearest clearly defined genus. The columella of my specimen is not perfect enough to warrant me in asserting that the inner lip may not be like that of *Pyropsis*, though I think, as described above, it is more like that of *Busycon*. Should this eventually prove to be the case, the species, with probably both the following, must be separated as a distinct genus, for which the name *Trochifusus* would not be inappropriate.

P. septemlirata, Gabb.

Cancellaria, id., Gabb, Proc. Acad. 1860, p. 94, pl. 2, f. 10.

A shell closely allied to the preceding, and also marked by revolving sculpture, but differing in having a much lower spire, less globose body whorl, tapering into the canal much more regularly in front. The species was described from internal casts, from the New Jersey marls, and in no case has the canal been preserved. Enough, however, has been obtained to show the peculiar curve of the columellar margin.

P. Alabamensis, Gabb.

Cancellaria, id., Gabb, Journ. Acad., 2 s., v. 4, p. 301, pl. 48, f. 14.

Also described from an internal cast, showing slight traces of longitudinal ribs. Another, smaller specimen, from Mississippi, also a cast, shows that the surface had both longitudinal and revolving ornaments. There were about 12 or 13 longitudinal ribs, crossed by eight or ten smaller, revolving ribs. This also shows part of a long, straight canal. The longitudinal ribs and the high spire separate this from all other species yet known in the genus. I also have it, but in a very imperfect state, from New Jersey (Vincenttown, Col. Bryan).

Volutidæ, Fleming.

Almost every author who has written on this family has suggested a different grouping of the genera, and no two fully agree in regard to the range of the genera themselves. Among the more modern writers, H. and A. Adams proposed three subfamilies: *Cymbiinæ*, *Zidoninæ*, and *Volutinæ*. Under the first, they place the genera *Cymbium*, *Melo*, with the subgenus *Ausoba*, and *Aulica*. In *Zidoninæ*, the genus *Zidonia* = *Volutella;* and in the last subfamily, genera *Callipara*, *Cymbiola*, *Scaphella*, with subgenus *Alcithœ*, *Voluta*, *Harpula*, *Fulgoraria*, with subgenera *Aurinia*, *Lyria*, with subgenera *Enæta* and *Volutilithes*. In the appendix to their work these authors change the arrangement, as follows:—

Subfamily VOLUTINÆ.

Genera Cymbium.
- Melo.
- Scapha.
  - Subgenera *Aurinia* (*Livonia*, Gray).
  - *Aulica.*
  - *Cymbiola.*
  - *Alcithœ.*
- Voluta.
  - *Chlorosina.*
  - *Harpula.*
- Fulgoraria.
- Lyria.
  - *Harpella.*
  - *Enæta.*
- Volutilithes.
- Callipara.
- Zidona.
  - *Ausoba* (*Nobilia*, Gray).
  - *Ericusa* (*Scaphella*, G., not Sw.).

Subfamily SCAPHELLINÆ.

Genus Scaphella (*Amoria*, Gray).

They also adopt Dr. Gray's subfamily *Volutimitrinæ* for the genus *Volutimitra*.

Dr. Gray, in the Guide to Systematic Distribution of Mollusca in the British Museum (1857), proposed a somewhat different arrangement, as follows:—

a. VOLUTINA.

†YETINA.

Genera 1. Yetus.
2. Cymbium.
3. Scapha.
4. Fulgoraria.
5. Callipara.
6. Voluta.
7. Lyria.
Subgenera *Lyria.*
Enæta.
8. Volutella.

††AMORIANA.

9. Amoria.

b. VOLUTIMITRINÆ.

10. Volutimitra.

And finally the subfamily Porcellanina, made up of *Porcellana* (=*Marginella*), *Closia* (=*Volutella*, Sw.), and *Persicula*. This latter group must be thrown out.

In 1873, Dr. Theodore Gill proposed an arrangement of the Families of Mollusca, in which he separates the family into two groups:—

$$a.\ \text{Volutimitrinæ} = \begin{cases}\text{Volutimitrina, Gray.}\\ \text{Amoriana, Gray.}\end{cases}$$

$$b.\ \text{Volutinæ} = \begin{cases}\text{Volutina, Gray.}\\ \text{Yetina, Gray.}\end{cases}$$

This division, as I have been personally informed by the author, is based on the dentition; a character not always the most reliable, though in this case it seems to be sustained by the others.

Reversing the position of the groups, as placed by Dr. Gill, it seems to me that the following genera include all of the known species, and are sufficiently clearly circumscribed:—

Subfamily VOLUTINÆ.

CYMBIUM, Klein, Auct.
Yetus, Adams, Gray.

MELO, Humph.
Type *Voluta melo*.

SCAPHA, Gray (not Humph. nor Klein).
Subgenus *Aurinia*, H. and A. Ad.
Type *S. dubia*.

AULICA, Gray.
Ausoba, H. and A. Ad.
Type *V. aulica*.

VOLUTELLA, D'Orb. 1839.
Zidona, H. and A. Ad.
Type *V. angulata*.

H. and A. Adams have renamed this genus because the name *Volutella* was preoccupied both by Perry and Swainson. But since neither of their names stand, D'Orbigny's, being the oldest, must, and *Zidona* becomes a synonym.

CALLIPARA, Gray, 1847.
Type *C. bullata*.

CYMBIOLA, Sw. 1853.
Type *C. ancilla*.

ALCITHŒ, H. and A. Ad. 1853.
Type *V. fulgetrum*.

VOLUTA, Linn.
Harpula, Sw.
Type *V. musica*.

Although *V. vexillum*, Swainson's typical species, looks sufficiently unlike *V. musica* to have warranted a separation, it only requires a study of a large series of specimens, of the few species in this group, to satisfy one that the division has not even a subgeneric value. *V. musica* alone varies through half a dozen specific names, some of the extreme forms almost as round as *vexillum*. I have fossil specimens from the Pliocene of Costa Rica, almost exactly the shape of *V. vexillum*, without a tubercle on the angle of the whorl, and marked with as many folds on the inner lip as a *Cypræa*.[1]

FULGORARIA, Schum. 1817.
Fulguraria, H. and A. Ad.
Type *F. rupestris*, Gm.

VOLUTODERMA, Gabb. New genus.

Shape similar to *Fulgoraria*, which it also resembles more or less in surface sculpture; apex not papillate; inner lip marked by from three to five well-marked folds, not very oblique, and of pretty uniform size. This is a group of shells characteristic of the cretaceous rocks, and, perhaps, peculiar to them. They are all somewhat slender, and are marked by longitudinal ribs, not always well defined, and by revolving ribs; the columella is always straight or nearly so, and the folds are as isolated and distinct as those of *Turbinella*. But the most strongly distinguishing character is the entire absence of the irregularly rounded mass at the apex of the shell, one of the best characters of *Fulgoraria*. The species have been referred to *Voluta*, *Volutilithes*, *Fulgoraria*, and even *Fasciolaria*. *V. Navarroensis*, Shum., Gabb, Palæontology of California, vol. i., pl. 19, f. 6, may be taken as the type. The genus includes such species as—

V. elongata, d'Orb. sp.
Voluta, *id.*, d'Orb., Pal. Fr. Cret., v. 2, p. 323, pl. 220, f. 3.
Volutilithes, *id.*, Stol., Sitz. Akad. Wien., lii. p. 74.
Fulguraria, *id.*, Stol., Pal. Ind., p. 87, pl. 7, f. 1–9.
Voluta Trichinopolitensis, Fbs., Tr. Geol. Soc. Lond. v. 7, p. 133, pl. 15, f. 5.

This shell is very variable in height, and carries three equal columellar folds. Specimens before me, sent to me by Dr. Stoliczka, from Trichinopoly, show that the apex is as acute as in my Californian shell.

Another shell, accompanying this, marked *Fasciolaria rigida*, Stol., bi. cit., p. 109, pl. 10, f. 10–16 (*Voluta rigida*, Baily), evi-

[1] For further remarks on this subject see Crosse, Journal de Conchyliologie, vol. 19, p. 271.

dently also belongs to this genus, as well as do *Fasc. carinata*, Stol., and *F. assimilis*, Stol.

AURINIA, H. and A. Ad. 1853.
Type *A. dubia*.

VOLUTOMORPHA, Gabb. New genus.

Shell elongate, fusiform; whorls cancellated by longitudinal and revolving ribs. Columella with one very oblique fold, and sometimes one or more smaller secondary folds. In shape this genus is not unlike the two preceding genera, but it differs from them all in having essentially a single large oblique fold. When more than one occurs, the secondary folds are smaller than the large primary.

Type *Volutilithes Conradi*, Gabb, Journal Acad. Nat. Sciences, 2 s., v. 4, pl. 48, f. 10.

V. CRETACEA, Con., *loc. cit.*, pl. 47, f. 18, also belongs to this genus, and *V. Delawarensis*, Gabb, Proc. Acad. 1861, p. 322.

ROSTELLITES, Con. 1855.

Type *R. Texana*, Con., Emory's Report, Mexican Boundary Survey, p. 158, pl. 14, f. 2.

A curious genus, the most slender of the Volutes, with numerous equal plaits on the columella, and with the outer lip somewhat expanded anteriorly.

VOLUTIFUSUS, Con. 1866.

Type *V. typus*, Con., J. Conch., 1866, p. 67, pl. 3, f. 2.

Very characteristic of the Miocene.

LYRIA, Gray, 1847.
Type *L. Delessertii*.

ENÆTA, H. and A. Adams, 1853.
Types *L. Cummingii*, *harpa*, etc.

Marked by a tooth in the middle of the outer lip, seems to be but a division of *Lyria*.

VOLUTILITHES, Swains, 1831.
Type *V. abyssicola*.

A genus abundant in the Eocene rocks, perhaps found in the Cretaceous, and represented in the living fauna by but a single species.

ATHLETA, Con., 1853.

Types *A. rarispina* and *A. Tuomeyi*, Con., J. Acad., 2 s. v. 4, pl. 47, f. 35.

A form separated by Conrad from *Volutilithes* on account of a heavy callosity deposited on the spire above the aperture.

LEIODERMA, Conrad, 1865, Proc. Acad., 1865, p. 184.

Type *L. leioderma*, Con., J. Acad., 2 s. v. 4, p. 292, pl. 46, f. 32.

Includes also *Volutilithes cretacea*, Con., *loc. cit.*, v. 3, p. 333, pl. 35, f. 16.

Subfamily SCAPHELLINÆ, H. and A. Ad.

Volutimitrinæ, Gill; *Volutimitrina and Amoriana*, Gray.

SCAPHELLA, Swains., 1832.
Amoria, Gray.
Type *S. Junonia.*

VOLUTIFUSUS, Con., 1866.

Type *V. typus*, Con., J. Conch., 1866, p. 67, pl. 3, f. 2.

Very characteristic of the Miocene, but does not include *V. Junonia*, as Mr. Conrad intimates.

VOLUTIMITRA, Gray.
Types *V. Grœnlandica.*

In addition to the above, there are perhaps several other genera among the fossil Volutes. *V. rarispina*, Lam., with which I am only acquainted by published figures, may be an *Athleta*, or it may be new. It certainly cannot be placed in any other genus.

The two shells, *Athleta purpuriformis* and *A. scrobiculata*, of Stoliczka, were referred to that genus from a misconception on the part of the author. They have not the characteristic callous, are subglobular, instead of being subfusiform and angulated, and the folds are very oblique, and on the anterior part of the columella. The genus might be called PTYCHORIS.

Ficulopsis Stoliczka, Pal. Indica, p. 84, founded on *Pyrula Pondicherriensis*, Forbes, is a *Ficus*, with folds on the columella. I have just received from the Cretaceous of Georgia an allied form, with a flattened columella and with a single fold. I cannot agree with the Doctor in placing it in the *Volutidæ*.

Megaptygma, Con., founded on a Miocene species, described by me under the name of *Voluta sinuosa*, differs only from *Volutifusus* in having the folds unusually heavy. Together with Mr. Conrad, I have compared it with several species of the latter genus, and find that some of the species, especially *V. mutabilis*, Con., vary so in this character, that we have agreed that the distinction is not a valid one. *V. mutabilis* varies not only in the presence and absence of folds, but also in their direction when present, and in the shape of the anterior half of the shell. Some specimens are perfectly straight in advance, while others are as twisted as the typical form of *V. Junonia.* In fact I am by no means convinced that *Volutifusus* should be separated from *Scaphella.*

LEIODERMA, Con.

L. canalis, Con. sp.

Conus, *id.*, Con., J. Acad., 2 s. v. 3, p. 331, pl. 35, f. 22.
Volutilithes cretacea, Con., J. Acad., 2 s. v. 3, p. 333, pl. 35, f. 16.

Common at Pataula Creek, Clay Co., Ga. A long, slender, fusiform shell, with a polished surface, high spire, with the upper whorls faintly ribbed longitudinally. The outer lip is slightly thickened at its junction with the body whorls, and obliquely truncated in advance. The columella bears a single faint very oblique fold. Its surface, although polished, shows strong lines of growth. Mr. Conrad agrees with me in the above synonymy.

I have a cast, apparently of the same species, from Crosswicks, New Jersey.

VOLUTODERMA, Gabb.

? V. biplicata, Gabb.

Volutilithes biplicata, Gabb, Journ. Acad., 2 s. v. 4, p. 300, pl. 48, f. 6.
Rostellites biplicatus, Meek, Cret. Check List, No. 690.

But a single specimen of this species has ever been found. It shows none of the surface, but its form is so peculiar that it cannot be mistaken. Its two folds are in such a position that I have little hesitation in referring it to this genus.

V. sp. indet.

Another form occurs in the brown marls of Vincenttown, N. J., of which two internal casts have been found by Col. T. M. Bryan. In size and general shape it approaches *Volutomorpha Conradi*, but has three strong transverse folds on the middle of the columella. From impressions on the inner face of the cast of the outer whorl its surface is covered by small longitudinal ribs, crossed by numerous revolving lines, the characteristic sculpture of the genus.

VOLUTOMORPHA, Gabb.

V. Conradi, Gabb.

Volutilithes, id., Gabb, Journ. Acad., 2 s. v. 4, p. 300, pl. 48, f. 10.
Rostellites, id., Meek, Cretaceous Check List, No. 691.

The typical species of the genus. A common fossil in New Jersey. I have not seen it yet from other parts of our Cretaceous deposits. It is a long, slender, fusiform shell, a little variable in shape, but always slightly subangulated on the upper part of the whorl; the middle is gently convex, with the sides converging in advance. The canal is straight, and the columella bears one large oblique fold. Sometimes one or two smaller secondary folds occur. The surface is marked by numerous longitudinal ribs crossed by more closely placed revolving ribs. Impressions of this surface in the matrix, and on the inner face of the cast of the body whorl are not rare, but I had never seen even a piece of shell preserved until a few days ago, when Col. Bryan brought me a body volution with a third of its surface covered with well-preserved shell.

V. Abbotti, Gabb.

Volutilithes id., G., Proc. Acad. Nat. Sci. 1860, p. 94, pl. 2, f. 7.

The surface of this shell is as yet unknown. The columella, besides the large typical fold, carries also three smaller and more transverse ones above.

V. Saffordi, Gabb.

Volutilithes id., Gabb, Journ. Acad., 2 s., v. 4, p. 300, pl. 48, f. 8.

A strongly cancellated species, approaching the preceding in form.

V. bella, Gabb.

Volutilithes id., Gabb, Journ. Acad., 2 s., v. 4, p. 300, pl. 48, f. 7.
Rostellites id., Meek, Check List Cret. No. 689.

A remarkably symmetrical fusiform shell, not very rare in New Jersey. Its surface is unknown.

V. Kanei, Gabb,

Voluta id., Gabb, Proc. Acad. 1861, p. 322.

V. mucronata, Gabb.

Voluta id., G., loc. cit. p. 322.

Rostellites, Con.

R. nasutus, Gabb, sp., Meek, Check List, No. 692.

Volutilithes id., G., Journ. Acad., 2 s., v. 4, p. 300, pl. 48, f. 9.

This shell has normally three folds on the columella, but I have seen specimens with five or six. It is the most slender of all the *Volutidæ* of New Jersey, and can be distinguished, even in casts, by the entire absence of longitudinal ribs or plications. Prof. Geo. Cook, State Geologist of New Jersey, who has loaned me all the desirable specimens of the survey collection, has at last obtained this shell, showing the surface. Unlike most of the marl fossils, these specimens, of which there are several, are fossilized, so that, while all shell structure is destroyed, being replaced by marl, the surface characters are perfectly preserved. The species is characterized by about 17 or 18 elevated, thin, revolving ribs, those in advance placed very obliquely; the interspaces are three or four times as wide as the ribs. All the specimens are more or less distorted, but enough remains to show that the outer lip was broadly expanded, and, perhaps, even very slightly everted in advance.

From Pataula Creek, Clay Co., Georgia, Dr. Little has sent me some imperfect internal casts which seem to belong to this species, but which are unusually large. Better material may prove them to belong to a distinct species.

Ptychosyca, N. gen.

Shell like *Ficus* in shape; surface smooth (or sculptured?); inner lip bearing one very oblique fold on the anterior part of the columella.

This shell fills in a gap in the series of genera, and connects Stoliczka's genus *Ficulopsis* with the true *Ficus*. *Ficulopsis* has the same general style of sculpture as *Ficus*, but bears several plaits on the columella, so like some of the Volutes that Dr. Stoliczka united it with them in the same family. The present genus has a fold, but it is small and very oblique. The posterior notch, which the author mentions as doubtfully a generic character in his species, seems, from a study of ours, to be so. In *Ficus*, the outer lip shows a very slight trace of it; in our genus it is more marked, while in the Indian fossil it develops into a regular Pleurotomoid sinus.

P. inornata, n. s., pl. 17, f. 2, 3, 4.

Shell small, regularly convex; spire small; number of whorls unknown (apex destroyed on the only specimen); suture nearly obsolete; surface without other marks than faint lines of growth; body whorl convex above, tapering in advance, slightly constricted by a broad, shallow, revolving groove in advance; canal short, notched in advance; outer lip very slightly notched posteriorly, immediately adjoining the suture; inner lip thinly encrusted and bearing one very oblique fold.

Length about 1.5; width about .75. The specimen is compressed, so that, with the loss of the tip of the canal, the measurements can be only approximate. The lines of growth, which are distinct, enabled me to ascertain the details of the anterior end.

A single specimen from the Ripley group, Pataula Creek, Georgia; Dr. Little.

GYRODES, Con.

G. abyssinis, Morton (sp.).

Natica id., Morton, Syn. Cret. p. 49, pl. 13, f. 13.
Gyrodes id., Gabb, Syn. Moll. Cret. p. 59.

Described originally from Prairie Bluff, Ala. We did not know the surface of this shell, until now I have received from Dr. Little specimens from the Ripley group, from Pataula Creek, Georgia. The surface is perfectly plain, slightly flattened adjoining the suture, and with the umbilical margin rounded. It is marked only by lines of growth, and has none of the crenation of the upper edge, characteristic of Conrad's species *G. crenata*. It also occurs, though rare, in New Jersey.

G. petrosa, Morton, (sp.).

Natica id., Morton, Syn. Cret. p. 48, pl. 19, f. 6.
Gyrodes id., Conrad, Journ. Acad., 2 s., v. 4, p. 289.
G. alveata, Con., loc. cit. p. 289, pl. 46, f. 45.

Originally described from internal casts from Prairie Bluff, Ala. Mr. Conrad's species, from the Ripley group of Mississippi, was described from shells retaining their surface. They are identical, and we have the same species from Glassboro, N. J., from Colonel Bryan, and from Mullica Hill, whence it was brought by Mr. John Ford.

Amauropsis, Mörch.

A. paludinæformis, H. and M. (sp.).

Natica id., H. and M., Mem. Am. Acad., Boston, v. 5, p. 389, pl. 3, f. 3.

A. id., M. and H., Proc. Phil. Acad. 1860, 185.

In the Academy's museum are half a dozen specimens of this species, brought by Mr. Conrad from Haddonfield, N. J.

Lunatia, Lam.

L. rectilabrum, Con.

There is yet some confusion about this species. Mr. Conrad described it as a *Natica* in the Journal Phil. Acad. 2 ser. vol. 4, p. 344, pl. 35, f. 28. In my synopsis of Cretaceous Mollusca, I placed it as a synonym of Hall and Meek's *concinna*. In Hayden's report, Mr. Meek refers it to H. and M.'s *obliquata*, and separates *concinna* and *obliquata* on the ground that the latter has an opercular groove, wanting in the former. This hardly seems to me to be a valid specific difference, and I believe the synonymy should stand as follows:—

L. obliquata, H. and M. (sp.), Meek, Cret. Check List, No. 672.

Natica, id., H. and M., Mem. Bost. Acad., v. 5, p. 389, pl. 3, f. 1.

N. concinna, H. and M., *loc. cit.*, p. 389, pl. 3, f. 2.

N. moreauensis, M. and H., Proc. Acad., 1856, pp. 64, 282.

Lunatia concinna, Meek, Hayden's Rep., p. 314.

N. rectilabrum, Con., J. Acad., 2 s. v. 4, p. 344, pl. 35, f. 28.

N. acutispira, Shum., Trans. St. Louis Acad., 1860, p. 597.

It is common everywhere in the Ripley Group, and Dr. Little now sends it from Pataula Creek. The altitude of the spire, and the obliquity of the body whorl differ considerably in the eastern shell, as is frequently the case with *Naticas*, and, consequently, if there is no difference except the presence or absence of a groove, and a slight one at that, made by the operculum on the pillar lip, the difference is too slight to divide them. *N. acutispira* of Shumard, of which I compared a specimen, some years ago, with the Atlantic form, also comes into this synonymy.

Scala (Klein), Humph. 1797.

Scalaria, Lam., 1801.

S. (Opalia) Thomasi, n. s.

Shell slender, thin, subulate, whorls numerous, increasing gradually in size, rounded, and curving abruptly to the suture; surface marked by numerous, small, very thin plates, and crossed by well marked though small revolving lines, base bordered by an angular carina. From the white limestone of New Jersey, a single specimen given me by Prof. W. H. B. Thomas. Its nearest ally, *S.* (*O.*) *Sillimani*, Morton, from Prairie Bluff, Ala., is a somewhat larger shell, with a wider apical angle, the varices, instead of being numerous thin plates, are fewer and thickened, and the revolving sculpture is much finer. From *S. annulata*, Morton, found with it in New Jersey, it can be at once distinguished by its much narrower apical angle, very much smaller size, and in the ornaments. In that species, in the adult stage, the ribs become rounded on their edges; in the young shells they are squamose, though not so numerous, and the revolving sculpture is fine and closely placed. From the following species it can be known by the plates being smaller and thinner, by the revolving sculpture, which in this is marked, while in that it is either very fine or wanting. Further, in this species, the carina at the base of the whorls is merely a strongly marked angle, over which the longitudinal markings cross without change; the plates very regularly decreasing in prominence from the sides to the base of the whorls, and reaching the lip as mere threads. In that species the carina is a strong rib, and the longitudinal plates continue well elevated and thick to the end. I have not described the mouth, because in the only specimen it is in great part broken away. From a trace in the umbilical region, it seems to have been bordered by the usual thickened lip.

S. (O.) cyclostoma, n. s.

Shell smaller and slightly more slender than the preceding; whorls seven, cross sections circular; surface marked by numerous prominent recurved ribs, one of which on each whorl is thickened, showing a periodical arrest in growth; between these ribs is very minute revolving sculpture, a little more distinct on the earlier whorls. Aperture circular, bordered by a very thick expanded lip; base of body whorl bordered by a strong rib.

Length .55 inch, width .25 inch.

In the large varices this is not unlike *S. Sillimani*, but it is distinguished by its smaller size, narrower whorls, less thickened longitudinal ribs, and by the base. In that species the base is much flatter, the revolving carina is less evident, and each rib, on the angle is reflexed back into a little lip or notch; these ribs also become much less distinct on the base.

S. (O.) annulata, Morton.

Scalaria, *id.*, Morton, Synopsis, p. 47, pl. 3, f. 10.

A character exists in this shell which has never been mentioned. It has a broad open umbilicus, bordered by an angle, as well marked as that of *Architectonica*, though, of course, not so large.

I have yet another species from Georgetown, Georgia, from Dr. Little, nearest to *S. annulata* in the character of its ribs, but apparently more like *S. Sillimani*, in the shape of the shell. It consists of only one whorl and a part of another imbedded in a hard rock and too imperfect for description.

Pugnellus, Con.

Dr. Little has sent me from the Ripley marl of Pataula Creek, Clay Co., Georgia, specimens of Conrad's original *Strombus densatus*, Journ. Acad., 2 ser. vol. 3, p. 330, pl. 34, f. 6, which have enabled me to discover that it is a very different shell from that which the same author called *Pugnellus densatus*, in the 4th volume of the same work, p. 284, pl. 46, fig. 31. It is more than twice as large as adults of the latter species, the canal is straight, and the outer lip is not so thickened. The first species, that from the 3d volume, must retain the specific name, and that in the 4th volume must be renamed. I, therefore, name it *P. typicus*, since that species was the one for which the genus was first founded. More perfect material than I yet possess may even prove that *P. densatus* may belong to my subgenus *Gymnarus*.

Anchura, Con.

A. arenarum, Morton, sp.

Rostellaria, *id.*, Morton, Syn. Cret., p. 48, pl. 5, f. 8.
R. arcuarium, d'Orb., Prod. Pal., v. 2, p. 227.
Chemnitzia distans, Con., Journ. Acad., 2 s. v. 3, p. 333, pl. 35, f. 30.

With the preceding, from Dr. Little.

A. Texana, Roem., sp.

Scalaria, *id.*, Roem., Kreid von Texas, p. 39, pl. 4, f. 11 *a–b*.
Chemnitzia, *id.*, Meek, Check List, No. 658.
" " Gabb, Pal. Cal., vol. 2, p. 261.
Aporrhais, *id.*, Stoliczka, Pal. India, vol. 2, p. 231.

Stoliczka says he examined, in the museum in Bonn, the original of *Scalaria Texana*, "and found that it was based upon an imperfect specimen of an *Aporrhais*." On re-examining my own specimen of the species I see nothing incompatible with its belonging to the genus *Anchura*, a view which is sustained by Roemer's figure, and doubtless Dr. Stoliczka found some remains of the expanded lip, or of the terminal ascending suture line. He did not understand the genus *Anchura*, restricting it to those species in which the outer lip bears two points, one posterior, the other running parallel with the canal. As I have shown elsewhere the genus cannot be so restricted, and there are not even valid grounds for retaining Meek's *Drepanochilus* as a subgeneric division. Stoliczka called two species of *Anchura* by the name of *Aporrhais*, and, therefore, I am satisfied that he meant this same group. The long, slender spire of the species in question is very like many species of *Anchura*, but is wholly incompatible with *Aporrhais*.

APORRHAIS, Dillw.

?A. bicarinata, n. s.

Shell small, spire elevated, number of volutions unknown; upper whorls bearing an angle in the middle, from which the surface slopes inward to the suture; below this angle it slopes very slightly outwards to the sutures below; body whorl bearing two angles on the middle, the upper slightly the largest; outer lip unknown, inner lip lightly encrusted, expanded, and slightly reflected, producing a groove which runs from the posterior angle of the aperture, parallel with the mouth, down to the canal.

Width of body whorl, less the expanded lip, about 0.5 inch. This species is described from two fragments from Pataula Creek, Georgia, sent me by Dr. Little. They are so mutilated that I do not know the outer lip, the canal, nor the upper whorls of the spire. In fact, nothing remains except the body volution and the one adjoining it. Both show the very remarkable character of the inner lip, so that I am convinced it is not an accidental result of crushing. The form of the body whorl is very similar to the little shell described by Mr. Meek, from the Yellowstone region, under the name of *Aporrhais biangulata*. It has the same two carinæ, and, like that shell, is smooth, unlike it, not showing, under a magnifying glass, any trace of sculpture. The most marked difference exists in size, our species being larger than Meek's magnified figure (Hayden's Report, pl. 19, fig. 6 *b*). Another difference occurs in the spire. In that all of the upper whorls are rounded, in this the upper carina of the body whorl is continued on the middle of the upper whorls, the suture following the lower carina. The peculiar character of the inner lip is not mentioned in Mr. Meek's description, as it certainly would had it been present. As to the generic relations of the present species, it may belong to *Aporrhais*, and I have so referred it on account of its close specific relation to the Northwestern species, or it may prove to be an *Anchura*. In this group the generic determination cannot be certain until we have all of the parts of the perfect adult shell, the classification resting almost entirely on the manner in which the adult forms its mouth.

Turbinopsis, Con.

This genus seems to be not remote from *Trichotropis*, resembling the subgenus *Iphinoe* in form, but differing in having a thick shell, and in bearing a rather obscure fold on the inner lip close to the anterior end. This fold is not visible externally, but can be seen if the outer lip is broken away or on casts.

T. Hilgardi, Con., Journ. Acad., 2d ser., vol. 4, p. 259, pl. 46, fig. 29.
Cancellaria, *id.*, Gabb, Syn. Cret. Moll., p. 42.
T. depressus, Gabb, Proc. Acad., 1861, p. 321.

Found in New Jersey, Delaware, Alabama, and Mississippi. My name given to casts from New Jersey must stand as a synonym.

Gyrotropis. New genus.

Shell thin, resembling *Trichotropis* in form, spire elevated; umbilicus open like in *Iphinœ* and *Turbinopsis;* surface biangulated like in the typical form of *Trichotropis*, but covered also with numerous very thin foliated varices like *Murex*.

A peculiar genus, combining a series of characters which ally it closely to *Trichotropis*, but markedly different in the presence of thin plates covering the surface, and expanded to an unusual degree.

G. squamosus, n. s., pl. 17, fig. 5.

Shell moderate in size, turbinate; spire about as high as the length of the mouth, whorls eight, apex acute, body whorl bicarinate, the carina high and very thin; outline sinuous in front to the umbilical margin, concave between the carinæ and above the upper one to the suture; upper carina carried on the middle of all the upper whorls to the apex; suture channelled, the channel formed by the upper surface of the lower carina, the succeeding whorl being soldered to the outer edge of the plate-like ridge; umbilicus open, narrow, deep, bordered by the sharp, acute angle of the base of the volution; surface ornamented by numerous very thin, squamose, murex-like varices, most marked on the anterior part of the shell, these are all crossed by closely placed revolving lines, somewhat alternated in size. Aperture broad, outer lip thin, inner lip rather heavily encrusted.

Length, 1.1 inch; width, 0.9 inch.

From Snow Hill, North Carolina, from the Ripley marl. Collection of the Academy.

Turritella, Lam.

T. encrinoides, Morton, Synopsis, p. 47, pl. 3, fig. 7.

Pataula Creek, Georgia, Dr. Little.

Laxispira. New genus.

Shell spiral, dextral, whorls with a circular cross section, few in number, and so rapidly descending as to form an open spiral; aperture simple, lips thin.

A curious genus, the relations of which are not clear to me. I propose it to receive some shells which have been long known as internal casts in the marls of New Jersey, but of which the surface was unknown until quite recently. In general form they might be compared to a partially uncoiled *Turritella.* From that genus they differ, however, in the whorls not being in contact, and from *Vermetus* and the allied genera in being regular spirals, but not having the apex either turritelloid or attached. Another analogy, though perhaps only one of external resemblance, might be adduced in such shells as *Euomphalus circinalis*, Goldf., or in some of the Delphinulas.

L. lumbricalis, n. s., pl. 17, f. 6, 7.

Shell with a circular cross section, whorls about as far apart as the diameter of the whorls, three or four in number; surface marked by numerous small, closely placed revolving ribs.

This description is from a small specimen from the Ripley marl from Haddonfield, N. J., presented to the Academy by Mr. Conrad. Casts over two inches long and about half an inch in diameter of aperture are common in the glauconite marl, and apparently belong to the same species.

Bivonia, Gray.

?B. cretacea, n. s.

Shell tubular, irregularly coiled in the young stage; curved, straight, or irregular as it grows older; surface irregularly wrinkled by lines of growth; aperture circular, substance thick.

Average diameter of shell .25 inch to .3 inch.

I propose this name for a shell consisting of a contorted tube common in the Ripley marls, and which shows so few characters that it is hard to describe it. I have never seen any signs of attachment, and no two specimens are of the same shape. Dr. Little has sent me a good series from Pataula Creek, Georgia.

Endoptygma. New genus.

E. umbilicata, Toumey (sp.), pl. 17, f. 8, 9.

Phorus umbilicatus, Toumey, Proc. Acad., 1855, p. 169.

This shell was described by Tuomey from internal casts well known in the Cretaceous of Mississippi and Alabama. It differs from the typical *Phorus*, Montf. (*Xenophora*, Fisch.) in having a strong revolving plate inside, nearly midway between the umbilical and outer margin on the base, leaving a groove on the cast. The irregularly pitted upper surface shows that the shell agglutinated foreign bodies to its surface in the same manner as in the genus from which I propose to separate it. Figure 8 shows the position of the internal plate, as represented by a groove on the cast; figure 9, a side view of a smaller specimen.

Ataphrus, Gabb.

Palæontology of California, vol. 2, p. 171.

Additional material has enabled me to become better acquainted with this genus, and obliges me to modify a little the generic description. The inner lip is rounded above, on the body whorl, and merges insensibly into the adjoining surface, covering up the umbilicus; but, instead of being round all of the way down, as described, it ends abruptly just at, or a very little in advance of, the umbilicus, in a little tubercle, on the outer or front face of the pillar, below which the lip is slightly grooved. The position I assigned it, associated with *Oxystele* and *Photinula*, is correct, it differing from the former in having the tubercle and the anterior groove, instead of being flattened; and in wanting the angular termination of the latter.

The figure of *A. crassus* is incorrect, in that it makes the pillar lip round all of the way down.

A. compactus, Gabb.

Littorina, *id.*, G., Pal. Cal., v. 1, p. 131, pl. 20, f. 89.

This is a member of the genus, but the figure and description are incorrect in the one character of the inner lip. Better specimens than the original (which, like that of *A. crassus*, were slightly weathered) show that the groove should only have been represented as extending half way up the inner lip, the upper half being regularly rounded and terminating in the tubercle mentioned. The anterior end of the mouth also is rounder than the figure.

In addition to the above, I have another species from the cretaceous of North Carolina. This shell, from the character of its fossilization gives us another character, the pearly structure; an additional proof of its family affinities, and one which was not attainable in its Californian congeners.

A. Kerri, n. s. Pl. 17, f. 10.

Shell small, turbinate; spire slightly elevated, whorls five, convex above and below, and obscurely angulated in the middle; suture well marked, following the angle in all the upper whorls, but in the adult shell, for the last fourth of a volution, descending at a slightly increased angle. Entire surface covered by small closely placed revolving ribs with acute interspaces. Aperture circular, outer lip retreating very obliquely from the suture and then regularly curving downwards on the middle of the upper half of the whorl; edge acute. Inner lip covering all of the minute umbilicus and then truncated abruptly, a little in advance, as described above.

Height 0.15 inch; diameter 0.21 inch.

A beautiful little shell, closely allied to *A. compactus*, but differing in being less elevated, in the subangulated whorls, in the more rapidly descending suture, near the mouth, and in the sculpture. In *compactus* the sculpture is a series of rather strong, though small revolving ribs. In *A. Kerri* the ribs are so close together, and the interspaces so small that in one case they became nearly obsolete. In another, however, they are stronger, approaching the Californian shell. *A. crassus* differs from this species in the entire absence of revolving sculpture and of angulation, and in its more sloping top.

Turnus, Gabb.

Subgenus *Xylophagella*, Meek.

T. (X.) contortus, Gabb.

Teredo contorta, G., Proc. Acad., 1861, p. 323.

A study of the valve of this species shows it to be an allied species to *T.* (*X.*) *elegantula*, but more oblique, and differing in sculpture.

Martesia, Leach.

M. cretacea, Gabb.

Pholas, *id.*, Gabb, J. Acad., 2 s. v. 4, p. 393, pl. 68, f. 18 (tube). *Id.*, G. Proc. Acad., 1861, p. 324 (shell).

Rare in the marls of New Jersey. The tubes are occasionally found perforating wood, but replaced by pyrites. I have before me an excellently preserved shell with both valves in contact, and which shows clearly the generic characters.

M. cithara, Mort. sp.

Pholas, *id.*, Morton. Syn. Cret., p. 68, pl. 9, f. 2.

P. pectorosa, Con., J. Acad., 2 s. v. 2, p. 293, pl. 24, f. 9.

Equally rare with the preceding. I have never seen but the two respective types.

Leptosolen, Con.

L. biplicata, Con., J. Conch., v. 3, p. 15.

Siliquaria, *id.*, Con., J. Acad., 2 s. v. 3, p. 324, pl. 34, f. 17.

Not rare on Pataula Creek, Clay Co., Georgia, Dr. Little.

Legumen, Con.

L. planulatus, Con. (sp.).

Solemya, *id.*, Con., J. Acad., 2 s. v. 2, p. 274, pl. 24, f. 11.

Legumen, *id.*, Gabb, Syn. Cret., 1861, p. 133.

L. elliptica, Con., Journ. Acad., 2 s. v. 3, p. 325, pl. 34, f. 19.

L. appressa, Con., *loc. cit.*, p. 325.

A fine shell growing three inches long; several specimens from Pataula Creek, Georgia. It is one of the most widely diffused species in the Ripley marl. On comparing the various types of the above names, I find that the names have been given to different ages of the same shell. The lines of growth at the same age in all the forms have the same direction.

PERIPLOMYA, Con.

Leptomya, Con., Nat. Ad.

Plicomya, Stol.

P. elliptica, Gabb.

Anatina, *id.*, Gabb, Proc. Acad., 1861, p. 324.

I place this shell under the above generic name, in accordance with the opinion of Mr. Conrad, who has examined seven original specimens, and recognized its generic relations. It is an extremely rare shell.

SOLYMA, Con.

Not *Solemya* (as in index).

S. lineolatus, Con., Journ. Conch., vol. 6, p. 75, pl. 3, f. 9.

Mr. Conrad has identified for me, under the above name, a little shell out of the Georgia collection of Dr. Little, from Pataula Creek. It is a little more than half as wide as long, the beak is median, the two ends are very nearly equal, and the base is very slightly convex. Although mine is a left valve, I am unable to describe this part of the hinge, since, in cleaning away the marl, the teeth were destroyed. These fossils are so fragile that, until after being hardened by gum, a breath will almost destroy them. Mr. Conrad, who cleaned this hinge, saw the teeth just at the moment of their destruction.

PHOLADOMYA, Sby.

P. Littlei, n. s.

Shell very large, gibbous, beaks large, prominent, nearly in contact, placed about a third of the length from the anterior end. Base irregularly convex, most prominent a little behind the middle, from which it slopes up with a broad gentle curve to the anterior end; posterior end broader than the anterior and gaping. Surface marked by about a dozen large acute ribs, with broad concave interspaces. The anterior end is not costate, or very faintly so; the first well-marked rib descends directly from the front part of the umbone directly to the base, curving slightly forward at its lower end. The strongest ribs are on the middle of the shell, and they are somewhat more widely placed, and become more oblique posteriorly.

Length 6 inches, width from beak to base 4 inches, diameter of both valves 3 inches.

This is the finest species of the genus with which I am acquainted, and I dedicate it with pleasure to Dr. Little, State Geologist of Georgia, who sent me three well-preserved specimens, one retaining the greater part of its surface, from Pataula Creek, Clay County. It can be at once recognized by its few large ribs, increasing rather than diminishing in size posteriorly, and in being less oblique than *P. occidentalis*, Morton, the only other large species known in America. It is twice the linear size of that shell.

CYMBOPHORA, Gabb.

C. lintea, Con. sp.

Cardium (*Protocardia*) *linteum*, Con., J. Acad., 2 s., v. 4, p. 278, pl. 46, f. 17.

Veleda, *id.*, Con., Journ. Conch. 1871, p. 74.

Veleda, *id.*, Con., Kerr's Geol. Rep. N. Car., p. 9, pl. 1, fig. 26.

Dr. Little sent me a good suite of this species, and on uncovering the hinge, I cannot find any valid difference between it and my typical form, on which to base a generic separation, unless it be on a peculiar cross striation of the lateral teeth, which I did not observe in the Californian shells. The species attains a large size. One specimen measures: length 4 inches, width 3 inches, depth of single valve 1 inch. In its young state it is thin, but becomes quite thick as it grows older. I have ventured to associate these large specimens with Mr. Conrad's species, although in all of them the hinges are destroyed; but I can find no good grounds either in form or surface markings for separating them. My smaller specimens on which I identified the species are an inch and a half long.

SCHIZODESMA, Gray.

? S. appressa, n. s.

Shell small, subtriangular, flattened, thin; beaks sub-central, a little in advance of the middle; anterior end rounded; posterior end produced, subtruncated, cardinal margins sloping rather rapidly from the beaks; base broadly convex; a distinct umbonal ridge runs from the beaks to the posterior basal angle; and one less marked runs nearly parallel with the posterior cardinal margin to the upper angle of the truncated posterior end. Surface marked only by lines of growth. The hinge agrees better with the above genus than with any other described; in the left valve the V-shaped tooth is delicate, though well marked, and encroaches slightly on the deep ligament pit; the lateral teeth are very small, short, and thin. The species can be at once distinguished from the preceding by its shape.

Length 1.2 inch; width 0.9 inch.

A rare species, from Pataula Creek, Georgia; Dr. Little.

Tenea, Con.

T. pinguis, Con. (sp.)

Lucina, *id.*, Con., Journ. Acad., 2 ser., vol. 2, p. 275, pl. 24, fig. 18.

Diplodonta parilis, Con., *loc. cit.*, vol. 4, p. 278, pl. 46, f. 16 (not 8 as in text).

Mysia gibbosa, Gabb, *loc. cit.*, vol. 4, p. 302, pl. 48, f. 17 (not f. 18 as in text).

Tenea parilis, Con., Journ. Conch., v. 6, p. 73, pl. 3, f. 12, *id.*, Con., Kerr's Geol. Rep. N. Car., p. 8, pl. 2, f. 25.

Mr. Conrad and I redescribed this species simultaneously in the 4th volume of the Academy's Journal, both of us overlooking the fact that it had been previously described as a *Lucina* and with a bad illustration. It does not possess the angular base given to it in vol. 2.

Tellina, Linn.

Tellinella, Gray.

T. (T.) Georgiana, n. s.

Shell moderately large, elongate; beaks central, elevated, anterior end produced, rounded; base very slightly convex; posterior end subangulated below, arched above; a strong umbonal ridge runs from the beaks to the angle. Surface destroyed on the only specimen I have seen.

Length 2.6 inches; width 1.25 inch.

The impression of the hinge is preserved in the matrix, and the shell is so strongly characterized by its form that I have not hesitated to describe it. It is from Pataula Creek, Georgia, in a hard calcareous marl.

Gari, Schum.

G. elliptica, n. s.

Shell moderately large, very thin, subelliptical in outline; beaks central, somewhat elevated; anterior end prominent above the middle, retreating below with a gentle curve to the base;

posterior end rounded, broader than the anterior; base most prominent a little in advance of the beaks. Surface marked by irregular lines of growth. Ligamental grove strongly marked; hinge consisting of two teeth in the right valve and one bifid tooth in the left.

Length 2.4 inches; width 1.5 inch.

This shell resembles in size and general shape *G. texta*, Gabb, of the Californian cretaceous, but is not so narrowed anteriorly; is less obliquely truncated posteriorly, and the beaks are more elevated; it also differs in the surface.

From the Ripley marl, Pataula Creek, Georgia.

PERONÆODERMA, Poli.

P. Georgiana, n. s.

Shell small, thin, flattened; elongate, beaks subcentral; in one case in the middle, in another a little posterior; cardinal margins sloping about equally towards both ends. Anterior end prominently and narrowly rounded; posterior rounded, subtruncate; base broadly and regularly convex. Surface marked by fine, regular concentric lines. Hinge composed of minute teeth.

Length 1.2 inch; width 0.8 inch.

Intermediate in form and size between *T. Hoffmani* and *T. longa* of the Californian cretaceous and differing from both in having the posterior cardinal margin convex, instead of concave. In this character and in the rounded base, it differs also from *Œneplana*, Conrad, of the N. Carolina Cretaceous. Two specimens from Pataula Creek, Georgia; Dr. Little.

CYPRIMERIA, Con.

C. depressa, Con., Kerr's Rep. Geol. N. C., p. 9, Palæontology.

Dosinia depressa, Con., J. Acad., 2 s., v. 4, p. 278, pl. 46, f. 6.

Sanguinolaria cretacea, Con., *loc. cit.*, p. 277, pl. 46, f. 11.

C. Cretacensis, Con., J. Conch., 1867, p. 9.

C. cretacea, Con., J. Conch., 1869, p. 98, not C. *cretacea* (Dosinia) Zittel, Con., J. Conch., 1866, p. 102.

Dosinia Haddonfieldensis, Lea, Proc. Acad. 1861, p. 149.

Georgia specimens, from Doctor Little, differ only from those from Alabama in being nearly twice the size.

C. torta, n. s.

Shell large, discoidal, inequivalve, the right valve more convex than the left; beaks in advance of the middle; anterior end and base regularly rounded; posterior narrowed, truncated and strongly deflected to the left side, more so below than above. Surface unknown.

An internal cast from Georgetown, Ga., from Dr. Little, measuring: length 3.0 inches, width 2.5 inches, internal diameter of valves 1.0 inch.

From *C. densata*, Con., the present species can be at once distinguished by its being shorter and in having the posterior cardinal margin nearly straight. From *C. excavata*, Morton (sp.), by being more quadrate and longer. From C. *Texana*, Roem. (sp.), in being narrower and more produced behind. I have casts from Texas of another species approaching this, certainly a different species, but too close to describe without more material than mere internal casts.

Cardium, Linn.

Subgenus *Pachycardium*, Con.

Stoliczka does not approve of Conrad's genus *Pachycardium*, and is inclined to associate it with *Pseudocardia.* The type *P. Spillmani*, if it does not stand as a separate genus, should rather be placed with *Lævicardium* than with *Protocardia*, since it has no ribs on the posterior face and only half a dozen obsolete radiating lines on the umbonal angle. It is clearly not a *Lævicardium*, from which it is separated by its very thick shell structure, its elongate form, and by the irregular transverse corrugations following the lines of growth. Most if not all of the *Lævicardia* are thin, delicate shells with polished surfaces. Whether the East Indian *bisectum* belongs to this genus or not, *C. Spillmani* should, in my opinion, be taken as the type of a separate genus, or subgenus.

Casts are not rare in a sandstone at Georgetown, Georgia. They show that the hinge teeth were enormously developed, especially the laterals; the muscular scars are very deep and, in advance of the posterior muscle, there is a thickening of the shell, broad and rounded and occupying the position of the plate of *Cucullæa.* The posterior portion of the internal margin is crenulated, but more closely than the part corresponding to the ribs on the umbonal ridge. The species is also found as casts in the brown and black marls of New Jersey, and associated with them I have a cast, more globose than any of the specimens that can be referred to Conrad's species. It is of the same size, shows traces of the same surface markings, but is broader, rounder, and has the beaks much nearer and more incurved than the internal moulds of either the other Jersey specimens, or those of Mr. Conrad from Mississippi.

Subgenus *Trachycardium*, Mörch.

C. (T.) Carolinense, Con., Kerr's Rep. Geol. N. C. Palæont., p. 7, pl. 2, f. 1.

A larger shell than *C. Eufaulense*, Con., more circular in outline and less angulated on the umbonal ridge. It is very closely related, however, and requires care and good specimens to distinguish it.

Not rare at Pataula Creek, Georgia; Dr. Little.

C. (T.) Eufaulense, Con.

Cardium (T.) id., Con., Journ. Acad., 2 s. vol. 4, p. 282, pl. 46, f. 12.

A single valve from Quitman Co., Georgia; Dr. Little. This shell is common in North Carolina.

C. (T.) Alabamense, Gabb.

Cardium multiradiatum, Gabb, Journ. Acad., 2 s., vol. 4, p. 395, pl. 68, f. 29; *not id.*, Sby., Darwin's Geol. Obs. S. A., p. 251, pl. 2, f. 16.

All three of these shells differ from the typical form of *Trachycardium* in having smooth ribs, in which character they approach *Cerastoderma*, with which probably they might better be associated.

GRANOCARDIUM, Gabb.

C. (G.) Tippanum, Con.

Cardium, *id.*, Con., J. Acad., 2 s., vol. 3, p. 326, pl. 34, f. 8 b.

Granocardium, *id.*, Gabb, Pal. Cal., vol. 2, p. 266.

Casts of this species are not rare in a hard brownish sandstone at Pataula Creek, Georgia.

CRASSATELLA, Lam.

C. pteropsis, Con., J. Acad., 2 s., vol. 4, p. 279, pl. 46, f. 5.

A rare shell at Pataula Creek, Georgia, though very common in North Carolina.

C. vadosa, Morton, Syn., p. 66, pl. 13, f. 12.

C. Ripleyana, Con., J. Acad., 2 s., vol. 3, p. 327, pl. 35, f. 3.

C. lintea, Con., *loc. cit.*, vol. 4, p. 279, pl. 46, f. 5.

C. Ripleyana of Conrad is the typical form of the species, previously described by Morton; convex on its posterior cardinal margin in the young state and straight or slightly concave below towards the posterior angle. *C. lintea* is a shell of the same species, having attained but half its full diameter. I am not sure but that *C. Carolinensis*, Con. (Kerr's N. Carolina Report, Palæontological Appendix, p. 6), should also be put down as a synonym. I only know it from the figure in the report, but the shape is very close to *lintea*, and the identity of this, I have proven by a critical comparison of the original specimens.

C. sp. indet.

A cast in brown sandstone, sent by Dr. Little from Pataula Creek, Georgia. The impression of the hinge is perfectly preserved, as well as most of the outline. It is two and a half inches long by two wide and rather flat. The posterior cardinal line is slightly arched throughout, and the posterior end broadly rounded. I do not think it belongs to any described species, but refrain from naming it until better material is found.

Anthonya, Gabb.

Scambula, Con.

Anthonya, G., Palæontology of Cal. 1864, p. 181, pl. 30, f. 236, a.
Scambula, Con., Journ. Conch., 1869, p. 48, pl. 9, f. 7-8.

On comparing my types of *A. cultriformis*, with those of Mr. Conrad's *S. perplana*, it proves that they are generically identical. the hinges agreeing perfectly. There is only one difference, and that of minor importance; my shell, which is very long, is slightly twisted, while Mr. Conrad's, which is much shorter, is all on one plane.

Opis, Dep.?

O. Conradi, Gabb,
Isocardia, id., G., Journ. Acad., 2 ser., vol. 4, p. 393, pl. 68, f. 21.

Lithophaga, Bolt.

Lithodomus, Cuv., *Lithophagus*, Muhlf.

L. Ripleyana, Gabb, Proc. Acad., 1861, p. 326.
L. affinis, G., *loc. cit.*, p. 327.
Arcoperna Carolinensis, Con., Kerr's N. C. Rep., Pal., p. 5, pl. 1, f. 6.

I named *L. affinis*, a form shorter, more convex, and a little curved, but I do not now believe that even a greater difference in form in a boring shell can be made the basis of a specific distinction, unless repeated in a very large suite of specimens. Mr. Conrad's name must be placed as a synonym; his figure agrees exactly with specimens of my species, which is not rare. I have before me a large series, some showing the valves perfectly preserved, and others bedded partially and entirely in fossil wood.

INOCERAMUS, Sby.

I. Tippanus, Con. (sp.).

Pholadomya Tippana, Con., J. A., 2 s., v. 3, p. 324, pl. 34, f. 9.
I. costellatus, Con., *loc. cit.*, p. 329, pl. 34, f. 12.

A rare shell; very thin and marked by both radiating and concentric sculpture. It is very inequivalve, as will be seen by the figure 12 above quoted.

TRIGONIA, Brug.

T. Leana, Gabb.

Trigonia Gibboniana, G., Pal. Cal., vol. 1, p. 190, pl. 17, f. 178; pl. 31, f. 262, not *T. Gibboniana*, Lea, Trans. Amer. P. Soc., 2 s., v. 7, p. 255, pl. 9, f. 7, 9.

From the rather poor figure and imperfect description of Mr. Lea, quoted above, I made a doubtful identification of the Californian shell with the South American. Recently, while studying some fossils from Peru, Mr. Lea kindly placed his types at my disposal, and, among other errors I have been enabled to correct, is this one. Our two species are of the same type, but they differ very materially in the ornamentation. I have therefore renamed the Californian species.

T. thoracica, Morton, Synopsis, p. 65, pl. 15, f. 13.

From the Ripley of Pataula Creek, Georgia; Dr. Little.

T. angulicosta, n. s.

Shell small, elongate, curved; anterior end regularly convex; base broadly rounded in the middle, slightly concave posteriorly; posterior cardinal line concave; posterior end prolonged, truncate. Surface divided by a ridge, separating the corselet from the broader part; corselet crossed by transverse ribs, corresponding in number to those below; towards the end these are directed obliquely backwards. Outer surface divided into three parts; nearest the beaks it is marked on the anterior half of the adult shell by about ten or a dozen prominent ribs, most of which, after traversing half the distance from the corselet to the base, suddenly bend forward at a slightly acute angle, and terminate at the anterior margin of the shell; posterior to these are about ten more ribs, which traverse the entire width, from the corselet to the base. On the anterior half of the basal margin are some short ribs, parallel with those last described, and which arise abutting against the lowest of the antero-posterior ribs, and reach the margin, becoming oblique forward until the most anterior becomes nearly parallel with the rib against which it originates.

Length 1.75 inch; width 1.3 inch.

From Pataula Creek, Georgia; Dr. Little.

This very peculiar shell has an internal cast not unlike *T. thoracica*, with which it is found associated; but its surface sculpture is unlike any other species with which I am acquainted. I have two fragmentary specimens before me, showing part of the surface but none of the antero-basal ribs described above. The details of the description are drawn from the impression of an entire surface in a hard sandstone.

VENILIA, Mort.

V. Conradi, Morton, Syn. p. 67, pl. 8, f. 1–2.

A cast of this species occurs in the same block with one of the casts of the preceding.

IDONEARCA, Con.

A genus represented in the Cretaceous of New Jersey alone by about a dozen species. Some of these are as yet undescribed for want of sufficient material, and most of them are known only from internal moulds.

I. vulgaris, Morton (sp.).

Cucullæa, id., Morton, Syn. Cret., p. 64, pl. 3, f. 8, and pl. 13, f. 5.

The commonest species. Casts (pl. 13, f. 5) are abundant in the marls, and are known as "squirrel heads" by the country boys. The cast is recognizable by its oblique form and prominent remote beaks. Dr. Morton described the shell from specimens from Arneytown, N. J. (pl. 3, f. 8). It is variable in its obliquity and convexity, the umbonal ridge being sometimes arched backwards and sometime straight, as seen from the side; the posterior face is nearly flat. The area is large.

I. neglecta, Gabb.

Cucullæa, id., Gabb., Proc. Acad., 1861, p. 326.

This species is not rare in the marls of New Jersey, and I have seen casts from the white limestone of Prairie Bluff, Ala., apparently belonging to it. Recently I have obtained from Prof. Cook, State Geologist of New Jersey, specimens from the New Jersey white limestone (Timber Creek limestone) in which the shells are in a beautiful state of preservation. The valves are subcompressed; beak small, placed a little in advance of the middle; area narrow, about half as long as the shell, and marked by very few impressed lines; hinge thin, median teeth few and small, lateral teeth long, narrow, and few. Base and anterior end regularly and broadly curved; posterior side convex and sloping, not angulated at the base. No umbonal ridge; surface regularly convex, sloping in a little, more abruptly on the posterior side than elsewhere. Surface smooth, marked only by a few obscure lines of growth.

Length 1.75 inch; width 1.4 inch; height of single valve 0.4. inch.

I. Carolinensis.

Shell subquadrate, convex, hinge line just one-half the length of the shell; beaks small, incurved, umbones prominent and rounded; posterior slope nearly vertical; anterior end regularly rounded, retreating obliquely below; base broadly convex, most prominent in the middle. Surface in the adult marked only by irregular lines of growth; in the young crossed by very numerous and very fine radiating lines; hinge small. In the adult the middle (transverse) teeth show a tendency to irregularity, and even partial obliteration. Lateral teeth perfectly parallel with the hinge line; area small. Internal plate thin and elevated.

Length 2.0 inches; width 1.5 inch; depth of single valves .75 inch.

This species grows about the size of *I. vulgaris*, but is less oblique, with rounder outlines and a more central beak. The area is smaller, and the whole shell is more quadrate. The markings of the young shell are as minute as those of *Trigonarca Saffordi*, G., but of a different character, and the present species is proportionally shorter, more oblique, and more convex than that. *I. capax*, Conrad, is a heavy shell, remarkably thick, and will, I think, prove to be identical with *vulgaris*. I referred it to *antrosa* by mistake in the Synopsis of Cret. Mollusca for that species. From *I. neglecta* this species can be at once distinguished by the more convex valves and by the umbonal angle.

From the Ripley Group, Snow Hill, N. Carolina.

I. Alabamensis, n. s.

Shell convex, oblique; area less than half the length of the shell; very narrow; beaks small, approximating; umbones small; anterior end broadly rounded, not retreating below; base convex in front, straight behind; posterior side oblique, uniting with the base by a marked angle; umbonal angle rounded, but narrow and abrupt; posterior face truncated; hinge narrow.

Length 1.5 inch; width 1.25 inch; depth of single valve 0.6 inch.

The nearest ally of this species is the preceding. It can be distinguished by the smaller beaks, much narrower area, the broader anterior end, the base straight behind, instead of being regularly convex, and by the strong umbonal angle and more truncated posterior end.

I have not attempted to describe the surface, since although the shell is well represented in all its details, except that, in the specimen before me, the shell substance has been replaced by a boring sponge (? *Cliona*); the shell itself has disappeared and the sponge has taken exactly its form except a thin outer film. Even two or three strong concentric lines of growth have left their impression on the sponge. This unique specimen, which might well serve as the type of two species of widely different organisms, is from the white limestone of Prairie Bluffs, Ala.

? **I. antrosa**, Mort. (sp.)

Cucullæa, id., Morton, Synopsis, p. 68, pl. 13, fig. 6.

A very convex form, almost as short as an *Axinæa* with central beaks and a strong internal plate. The species is only known from casts, although it was described over forty years ago. Its hinge line is so curved that it may prove eventually to be a *Trigonarca*, and may even belong to Conrad's subgenus *Breviarca*. I have placed it under the above genus in accordance with the opinion of Mr. Conrad, with whom I have consulted on the subject.

I. sp. ?

Associated with the casts of *antrosa* are some of a more elongated and angulated form, evidently an undescribed species.

Besides the difference of outline, it has a remarkably thick internal plate running far up into the cavity under the umbones. A mashed shell from Haddonfield, found by Mr. Conrad, and evidently of this species, shows the surface to be plain, marked only by lines of growth.

The Academy's collection contains also two other species of this genus from New Jersey, represented by internal casts, but which I refrain from describing, trusting that we may obtain more material in the future.

I. Littlei, n. s.

Shell very large, oblique, gibbous, beaks large, prominent, remote, incurved; area broad; anterior end prominent, narrowly rounded, retreating below; posterior end obliquely sloping; base nearly straight, most prominent below the beaks; internal plate very large, prominent and continued up into the cavity under the beaks. Surface marked by coarse lines of growth.

Length (of casts) 5 inches; width 4.8 inches, greatest transverse diameter 4 inches.

This enormous species, not surpassed in size even by *Arca grandis*, is described from a nodular mass showing at the same time the impression of the surface and the mould of the interior. I take pleasure in dedicating this, the largest species of the family, to the State Geologist of Georgia, despite the fact that the name might be punningly suggestive of a specific character, especially inappropriate. It is from Pataula Creek, Georgia.

Nemodon, Con.

N. angulatum, Gabb.

Leda, id., Gabb, Proc. Acad. 1860, p. 94, pl. 2, fig. 12.

A re-examination of this species shows it to belong to Mr. Conrad's genus.

Trigonarca, Con.

T. cuneata, n. s.

Shell small, obligue; beaks slightly in advance of the centre, small, incurved, and approximated; area very small and marked by numerous transverse lines; anterior end produced, narrowly rounded, most prominent below; posterior side very sloping, the posterior end of the area being barely visible beyond the umbonal ridge; below the posterior end is narrow and caudate, almost like some Crassatellas; base slightly convex in advance, nearly straight, or even a little concave and sloping upwards behind; umbonal ridge strongly marked; posterior face truncated; surface marked by obsolete radiating lines, and by stronger lines of growth. Hinge broad and with numerous radiately placed teeth.

Length 1.1 inch; width 1.0 inch; depth of valve 0.3 inch.

Very closely allied in generic character to *T. Maconensis*, Con., the type of the genus, but differs in its small size, the measurements being given from the largest of a large series. In shape it differs in being proportionally much larger, less produced in front and more produced behind, and in having a less rounded base.

Of about the same size as *Breviarca Carolinensis*, Con., it is a more robust shell, with a stronger umbonal ridge; is caudate behind instead of being convex; is less prominent in front, and is altogether a much more triangular shell.

Abundant at Pataula Creek, Clay Co., Georgia.

Axinœa, Poli.

A. hamula, Morton, sp.

Pectunculus hamulus, Morton, Syn. Cret., p. 64, pl. 15, f. 7.

? *A. bellasculpta*, Con., J. Acad., 2 s., v. 4, p. 295.

The posterior extremity is *not* angulated as described by Dr. Morton. His description and figure would be unintelligible without his types. His specimens are slightly truncated posteriorly though very faintly, and others are equally round on both margins. There seems to be a considerable difference in the amount of convexity in the species, and, although I have not seen so many specimens as I would like, I think fuller series will prove that there is no difference between this and *A. subaustralis*, d'Orb. (*P. australis*, Mort., not Quoy). The only character depended on is the convexity, and that certainly varies very much in Georgia specimens sent me by Doctor Little. In fact, in some cases I am in doubt whether to call them by one or the other name, with Dr. Morton's types beside them. With about the same longitudinal and transverse diameters, the deepness of the valve of Morton's original *hamula* is .5 inch, while that of *Australis* is .25 inch. All of the casts (there are no shells) from New Jersey, are of this latter form, though Dr. Morton speaks of them as another species. The character on which Mr. Conrad separated *A. bellasculpta* is visible on some of the Georgia specimens, to a less degree than on his types from Mississippi, and on comparing the whole series, I can find no valid ground for a specific distinction between them and *A. hamula.*

Nucula, Lam.

N. percrassa, Con.

Journ. Acad., 2 s., v. 3, p. 327, pl. 35, f. 4.

A fine species, common at Pataula Creek, Ga.

N. Slackiana, Gabb.

Leda, id., G., Journ. Acad., 2 s., v. 4, p. 397, pl. 68, f. 37.

This was described from casts in the marls of New Jersey; the surface characters have never been obtained, but from its size and shape I have little doubt it will prove identical with *percrassa.*

Nuculana, Link.

Leda, Schum.

It is doubtful if the names of Link should be regarded. To all intents and purposes his book was never published, although printed, until the names were resurrected by Mörch. I, however, under protest, follow H. & A. Adams, Stoliczka, Conrad, and Meek in the use of this name, regretting the habit so common of "reducing scientific nomenclature to a branch of archæological research."

N. protexta, Gabb (sp.), Meek, Check List, No. 204.

Leda, id., Gabb, Journ. Acad., 2 s., v. 4, p. 303, pl. 48, f. 23.

A single specimen from Pataula Creek, Georgia.

Camptonectes, Agas.

C. Burlingtonensis, Gabb.

Pecten, id., Gabb., Journ. Acad., 2 s. v. 4, p. 304, pl. 48, f. 25.

One of our finest *Pectens.* It was described from a very perfect mould in the brown sandy marl of New Jersey. Since then Mr. Conrad has found the shell in the Ripley marl of Haddonfield, New Jersey. The right ear of the lower valve is long and narrow, and has a very deep, narrow sinus. The surface is marked by regularly placed thin subsquamose plates surmounting each a small concentric ridge. Between these plates are visible very minute radiating impressed lines. This radiating sculpture is only visible on well-preserved specimens, and, while it takes the directions common in Agassiz's genus, it differs from all the previously described species in its almost invisible character.

SINCYCLONEMA, Meek.

S. simplicius, Con., Meek, Check List Cretaceous, No. 196.
Pecten, *id.*, Con., J. Acad., 2 s. v. 4, p. 283, pl. 46, f. 44.

This little shell grows to a diameter of 0.6 inch, and is an abundant fossil. In the older specimens, many are marked by strong concentric squamose ridges, between which are microscopic radiating lines.

NEITHEA, Drouet.

N. complexicosta, n. s.

Shell moderate in size; lower valve deeply convex, upper valve unknown. Surface marked by six large ribs, regularly distributed at equal distances, between each pair of which are two smaller ones. Each rib, large and small, is divided on its upper surface into three thread like ridges; the interspaces between the ribs are regularly concave, and without longitudinal marking; entire surface crossed by minute, regularly placed subsquamose lines.

Length one inch. Locality, Uniontown, Ala.

A very pretty species, of the typical shape of *N. quinquecostata*, etc., but differing from all the described species in the character of its ribs. It is probably nearest to D'Orbigny's *N. striato-costata*, but the large and small ribs are more nearly equal in size, and they differ in the manner in which the ribs are ornamented. In our species, the broad concave interspace rounds up to nearly the full height of the rib, and only on the top does it show the two grooves which divide it into three little linear ribs. *N. alpina*, D'Orb., has the same number of large and small ribs, but they are rounded and plain on top.

ANOMIA, Linn.

A. argentaria, Morton, Syn. p. 61, pl. 5, f. 10.
A. tellinoides, Mort., *loc. cit.*, p. 61, pl. 5, f. 11.
A. sellæformis, Con., J. A., 2 s. v. 3, p. 330, pl. 34, f. 6.

I have compared large suites, including Dr. Morton's original specimens, and conclude that all three of the above names must go together. The differences depended on for the separation were only those of outline, and there is no possible ground for the second specific name given by Dr. Morton. Mr. Conrad's name was given to a single specimen distorted by growing on an irregular surface. The species is common at Pataula Creek, Georgia, and grows to more than an inch in diameter. The most regular form, before the shell becomes distorted, is nearly circular, with a well-marked little beak, adjoining to, and sometimes overhanging the cardinal margin. The surface is faintly squamose and ornamented by microscopic radiating lines.

Accompanying these is another form, represented by no less than fifteen specimens agreeing well with one another. Unlike the typical *A. argentaria*, they are ornamented by a uniform pattern, clearly not the impression of a surface, to which they were attached. In form and size they do not differ from *A. argentaria*, but the ornament is a series of radiating ribs, one set large, flattened on top, and well defined; between these are interpolated from one to three smaller ribs. In most cases this alternation is well defined; though in two or three the large ribs are nearer in size to the small ones. On the typical *argentaria* this radiation is never observed, even in a rudimentary manner, and on some of my specimens it begins at the very apex; but on several the first half inch in diameter, or less, of the shell does not differ from *argentaria*, while after that the ribs begin, first on thread-like lines, finally developing to full size. In consequence of this I feel reluctant to separate the form as a distinct species, believing that more material will merge the two. I therefore content myself with proposing the name of *A. argentaria*, var. *ornata*.

Paranomia, Con.

P. Saffordi, Con., Journ. Acad., 2 s. v. 4, p. 290, pl. 46, f. 21.

Several specimens from Pataula Creek, Georgia.

Ostrea, Linn.

O. subspatulata, Fbs., Quart. Journ. G. Soc., v. 1, p. 61.

Five miles north of Lumpkin, Stewart County, and near Fort Gaines, Georgia; Dr. Little. The species is characterized, even when not two inches long, by a tendency to great thickening of the upper half, the lower half being a thin tongue-like process.

O. larva, Lam., A. S. V., v. 6, p. 216.
O. falcata, Morton, Syn., p. 50, pl. 3, f. 5.

Not common at Georgetown, Quitman Co., Georgia.

O. plumosa, Morton, Syn., p. 51, pl. 3, f. 9.

With the preceding.

O. pusilla, Nills., Petr. Suec., p. 32, pl. 11, f. 7, *a–c*.

O. tecticosta, Gabb, Journ. Acad., 2 s. v. 4, p. 403, pl. 68, f. 47, 48.

From Georgetown, Pataula Creek, and five miles north of Lumpkin, Stewart County, Georgia. Some of the specimens are much larger and broader than those from Tennessee and New Jersey, from which I described the species. I am convinced that not only is this shell identical with the Swiss species, but, by looking over Nillson's work, there are nearly a dozen others that will probably prove synonymous. Among these might be mentioned *Gryphæa lateralis* and *Ostrea larva*, of which the broad form, called by Nillson *O. lunata*, also occurs in New Jersey.

O. Bryanii, n. s.

Shell moderate in size, subtrigonal, oblique, irregular in outline, rather thick. Lower valve deep, upper valve flat, or more or less concave towards the basal margin. Shell usually free, sometimes showing signs of attachment near the beak; surface irregularly squamose, more so as it grows older; a few broad but not very prominent radiating lines or ribs are visible usually, though not always, on the most convex part of the lower valve. I have never observed any on the upper valve. Hinge long, triangular, deeply grooved in the middle, and strongly deflected to the left side. Inner margin crenulated, though sometimes obscurely, near the hinge. Muscular scar large.

Usual size about 1 inch to 1.5 in length; I have one specimen three inches long.

Found abundantly near Vincenttown, New Jersey, in the marl at the top of the Cretaceous, by Col. Bryan. In a few minutes, in company with that gentleman, I collected more than fifty specimens on the marl heaps of the West Jersey Marl Co.

O. Littlei, n. s.

Shell small, irregularly elongate-falcate to subtriangular; more regular in the young state; thin. Young shell marked, at least on the lower valve, by faint radiations, which become obsolete in the adult; these are crossed by unusually faint lines of growth, not squamose. Hinge elongate, triangular, deflected to the left. Associated with the lower valves are some upper ones of corresponding form and size, with the same surface markings except that they are not radiated even towards the beaks. The margins are crenulated, corresponding to the ends of the radii in the lower valve.

Length of largest specimen 2.5 inch; width 1.0 inch; depth of lower valves 0.5 inch.

From Pataula Creek and Georgetown, Georgia. I have also found some valves of this species among the undetermined oysters sent me in 1860 by Prof. Safford from the Ripley Marls of Tennessee.

Nearly as smooth as *O. plumosa*, Morton, this shell differs in its more triangular form, elongate, and somewhat bent; the lower valve is subangular and deep, and the young shell has radiations which point to a resemblance to some of the more triangular forms of *O. larva*. From that species it differs in being less falcate than the shortest and broadest specimens, and in having a mere trace of the radiations and none of the marginal plications.

O. exogyrella, n. s.

Shell subequivalve, nearly equilateral, elongate, more or less quadrate; sides subparallel, cardinal margins more or less sloping; beaks usually nearly median, sometimes a little deflected; base rounded; surface marked by distant subsquamose lines of growth not radiated at any stage; hinge broad, shallow, normally triangular, varying to nearly subquadrate.

Length 1 to 2 inches; usual proportion a third longer than wide.

From Pataula Creek and Georgetown, Georgia; Dr. Little.

I have purposely omitted a very important point in the above diagnosis, to mention it more in detail here. The shell shows an additional character, which I have failed to discover in any other true oyster, and which shows the transitional character from *Ostrea* to *Exogyra*. Fortunately, I have a good series of specimens, and every lower valve possesses a "nuclear whorl," if I may be permitted to use such a phrase in connection with a bivalve. In other words, up to a diameter of nearly a quarter of an inch, every specimen has been a well-characterized *Exogyra*. After this the direction of growth changed to a right line, and the spiral is partially imbedded in the succeeding layers, or projects as a slightly deflected tip or beak on an unusually symmetrical oyster. This spiral is on the normal side of *Exogyra*, and under the deflected beak there is a slight emargination, a corresponding convexity existing on the opposite side.

This character is of the greater interest, since it is a transition to the generic characters of the species variously known as *Ostrea*, *Gryphæa* and *Exogyra lateralis*, Nillson, Petr., Suec., pl. 7, f. 9–

10. (*G. vomer*, Morton, Syn. Cret. p. 54, pl. 9, f. 5.) This shell is a well-marked *Exogyra* in its young state, but in some cases in the adult the spiral beak is entirely covered up. Mr. Conrad proposed for this group, although I think on insufficient grounds, the subgeneric name of *Gryphostrea* in the genus *Ostrea*. This last species survived to the Eocene, where it is known in the Paris Basin as *O. eversa*, and in Maryland as *O. sub-eversa*.

Gryphæa.

G. vesicularis, Lam. (sp.), Bronn, Leth. Geog. pl. 32, f. 1.
Ostrea, id., Lam., Am. Mus., v. 8, p. 160, pl. 22, f. 3.

Common at Georgetown, Georgia; Dr. Little.

G. Thirsæ, Gabb, Proc. Acad., 1861, p. 329.

This is a rare species, and seems to be confined to the neighborhood of Alabama and Georgia. I described it from the former State, and now have it from near Fort Gaines, Georgia, whence it was sent by Dr. Little. It is intermediate between the narrowest forms of *G. vesicularis* and *G. pitcherii*. From the former it can be distinguished by the sides being narrowed and sloping nearly straight from the umbone, which is narrower and more prominent than is Lamarck's species. From *G. pitcherii*, which it most resembles, it can be distinguished by being less distinctly lobed laterally; by the hinge area of the lower valve being broader and flatter, and by the beak being very minute instead of being large and incurved.

Exogyra, Say.

E. costata, Say, Journ. Phila. Acad., 1 ser., vol. 2, p. 43.

To the already long synonymy of this species must be added *E. interrupta*, Con., Journ. Acad., 2 s. v. 3, p. 330, pl. 34, f. 15.

I have this latter, which is only an attached lower valve of *E. costata*, of every size and of every degree of attachment from an almost total obliteration of the ribs, to a perfectly free and typical *costata*. They are marked Georgetown, and five miles north of Lumpkin, Stewart County, Georgia.

Discoidea occidentalis, Gabb.

This echinoderm was described by me as coming from the Cretaceous of Oregon. It was given me by a friend, who at the same time told me that was the locality. Since then an extensive acquaintance with the Cretaceous rocks of the west coast of North America, including not a little with the geology of Oregon, renders me doubtful of the accuracy of the information. The specimen is preserved in a light-colored limestone, entirely unlike anything I know of in our Pacific States, but which looks suspiciously like some Cretaceous rocks I have seen from Peru. It may consequently prove to be a South American fossil, though this is only a conjecture.

Paliurus. New Genus.

A free serpuloid tube, usually with a triangular cross section externally; circular internally; tube straight or slightly twisted or bent.

P. triangularis, n. s., pl. 17, f. 11, 12, 13.

I propose this name for a common little annelid in the white limestone, found especially abundant at Vincenttown, New Jersey. It is free, and, as above described, has an external triangular cross section; the two ends are open, and the apertures are circular. The carinæ are subangular or rounded, the sides more or less deeply grooved, and the entire shell, usually about three-fourths of an inch long, is slightly twisted or irregularly curved, though varying little from a straight line. The diameter is about .06 or .07 inch.

DECEMBER 5.

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

Forty-two members present.

The following papers were presented for publication:—

"Our Sidereal System and the Direction and Distance of its Centre." By JACOB ENNIS.

"On some Extinct Reptiles and Batrachia from the Fort Union and Fox Hills Beds of Montana." By EDW. D. COPE.

On Ozocerite.—Prof. LEIDY remarked that the fine collection of specimens of Ozocerite, and minerals with which it is found associated, presented this evening by Mr. Paul Dobel, through Dr. F. Migerka, the Austrian Commissioner, were well worthy the attention of the members. The Ozocerite, Erdwachs or mineral wax of the Germans, is found in association with clay, sand, and salt, at Boryslaw, in the Carpathians, Galicia. The collection consists of a fine series of the Ozocerite of different varieties: the ordinary brown resin-like kind; a lemon-yellow flaky form; another lemon-yellow but fibrous kind; a black carbonaceous form, etc., with specimens associated with rock salt, and others with clay and sandstone. Besides these there are a number of specimens obtained from the crude material; a mass of chocolate-brown hue; another undistinguishable in appearance from ordinary yellow beeswax, and a third looking like white wax or like paraffine.

On Hyraceum.—Prof. LEIDY remarked that the large, black bituminous-looking mass presented this evening, through Mr. H. C. Coates, Commissioner of the Colony of Cape of Good Hope, is the substance called Hyraceum, and is said to be the inspissated urine of the *Hyrax capensis*. The animal is reputed to inhabit gregariously, rocky places at the Cape of Good Hope. The accumulated urine in hollows of the rocks, gradually evaporating, is supposed to give rise to the product in question. It is reported as having been employed in medicine with the same effect as castoreum.

Prof. Cope remarked that a material resembling the concretion made by the urine of Hyrax was found in the fissures of the rocks in New Mexico. It was probably the fecal and renal deposit of the wild rat, *Neotoma*.

On Itacolumite.—Prof. W. P. BLAKE remarked that the Mineral Department of the National Museum at the Centennial Exhibition had recently received some specimens of flexible sandstone, reported to be from Mariposa County, California, which are interesting and worthy of note by reason of the new locality, and as showing the peculiarities of this kind of sandstone in a marked degree. The specimens are, also, unusually fine, some being over thirty inches in length, and only two square inches in section. The color and the structure appear to be the same as in flexible sandstone from other localities. Thin and small scales of silver mica are abundant. It bends with little resistance up to a certain point, and without elasticity, but is rigid beyond that point. When held up by one end and shaken, the motion is transmitted in wave-like vibrations as in a cord, but the limit of movement is sensibly felt like a blow or shock. A specimen thirty-two inches in length may be bent seven and a half inches to one side or the other of a straight line. The freedom of movement is greatest at right angles to the plane of lamination. The specimens are also capable of being sensibly extended when pulled. In a specimen thirty-two inches long the extension amounted to about half an inch. No examinations under the microscope have been made, as they should have been, to show the structure. The freedom of movement up to a certain point, and the rigidity beyond that point indicate that there is a tolerably uniform distance between the grains of sand and a certain amount of movement possible among them, and that by bending, the grains are brought into contact with each other. The theory of the late Prof. C. M. Wetherill that the grains of sand are shaped like dumb-bells was referred to with a doubt of its correctness. The part which the scales of mica play can only be shown by the examination under a microscope of carefully ground sections of the stone, which might perhaps be prepared for cutting by solutions of soluble glass.

Prof. Leidy stated that he had examined Itacolumite microscopically without being able to detect anything like the dumb-bell structure described by Dr. Wetherill. He supposed that the intermingling of grains, differing in translucency and color, gave rise to the impression of a dumb-bell arrangement. Thus a pair of adherent translucent grains surrounded with smaller colored ones would give rise to such an impression.

December 12.

The President, Dr. Ruschenberger, in the chair.

Forty-four members present.

DECEMBER 19.

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

Thirty-five members present.

Mineralogical Notes.—Mr. JOSEPH WILLCOX said that the two fine crystals of scapolite, which were presented this evening by Mr. Vaux, were found at a new locality for this mineral, in St. Lawrence County, N. Y., and that a specimen from the same locality had recently been received in this city which weighs about 25 pounds, and is probably the largest scapolite crystal ever found.

He also referred to a specimen of quartz on the table from the well-known locality of green quartz at Blue Hill, in Delaware County, Pa. This specimen had been exposed to the weather for a few weeks, and had lost nearly all its green color. This green quartz is found in several veins of chlorite, much decomposed, and each of different intensity in color. The quartz occurring in each vein corresponds in color to the matrix.

Impurities in Drinking Water.—Mr. WILLCOX also stated that, during the last eight years, whenever the Schuylkill River has been covered with ice, he observed that the water supplied by the city possessed a disagreeable odor and taste, like chlorine. Large quantities of chloride of lime are daily used at Manayunk and at the Wissahickon for bleaching purposes, and the chlorine gas is liberated from it by the application of alum and sulphuric acid. A large portion of the chlorine gas subsequently escapes from the water before it reaches Fairmount; but when the river is covered with ice, this process of purification is retarded, and the offensive element is practically conveyed, in a covered trough, from the mills to the pumps that supply our city with water. He was not competent to state if chlorine in this condition is prejudicial to health. Being a powerful disinfectant it may be a providential interposition for the prevention of disease that might be caused by the foul material that is carried in such profusion through the sewers into the Schuylkill River, and which, on account of the ice, would otherwise be transported into our water-pipes in its original impurity.

On Excrescences and Excentric Wood Growths in the Trunks of Trees.—Mr. THOMAS MEEHAN said that on many trees were peculiar excrescences, which, up to a few years ago, had been referred primarily to insect origin. Cutting these through lengthwise there was no appearance of this agency. There were layers of wood of annual growth, just as in the normal parts of the tree.

Examining some oak knots of this character, and finding pulverulent fungoid matter abundant on the surface, he said he had introduced some of these to the Academy a few years ago, and suggested this as a substitute for the insect theory, but subsequently Professor Farlow had kindly examined them critically and found no trace whatever of fungoid matter in their structure. This left us wholly in the dark as to the exact origin of these stuctures.

It was worth noting that these excrescences were often of a uniform character in each species of tree. In many cases, no matter how large or how old they were, they would separate from the parent stem easily by a short sudden blow. He had made collections of these and in most cases found great uniformity. In *Quercus obtusiloba* they were depressed globose, in *Fagus sylvatica* (American beech) they were convex and oval, with the narrow ends crosswise with the trunk. In the *Acer rubrum* (red maple) they were oval but drawn out lengthwise. In the common weeping willow they varied very much in size, sometimes being as large as a bushel measure, but always knocking out easily as in all named before. In the common cherry (*Cerasus avium*) and the paper mulberry (*Broussonnetia papyrifera*) the excrescences were also very irregular in form, and seemed to have a stronger attachment to the parent stem than the others. The apple had very small and numerous ones in some species ; and it was from an examination of these, he said, that he had derived the key to the whole subject. On the bark of some kinds of apple trees numerous small pea-like projections would exist on the bark within a space of a few inches. On cutting open, these were found to be not vesicular, but to be filled with hard and perfect wood. A careful examination showed that these woody masses took their rise seemingly from the liber, to which, in the newly formed cases, they would be found still attached by a small thread-like vessel.

In order to understand their formation, it was necessary to understand how wood was made. In many trees the annual layer was so regular, and seemed to be placed so nicely, that one not a botanist might be pardoned for believing that the sap was changed to woody matter in the leaves, and the new formed matter sent down, sliding over the old layer like the sections of a telescope; but though the food was prepared by the leaves in a great measure, the actual growth was made by the germination of some of the cells along the whole outside wall of last year's wood beneath the inner bark. In his own observations of this process he had taken the common cherry for his experiments. The germination of the cells takes place here about the middle of June. He takes a healthy cherry tree and strips it entirely of its bark to any length desired. At that season a viscid liquid will be found covering the woody surface in abundance. The stripped part is covered with a cloth to prevent evaporation, and in a few days numerous dots, like needle points, will be seen about the sixteenth of an inch apart all over the surface. These are the young cells which have germinated from those of last year. They continue germinating, one from the other, until they meet, when they unite and form a complete surface. In the fall a layer of wood will be found just as thick as in the part of the tree not disbarked, and a single layer of liber, with its outer coat of cellular matter—perfect bark—will have been formed over the whole. The entire formation of wood and bark can thus be seen by the ordinary observer, without the necessity of any nice microscopical work. Other people have tried the experiment with other trees. He has seen large apple trees that have had their bark peeled wholly off from their trunks, at the season named, make an entire new layer of bark and wood, not only with no injury to the tree, but to its manifest enjoyment; but his own experiments were confined exclusively to the cherry.'

By this experiment we learn that there is no difference primarily in any part of the annual covering. The same cell may become permanent tissue or generating tissue—and from the generative tissue may come before the season of growth closes every form of structure known to anatomists, from pure wood to the outermost cuticle of the bark. How these cells become differentiated may be passed over here. We know that cell-growth is not always uniform in its operations. The law that changes the outermost series of newly made cells into liber need not necessarily operate so exactly as to make them perfect to this end—a few may be thrown off into the liber as generative tissue—and, granting this possibility, we see how the woody granules in the apple bark are formed.

How cells usually of one character may be made to assume others is shown in the formation of adventitious buds. Sachs (Text Book, Eng. ed., p. 563) thinks that few dicotyledons produce adventitious buds. The shoots that often spring from the bark of the older stems of trees, he says, are probably from dormant buds which have retained vitality, though buried from the first growth of the stem. This sort of growth is true. In *Gymnocladus* the buds formed the first year in the axil of the leaves are in a linear series of three or more, of which but one is generally seen above the surface; but after many years, if the bark be gently shaved, these will be found just beneath the surface as they were the first year, having kept along their hidden growth all that time. In some magnolias (*M. acuminata*, *M. tripetela*), besides the axillary bud one forms exactly horizontal to it, on the side opposite to the direction of the spiral growth. This bud is rarely seen above the surface, and has not been before made known to botanists as I believe, but may always be found beneath the surface of the stronger shoots when the bark is gently shaved, no matter how great may be the age, unless, as sometimes happens, some accident should favor its development to a perfect branch. These are the sort of buds referred to by Prof. Sachs, and of course make up their share of new branches when time comes to favor them. He knew of no dicotyledonous tree that could not be made to throw out numerous adventitious buds from any part of its surface by sawing off. In our common street maples this was everyday experience. A few inches below the cut generally died back from evaporation of the juices; but when the shoots pushed out they came by the dozens in the space of a few inches. Now in the original shoot—the first year's growth—there would be found in a vigorous specimen seldom more than six buds in a length of six inches; but in a strong six year old branch of maple (*Acer dasycarpum*) cut back he had seen as many as fifty shoots in that space. He exhibited a one year shoot of *Catalpa*, where the normal buds were ten inches from each other. In old branches cut back in early winter, so that the surface may harden a little before spring, and thus the tree lose little of its juices by evaporation, shoots will come out numerously from any part of the foot space between these original buds.

It was interesting, however, to note that in no case that he knew of would adventitious buds be produced between the nodes from a one year old branch. Such a branch cut beneath the node invariably died to the next. It would seem as if the demand on the nutritive powers of the plants for the axial elongation had left the generative tissue with less power than in subsequent years they may possess.

How cells which under some circumstances become permanent tissue, or at best generative tissue, may become the parents of adventitious buds and shoots was well shown in cutting down horse chestnuts, some poplars, and some birches. As before said, during the season following the first year, no adventitious buds will form between the nodes, when the branch is shortened; but in the older trees, the new cells from the generative tissue all along the exposed part or surface of the stump form adventitious buds and branches. The whole circle between last year's wood and the bark produces a forest of branches. He had seen this also, he said, in Cotyledons and other succulents under greenhouse culture.

From these considerations there was no reason why cells, predestined, under ordinary circumstances, to be merely bark cells in their change from wood cells, should not occasionally retain enough of growth force to carry on a feeble wood constructing system of their own.

We thus come naturally to the origin of these woody excrescences. Imperfectly formed liber cells, still retaining their generative power, would make a growth the next season, forming a layer of wood and making its own cortical layer, simultaneous with the normal wood growth of the tree, assimilating from the same store of reserve material that the normal growth does. The proof of all this lies in the cutting through longitudinally of one of these excrescences when it will be found to have made one more annual layer from the point of its origin than the tree itself, showing that the origin dated from a double set of germinating cells in that one year.

Where, as in the weeping willow and cherry, the excrescences are protruded much beyond the normal diameter of the tree, the annual layers of wood are on the average thicker, through having assimilated a greater share of food; as is generally the case with cells situated above an obstruction, for instance, as when a wire is fastened around a branch, a ring of bark taken off, or other means employed to interfere with the connection between root and foliage.

Mr. Meehan further said that explanation of growth in connection with these excrescences, explained also much that was usually inexplicable in the various excentricities of growth. He exhibited a specimen of a trunk of a *Bauhinia*, presented to the Academy by the Brazilian Centennial Commission, in which the wood seemed a mere fasciculus of many separate stems, forming a sort of ligneous mosaic work. The trunk was about six inches in one direction, and two in the other. The first year's growth, round the small pith, was circular; the subsequent ones irregular through the varying powers of growth in the germinating tissue. Very often, but a very small section of the previous year's circle of wood would germinate, in which case the whole growth would be made from that point pressing round and over, with great luxuriance, and enveloping the bark as well as wood of the previous year. Mr. Meehan thought it quite likely that the cases of *Wistaria* with bark between some of the annual layers of wood, might be explained in a similar way.[1] The subject of the excentricity of the annual layers of wood in trees could also be understood, keeping in mind the generating tissue, and its varying powers of life and transformation. Anything which favored nutrition in one part of the mass of cells more than in another, would increase their power of growth, and induce thicker layers at that point than in others. A very hot sun on one side, or in one season on one side, or on particular spots on one side, inducing an inordinate evaporation from those parts, would weaken the vital power of the cells just there. The germination would be weak, and the woody layer thin. Cold winds on one side in very

[1] Since making the above remarks I have had brought to my attention that in 1873, M. Licopoli, of Naples, in some publication not known at this writing, has suggested that the appearance of bark mixed with the wood of *Wistaria* is due to the formation of woody matter by the bark, which wood then continues to grow, and leaves the bark, as it were, behind the wood, instead of being pushed steadily before, as in normal wood growth. Although sure that my facts were as I detailed them, it is pleasant to have the confirmation of my views of these abnormal wood growths in this independent way.

cold weather would have the same effect in some cases. The continual blowing of trees always in one direction might favor assimilation by the cells on one side more than on the other, or even the closer proximity of some cells to healthy foliage or vigorous roots, would give them a great advantage over others, and the layer would thicken. In some plants there was pretty equally divided power. The whole mass of tissue seemed equally and regularly vitalized, and the generative tissue formed a new layer of wood of about equal thickness all round. But in other trees some masses of cells seemed to easily draw from the others more than their share, and the latter were correspondingly weakened. This was beautifully illustrated in the Hornbeam (*Carpinus Americana*). Here the irregularities in the thickness of the annual layers defied all system. They might be very thick at one point, and yet at an inch or two above or below the same layer, be very thin. The red cedar (*Juniperus Virginiana*) exhibited similar characters, except that the loss of generative power in some of the cells was more uniformly in a direction lengthwise with the stem. In a section he had recently examined the annual layers were tolerably regular for fifteen years. A young tree of the same species had then grown up close to it on one side, and the annual layers became thinner, finally ceasing there. The other sides grew on as before, the layers tapering, with the weakened vitality, to where the tissue was wholly at rest. So in various parts of the outline could be noted the time when various parts of the generative tissue lost vital power. In one part of the section, in a direct line from the centre, there was a continuous and nearly regular annual layer for over fifty years; but in many directions, by counting the rings or layers, the time could be traced when the tissue ceased to be generative or almost so, fifteen, eighteen, twenty-eight, and so on. All the cases of peculiar excentricities, *Hedera*, *Toxicodendron*, *Ampelopsis*, and the peculiar cases of ordinary timber trees, could be explained by this, so far as to note that the immediate law was a loss of generative power in the cells of the annual layer. Of course, the indirect causes leading to this would be very numerous, and left room for much more investigation. The remarks were made as much as possible in language divested of botanical technicalities for the benefit of those interested in the many other branches of science present; but those who would pursue the subject of wood-growth, as described here and applied to the explanation of excrescences and eccentricities, are referred to Sach's Text Book of Botany.

Mr. Martindale inquired if Mr. Meehan had noted the square growth of a coniferous trunk from the Pacific coast, on exhibition at the recent Centennial, and if that growth could be accounted for on his explanations?

Mr. Meehan replied that he had examined that trunk. It was square only at the lower end. It was of *Picea amabilis*. At the four corners the annual layers were thicker than at the sides. He had no doubt that in that case, and in similar ones if they were repeated, four strong roots had grown out at nearly equal distances, and the mass of cells nearest to these roots had an advantage in nutrition. We saw this in the trees of our own forests. Just in proportion to the vigor of the roots below was the thickness and irregularity of the trunk for a considerable distance above. If these trees had but four main roots of equal strength at equal distances, a portion of the trunk would be about square.

Mr. J. H. Redfield inquired whether Mr. Meehan would class cypress knees among the excrescences he had described?

Mr. Meehan replied not, as they were an outgrowth from the normal woody system of the roots of the tree, while the excrescences originated in the liber, or the tissue very closely allied thereto.

Pickeringite from Colorado.—Mr. E. Goldsmith stated that he has observed, in the Mineralogical Collection of the Academy, a white mineral which had not been determined. His examination, which was principally a chemical analysis, proved it to be the above-named species. As Peru and Nova Scotia are localities where this mineral has been found previously (see Dana's Descriptive Min., p. 653), this seems to be the first observation of Pickeringite in the U. S. Dr. John LeConte collected it. The particular note on his label is, near Monument, near Colorado City, Col. Terr.

The mineral is crystallized in very thin needles, which can only be seen when it is broken; these crystals keep within the mass well. Externally it is apt to become powdery. Its taste is astringent.

Hardness about = 1.
Specific gravity in oil of turpentine = 2.0105
" " " water = 1.7290

In the flame reaction he noticed the presence of sodium and potassium. The last element has been noticed by How in the Pickeringite from Nova Scotia. Sodium seems not to exist in the compound found in Nova Scotia or Peru.

The blowpipe reaction indicated water, alumina, and sulphuric acid.

The qualitative analysis proved also the occurrence of a minute quantity of proto and sesquioxide of iron, and magnesia was recognized to be in the solution.

The quantitative analysis gave this result:—

$\dddot{\mathrm{S}}$	= 38.69	per cent.
$\dddot{\bar{\mathrm{Al}}}$	= 11.90	"
$\dot{\mathrm{Mg}}$	= 4.89	"
(Ka) $\dot{\mathrm{Na}}$	= 0.68	"
Sand	= 1.90	"
By difference $\dot{\mathrm{H}}$	= 41.94	"
	100.00	"

He was inclined to believe that the average sample had lost some water of crystallization.

An attempt was made to separate the potassa from the soda, which were both in combination with chlorine, but the reagent applied failed to affect it. The chloride of potassium could have been but a trace. Having also observed that the quantity of iron in the mineral was small, it was considered useless to measure it.

Epsomite on Brick-walls.—Mr. Goldsmith remarked, with the beginning of the cold season the brick-walls of Philadelphia often become coated with a whitish incrustation. The supposition was current, to some extent, that the incrustation was a mixture of chloride and nitrate of sodium.

Mr. W. H. Dougherty, of this city, collected, in the beginning of December, a sufficient quantity of it, and examined it chemically; to his surprise he found that it reacted strongly on magnesia and sulphuric acid. The gentleman handed to Mr. G. some of the substance, which the latter redetermined. The result was the same. The epsomite contained besides, as an impurity, a small quantity of sodium, potassium, and chlorine.

Mr. Dougherty endeavored to trace out the origin of the epsomite, and analyzed some mortar which he collected from a wall that had on its surface this soluble salt. The reactions obtained proved that it was present. When fresh mortar was treated in the same way the presence of magnesia was recognized, but sulphuric acid was not found in it.

The idea that sulphuric acid, in a free state, could be present in bricks is improbable; hence, a plausible hypothesis is offered to explain its presence: The coal and gas used in the city contain small quantities of sulphur, which, when burnt, is oxidized into sulphuric acid, and this, being precipitated on the wall, will eventually also touch part of the mortar, out of which it will extract the magnesia, and thus form epsomite. From this explanation it may be inferred that the lime in the mortar cannot be any longer caustic, for caustic lime will not permit the sulphuric acid to combine with magnesia, as long as it is present in the mixture. The lime in mortar is converted into silicate of lime, but whether the magnesia is also changed into a silicate is, I presume, not known at present.

DECEMBER 26.

The President, Dr. RUSCHENBERGER, in the chair.

Seventy-four members present.

The following papers were ordered to be printed:—

NOTES ON FISHES FROM THE ISTHMUS OF PANAMA, COLLECTED BY DR. J. F. BRANSFORD, U. S. N.

BY THEODORE GILL.

The present article is devoted to an enumeration of fishes collected by Dr. Bransford during a recent survey of the Isthmus. Although small in numbers, the collection is of considerable interest, inasmuch as there are in it several new species, and among them representatives of two genera which have not before been known to be represented in that country. These, for the Isthmus, new generic types, are *Platypœcilus*, hitherto exemplified by a single Mexican species, and *Piabucina*, previously known only from two species found in Guiana and Venezuela.

I have adopted the formulas employed by Dr. Günther, to enable comparisons readily to be made with the descriptions of the new species.

GOBIUS SOPORATOR.

Synonymy.

Gobius soporator, *Cuv. and Val.*, Hist. Nat. des Poiss., vol. xii. p. 56; *Guich.*, Hist. Cub. por de la Sagra, Poissons, p. 127; *Günther*, Cat. Fishes B. M., vol. iii. p. 26; *ib.* Trans. Zool. Soc. London, vol. vi. p. 388 ("Atl. and Pac. Panama.")

One specimen was obtained at Washington Station.

CICHLASOMA CŒRULEOPUNCTATA.

Synonymy.

Acara cœruleopunctata, *Kner and Steindacher*, Sitzurgsber. d. bayer. Akad. dl. W., 1863, p. 222; *ib.*, Abhandlungen d. bayer Akad. der W., II. Cl., b. x., p. 16, tab. 2, fig. 3. 1864; *Günther*, Trans. Zool. Soc. London, vol. vi. p. 449, 1868.

A number of specimens were obtained from different localities, viz, Empire Station, February, 1875; Rio Frijoli, March, 1875; and Bahia Soldado, March, 1875.

PLATYPŒCILUS MENTALIS.

D. 10. A. 9. V. 6. L. lat. 25. L. tr. 7.

Body regularly compressed backwards, and moderately elevated; its greatest depth being in advance of the dorsal fin, and contained three and a half times in the total length, without the caudal; head less compressed than the body; the width of the interorbital space is less than one-half the entire length of the head; the length is contained three times and a half in the entire length without the caudal; the diameter of the eye considerably exceeds the length of the snout, and equals one-third the length of the head; the dorsal fin is moderate, higher than long, and its origin is about midway between the snout and the middle of the caudal fin; anal fin small; its origin is opposite the middle of the dorsal fin; caudal fin round, equal to the length of the head; its depth at base equals three-fourths the length of the head; the pectoral fin extends considerably beyond the root of the ventral; the ventral does not reach the origin of the anal. The color is a uniform brownish-olive, with no caudal spot; a linear band crosses the chin parallel with the lip; the dorsal has a deep, black, band-like spot near the base crossing the anterior half.

A single female specimen, 65 millimetres long, was obtained from a stream on the Atlantic side of the Isthmus.

Inasmuch as this species agrees with *Platypœcilus maculatus* generically in the position of the ventral fins under the dorsal, and thus differs from all related forms, it appears to be congeneric with it. It, however, differs much in the comparatively elongated body and less number of rows of scales between the dorsal and anal, as well as in other respects.

ASTYNAX ÆNEUS.

Synonymy.

Tetragonopterus æneus, *Günther*, Proc. Zool. Soc. London, 1860, p. 319; *ib.*, Cat. Fishes B. M., vol. v. p. 326; *Kner and Steindachner*, Abhandl. k. bayer. Akad. W., II. Cl., b. x. p. 46; *Günther*, Trans. Zool. Soc. London, vol. vi. pp. 394, 478.

Numerous small specimens, which would at least have been referred by Mess. Kner and Steindacher to this species, were obtained from Empire Station, Bahia Soldado, and the Rio Frijoli.

PIABUCINA PANAMENSIS.

D. 10. A. 12. L. lat. 30. L. trans. 8.

The height of the body equals one-fourth of the length, excluding, and one-fifth of the total, including the caudal; the head enters a little less than three and a half times in the length, exclusive of the caudal; the lower jaw projects slightly beyond the upper; the supramaxillary extends below the anterior half of the eye; the diameter of the eye equals about three-fourths of the interorbital space, is somewhat greater than the length of the snout, and about one-fourth the length of the head; the middle postorbital about as high as long; the dorsal fin commences nearer the snout than the sinus of the caudal fin, and behind the vertical from the ventrals; caudal emarginated, scaly at its base; the pectoral fin equals about one-fourth the length of the head, and its point is about intermediate between its upper axil and the ventral; ventrals decidedly shorter than the pectorals. The color is yellowish-brown, with a dark lateral band extending from the post-humeral spot to a dark area at the base of the caudal; the dorsal fin has a black spot near the base, which crosses the anterior rays.

Three specimens—an old and young—were collected in the Rio Frijoli, and an adult in another stream emptying into the Atlantic. The two adults were 82 millimetres long.

This species is interesting on account of its western and northern habitat, *Piabucina erythrinoides* having been discovered in Lake Maracaibo, and *Piabucina unitæniata* in British Guiana. The present species is most nearly related to the former, but differs in the smaller scales and otherwise.

RHAMDIA BRANSFORDII.

D. I. 6. A. 12.

The head is covered with soft skin above; the adipose fin is long, and enters two and two-thirds times in the total length without caudal; its distance from the dorsal is only equal to half the length of the dorsal; the maxillary barbels extend behind the anus, or the origin of the adipose dorsal, and the outer ones of the mandible beyond the inner axil of the pectorals; the height of the body below the dorsal equals nearly one-fifth of the total length without the caudal; the head forms less than one-fourth of the length without the caudal; the lower jaw is considerably the shorter; the band of intermaxillary teeth is about six times as wide as deep; the eyes are nearly midway between the snout and subopercular margin; and the diameter is contained two and a half times in the width of the interocular space; the dorsal fin is scarcely higher than long; its first spine is quite slender, and equal to about three-fourths of the head's length; the pectoral spine is half as long as the head; a minute porus axillaris is developed; the posterior rays of the anal fin, when depressed, fall some distance short of the end of the adipose fin; the free portion of the tail is somewhat higher than long; caudal fin forked, with both lobes rounded; the length of the lower is contained five and a half times in the total; the color is a uniform purplish-brown; the dorsal fin lightened by the usual basal cross-band. A single specimen was obtained at Camp Marie Caretta, January, 1875.

The specimen is distinguished from those of *R. Wagneri* described, by the proportions, although it is possible that it may be conspecific with them.

LORICARIA URACANTHA.

Loricaria uracantha, *Kner and Steindachner*, Abhandl. bayer. Akad. Wiss., II. Cl., b. x., p. 56, taf. 6, fig. 3; *Günther*, Trans. Zool. Soc. London, vol. vi. pp. 393, 478.

Eight specimens were obtained at Empire Station.

LORICARIA BRANSFORDI.

D. 1, 7. A. 6. V. 1, 5.

Snout (probably broad?—broken off); eye small, its vertical diameter being about equal to half of the width of the interorbital space; the space itself is flat, and the orbits are surmounted by slight crests; the posterior portion of each orbit has a slight notch tending upwards; (teeth probably small, and numerous in both jaws?); lower side of the head naked; opercula and the marginal scutes of the head with a broad, dense band of nearly equal erectile bristles; scutes of the neck with two obsolete carinæ; L. lat. 28; there are six lateral scutes between the pectoral and ventral fins; the scutes of the thorax are polygonal and in irregular rows; those of the belly scale-like—*i. e.*, with convex margins—and arranged in transverse rows, somewhat arched forwards; the two lateral ridges coalesce on the eighteenth lateral shield; the origin of the dorsal fin is nearly above the middle of the base of the ventral fin; the caudal fin is slightly emarginated, with its upper lobe somewhat produced, and with the upper spine somewhat swollen at its basal half, the lower lobe obliquely truncated. The color is yellowish-brown; the fins with their rays only banded or spotted.

A single specimen, somewhat over 130 millimetres long, was obtained at Empire Station. The snout and jaws have been lost, and consequently some important characters require to be ascertained. The species is, however, evidently nearly related to the *Loricaria lima* of Kner, but is distinguished by differences in proportions. I take pleasure in connecting with it the name of the discoverer, Dr. Bransford.

CHÆTOSTOMUS CIRRHOSUS.

Synonymy.

Hypostomus cirrhosus, *Val.*, Voyage Amér. Mérid. par d'Orbigny, Poiss., pl. 7, fig. 3; *Cuv. and Val.*, Hist. Nat. Poiss., t. xv. p. 511.

Ancistrus cirrhosus, *Kner and Steindachner*, Abhandl. bayer. Akad. Wiss., II. Cl., b. x. p. 61.

Chætostomus cirrhosus, *Günther*, Cat. Fishes B. M., vol. v. p. 247; *ib.*, Trans. Zool. Soc. London, vol. vi. pp. 393, 478.

Two specimens were obtained, one at Camp Marie Caretta, March 27, 1875, and the other at Empire Station.

ON SOME EXTINCT REPTILES AND BATRACHIA FROM THE JUDITH RIVER AND FOX HILLS BEDS OF MONTANA.

BY E. D. COPE.

LÆLAPS, Cope.

Proceed. Acad., Phila., 1866, p. 275. Extinct Batr. Rept. N. Amer., 1869, p. 100.

Two species of this genus were described in the latter memoir above cited, the *L. aquilunguis*, Cope, and *L. macropus*, Cope, both from the greensand or Fox Hills group of the cretaceous of New Jersey. A considerable portion of the skeleton of the former was described, including the peculiarities of the ankle-joint, which led me to the conclusion, previously unsuspected by naturalists, that the *Dinosauria* present affinities to the cursorial birds. The teeth of this species were described and figured, but in the *L. macropus* they were, and still remain, unknown.

In a preliminary report on the extinct vertebrata obtained by the writer on the Upper Missouri the present year, three additional species were referred to this genus, viz.: the *Lælaps incrassatus; L. explanatus*, and *L. falculus*. Their characters were ascertained from teeth alone, so that their pertinence to the genus *Lælaps* is not fully assured. A fourth species of carnivorous dinosaurian was described under the name of *Aublysodon lateralis*.

One of the most valuable specimens obtained by my expedition of 1876, is the nearly entire left dentary bone of the *Lælaps incrassatus*, which exhibits the teeth of its two extremities. The different forms of the teeth of the carnivorous *Dinosauria* graduate into each other by such easy stages, as to have given rise to question in reference to their proper interpretation ; whether they indicate different species or only different positions in the dental series. In describing the *Aublysodon horridus*, the first known of the species of the Judith River beds, Dr. Leidy expressed the suspicion that a certain form characterized the teeth in the position of incisors, another those in the position of canines, and another form the remainder of the series. The teeth of the last kind have the form of those of *Lælaps;* in others the posterior serrulate cutting edge is latero-posterior. the posterior aspect being thickened, and either transverse or convex in section. In the supposed canines the anterior serrulate edge is wanting, or represented by a second posterior edge parallel with the original one, thus forming a compressed chair-shaped crown. Numerous specimens of all these forms were obtained by the expedition.

Examination of the dental series of the *Lælaps incrassatus* shows that the antero-posterior diameter of one or two teeth in the position of canine, becomes oblique in the curved long axis of the dentary bone. The transverse diameter is also greatly increased so as to equal or even exceed the antero-posterior; the serrate edges are opposite to each other. A tooth of this type was the first of this species which I observed, and the name has reference to its peculiar form. A tooth in the position of first or anterior incisor, differs in having the anterior serrate crest removed to the middle of the inner aspect of the apical portion of the crown, while tbe posterior edge retains its usual position. Further posterior transfer of the anterior cutting edge and a grooving of the posterior face, would produce a tooth of the form suspected by Leidy to be the canine of *Aublysodon horridus*, while the canine just described is different from any tooth referred by Leidy to the same species. But a large tooth found in immediate association with the jaw, but separated from it, has the posteriorly truncate form described by Leidy as typical, and is very probably the tooth of the maxillary bone, near the position of the superior canine of a mammal.

It may be observed in conclusion, that if the teeth suspected by Leidy to be canines of *Aublysodon horridus*, but which I suppose to be incisors, are really such, *Aublysodon* must be regarded as a genus distinct from *Lælaps;* while, on the other hand, should such determination prove to be inadmissible, and the two genera be the same, the name *Lælaps* must be preserved as the older; it was published in 1866, while *Aublysodon* bears date 1868.

In examining the very numerous teeth discovered by the expedition, I find four species in addition to those already named. A list of all the species is now given.

Lælaps incrassatus, Cope, Proceed. Acad. Nat. Sci. 1876, Oct.

The dentary bone of this species, above alluded to, is of compressed form, and becomes thin and plate-like in its posterior portion. The latter is excavated on the inner side, where it is probably applied to the opercular and surangular bones, if they exist, and a large foramen is continued from the concavity into the remaining part of the dentary, as a tubular canal. Above the foramen there originates a groove which runs parallel to the inner alveolar border to the posterior edge of the symphysis. The latter is short, and scarcely distinguished from the other surfaces; the attachment of the rami was evidently ligamentous and more or less movable. The anterior alveolar portion of the ramus is produced, so that the symphysis slopes backwards below. The inferior border of the dentary bone is gently concave behind its middle. It is throughout convex in the transverse direction.

The external alveolar wall is an inch higher than the internal. The inner portions of the septa are apparently subject to exfoliation and subdivision in connection with the renewal of the teeth as a groove which is continuous with the inner alveolar borders, cuts them off from the other interior surface of the dentary bone. The external face of the dentary is in general plane, but is variously excavated along its superior border. An inch below the latter there extends a series of large foramina, each one of which is situated opposite to an interalveolar septum. They are more numerous anteriorly, a foramen being opposite each alveolus as well, and each foramen is connected with the border by a shallow groove. Similar foramina extend down the outer side of the symphyseal border, and along the inferior border of the dentary for two-thirds of its length. The same proportion of the external face is obsoletely rugose through the presence of delicate lines of growth. Such lines extend on the lower part of the interior face obliquely upwards and backwards.

There are alveolæ for fifteen teeth in the dentary bone. Of these only the second, third, fourth, fifth, twelfth, and fifteenth contained teeth capable of functional use at the time the jaw was inclosed in the lacustrine mud. Successional teeth occupy the first, tenth, and twelfth, but no two teeth are in an identical stage of protrusion. The section of the crown from and including the fourth to the last is nearly equilaterally lenticular. Their surface is smooth.

Measurements.

		M.
Length of entire dentary bone		.525
Depth at posterior border of symphysis		.110
" " last tooth		.192
" to internal groove		.060
" " " foramen		.074
Length of crown of second tooth		.029
Diameter of second tooth at base	antero-posterior	.013
	transverse	.018
Length of crown of twelfth tooth		.043
Diameter at base of twelfth tooth	antero-posterior	.025
	transverse	.017
Length of crown of superior ?canine		.062
Antero-posterior diameter of do.		.028

As compared with the *Lælaps aquilunguis*, of which a portion of the dentary bone is known, this species differs in the greater diameter of its inferior border anteriorly, in the presence of the internal groove, in the greater elevation of the external alveolar wall, and, if the character be constant, in the greater robustness of the form of the dental crowns. The individual here described is rather larger than the type of *L. aquilunguis*, but it is probable that the species were not very different in dimensions.

Lælaps hazenianus, sp. nov.

Seven teeth from different localities present constant characters which readily distinguish them from all other species of the genus. Their size is less than those of the two species above mentioned, and is greater than in the species enumerated below.

The crowns are short and robust, and are abruptly terminated by the strong recurvature of the anterior cutting edge. The apex has, therefore, a more posterior direction than in the *L. incrassatus*, while the anterior cutting edge is shorter. The latter is shortened below also, not extending to the base of the enamel, but terminating in a short lateral curvature. At the base, therefore, the anterior border is rounded, while the posterior is acute. The denticulations are of medium size, measuring M. .00033.

Measurements.

		M.
Length of crown		.014
Diameter of crown	antero-posterior	.011
	transverse	.007

Both sides are convex, but not equally so, and the surface is smooth, and without facets.

This saurian is dedicated to General Hazen, now in command at Fort Buford, Dakota, as a token of respect for his qualities as a man and his services in the interest of science.

Lælaps lævifrons, sp. nov.

A tooth half the size of those referred to the *L. hazenianus*, and exceeding by a little the largest of those of *L. explanatus*, presents such characters as induce me to believe that it belongs to a species distinct from either. It is of the elongate acuminate form of some of those referred to the *L. incrassatus*, and both sides are convex, but not equally so. A shallowly concave plane occupies the middle of the more convex side. The posterior cutting edge is denticulate to the base, but the anterior, though of the same form as in the other species, and unworn, is absolutely smooth. In this respect it differs from the other species, excepting *L. falculus*. The denticulations are finer than those of any other species, measuring M. .00020; in *L. explanatus* they measure M. .00022.

Measurements.		M.
Elevation of crown		.015
Diameter of crown	antero-posterior	.007
	transverse	.004

Lælaps explanatus, Cope, Proceedings Academy, October, 1876.

Lælaps falculus, Cope, loc. cit.

Lælaps cristatus, Cope, sp. nov.

Another small species well distinguished by the form and coarse denticulation of the teeth, approaching the genus *Troödon*.

The crowns of the teeth are short, stout, compressed, and curved. Both sides are convex, and neither is facetted. The denticles are large, those of the posterior cutting edge the largest, and measuring M. .0005. A characteristic feature is the full development of the denticulate anterior cutting edge of the crown. This extends to the base, becoming more prominent as it descends. Surface smooth.

Measurements.		M.
Elevation of crown		.011
Diameter of crown	antero-posterior	.006
	transverse	.003

ZAPSALIS, Cope.

The teeth of this genus are intermediate in form between those of *Lælaps* and *Paronychodon*. They have one flat and one convex side, whose junctions form the anterior and posterior edges of the crown, as in the latter genus; and like the latter, there is no anterior cutting edge, but instead, a solid angle. But the posterior edge is denticulate as in *Lælaps*, and the plicæ or keels of *Paronychodon* are here only recognizable in low angles. Some light may be cast on the affinities of the latter genus by the discovery of *Zapsalis*.

Zapsalis abradens, sp. nov.

This reptile was apparently about the size of the *Lælaps lævifrons*. The best preserved tooth is that of a probably adult animal, as it displays considerable attrition, especially on the flat side. Here three worn lines indicate the former existence of as many low longitudinal angles of the surface, of which the median is basal and short. The convex side exhibits four low angles of nearly equal length, all stopping short of the apex. The facets between them, excepting the anterior two, are slightly concave. The denticles are of moderate coarseness, measuring M. .00033.

Measurements.		M.
Elevation of crown		.0120
Diameter of crown	antero-posterior	.0065
	transverse	.0030

URONAUTES, Cope.

Genus novum Sauropterygiarum. Cervical vertebræ, like the dorsals and caudals, short and transverse, and distinct from each other. Neural arches and transverse processes coössified at maturity. Transverse processes of the cervicals simple and depressed. Extremities plesiosauroid.

This genus might be referred to *Polycotylus*, Cope, were it not for the distinctness and greater abbreviation of the cervical vertebræ. From *Cimoliasaurus*, Leidy, it differs in the coössification of the caudal diapophyses and the much greater abbreviation of the cervical vertebræ. The centra are amphiplatyan in *Cimoliasaurus*, biconcave in *Uronautes*. From *Pliosaurus*, Owen, which resembles the present form in the shortness of the cervical vertebræ, the coössified transverse processes of the cervicals separate it. The present is pre-eminently a short-necked genus of the order.

The remains on which it reposes are the cervical, dorsal, and caudal vertebræ, with portions of limb and rib bones.

Uronautes cetiformis, sp. nov.

The cervical vertebra of this species is of unusual form, being short and transverse, and not wider than deep. In *Polycotylus latipinnis* this vertebra is much wider than deep, and as long as wide. The neuropophyses are compressed so as to be antero-posterior, and they inclose a rather wide neural canal. The parapophyses are directed equally downwards and outwards, occupying the position of the angle of a subquadrate outline, since the sides are nearly vertical. The articular faces are slightly concave, and the centrum is perforated vertically by the usual two foramina.

A dorsal vertebra found in immediate proximity to the cervical just described is much like that of the *Polycotylus latipinnis*. That is, it is exceedingly short antero-posteriorly, and has concave articular faces, the concavity with flat fundus, and marked with a few obscure concentric grooves. The sides are also slightly concave, and are pierced with a foramen at the superior portion. The vertical foramina are also present. The neural arch is in this specimen separated from the centrum, not having become coössified. This circumstance might lead to a doubt as to the proper reference of the specimen to this animal, but such doubt has little foundation. In one of the caudal vertebræ one of the diapophyses is coössified, and the other is not. The suture of the surface thus exposed is of a very fine texture, and evidently not like that seen in the genera where it is to act as a permanent articulation. In the case of the dorsal vertebra, the suture for the neuropophysis has the same character. This vertebra is much larger than the cervical, but does not much exceed the proximal caudal in size; preserving the relations seen in the *Polycotylus latipinnis*. Adjoining the border of the fossa of the neuropophysis is a small parapophysial tuberosity.

A proximal caudal vertebra has a very small fore and aft diameter, and the vertical exceeds the transverse diameter. The diapophyses spring from the middle of the sides of the centrum, while the inferior face is separated from the inferior lateral faces by an obtuse longitudinal angle. In general, the form is that of a transverse hexagon. The chevron facets are very slightly developed. Another probably distal caudal vertebra considerably resembles that in the corresponding part of the skeleton of a cetacean. It is without neural arch, transverse, flat below, and with the two lateral faces of unequal length, the superior being the longer. The vertical perforating foramina join at the neural canal, and there is a short subquadrate plane on each side of the latter. There are no indications of chevron facets. These vertebræ are different from any of those yet known in *Polycotylus*.

Measurements.		M.
Diameter of a cervical centrum	antero-posterior	.016
	vertical	.026
	transverse	.029
Diameter of a dorsal	antero-posterior	.030
	vertical	.055
	transverse	.056
Diameter of a proximal caudal	antero-posterior	.022
	vertical	.040
	transverse	.062
Diameter of a distal caudal	antero-posterior	.015
	vertical	.017
	transverse	.038
Diameter of neural canal of the proximal caudal above measured		.012
Do. of diapophysis of do. at base		.018

The distal end of a proximal limb bone is much like the corresponding part of *Polycotylus latipinnis*. It is relatively of large size, flat, and strongly convex at the extremity, which is not transversely truncate. A portion of another limb bone, perhaps belonging to the distal segment, is symmetrical. The shaft is broken off, and displays a large medullary cavity, with thin walls, which soon terminates towards the articular end, in a fundus with a fissure in the bottom. The proximal portion of a rib has a truncate head of an oval outline. The inferior border presents a low tuberosity, which may represent the capitulum.

Measurements.		M.
Width of distal end of proximal limb bone		.109
Thickness of the same		.032
Diameter of proximal end of a rib	longer	.030
	shorter	.028

The bones above described were found together by the writer, on a slope of the cream-colored soft sandstone, which lies above the black shales of Cretaceous No. 4, near Amell's Creek, Montana. I suppose the formation to be the No. 5, or Fox Hills group of Meek and Hayden. Near them were found shark's teeth of the genera *Otodus* and *Lamna*, and a species of *Enchodus*. Above them I found lying loose a fragment of a *Baculites*.

CHAMPSOSAURUS, Cope.

Genus novum. Vertebræ of more than a hundred individuals referable to several species, which I obtained from the Judith River beds of the Upper Missouri region, present characters which demand the establishment of a new genus for their reception.

The characters presented by the vertebral column are the following: The ribs have a single head, which articulates with a prominent tuberculum, excepting those of the cervical vertebræ. On these there is a small capitular tubercle below the diapophysis. It commences very small, and inferior in position, being removed, in fact, but a short distance from the inferior middle line in the first vertebra in which it appears. It rises rapidly in the succeeding centra until it is merged in the tuberculum of the diapophysis. The latter projects from the neural arch, which is free from the centrum, but in none does the base of the diapophysis rise from a point above the floor of the neural canal. On the dorsals it is vertically compressed. One of the anterior cervicals, probably the axis, is obliquely truncated below its anterior articular face, for a free hypopophysis or *os odontoideum*. This vertebra has no parapophysis, and the articular faces for the neuropophysis are superior. The few vertebræ in each of several series, probably from the sacral region, are more depressed than the others, and the facets for the diapophyses present a greater antero-posterior extent, but none are coössified. The caudal vertebræ are distally quite compressed. In all, except the anterior ones, the neural arch is coössified with the centrum, and in such there are no diapophyses. In those with free neural arch, the facets for the neuropophyses turn down on the sides of the centrum.

The articular extremities of the centra are plane, those of the caudal series slightly concave. There are no hypapophyses behind the axis, excepting a longitudinal carina, which ceases to exist on the dorsal vertebræ. The zygapophyses are simple. The chevron bones are free.

The relations of the atlas and axis, though not fully elucidated by my specimens, are peculiar. The former has separate neurapophyses, which have nearly the shape of those of the Streptostylicate *Reptilia*, resembling much those of the *Pythonomorpha*.

Although I procured numerous cervical vertebræ, there are but few which exhibit the antero-inferior facet for supposed hypapophysis, already described. The position of this vertebra was in front of the first cervical which displays a parapophysis, and is, on this account, likely to be the axis or the third cervical vertebra. It is the more probably the axis, as there is no other among the large number of vertebræ in my collection which can be referred to that position. Its anterior articular face is smooth and like the posterior, showing that the odontoid bone was not coössified with *it*. Now in the *Crocodilia* the odontoid bone is united with the anterior extremity of the axis by suture, which may become coössified with age, while the free hypapophysis is wanting. In the streptostylicate orders the hypapophysis is present, and the odontoid is above it, but united to the axis by suture. On the other hand, in the *Rhynchocephalia*, the axis is coössified with both odontoid and hypapophysis, and a few succeeding vertebræ possess free hypapophyses. Thus it is possible that I am yet unacquainted with the axis of *Champsosaurus*.

One entire rib and the heads of several others are all that were obtained. The former is from the anterior part of the dorsal series, and is stout and short. The head is truncate and compressed, its articular face is contracted, forming a narrow figure eight. The shaft is obliquely flattened. The extremities are separated from the lateral surfaces by a narrow angle, as though capped with cartilage in life, as in the *Pythonomorpha*.

Bones of the extremities are very rare. One fragment resembles the proximal end of a crocodilian tibia, and another is like the distal half or more of the tibia of the same type.

There is considerable resemblance between the vertebræ of this genus and those of *Hyposaurus*, Ow., from Cretaceous No. 5, of New Jersey, but the relations of the axis and atlas in that genus are as in other *Crocodilia*, and not like those seen in *Champsosaurus*. The absence of sacrum precludes the possibility of regarding this form as dinosaurian. It rather seems to share some rhynchocephalian characters with general amphiplatyan crocodilian resemblances. The shortness and robustness of the thoracic ribs is a feature quite unique, and reminds one of the *Batrachia*. The teeth are unknown in their true relations, but there are several types in the collections which may be found to belong here. These are of the rhizodont character.

As a summary of the preceding, I propose to refer the genus *Champsosaurus* to the order *Rhynchocephalia*, provisionally. It differs very much from the typical genus of that order, *Sphenodon*, in the non-coössification of the sacral vertebræ, and non-union of the neural arches of the vertebræ with their centra, and the absence of the chordal perforation of the latter. It differs from the extinct genera *Clepsydrops* and *Cricotus*, Cope, in the last mentioned two characters. On these grounds it may constitute a distinct suborder, under the name of *Choristodera*.

It is possible that the tooth, which I referred to a new genus and species, under the name of *Paronychodon lacustris* (Proceedings Academy, 1876, October), may belong to one of those of the present genus. In that case the older generic name takes precedence of the later. I may add that some vertebræ of this genus have been figured and described by Dr. Leidy in the Transactions of the American Philos. Society, 1860, without name.

I recognize four species among the vertebræ, chiefly by characters observed in the cervical region. There is a great discrepancy of size among them, and the small ones may be immature.

Champsosaurus profundus, sp. nov.

This species is chiefly known from a series of vertebræ found together, and having every appearance of pertaining to the same animal. It consists of a cervical, three dorsal, and a sacral vertebræ. Other isolated vertebræ of several individuals present similar characters.

The primary feature is the great vertical diameter of the dorsal vertebræ as compared with the transverse measurement. This is occasioned by the great development of the inferior keel, to which the sides of the centrum converge, without concavity. In corresponding centra of the *C. annectens* the inferior face is merely angulate. Another character is the obliquity of the articular faces to a vertical plane drawn at right angles to the long axis of the centrum. This is most strongly marked on posterior dorsals, where the inferior keel is less prominent. The sacral vertebra has a depressed form.

An anterior caudal vertebra may belong to this or an undescribed species. It has rudiments only of the chevron-facets, and having a large neural arch, is doubtless from the anterior part of the series. It is more compressed than the corresponding one in *C.*

annectens, and has an acute inferior angle, which is wanting in the latter.

Measurements.

		M.
No. 1.		
Diameter of cervical centrum	longitudinal	.020
	vertical	.020
	transverse	.018
Diameter of anterior dorsal centrum	antero-posterior	.020
	vertical	.022
	transverse	.019
No. 2.		
Diameter of posterior dorsal centrum	antero-posterior	.023
	vertical	.019
	transverse	.019

Champsosaurus annectens, Cope, sp. nov.

The greater number of vertebræ obtained belong to this saurian, which may therefore be looked upon as the type of the genus.

The cervical which bears the hypapophysial facet presents a carina below, which is only prominent between the articular faces. One such cervical in the collection is rounded below, and may be anterior in the series, or may belong to another species. The inferior keel is strong on the other cervicals, but soon disappears on the anterior dorsals. The remaining centra are rounded below. The parapophyses where present are knob-like, and the corresponding part of the transverse process is similar in the anterior dorsal vertebræ. The base of the neural arch is nearer the anterior than the posterior articular face. These faces are nearly round in the anterior caudal centra, but soon become vertical ovals, with the compressed form. There is a fossa below and in front of the parapophysis, which continues to beyond the anterior dorsals. The dense layer of the surface of the centrum is smooth, except some delicate striations near the articular borders. These are most marked along the median inferior face of the caudal vertebræ, which is flat, grooved, and distally acute.

I cannot certainly connect the vertebræ of a series as those of a single individual.

Measurements.

		M.
No. 1.		
Diameter of a cervical with hypapophysis	antero-posterior	.023
	vertical	.021
	transverse	.020

		M.
No. 2.		
Diameter do. without hypapophysis	antero-posterior	.017
	vertical	.0165
	transverse	.017
No. 3.		
Diameter do. without hypapophysis	antero-posterior	.011
	vertical	.0105
	transverse	.011
No. 4.		
Diameter of an anterior dorsal	antero-posterior	.023
	vertical	.023
	transverse	.023
No. 5.		
Diameter of an anterior dorsal	antero-posterior	.008
	vertical	.0072
	transverse	.0075
No. 6.		
Diameter of a sacral centrum	antero-posterior	.010
	vertical	.009
	transverse	.009
No. 7.		
Diameter of an anterior caudal	antero-posterior	.083
	vertical	.053
	transverse	.058
No. 8.		
Diameter of a median caudal	antero-posterior	.017
	vertical	.011
	transverse	.011
No. 9.		
Diameter of a posterior caudal	antero-posterior	.014
	vertical	.0086
	transverse	.007

A vertebra not distinguishable from the corresponding one of this species was found near Amell's Creek, on a bank of deposit of the Fox Hills group (No. 5), with the bones of the *Uronautes cetiformis*, supra. I cannot account for this circumstance, as it is the most abundant fossil of the Judith River beds (No. 6).

Champsosaurus brevicollis, sp. nov.

On one occasion the writer discovered a number of vertebræ of this genus close together, and in such relation as to induce the belief that some of them belonged to the same individual. Parts of several were obtained, however, adding another evidence of the manner in which the fossils of this formation have been dislocated and scattered. The evidence for the existence of this species must be allowed to rest at present on a cervical vertebra, with free hypapophysis. This body differs from the corresponding one in the *C. annectens* in its greater brevity as compared with its length. The vertical and transverse diameters exceed the longitudinal in the *C. brevicollis*, while in the *C. annectens* the length exceeds both. The inferior aspect of this centrum is broadly rounded, not carinate as in *C. annectens*. The value of this character is uncertain, but a centrum similarly rounded below (above alluded to) has the more elongate form of the *C. annectens*.

Measurements.		M.
Diameter of centrum	antero-posterior	.013
	vertical	.014
	transverse	.015

Champsosaurus vaccinsulensis, sp. nov.

This reptile is indicated by a posterior dorsal vertebra in which the common base of the neural arch and diapophysis is decurved to below the middle of the side of the centrum. This surface has somewhat the outline of the section of a T-rail, the inner portion being on the superior face of the centrum. The centrum is shorter than the corresponding ones of the *C. annectens* and *C. profundus*, so that the basis of the neural arch approaches near the borders of the articular faces above. The centrum is perforated by two vertical foramina as in most *Sauropterygia*. The osseous tissue of the bone is quite dense, and the surface is smooth.

Measurements.		M.
Diameter of centrum	antero-posterior	.026
	vertical	.029
	transverse	.045

Besides the much larger size, this species differs from those previously referred to this genus in almost all details of proportion, etc.

SCAPHERPETON, Cope.

Genus novum Batrachiarum. Vertebræ deeply biconcave, with opposed, but not continuous, foramina for the chorda dorsalis. Neural arch with zygapophyses, and well-developed neural spine. Centrum with vertically compressed, short diapophysis near the posterior extremity, a prominent hypapophysial keel, and prolonged neural spine. Supposed proximal limb bone with a branch-like trochanter. Supposed teeth in several rows, attached in shallow alveoli, those of the marginal series larger; the crowns obtusely conic and simple.

In the above diagnosis are expressed the general characters of a genus of probably tailed *Batrachia* which has left remains of several species in the Judith River beds of the Upper Missouri region. Although the vertebræ resemble no little those of *clepsydrops*, Cope, a rhynchocephalian lizard from supposed triassic or permian formations, the atlas is that of a batrachian. The limb bone probably belonging to it, is unlike that of any genus of the *Proteida* or *Trachystomata*, differing also from that of *Menopoma*, but approaching nearly that of the typical salamanders. The diapophyses are different in form from those of the *Trachystomata Proteida* and *Amphiumidæ*, but resemble in their vertical compression those of *Menopoma*. They are generally broken in the specimens, but where preserved, are much shorter than in that genus, being even less produced than in most of the recent salamanders. The prominent keel of the median line below is not found in salamanders, and it has no posterior prolongation resembling the structure seen in *Amphiuma* and *Cæciliidæ*. The produced neural spine is a character not found among tailed *Batrachia*, and the posterior direction which it takes reminds one of the *Dinosauria* more than anything else, and is not like the form seen in *Lacertilia*. It is a prolongation of the roof-like extension of the neural arch seen in some of the tertiary salamanders of France.

The structure of the proximal limb bone, and the form of the diapophyses of the vertebræ refer this genus with much probability to the *Urodela*. The produced neural arch, and the probably complex disposition of the teeth, indicate a family different from any of those now living. The biconcave centra place it nearest to the *Amblystomidæ*.

The teeth above mentioned are attached to a fragment of a jawbone. The crowns are all imperfect, and mostly broken off. There are three series of smaller teeth and a marginal series of teeth of one half greater diameter. They exhibit a moderate pulp cavity, and the superficial investment of the crowns is not inflected. It has a minute granular rugosity, and the bases of the teeth are rugose with impressed punctæ. The teeth are described here because it is not known to which species they belong. It is, indeed, not certain, but only probable, that they belong to this genus.

Four atlases preserved indicate two species; one being more depressed than the other three, and the anterior cotyli therefore more transverse.

The vertebræ indicate four species. It is probable that they present some pecularities at different points in the same column, the caudals at least differing in some degree from the others. The characters of the species are quite well marked.

Scapherpeton tectum, sp. nov.

Represented by a vertebra which is one of the best preserved in the collection. The most prominent specific character is seen in the entire roofing over of the neural canal between the anterior zygapophyses, and in the downward production of the inferior median line of the centrum, and accompanying downward prolongation of the articular cups. The chordal perforation is at the superior fourth of the vertical diameter of the cups. The neural spine is produced backwards and curved upwards, and is narrowed between the posterior zygapophyses, and is striate grooved on the under surface. About half of the posterior zygapophysis projects beyond the edge of the cup of the centrum. Immediately below the anterior edge of the posterior zygapophysis, the diapophysis begins. It is vertical, of an irregular figure 8 in section, and is directed outwards and backwards. A foramen passes under its middle, emerging a little before the middle of the same horizontal diameter of the centrum. It is joined by another which strikes it from below at right angles. There is a deep notch embraced between the superior part of the diapophysis and the posterior zygapophysis. The neural canal is wider than deep.

A fragment accompanied this vertebra when found, which resembles the articular portion of the mandible. There is no angle projecting behind the quadrate facet, which is oblique, truncating the extremity of the ramus. The lower edge is acute, behind roughened, and a thickening extends along the middle of the inner side of the ramus so far as preserved. The character is that of a Urodele Batrachian.

Measurements.		M.
Diameter of centrum	antero-posterior	.0875
	vertical	.0750
	transverse	.0500
Vertical diameter of diapophyses		.0500
Transverse diameter of neural spine between posterior zygapophyses		.0500
Depth mandibular ramus at front of quadrate cotylus		.0800

Scapherpeton laticolle, sp. nov.

Vertebræ of several individuals of smaller size than those referred to the *S. tectum* differ in the less extensive development of the roof connecting the anterior zygapophyses, and the greater compression of the centrum, in consequence of the downward production of the inferior keel. The neural arch is openly notched between the anterior zygapophyses, but the notch is bounded by a recurved lamina distinct from the zygapophyses. The diapophyses are much as in *S. tectum;* the ridge from the inferior portion of it is quite prominent, and includes with the base of the neural arch a deep fossa.

Accompanying a dorsal vertebra like those of this species, and probably belonging to the same skeleton, is an atlas of a more depressed form than those presumably belonging to the other species. The median tuberosity is well developed, constricted at the base, and much flattened. The condyloid facets are narrow and transverse.

Measurements.		M.
Diameter of dorsal centrum	antero-posterior	.070
	vertical	.050
	transverse	.030
Width of the neural canal		.020
Vertical diameter of base of diapophysis		030

If it should appear that the dorsal vertebræ do not represent a species distinct from the *S. tectum*, the *S. laticolle* may rest on the atlas described.

The limb bone above mentioned is associated with the neural arch of a vertebra of the character ascribed to this species. Both extremities are eroded so as not to display the forms of the condyles, though almost the entire length is preserved. The trochanter is imperfect, but its base is that of a subcylindric process. The head of the bone is subtriangular, and the section of the distal end an oval with a flat side. The diameter contracts gradually to the middle.

Measurements.		M.
Length of bone		.0150
Diameter	proximally	.0036
	medially	.0019
	distally	.0037

This bone is plainly that of a urodele salamander.

Scapherpeton excisum, sp. nov.

This salamander is represented in the collection of the expedition by vertebræ of three individuals of different sizes. They all agree in having the anterior zygapophyses separated by the concave excavation of the roof of the neural canal usual in ordinary salamanders, and in the moderate development of the hypapophysial keel. As a result, the articular extremities of the centra are not produced so far inferiorly as in *S. laticolle.* The longitudinal ridge from the inferior part of the diapophysis is pronounced, and separates a deep fossa above it from another below it. The longitudinal perforation of the base of the diapophysis issues in the superior fossa, while in the two smaller specimens a vertical perforation joins it from the inferior fossa. As in the preceding two species, one articular face is a little deeper than the other.

Measurements.		M.
Diameter centrum No. 1	longitudinal	.009
	vertical	.006
	transverse	.005
Width of neural canal do.		.003
Depth " "		.0015
Diameter centrum No. 2	longitudinal	.0060
	vertical	.0033
	transverse	.0030

Specimen No. 1 is as large as the corresponding portion of an *Amphiuma means.*

Scapherpeton favosum, sp. nov.

The vertebra which I select as typical of this species is more distinct in character from those of the three species above described, than they are from each other. Although the centrum presents a strong inferior keel, its border is not horizontal or convex, but concave, and the articular cups are proportionally little elongated downwards. The diapophyses have at their bases a relatively small vertical diameter, and the longitudinal perforation enters below and before the base and not behind it. The longitudinal ridge from the inferior part of the latter is very prominent and horizontal, bridging over the vertical perforation, which enters the superior lateral fossa. It is separated below from the posterior perforation by a short oblique bridge. The neural arch is lost from this specimen.

There are other vertebræ which display a slightly developed inferior keel, and articular cups little produced downwards, but the fossæ are less developed than in the one described.

Measurements.		M.
Diameter of centrum	antero-posterior	.006
	vertical	.004
	transverse	.003

The typical individual was about as large as the *Menopoma.*

HEMITRYPUS, Cope.

Represented by a vertebra of the general character of those of the genus *Scapherpeton*, but which lacks the foramen chordæ dorsalis of the posterior half of the centrum, and is not carinate on the inferior surface. The diapophysis is directed backwards just below the posterior zygapophysis, inclosing with it a notch into which the anterior zygapophysis is received. Anterior zygapophyses connected by a prolongation of the neural arch.

I had suspected that this vertebra might be one of those of the cervical region of a species of *Scapherpeton*, but the position of the foramen chordæ dorsalis renders this highly improbable. The only positio n to which it could be assigned in the column of this genus would be that of the axis. But the foramen is present in the posterior half of the atlas and thus probably in the axis in *Scapherpeton*, as in vertebræ from all other regions of the column, so that such an exception as is presented by the present centrum is not to be looked for. The absence of the carina, and the cylindric form of the centrum, add to the belief that the species does not belong to *Scapherpeton.*

Hemitrypus jordanianus, Cope, sp. nov.

No emargination between the anterior zygapophyses; neural spine directed upwards and backwards. The diapophyses vertically compressed, directed downwards, inwards, and backwards, and not giving origin to a strong ridge on the side of the centrum, as is seen in the species of *Scapherpeton*. Neither is there any fossa on the side of the centrum as in that genus. There is a small longitudinal foramen which enters the inner base of the inferior half of the diapophysis. There is a low ridge on each side of the neural arch, which extends backwards and inwards. The anterior articular face is a wide oval somewhat contracted below, and is pierced by a foramen at a point within the superior third of the vertical diameter. It is not so deeply excavated as in the species of *Scapherpeton*. The posterior articular face is a regular vertical oval, is concave, but not excavated, as is seen in the centra of the genus just mentioned. The inferior face of the centrum is rounded, with some feeble lateral ridges.

Measurements.		M.
Diameter of centrum	longitudinal	.0070
	vertical	.0050
	transverse	.0040
Total elevation at middle		.0090
Expanse of posterior zygapophyses		.0070
" " " diapophyses		.0095

About the size of the *Menopoma allegheniense*.

This batrachian is dedicated to Prof. D. S. Jordan, of the Northwestern Christian University, author of the Manual of the *Vertebrata* of the Eastern United States.

OUR SIDEREAL SYSTEM, AND THE DIRECTION AND DISTANCE TO ITS CENTRE.

BY JACOB ENNIS.

I. THE FORM OF OUR SIDEREAL SYSTEM.—Before we can find the centre of an object, we must have a knowledge of its form. The form of our system is determined by the ring of the galaxy; because it is computed to contain eighteen millions of stars, while all the other stars situated around and within that ring are supposed to number only about two millions. The best observers declare that they can look fairly through the galaxy, and see beyond only the black ground of empty space. Its ring form is further proved by the fact that the great mass of its stars are of the same small magnitudes, from the 9th to the 12th. If it were merely the appearance of a *stratum* of stars extending outward from our own vicinity, it would contain many more stars of large magnitudes, and these magnitudes would regularly and gradually decrease in size from their increasing distances. But no such appearance is presented. Therefore, as Sir John Herschel announces, "it is not a *stratum*, but an *annulus*."

In the general direction of the galaxy, though situated far beyond, there are very many easily resolvable nebulæ, which are unique among all nebulæ, from their very irregular forms and aspects. From their appearances and positions, and resolvability, they must be members of our own sideral system, and they occupy the same relative position to the galaxy, as the systems of Jupiter, Saturn, and Uranus hold to the ring of the asteroids.

In some places observers cannot apparently see through the galaxy; stars, or rather nebulæ, appear beyond one another indefinitely. These appearances are explained by the resolvable nebulæ just mentioned, which are the extremely distant members of our system, and by the irresolvable nebulæ in the same direction, though far beyond, which are independent sidereal systems. The two seem to make a continuity of stars. Mere vision in such cases fails to distinguish these distant sidereal systems from the outlying members of our own system; the same as Saturn and Sirius when side by side, seen by mere vision, seem to be equally distant. Irresolvability is at present a decisive test between the outlyers of our own system, and other independent sidereal systems.

That our sidereal system has definite bounds, we may believe from the definite boundaries of other distant sidereal systems. Often they are regularly round or elliptical; and even those with irregular contours may have their stars to revolve in nearly circular orbits; the same as our solar system must appear to distant observers to be extremely irregular in contour, although its revolutions are nearly circular.

Neither is our opinion of the definite boundary of our system disturbed by the appearance of new stars with every new power added to the telescope. These newly-discovered stars may be its smaller members, and comparatively near, and visible only by high powers.

Nor is it an argument against the ring form of the galaxy, because it is broken by a slight transverse rift in the southern hemisphere. My recollections are distinct that this rift is exceedingly narrow, hardly observable, and smaller by far than the longitudinal rifts in both hemispheres.

Therefore all objections are easily answered, and we have solid grounds to conclude that our sidereal system is round, and in the main, disk-like in form, with the vast majority of its stars in or near the plane of the galaxy. The ring form of the chief mass of our system, is confirmed by the existence of other rings of stars, as the annular nebulæ, the ring of the asteroids, and the rings of Saturn, composed, there is good reason to believe, of very little stars, the majority not larger than meteorites.

II. The Position of the Centre of Gravity.—From the form of our sidereal system the conclusion is clear and irresistible that the centre of gravity of the system must lie in the plane of the galaxy. It is also equally clear that this centre must be situated in the centre of that plane. Because the stars in general are equally numerous, and equally large and bright in all extended regions of that ring. They appear a little brighter towards the southern pole; but this seems an indication that our own position is a little nearer that side of the galactic ring.

III. All the Stars of our Sidereal System Revolve with high Velocities around its Centre of Gravity.—It was formerly supposed that the vast distances between the stars cut off this intergravitating force. Newton, in his Principia, uses this language: "The fixed stars, therefore, being at such vast distances from one another, can neither attract each other sensibly, nor be attracted by our sun." This opinion was generally held among his followers, one of whom has remarked: "So remote are the nearest of the fixed stars, that it may be doubted whether the sun has any sensible influence on them." It is remarkable that the thought occurred to no astronomer to calculate the force of gravity from our sun on the fixed stars, until more than a quarter of a century after the distances of some of these stars had been approximately discovered. Then this was first done by myself, and the amount of this force was found to be surprisingly large. To present an impressive and graphic view of that amount, I brought it out in terms of the velocity around our sun required for gaining a centrifugal force so great as to prevent a revolving body from falling in the sun. I employed two methods of demonstration quite independent of each other, and by both the same results were obtained. As these methods have already been stated in the "Origin of the Stars," they need not be repeated here. By them it was proved that our sun acts so powerfully on Alpha Centauri that, if there were no other influence, Alpha Centauri would have to revolve around our sun at the rate of 145 miles an hour to gain a counterbalancing centrifugal force. That star, judging from its distance, and its amount of light, must be two and a third times greater than our sun. Therefore its power of gravity alone on our sun is such that, without any other influence, our sun must revolve around it at the rate of 222 miles an hour to gain a counterbalancing centrifugal force. Judging from its distance and its light, Sirius is at least sixty times greater than our sun. Therefore our sun would have to revolve around Sirius at the rate of 580 miles an hour to avoid falling into its flames. In all these instances, the gravity of a single star has alone been calculated, and not the combined force of the two.

These velocities impress strongly on our minds the greatness of the force of gravity between the stars of our sidereal system. How inconceivably mighty must be the united force between the twenty millions of stars. How strongly must they all be impelled toward this common centre of gravity. And how swift must be their velocities around that centre to gain a centrifugal equal to the centripetal force. Now, first, we understand the necessity of such high velocities as those of 61 Cygni, and of

Arcturus, and of other stars ; that is, velocities from nearly 2000 to nearly 3000 miles per minute, velocities about double any of those seen among the planets of our solar system.

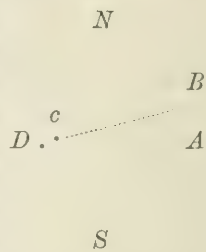
It is evident that the stars of the galaxy must all move in the same direction around in the plane of the galactic ring, otherwise they wound fly off, and soon there would remain no ring.

It is also evident that such rings of stars revolving with high velocities, both in our own and in other sidereal systems—annular nebulæ—coincide perfectly with the nebular theory which teaches the absolute necessity of ring formations abandoned by centrifugal force in high velocities of revolution.

IV. The Direction from our own Position to the Galactic Centre or to the Centre of Gravity of our Sidereal System.—Our own position is certainly on the north side of the galactic plane; that is, on the same side with Ursa Major, and not on the side on which Orion appears. The median line of the galaxy, or its plane, does not coincide with a parallel great circle. Between the two, as projected on the heavens, there is a distance of about 2°, the precise distance being not yet determined within half a degree, more or less. This appears as follows: The median line of the galaxy is distant about 32° from the north pole; but on the opposite side of the heavens it is distant from the south pole only about 27°. Other measurements in other regions, not polar, correspond. This difference of five degrees must be equally divided, and there remains about 2½° as the distance in arc between the median line of the galaxy and a parallel great circle. Our own position therefore is situated, as measured by our great circle, about 2½° away from the galactic plane, and on its north side. We are further confirmed in this conclusion because it explains the fact that more stars are seen in the southern galactic hemisphere than in the northern. Many of these southern stars are really on the north side of the galactic plane, but being ourselves so much further north, they are projected on the southern galactic hemisphere. At first view this seems unlikely, but forthcoming proofs are convincing.

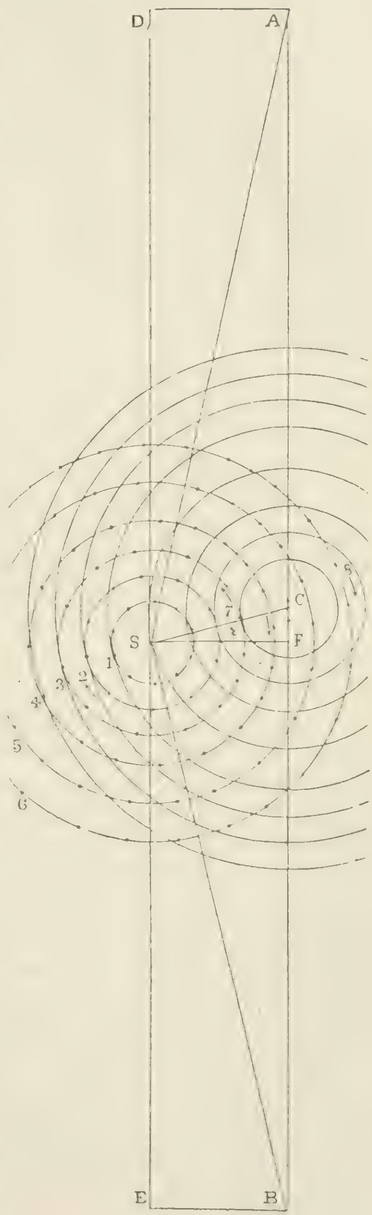
Now, being on the north side of the galactic plane, and if we were equally distant all around from the galactic ring, then the conclusion would be certain that the direction of the centre of the galactic plane, or the centre of gravity of our system, would be *precisely toward the south galactic pole*, that is, at about 119°

N, *P*, *D*, and a little east of the equinoctial colure. In such case there could be no other decision. But because the galactic ring appears a little brighter in the southern regions, it seems probable that we are situated a little nearer towards the southern side of that ring; consequently the galactic centre must be projected on the heavens a little to the north—the geographic north—of the south galactic pole, say in the tail of the constellation Cetus. This northern projection of the galactic centre may be illustrated as follows: Let *N* be a point in the geographic northern side of the galaxy, *S* the opposite point in the southern side, *A* the south galactic pole, and the dot at *c* the centre of the galactic plane or centre of our system. Then our position at *D* being a little nearer the southern side of the ring at *S*, the centre *c* would be projected on the heavens at *B*, that is, geographically north from the south galactic pole *A*. In the figure there is an exaggeration in the position of *B* to render the principle plain.



Therefore we may affirm, without pretending to absolute precision, that the DIRECTION of the centre of our sidereal system, and consequently its centre of gravity, must lie a little east of the equinoctial colure, and a few degrees north geographically of the south galactic pole; that is, in the tail of the constellation Cetus. It remains now to demonstrate—

V. THE DISTANCE FROM OUR OWN POSITION TO THE GALACTIC CENTRE, OR CENTRE OF GRAVITY OF OUR SIDERAL SYSTEM.—To find this we have the following data: First, that the median line, or plane of the galaxy, is distant from a parallel great circle $2\frac{1}{2}°$; second, that the distance of the galactic ring from our own position is such as to require 2000 years for its light to reach us. This latter is Sir John Herschel's estimate of its nearest stars of the 9th magnitude. Struve computes that light requires 3400 years to reach us from the galactic stars of the 12th magnitude. In this demonstration the 9th magnitude galactic stars, with the distance for light travel of 2000 years, will be taken. In the figure *S* represents the position of our sun or our own position. The dotted circles are the distances of the stars of the several numbered magnitudes. *A B* is the plane of the galaxy, and *C* its centre. *D E* is the plane of a parallel great circle. *S C* is the



distance from ourselves to the galactic centre, or the centre of our sidereal system. $S\ F$ is a line perpendicular to the galactic plane. Our position S is made a little nearer to the geographical southern side of the galaxy at B, for the reason already stated. $D\ A$ is the arc, and $D\ S\ A$ the angle between the galactic plane and a parallel great circle, at present assumed at $2\frac{1}{2}°$. $S\ A\ F = D\ S\ A$. Light requires 2000 years to travel from A to S, or from A to F nearly. Here we have a right-angled triangle with three known elements, namely, $A\ F = 2000$; $S\ A\ F = 2\frac{1}{2}°$; $S\ F\ A = 90°$. From these elements it follows from the most simple of all trigonometrical processes that $S\ F$ equals 87. Therefore it requires light 87 years to pass between ourselves and the plane of the galaxy, or about the same to reach the galactic centre at C. But according to the estimates of astronomers, light requires 85 years to reach us from the stars of the 5th magnitude; therefore the centre of our sidereal system is distant from our own position about as far as the stars of the 5th magnitude.

But the amount of the arc $D\ A$ or the angle $S\ A\ F$ is not yet precisely determined. If it be only 2°, then the distance from the plane of the galaxy is such that light from there requires 70 years to reach us, and it must lie beyond the stars of the 4th magnitude, as it is drawn in the accompanying figure. If the angle *S A F* equals $1\frac{1}{2}^{\circ}$, then the light from the region of the galactic plane requires 52 years to reach us, and that plane must lie beyond the stars of the 3d magnitude. And so on, after the following table, where the third column expresses the number of years required for light to reach us from the stars of the several magnitudes, according to Struve, and also from the galactic plane, when the first column expresses the different values of the arc *D A* or the angle *S A F*.

Angle S A F.	Star magnitudes.	Distances in years.
	1	15
$\frac{1}{2}^{\circ}$		17
	2	28
1°		35
	3	43
$1\frac{1}{2}^{\circ}$		52
	4	61
2°		70
	5	85
$2\frac{1}{2}^{\circ}$		87
3°		104
	6	120
4°		140

We have now discovered approximately both the DIRECTION and the DISTANCE to the centre of our sidereal system. I need not at this early day be precise in my statements of either of these elements: these will require the careful observations and measurements of many years. When Copernicus had announced the centre of our solar system, his discovery was not vitiated nor rendered the less valuable because he made such an enormous error about the distance of that centre. Even yet, after the studies of 10 generations, that is, of 333 years, astronomers are still endeavoring to find more nearly the distance to the centre of our solar system. These round numbers just named measure the long flight of time which has intervened between the discoveries of these two centres, the centre of our solar and the centre of our sidereal system. In attaining precision in the distance to the centre of our sidereal system, the first element to be determined is the arc *D A*, or the angle *S A F*. Its nearest value seems to me at present to be 2°, and the figure is drawn on that supposition, locating the sidereal centre between the stars of the 4th and 5th magnitudes.

In addition to the data contained in the five sections already given, our present determination of the direction and distance is confirmed by the observed movements of the stars. Hitherto, the proper motions of the stars, amounting to nearly 2000, have presented the most wild and disorderly confusion. Nothing can be more hopeless and forbidding than an attempt to find our sidereal centre from the study of these motions. But our present determination of that centre shows the causes of this apparent confusion. It is because we are situated on one side of our system, far outwardly and away from the centre, with some stars interior and other exterior to us; precisely the same reason why the motions of the planets seemed so tangled before the discovery of the centre of our solar system. I will here point out the operations of this cause in detail, along with other causes of this apparent disorder.

1. In our figure the two stars within the dotted circles, marked with arrows at 2 and 7, move in the direction of the arrows. On the face of the heavens, or on a celestial globe, they seem to move around in contrary directions, the same as they seem to move in our figure in contrary directions around our position at *S*. But in reality they both move in the same direction around our sidereal centre at *C*.

2. The stars at 7 and 8, marked with arrows, seem, from our position at *S*, to move in contrary directions, but in truth they both move in the same direction around the sidereal centre at *C*.

3. Our sun's motion must give apparent motions to many stars, and some of these may be contrary to their real motions, the same as our earth gives retrograde motions to the planets. To separate these apparent from their real motions will be a task of many years, even after we learn the true direction of the sun's motion.

4. As our sun is on the north side of the galactic plane, and nearly equidistant from the galactic ring all around, it follows that the plane of his orbit is nearly, perhaps quite, at right angles to the galactic plane. It is evident also that thousands of other stars move in planes either at right angles, or highly inclined, to the galactic plane. Hitherto all this has been a source of perplexity, but now we may begin to lay down the lines of their nodes

on the galactic plane, and make real progress in sidereal astronomy, evolving beautiful order out of this apparent confusion.

5. In a system like our solar system, with a large central orb, and all the stars nearly in the same plane, it is generally conceded that the revolutions of these stars must be around in the same direction; contrary motions being incompatible with stability. But this cannot be affirmed of our sidereal system, which has no large central and controlling orb, where the stars are very far apart, and where their orbits are highly inclined in opposite directions, nearly or quite at right angles to the galactic plane, and so have come to move in opposite directions around the sidereal centre. This has occurred to thousands of stars in our sidereal system. It has occurred also in other far distant sidereal systems, for they are globular in shape. If only a few appeared round we might suppose them discoid, with the planes of their disks perpendicular to their lines of sight. But such large numbers of round systems argue globularity of form.

6. My discovery of the intergravitation among the members of our sidereal system, as stated in Section III. of this paper, aids to prove that collisions must be impossible, or very rare between the members of our system, even when they move in opposite directions. When two stars are meeting from opposite directions, they are under the influence through gravity of all the neighboring stars, drawing them from the line toward each other's centres of gravity, and therefore the chances are infinite against their moving towards each other's centres of gravity. They must approach each other, not directly, but obliquely; they may pass so near to each other as to remain forever under the power of their mutual gravitation, revolving around their common centre of gravity, and becoming a double star. Hence, the wonderful spectacle in the heavens of ten thousand double and multiple stars, with many more still to be discovered. A pair of stars may attract a third, and a fourth, and indeed a larger group like the Pleiades and Coma Berenicis, and the clusters in Hercules. A considerable cluster by their united gravity might draw to themselves all or nearly all the neighboring stars, leaving nearly vacant spaces around the clusters. Whenever Sir William Herschel, in his sweeps of the heavens, came upon one of these vacant spaces poorly furnished with stars, he was sure to look out for a cluster, or nebulous looking mass, consisting of the stars collected to-

gether from the nearly vacant spaces. We know that binary systems of stars may have proper motions, and so may larger groups.

7. In constellations like Ursa Major, and Cassiopeia, and others, the motions of their individual stars around the centre of gravity of the constellation, may obscure or hide their motions around the centre of our sidereal system. The revolutions of the satellites of Jupiter and Saturn and Uranus have more rapid velocities around their primaries than the velocities of those planets around the sun. A like state of things, though not so extreme, may exist in a constellation. According to Struve and others, the distance of second magnitude stars is such as to require their light 28 years to reach us. If in a triangle we take this number for each of the two sides, and for the included angle the divergence between two adjacent stars in Ursa Major, we are surprised on computing the third side of our triangle, to find how near those stars must be together. Therefore knowing the gravitation of our sun on our neighboring stars, we must conclude that in a cluster like Ursa Major, the revolutions around its centre may greatly modify and perhaps reverse for a time, the proper motions of those stars around the centre of our system.

8. As our sun's motion may give apparent retrograde motions to some of the stars, it is of the first importance in sidereal astronomy to learn the point to which our sun is tending. In our search for this we may now confine our endeavors to a narrow zone in the heavens. The sun's motion must be nearly at right angles to the line drawn to the centre of our system. This motion therefore must be toward some point in the zone of the galaxy. The method hitherto employed to ascertain the direction of our sun's motion, is very deceptive. As we travel through a wood the trees appear to grow wider apart in front of us, and closer together behind us. The same principle has been applied to the stars, comparing them with the trees. But how could such appearances, wider and closer, occur among the trees, if those trees were all in motion as rapidly as ourselves? The other stars are moving like our sun. Therefore this tree method of learning our sun's motion, is liable to grave objections.

9. The zone of the galaxy varies in breadth on the face of the heavens, but on an average it is from eight to ten degrees wide. If we be $2\frac{1}{2}°$ from its median line or plane, then this wide band

stretches not only over our own position, but over all the stars of the first and second magnitudes in the direction away from the galactic plane, and also on the other side of that plane far beyond the stars visible to the naked eye. Where the zone of the galaxy is 8° wide, then, calculating from its distance, light requires 280 years to cross that zone. And where it is 10° wide, light requires 350 years to cross it. When we look at right angles away from the plane of the galaxy to the distant stars of the sixth magnitude, and also in the opposite direction on the other side of the galaxy to the distant sixth magnitude stars, and then look up at the galaxy itself, we see apparently a narrow milky band, but it is broader than the entire distance between the opposite stars of the sixth magnitude.

The other dimension of the galaxy at right angles to this, that is, the distance from its nearer to its further or outer surface, is probably four or five times greater. Its nearer stars, those of the ninth magnitude, require 2000 years for their light to reach us, but its more distant, those of the twelfth magnitude, require 3400 years. Therefore the difference of 1400 years is required for the passage of light from its more distant to its nearer stars. Considering the wide space existing within these dimensions, we cannot say that the galactic stars are nearer together than our sun and its neighboring stars. Moreover the specific gravity of the four outer planets of our solar system is many times less than that of the four inner planets. Saturn, for instance, is nine times lighter than Mercury. In like manner the galactic, or the outer stars of our sidereal system, may be many times lighter than our sun and his neighboring inner stars. From both these causes, distance apart and lightness, gravitation between the galactic stars may be less than that between our sun and his neighboring stars. This aids to understand why, from their apparent nearness together, the galactic stars are not brought by gravity in contact, or in very closely revolving systems, like binary stars.

10. By assuming with Herschel that the nearest part of the galaxy requires 2000 years for its light to reach us, we may then calculate its circumference, or the orbits of its stars, and the time required for those stars to make one revolution in their orbits. A star moving at the rate of 3000 miles per minute, about like that of Arcturus, must require 50,000,000 years for a single revolution around the sidereal centre. A star revolving at the rate of 2000

miles per minute, about like that of 6 Cygni, requires 75,000,000 years. And a star moving at the rate of 1000 miles per minute, about like that of our earth around the sun, requires 150,000,000 years for one revolution around the sidereal centre!

Assuming the very probable estimate of 2° between the galactic plane, or median line, and a parallel great circle, then 70 years are required for the passage of light from our sidereal centre to ourselves, and the following table gives the times for a single revolution of our sun, around that centre, at the three different velocities above recorded.

3000	miles	per	minute,	1,760,000	years	for	one	revolution.
2000	"	"	"	2,640,000	"	"	"	"
1000	"	"	"	5,280,000	"	"	"	"

These almost endless periods teach some practical lessons. One is that the direction of our sun's motion for two or three centuries must be sensibly toward the same point in the heavens, or very nearly. If a star in the galaxy performs a revolution in 50,000,000 years, that is, with the velocity of 3000 miles per minute, then about 40 years are necessary for it to move through one second of arc, the smallest quantity measurable in astronomy. That is, if the position of a galactic star be taken and recorded with the most refined accuracy, then it will not be until the next generation of astronomers that the movement of the star can be recognized. If the velocity of the star be 2000 or 1000 miles per minute, then the time required to move through one second of arc must be in one case 60 and in the other case 120 years! No wonder that we cannot tell in which direction the Milky Way revolves. From the well-established intergravitation of the stars, we are sure that it must wheel around in its mighty circle, but we know not which way the wheel turns. This want of apparent motion in the galactic stars is proof positive of their vast distance. It confirms the same conclusion of astronomers founded on the smallness of this magnitude. We now see in a strong and clear light the importance of having portions of the galaxy mapped out, and their positions determined with the closest exactness, so that coming generations of astronomers may learn which way around the great Milky Way revolves.

The following reports were read and referred to the Publication Committee:—

REPORT OF THE PRESIDENT.

Several events in the history of the Academy have occurred during the year just closed which are worthy of notice or record.

On the 4th of January, 1876, the Society met in its hall at the northwest corner of Broad and Sansom Streets for the last time. It had been domiciled there since February 18, 1840, a period of very nearly thirty-six years. It held its first meeting in the north wing of the new edifice on Tuesday evening, January 11th. Possession of the old building was transferred to the purchaser the next day.

At the close of the sixty-fifth year since its foundation the Society may be justly congratulated on the progress it has made, in the extension of its museum and library, on the work recorded in its publications, and on the value of the real estate which it has acquired through the generosity of very many friends. It possesses a commodious fire-proof building (which is the north wing of the proposed structure), and a plot of ground upon which it can be extended. The Academy is free from debt, and its settled policy is to incur no pecuniary obligation before means to cancel it have been provided.

It seems not unreasonable to conjecture that the Society may be found occupying this same locality at the close of the second century of the nation, still endeavoring, under the benevolent precept *non sibi sed omnibus*, to acquire knowledge of the sensible creation and to diffuse it by all means at its command.

The propriety of representing the Academy through an exhibit of its publications, etc., in the International Exhibition, was suggested February 15th, and the committee then appointed—Dr. John L. LeConte and Messrs. Charles E. Smith and Wm. S. Vaux—reported substantially, March 7th, that it was inexpedient, and was discharged from further consideration of the subject.

The formal transfer of the building and site upon which it stands by the trustees of the building fund, in accordance with their suggestion, was postponed for the time, by a resolution adopted March 14th.

Under authority of a resolution of May 9th, an invitation to visit the museum and library as frequently as might be agreeable to them during their sojourn in the city was given to the commissioners accredited to the International Exhibition as well as to members and delegates of societies and associations which met in Philadelphia in the course of the year.

On specified conditions it was agreed, November, 1875, that the American Entomological Society should be received into the Academy, and on the 16th of May the report that the Entomological Section of the Academy had been organized, was made, in pursuance of a provision of the by-laws.

May 30th an application of members of the Society to form the Botanical Section of the Academy was approved, and the report that its organization had been completed was made June 20th.

The association of members occupied in a special branch of study into sections, besides being a source of gratification to them, is useful to the Academy. The collections placed in charge of the sections receive their particular care, and the Curators of the Academy are so far relieved from the necessity of giving special attention to their preservation and arrangement.

At present the Academy includes four sections, namely:—

The Biological and Microscopical Section.[1]

The Conchological Section.[2]

The Entomological Section.[3]

The Botanical Section.[4]

All members and correspondents of the Academy have the privilege of being present at the stated meetings of the sections.

August 31, 1875, the Council was requested to examine the by-laws and report such changes as may be necessary for the better government of the Academy. The Council deliberated long on the subject and recommended several important modifications. The series of amendments proposed by the Council were considered and debated at several meetings of the Academy, altered in many particulars, and finally adopted May 30th of the present year.

In conformity to one of these laws, on the 16th of May, twelve

[1] Stated meeting on the first Monday evening of every month.

[2] Stated meeting on the first Thursday evening of every month.

[3] Stated meeting, second Thursday evening of every month.

[4] Stated meeting, second Monday evening of every month.

councillors were elected, four for three years, four for two years, and four for one year.

Since the adoption of the new laws sufficient time has not yet elapsed to test satisfactorily their practical working. Some of the elder members of the Society doubt whether the changes made will prove to be better in practice than the displaced legal requirements. Perfection in by-laws of a society cannot be reasonably expected. The ordinary progress of events and changed conditions renders a modification of them from time to time desirable; and there is always ground for honest difference of opinion. Even the Constitution, the organic law of the United States, formed by the wisest and most judicious minds in the country, has been found, during the experience of a century, to require amendments.

In reference to one important feature of the new by-laws, I venture to make a few comments which I hope may not be considered out of place.

To the extent of its means the Society endeavors to diffuse information of what is known within the field of its labors, to increase the popular taste for natural science, and to assist those engaged in original investigations by granting to them the free use of its library and museum, and by publishing the results of their labors, in its Journal and Proceedings.

The Academy desires to extend the usefulness of its library and museum in this direction, and to project paths among the unknown things of the earth which men may pursue and retrace, always bringing back a revelation of some fact not previously known. It is believed that there are many men eminently qualified in all respects to engage in original research, whose scientific work is greatly restricted because almost all their time is necessarily spent in gaining a livelihood, who, like the Davys, Faradays, Huxleys, and Tyndalls of the Royal Institution, would gladly accept a moderate support of assured continuance, and in return for it devote all their energies to scientific investigations and teaching.

In the hope of increasing the number of original investigators by providing places for men of this character, and of securing systematic elementary and popular instruction by courses of lectures and otherwise, the Academy has modified its by-laws in such manner as to authorize the appointment of professors and assistant professors.

The plan is commendable, and its realization should be encouraged by the friends of scientific progress; but to realize it completely in all its details requires in the aggregate a very large sum of money.

In the present condition of the Academy's resources, the objection to this scheme is that to appoint professors before providing a laboratory in which they may pursue their investigations; or a lecture-room for the accommodation of those who would listen to their teachings; or means for their permanent and entire support, would be merely to bestow complimentary titles, without advancing the interests of original research in any manner or degree. Gentlemen elected to professorships without income would not find in the title of professor alone the means of living. Such title would not relieve them from the necessity of giving their time and labor to some exacting vocation in exchange for daily bread, nor afford them more leisure than they may possess without it. Those devoted to original investigation who are pecuniarily independent of secular employment do not need the assistance which hoped-for endowments are designed to give. As the library and museum are accessible to all for the purpose of study, they are in condition to pursue their scientific labors without acquiring the title of professor from the Academy.

The by-laws indicate that each professor will have exclusive control of such collections as may be assigned to his care, and be responsible for their arrangement, increase, and preservation. For partial or entire neglect of this very important duty, there seems to be no remedy of easy administration as long as it is confided to any one who has no right to compensation for his time and labor from the Academy. Where pecuniary consideration for services to be rendered is in any manner contingent upon their performance, there is an obvious and efficacious remedy for neglect.

If such objections have any force, they suggest that the interests of the Academy, and of science, will be best served by postponing the election of professors until after substantial endowments for their support have been secured. Until these are acquired the collections may be still properly confided, as they always have been, to the custody of the four curators, under whose care they have attained their present condition and magnitude, and in the mean time the Academy may continue its efforts to develop and make useful its resources.

The Emperor of Brazil, who is distinguished as much by his varied learning as by his high political position, was present at the stated meeting of the Society, held June 27.

On the evening of July 7, the gentlemen officially connected with the International Exhibition, and many others, were received and entertained in the Academy, the entire expense being borne by several generous members of the Society.

In August, Professor Huxley was invited, in anticipation of his coming to Philadelphia, to be present at the meetings of the Society, but he regretted his inability to accept the invitation. He arrived in the city about two o'clock P. M. of Thursday, Sept. 14, and spent two or three hours of the afternoon in the museum. The next afternoon he departed for New York.

At the instance of the Centennial Commission, a committee was appointed Oct. 10, "to investigate and report upon the introduction of new species of insects and plants through the medium of foreign exhibits at the Centennial Exhibition."

The report in relation to the introduction of insects, by Drs. J. L. Le Conte, Geo. H. Horn, and Joseph Leidy, was made Nov. 14. The labors of the botanists of the committee are necessarily deferred until the ensuing spring; the results of their observations cannot be expected until some time next year.

The stated meetings of the Society in the new locality, contrary to the anticipation of some of the members, have been more numerously attended than those in the old hall, and have been no less interesting.

In behalf of the council I have to report that its stated meetings have been regularly held, and the matters submitted to it have been carefully considered.

Respectfully, etc.,

W. S. W. Ruschenberger.

REPORT OF RECORDING SECRETARY.

During the twelve months ending Nov. 30, 1876, ninety members and nineteen correspondents have been elected.

Announcement was made of the death of two members—J. S. Phillips and Geo. Washington Smith.

Twenty-seven papers have been presented for publication, as follows: Wm. H. Dall, three; Wm. M. Gabb, three; Edw. D.

Cope, two; Geo. A. Koenig, two; Mariano Bárcena, two; and J. A. Allen, H. C. Chapman, Chas. A. White, D. S. Jordan and H. E. Copeland, Geo. Hay, Harrison Allen, Isaac Lea, Wm. G. Mazyck, Herman Strecker, Chas. Pickering, Wm. G. Binney, J A. Ogden, Jos. Leidy, T. A. Conrad, and Theo. Gill each one. Dr. Leidy's paper and one of those presented by Mr. Gabb were accepted for the Journal; the others were ordered to be published in the Proceedings.

The verbal communications have been much more numerous than heretofore, scarcely a meeting having been held at which some subject of scientific interest was not discussed. These communications have been for the most part reported by their authors for publication in the Proceedings.

Reports of the meetings continue to be published in two of the evening papers with, it is believed, the good effect alluded to in my last report.

During the year the ninety-five concluding pages of the Proceedings for 1875, and two hundred pages for 1876, with ten lithographic plates, one of them colored, have been issued. No portion of the Journal has been published, but artists are employed on plates illustrating papers by Dr. Leidy and Mr. Gabb, and it is hoped that the next part may be completed during the coming year.

All of which is respectfully submitted,

Edward J. Nolan,
Recording Secretary.

REPORT OF THE LIBRARIAN.

The Librarian respectfully reports that the additions to the library, during the twelve months ending November 30, 1876, amount to 2491. This is in excess of the increase for any other year of which we have a record, except that for 1850, when the late Dr. Thos. B. Wilson, and his brother Edw. Wilson, contributed a larger number of books than at any previous or subsequent period.

Of the additions during the past year 683 were volumes, 1784 pamphlets and parts of periodicals, and 24 maps, photographs, etc.; 1889 were octavos, 508 quartos, 44 folios, and 26 duodecimos.

They were derived from the following sources:—

Societies	1034	J. H. Redfield	3
Editors	400	War Department	2
I. V. Williamson Fund	350	Louis Godey	2
Bequeathed by John S. Phillips	221	East Indian Government	2
Authors	142	James Hall	2
Wilson Fund	71	Wm. S. Vaux	2
Brazilian Centennial Commission	35	Angus Mackay	2
Department of the Interior	19	H. H. Higgins	2
Dr. Jos. Leidy	15	Joshua Lindahl	2
Isaac Lea	12	Dr. James Hector	2
Geological Survey of Canada	12	West Virginia Centennial Commission	2
Geological Survey of Spain	12	Mexican Commission	1
Publishers	9	Chinese Commission	1
Smithsonian Institution	9	Japanese Commission	1
M. Lavoinne	9	Austrian Commission	1
Adolph Sutro	8	Ward B. Haseltine	1
Geological Survey of India	7	T. R. Peale	1
Geological Survey of Sweden	7	J. S. Newberry	1
Geological Survey of Penna.	7	Edw. Stabler	1
Alfonso Herrera	7	Mr. Davies	1
J. A. Ryder	5	Lorin Davenport	1
Engineer Department, U. S. A.	5	Chas. Dury	1
Dr. F. V. Hayden	5	Chas. S. Rand	1
New South Wales Centennial Commissioner	5	D. S. Sheldon	1
Treasury Department	4	Mrs. E. P. Gurney	1
Thos. Meehan	4	G. M. Levette	1
C. W. Williamson	4	K. Kuroda	1
J. Laidlaw	4	Saml. Davenport	1
Wisconsin Centennial Commission	4	Isaac Burk	1
Dr. F. A. Hassler	3	Rev. Dr. Honeyman	1
Minister of Public Works, France	3	W. C. Stevenson	1
J. E. Cook	3	T. A. Conrad	1
G. W. Tryon, Jr.	3	J. B. King	1
Michigan Centennial Commission	3	Alex. Agassiz	1
		Geological Survey of Illinois	1
		Navy Department	1
		Surgeon General, U. S. A.	1
		Department of Agriculture	1

They were divided as follows:—

Journals	1745	Chemistry	10
Geology	177	Ichthyology	9
General Natural History	159	Herpetology	8
Conchology	129	Mineralogy	7
Botany	55	Medicine	7
Entomology	28	Encyclopædias	6
Anatomy and Physiology	26	Mammalogy	5
Ornithology	24	Bibliography	5
Physical Sciences	24	Geography	4
Anthropology	17	Education	3
Helminthology	16	Agriculture	1
Useful Arts	15	Antiquities	1
Voyages and Travels	10		

One hundred and seventy-one volumes have been bound during the year, and 55 volumes are now in the hands of the binder. These include all the unbound books which have been credited to the Wilson and I. V. Williamson Funds, together with such journals received in exchange for the Academy's publications as are in constant use and likely to be damaged if left unbound. The volumes of other exchanges have been tied up, to remain in this condition on the shelves until the Academy is able to bear the expense of binding.

The early months of the year were occupied in transferring the library from the old building, and roughly placing the books in the new cases prepared for them. With the assistance of Mr. Russell Hill and Mr. J. A. Ryder, this work was accomplished in less time than it was supposed it would be necessary to devote to it, and the more careful classification and arrangement of the various sections have since proceeded as rapidly as circumstances would permit. The catalogues which were completed before the removal, have been revised so as to accommodate them to the new disposition of the books, and the current additions to the library have been added to the card catalogue. Special attention has been given to the arrangement of the journals and periodicals. The greater portion of this department has been carefully examined, all deficiencies have been noted, and fifty letters applying for parts required to complete sets have been written. The answers to these applications have been such as to warrant the belief that a much larger return will be secured by written requests to societies and editors than could be hoped for in answer to printed circulars, no matter how urgently they may be worded.

Various plans for the re-arrangement of the library in the present building have been suggested and considered, but the simplicity of the system of consecutive numbering of the volumes, adopted before removal, and the readiness with which, by means of it, any given book may be found, has caused the Library Committee to authorize its continuance. It will, however, be supplemented by a shelf or alcove catalogue of the recent additions to each department until they accumulate sufficiently to permit of their being numbered.

An examination of the library in April showed that it contained at that time 22,440 bound and 621 unbound volumes, and

1255 unbound pamphlets, which would probably form 125 volumes, making 23,186 volumes in all, exclusive of duplicates and the libraries of sections. If these be added the total will reach 25,495 volumes.[1]

Portraits in oil of Jacob Gilliams, M.D., and John Speakman, two of the founders of the Academy, were presented by Dr. Jas. S. Gilliams and Thos. Say Speakman respectively.

It will be seen by reference to the annual list of additions to the library how deeply the Academy is indebted to Mr. Isaiah V. Williamson for his munificent gift. Many of the most valuable publications of the last two or three years have been obtained by means of this fund, and the library is consequently better supplied with the recent literature of natural history than it has been since the death of Dr. Thos. B. Wilson. Much, however, remains to be added before the library in many of its sections can be considered as approaching a state of completeness, and it is earnestly desired that specialists will furnish the titles of such works as may be lacking in their departments. A catalogue of current scientific books already begun for the use of the Library Committee will be continued and kept as complete as possible. It is hoped that the means at the disposal of the committee are now sufficient to enable it to authorize the ordering of all approved books, while the titles of those works which it is not thought desirable to purchase immediately, will yet be kept for reference in the future.

All of which is respectfully submitted,

Edw. J. Nolan, *Librarian.*

REPORT OF THE CURATORS FOR 1876.

The removal of the Museum of the Academy from the former building to the one now occupied, was completed before the close of the last year; the removal of the library immediately followed, and was completed in the first week of January of the present year. The first meeting of the Academy was held in the new building on the 11th of January.

Through the able superintendence and incessant labor of my colleagues, Messrs. Tryon and Parker, aided by Dr. James A. Ogden, Miss Sarah P. Monks, John A. Ryder, Russel Hill, and others, the different collections were so far arranged in their

[1] The increase of the year makes the aggregate of the library November 30, 1876, about 26,356 volumes.

respective places that the Museum was opened for exhibition to the public on the first of May. From that time to the present it has been open to visitors daily except on Saturday and Sunday. Since then, also, the regular and systematic arrangement of the collections of the Museum has continued in the usual manner.

Those departments of the Museum under the charge of special sections of the Academy have been equally well attended to in the arrangement of their appropriate collections. On the condition of these and the additions thereto during the year, I refer to the reports of the Conservators of the Sections.

In July, I regret to say, Mr. Tryon resigned his position as Curator. Dr. H. C. Chapman was appointed to fill the vacancy. Since that time the Museum has been mainly under the superintendence of Mr. Parker, whose services have proved so valuable that I hope the Academy may secure their continuance.

Mr. John A. Ryder has arranged the mammalian collection, and affixed labels when required. The crania of mammals are partially arranged and labelled.

The collection of human crania has been rearranged. (Mr. Parker reports the following skulls as missing: Nos. 210, 215, 223, 224, 227, 232, 401, 568, 719, 736, 843, 872, 878, 898, 981, 1039, 1042, 1050, 1067, 1236, 1246, 1282, 1348, 1414, 1479, 1485, 1557—in all 27.)

The collection of mammalian and bird skins has been thoroughly examined.

The ornithological collection has been arranged in the cases by Dr. James A. Ogden, Miss Sarah P. Monks, and Mr. Russel Hill. Miss Monks has identified, labelled, and catalogued the species of twenty-three families; and, in addition, has arranged and attached the generic and family names to those identified by her the previous year. Mr. Spencer Trotter has identified the species of the family Sylvicolidæ.

Mr. W. G. Freedley is arranging and labelling the collection of bird's eggs.

The alcoholic specimens of the Museum have received due attention.

The cretaceous vertebrate fossils have been carefully gone over and placed in a condition to prevent their destruction through the decomposition of the sulphide of iron with which they are impregnated.

The invertebrate fossils have been partially arranged by Mr. Russel Hill, under the supervision of Mr. Wm. M. Gabb.

Most of the specimens donated, deposited, and purchased during the year have been labelled and arranged in their appropriate places.

(Several valuable specimens of minerals are missing from the collection.)

The contributions to the Museum during the year are as follows:—

Mammals.—A mounted skeleton of the Giraffe, 18 feet high, a fine specimen from Africa, purchased in London in 1875, presented by Wm. S. Vaux and Henry C. Gibson.

A Dugong, in alcohol, presented by Mr. John Ching, Wide Bay, Queensland, through Mr. Angus Mackay, Commissioner of Queensland.

Two skeletons of Marmoset, presented by Dr. Ed. Hartshorne. A squirrel, from Mexico, presented by the Zoological Society. A monkey, *Semnopithecus entellus;* a leopard, *F. pardus;* a Sun bear, *Helarctos euryspilus;* and a *Zalophus Gillespii*, deposited by O. B. Gross.

The following were also presented: a fœtal pig, by John Krider; a fœtal kitten, by C. F. Parker; a mouse with fungus growth, by P. F. Wells; a hydrocephalic skull of a calf, by Mrs. A. A. Crawford; and an irregular osteo-dentinal growth from the tooth of a sperm whale, by S. Powel.

Birds.—A black-throated quail, *Ortyx virginianus* var. *Hoopesii*, and a Trumpeter Swan, *Cygnus americanus*, presented by John Krider. A Massena partridge, *Cyrtonyx massena*, from Neuces R., Texas, presented by Lieut. A. C. Markley, U. S. A. A young heron, from New Jersey, presented by John Mays. An albino King bird, from New Jersey, presented by George W. Earle. Four bird skins, presented by John Wagner, through the Zoological Society.

Ten specimens, five species of bird skins, from Demarara, presented by Col. P. Figgelmesy, U. S. Consul, Demarara.

A finely mounted American eagle, from Arkansas, presented by Dr. George W. Lawrence, Commissioner.

The following were also presented: Five eggs of the Sage fowl, by Dr. J. Van A. Carter; three eggs of the Jew bird, *Crotophaga*, from San Domingo, by Wm. M. Gabb; three eggs of *Larus argen-*

tatus, by C. Mann; a nest of the Oriole, by Thos. L. Cernea; and a nest, by S. S. Haldeman.

A *Cygnus olor* was deposited by O. B. Gross.

Reptiles, Amphibians, and Fishes.—Fourteen jars of reptiles from British Guiana, presented by Mr. Gilbert, of Demarara, through Mr. A. A. Outerbridge, Commissioner for British Guiana. Eight species of reptiles, from Trinidad, presented by Col. P. Figgelmesy. There were also presented a small collection of reptiles, from San Domingo, by Wm. M. Gabb; and another from Port au Prince, Hayti, by Thomas Bland. Two snakes, from Pocono, by T. Wagner and R. Fulmer. Several salamanders, from Brush Mt., by Rev. H. C. McCook. A terrapin, by Mr. Mather; and several turtle eggs, by J. A. Ryder.

Forty-two specimens, forty-one species of fishes, from South America, collected by the Hassler Expedition, and forty-five specimens of twenty-six species, from the United States and West Indies, were presented by the Museum of Comparative Zoology of Cambridge, Mass.

Forty-eight specimens of thirty-six species of fishes, mostly from the U. S. Atlantic coast, presented by E. D. Cope.

Six species of fishes, from Janira R., San Domingo, and one Flying-fish, were presented by Wm. M. Gabb.

The following were also presented: A salmon trout, from Hobart Town, Tasmania, by the Tasmanian Salmon Commisson; several viviparous fishes, from Vancouver Isl., by A. C. Engard; two shad and an alligator Gar, from Ouchita R., Ark., by Dr. G. W. Lawrence; a Lucioperca and an Amia, by E. D. Cope; a *Platyrostra edentula* and *Megalops trissoides*, by the U. S. Fish Commission; a Lump fish, from Barnegat Bay, by D. M. Yost; a Tunney, from off Atlantic City, by R. Buckman; a Saury, from the same locality, by Geo. W. Bugbee & Co.; *Selene argentea*, *Alutera cuspidata* and *Carangus*, Squan R., N. J., by W. H. Dougherty; three species of fishes from the same river, by Jos. Willcox; *Mustelis canis* and *Anguilla*, Atlantic City, by Geo. W. Tryon, Jr.; *Engraulis*, by T. P. Parker; palatine teeth of drum fish, by J. F. Leaming; jaws of a fish, by Mrs. A. A. Crawford; and photograph and scale of the Tarpum, by R. Bridges and S. Powel.

A small collection of reptiles and fishes, from South America, was presented by Dr. C. Hering, and another collection from various localities was presented by Dr. F. B. Stevenson, U. S. N.

Articulates.—A small collection of insects, etc., from Port au Prince, Hayti, was presented by Thomas Bland; a small collection of crustaceans and spiders, by Dr. F. B. Stevenson, U. S. N.; a small collection of crustaceans, from San Domingo, by Wm. M. Gabb; a small collection of myriapods, from Iowa, by D. S. Sheldon through Dr. H. C. Wood; three *Scolopendra*, from Trinidad and Demarara, by Col. P. Figgelmesy; seven species of spiders, from Costa Rica, by Wm. M. Gabb; *Calappa convexa*, by Capt. L. D. Barrett; *Platyonychus ocellatus*, by G. W. Tryon, Jr.; *Alaus occulatus*, E. S. Whelen; *Polydesmus*, by J. O. Shimmel; a grasshopper, from Guayaquil, by C. S. Rand; larva of *Cuterebra*, from the skin of a rabbit, by Prof. J. Lawrence Smith; a beetle with fungus growth, by T. Pennington Conrad; and a hornet nest, by W. R. Jones.

Radiates and Protozoans.—A superb collection of thirty-seven corals, from Key West, Florida, presented by Wm. S. Vaux.

A fine collection of seventeen corals, presented by Clarence S. Bement.

Seventeen species of Echini, and a large Neptune's cup sponge, presented by Dr. Isaac Lea.

Six corals, from Samoan Islands, and one coral from Alaska, presented by J. M. Emanuel.

A Gorgonia and an Ophiura, and one hundred bottles of marine dredgings, etc. (including protozoans, radiates, annelides, crustaceans, mollusks, etc.) from the Pacific, presented by Dr. Wm. H. Jones, U. S. N.

A small collection of echinoderms in alcohol, from various localities, presented by Dr. F. B. Stevenson, U. S. N.

A coral, from Bermuda, presented by J. P. Hand; and an Echinus, *Hipponoë esculenta*, Caribbean Sea, presented by A. Duer, through Mr. Dougherty.

A fine large specimen of *Madrepora palmata*, from Turk's Island, was purchased.

There were also presented three sponges, from Turk's Island, by Wm. M. Gabb; and a Halicondria, from Egg Harbor Bay, N. J., by W. H. Dougherty.

Fossils.—A fine series of fossil foot tracks in slabs of red sandstone, together with a collection of remains of fishes, from the valley of the Connecticut, presented by Dr. Isaac Lea. To the same donor we are indebted for teeth and other remains of *Mastodon*, of *Ichthyosaurus*, etc.

A collection of fossils from the phosphate beds of Ashley R., S. C., consisting of vertebræ of squalodonts and cetaceans, the beak of a ziphioid cetacean, teeth of sharks, etc., was presented by Clarence S. Bement.

Portion of the femur of *Megatherium*, vertebra of *Squalodon*, teeth of *Equus major*, and dental plate of *Myliobates*, from the Ashley R. phosphate beds, presented by Mr. George T. Lewis.

Teeth and vertebræ of *Mosasaurus*, from Lumberton, Burlington Co., N. J., presented by Thomas Moore through Col. T. M. Bryan.

Three different small collections of shark's teeth and other remains of fishes and of reptiles, from the vicinity of Vincenttown, N. J., presented by Col. T. M. Bryan.

There were also presented the following: cetacean vertebra, from Ashley R., S. C., by S. Thayer Abert; tooth of *Mastodon andium*, from the Amazon, by Dr. Isaac T. Coates; cast of the lower jaw of the Cohoes Mastodon, presented by Prof. James Hall; remains of *Sphenosaurus clavirostris*, by S. S. Haldeman; do. of fishes from the mesozoic red shale of Montgomery Co., Pa., by Prof. Joseph Leidy; *Emys wyomingensis*, from Ft. Bridger, Wyoming, by Dr. J. Van A. Carter; tooth of *Carcharodon megalodon*, from Chesapeake Bay, by J. O. Schimmel; and coprolites, from Cambridgeshire, England, by Joseph P. Hazard.

Other fossils received by the Academy consist mainly of invertebrate remains.

Mr. Wm. M. Gabb, always a liberal donor to the Academy, as well as an active contributor to geological science, has presented the following collection:—

Sixty species of cretaceous fossils, mostly original types; 42 eocene fossils, from Texas, all original types; 31 miocene, 23 pliocene, and 85 post-pliocene fossils, of California, many original types; 42 species of post-pliocene fossils of San Domingo, and 72 pliocene fossils of Costa Rica. Mr. Gabb also presented 45 species of cretaceous fossils, most of which are described in his paper of November 7th.

Mr. Gabb further presented 225 specimens of 114 species of cretaceous fossils of India, being duplicate types of the "Palæontologia Indica," and labelled by Dr. Stoliczka.

Our venerable friend, member, and ever zealous student of natural history, Dr. Isaac Lea, has presented a collection consisting of 250 species of secondary and tertiary fossils, American and European, and 14 South American cretaceous fossils, types of his paper in the Trans. Am. Phil. Soc., 2d ser., vol. vii. He has also presented a collection of 40 species of American and foreign palæozoic cretaceous and tertiary fossils.

A collection of forty-seven lower carboniferous fossils, and five others from the lower coal measures from Jefferson Co., Alabama, were presented by Dr. Wm. Gesner.

Three fine specimens of *Eurypterus remipes*, from the Waterlime group, near Buffalo, N. Y., presented by Tobias Witner, Esq., through Prof. S. S. Haldeman.

Twenty palæozoic brachiopods, from Huntingdon Co., Pa., were presented by John M. Hartman.

Forty-four devonian and silurian fossils, comprising brachiopods, corals, and a large slab of shale with a multitude of trilobites, etc., from Ontario, Canada, presented by Thos. Burnett.

Twenty species of cretaceous fossils, from New Jersey, and a collection of minute fossils, comprising many specimens and species, from the cretaceous limestone of Vincenttown, N. J., presented by Col. T. M. Bryan.

Of other invertebrates, the following were presented: a collection of shells from the Paris basin, etc., and encrenites, by Dr. Isaac Lea; a collection of marl fossils from Vincenttown by Col. Bryan; cobble stone with *Scolithus linearis*, from drift, Washington, D. C., by Prof. Wm. B. Rogers; numerous *Amnicola galbana*, Sussex Co., N. J.; *Inoceramus* and another cretaceous fossil, from Texas; and *Inoceramus barabeni*, Selma, Alabama, by Prof. Haldeman; *Ammonites obtusus*, England, by Miss Mary Haig; coral, Luzerne Co., Pa., by E. K. Bryer; *Gryphæa vesicularis*, New Jersey, by W. H. Dougherty; *Avicula*, Munroe Co., Pa., by C. F. Parker; two Orthoceratites, Arkansas, by Dr. G. W. Lawrence; a new species of Nautilus from Vincenttown, N. J., by Col. Bryan; seven fossils from Hayti, by Thos. Bland; several from New Jersey, by Mr. Gabb; and a Gryphæa and an Ammonite from Hemstead Co., Ark., by Dr. Geo. W. Lawrence.

Of fossil plants, Dr. George W. Lawrence, Arkansas Commissioner, presented two large silicified trunks, measuring each upwards of four feet in length and a foot in diameter, from Hot Springs Co., Arkansas. Dr. Isaac Lea presented nine fossil plants, and Dr. Lawrence one coal plant from Arkansas.

Minerals.—Among the most interesting of the minerals given to the Academy, is a collection of fifty-six specimens of Ozocerite and the associated rock strata, from Boryslaw, Carpathian Mountains, Galicia, presented by Paul Dobel through Dr. F. Migerka, Austrian Commissioner.

A crystal of Barytes, sixty pounds weight, from Dufton, Cumberland, England, was presented by Wm. S. Vaux. The following were also presented by the same gentleman: a large crystal of Apatite, from Burgess, Canada; Anglesite, Phœnixville, Pa.; Brown Tourmaline, Governeur, N. Y.; Apophyllite with Analcime; and Datholite, from Bergen Hill, N. J.

Dr. Isaac Lea presented the following: one hundred specimens of rocks from Scotland; thirty-seven do. from a coal shaft, England; forty do. from the route from Cruces on Chagres R. to Panama; eight additional rock specimens; thirty-five coprolites and septaria from near Edinburgh; a mass of mesozoic conglomerate, Plymouth, Montgomery Co., Pa.; Clinochlore in Chlorite, from Chester Co., Pa.; Magnetite, from Tilly Foster Mine, N. Y.; and a specimen of silicified wood. Dr. Lea also deposited an iron meteorite, weight two hundred and fifty-four pounds, from the mountains of East Tennessee.

Mr. Joseph Willcox presented collections consisting of two Rutiles, Georgia; two Apatites, Canada; Sulphur, Nevada; four Houghite, Strontianite, all St. Lawrence Co., N. Y.; Emerylite, Cyanite, N. Carolina; Pyrophyllite, S. Carolina; Tremolite, Conn.; Hornblende, N. J.; Tourmaline, three Anthophyllite, Del. Co.; two Actinolite, Fibrolite, Deweylite, Chester Co.; Mesolite, Nova Scotia; Zoisite, Ducktown, Tenn.; Pyrite, Columbia Co.; Tachylite, Nova Scotia; and Pyrophyllite, N. Carolina.

A fine specimen of Fire Opal, from Zimapan, Mexico, was presented by Prof. Mariano Bárcena.

A collection of minerals from Arkansas, consisting of Quartz and its varieties, Arkansite, Rutile, Schorlamite, Garnet, Magnetite, etc., was presented by Dr. Geo. W. Lawrence.

Fifty-nine rocks and minerals of Brazil, presented by Dr. J. M. da Silva Coutinho, Secretary of the Brazilian Commission.

A collection consisting of Sussexite, Jeffersonite, Rœpperite, and Calamine, from Franklin, Sussex Co., N. J.; Unakite, North Carolina; Copper, Lake Superior; Dendrites in shale; and eight Hematites and Limonites, Michigan, presented by John M. Hartman.

Two Satin-spars, England; Gypsum, Michigan; a collection of rocks, mostly fragments of boulders, eleven other rocks; two calc-tufas, and five fragments of glacial polished rocks, from Niagara, presented by Thomas Burnett.

Of other minerals, there were presented the following:—

Manganite, Ihlfeld, Hartz; Aragonite, Herrngrund, Hungary; two Arkansites, and a Rutile, Magnet Cove, Ark., presented by C. S. Bement. Vivianite, from Vincenttown, N. J., by Col. T. M. Bryan. Diaspore, from near Unionville, Chester Co., by T. F. Seal. Cassiterite, Durango, Mexico, by S. C. Bruce. Peat, Ireland, by Mary Mulholland. Two phosphatic nodules, Ashley R., S. C., by Geo. T. Lewis. Mullicite, Mullica Hill, N. J., by T. D. Rand. Native Mercury, Cal., by Dr. T. H. Streets. Strontianite, Mifflin Co., Pa., by H. C. Lewis. Serpentine, Harford Co., Md., by Wm. Struthers. Four topazes, Bass' Straits, by Miss Hull. Copper, Lake Superior, by B. A. Hoopes. Eleven iron ores, Alabama, by Dr. Wm. Gesner. Sixteen iron ores, Bohemia, by W. Nedwied & Son, through Dr. F. Migerka. Magnetic iron, Costa Rica, by W. M. Gabb. Three Graphites, Canada, by the Plumbago Co., Ottawa, Canada. Stibnite, Blende, Galena, Chalcopyrite, etc., Arkansas, by W. E. Powell. Gypsum and Kaolin, Ark., by Thomas Essex. Sphene and casts of crystals, Chester Co., Pa., by W. H. Forwood, M.D. Two Calcites, Montana, by V. E. Cline and P. Barbite. Celestine, Blair Co., Pa., by Rev. H. C. McCook. Four auriferous Quartzes, Chalcopyrite and Garnet, Siberia, by Dr. S. H. Linn. Halloysite, Indiana, by Mr. Dougherty. Halloysite, N. Y., by E. Goldsmith. Fichtelite, Bavaria; and four rocks from Lehigh and Delaware Co., by Dr. Leidy. Seven minerals, Australia, by J. M. Emanuel. Rose chalcedomy, California, by W. H. Dougherty.

There were also purchased: Hornblende, from Edwards, N. Y., Heulandite, Iceland; Garnet, Chester Co., and a fine crystal of Amazon stone, Pikes' Peak, Colorado.

Ethnological and Miscellaneous.—A collection of American Indian stone relics, from Arkansas, was presented by Dr. G. W. Lawrence.

A collection of ten pieces of pottery, etc., from Nicaragua, was presented by Dr. J. H. Bransford, U. S. N.

Twelve pieces of pottery, from Peru, and three pieces of tapa cloth from Hawaii, etc., presented by Dr. W. S. W. Ruschenberger.

In addition, the following were presented:—

A fossil tooth of *Carcharodon magalodon*, artificially shaped into an Indian implement, taken with stone relics, etc., from a shell heap at Cedar Keys, Florida, by R. M. Smith. Rope, mat, and paper, from the Samoan Island; native sword, fans, etc., from Fiji Isle, and opium pipe, from China, by J. M. Emanuel; several arrowheads and chips, from shores of Delaware; an arrowhead from Tennessee, and a pestle from New Jersey, by Dr. I. Lea. An Eskimo ice-pick, by Prof. S. S. Haldeman; stone hatchet and arrowhead, Glassboro, N. J., by Charles Berry; an arrowhead from Ohio, by T. C. Heighway; and a peculiar stone relic, by Mr. Trimble.

Dr. R. M. Bertolet deposited a collection consisting of one hundred and eighty-two arrowheads, two axes, one chisel, etc., besides forty-six specimens consisting of axes, pestles, pottery, carved pipe bowl, etc.

Respectfully submitted by

JOSEPH LEIDY,
Chairman of Curators.

REPORT OF RECORDER OF BIOLOGICAL AND MICROSCOPICAL SECTION.

The extraordinary demands upon the time, attention, and resources of Philadelphia physicians, throughout the centennial year, consequent upon the meeting in this city of the International Medical Congress, the American Medical Association, and the Pennsylvania State Medical Society, have seriously interfered with the prosecution of scientific research among our members during the past twelvemonth. On the other hand, however, by way of compensation, the presence of representative scientists from all parts of the world in attendance upon these conventions and on the Centennial Exhibition itself, has not only rendered the discussions at our meetings of the section more interesting and instructive, but has enabled us to give on the 16th of October last, by far the most successful microscopical exhibition and conversazione that has ever been organized in this city.

As remarked by the editor of a well-known Journal of Microscopy in concluding his account of the exhibition: "Altogether the meeting was a most pleasant and instructive one. It brought together face to face a large number of men who had known each other by reputation for years, but who had not previously met, and it afforded such an opportunity for comparing the different forms of microscopes as does not often occur."

During the year communications have been presented by Dr. J. Gibbons Hunt, "On the Potato Fungus," "On the Study of Embryonal Tissue," "On Aleurone," "On The Lasso Cells of *Physalis Caravella;*" by Dr. J. H. McQuillen, "On *Sporendonema musca:*" by Dr. Carl Seiler, "On an Economical Heliostat," "On a New Cement for Glycerin Mountings," "On a Novel Method of Silver Staining with the Iodine and Bromine Compounds;" by Prof. T. G. Wormley, of Columbus, Ohio, "On Improved Double Slides of Red Blood Corpuscles;" by Dr. H. Allen, "In regard to Microscopic Changes in Mucous Membranes after Topical Medication;" by Mr. J. Zentmayer, "On the Improved Large American Microscope;" by Mr. W. H. Walmsly, "On the Double Staining of Vegetable Tissue;" by Mr. D. S. Holman, "On a New Form of Life Slide;" and by Dr. J. G. Richardson, "On the *Amphiuma* (or *Muranopsis*) *tridactylum.*"

All of which is respectfully submitted,

Jos. G. Richardson,
Recorder.

REPORT OF THE RECORDER OF CONCHOLOGICAL SECTION.

The Recorder of the Conchological Section respectfully reports that the malacological papers accepted by the Academy, and published in its Proceedings during 1876, aggregate 26 pages, as follows:—

Wm. G. Binney,	10 pages.	C. A. White,	7 pages.
Wm. H. Dall,	4 "	T. A. Conrad,	2 "
R. E. C. Stearns,	2 "	W. G. Mazyck,	1 "

A valuable paper entitled "Description of a Collection of Fossils made by Dr. Raimondi in Peru," by Wm. M. Gabb, and fully illustrated, is also in course of publication in the Journal of the Academy.

For a list of donations to the library, see report of the Librarian of the Academy.

The principal donation to the museum was the fine collection of the late John S. Phillips by bequest. Of this valuable acquisition. 2584 specimens have been labelled and mounted in 938 trays. Few of these are specific novelties, but they add either to the varieties or the geographical suites. It is estimated that an equal number may be added from portions of this cabinet not yet examined. The aggregate of specimens labelled and mounted during the year is 2913 specimens in 1104 trays.

At its November meeting the Section appropriated $235.00 for fitting glass sashes in the drawers beneath the shell cases. When this work is completed, the collection will occupy a total space of 4765 square feet, or more than two and a half times as much as that occupied in the old building.

The officers of the Section for 1877 are—

Director	W. S. W. Ruschenberger.
Vice-Director . . .	William M. Gabb.
Recorder	S. Raymond Roberts.
Secretary	E. R. Beadle.
Treasurer . . .	William L. Mactier.
Librarian	Edward J. Nolan.
Conservator . . .	Geo. W. Tryon, Jr.

The following is a list of donations to the Conchological Cabinet, taken from the Report of the Conservator of the Section:—

Avicula, from the South Sea Islands. Presented by Dr. W. H. Jones, U. S. N.

Physa gyrina, Say. From Watkins Glen, N. Y. Presented by John H. Cooper.

Eleven species of *Unio*, *Anodonta*, *Etheria*, *Iridina*, and *Monocondylœa*. From Cambodia, the Nile, and New Caledonia. Presented by S. S. Haldeman.

Helix Van Nostrandi, Augusta, Georgia, and six species of *Bulimus* and *Cylindrella*. Presented by Thos. Bland.

Group of Eggs of *Ampullaria depressa*, Say. From Florida. Presented by Joseph Willcox.

The collection of shells of the late John S. Phillips, comprising about 2500 species, together with the cases containing the same. Bequeathed by him.

Oyster shell with eggs attached. Presented by C. M. Hyatt.

Twenty-seven specimens of *Helix rareguttata*, Mouss. Java.

Four specimens of *Helix puella*, Brod.; five *H. pulcherrima*, Sowb.; and six *H. argillacea*, Fer., Timor, Philippines. Presented by Mr. Gregory.

Fifty species of European shells, and thirty-eight types of Mühlfeldt's Genera of Mollusca. From Dr. I. Lea.

Helix ænigma, Dohrn. From New Granada. Presented by Thos. Bland.

Six species of shells. From Samoan Islands. Presented by J. M. Emanuel.

Two specimens of *Vivipara lineata*, Val.; *Pupa contracta*, Say; *P. armigera*, Say; and *Conulus chersina*, Say. From Davenport, Iowa. Presented by D. S. Sheldon.

Several specimens of *Cypræa moneta*. From Rutgers College in exchange.

Eggs of *Loligo punctata*, DeKay; specimens of nidus of *Natica; Ilyanassa obsoleta*, Say; *Natica duplicata*, Say; *Mya arenaria*, Lin.; *Mactra solidissima*, Ch., and seven other species. From Atlantic City, N. J. Presented by Geo. W. Tryon, Jr.

Eight specimens of *Hemimactra solidissima*, Chemn. From Atlantic City, N. J. Presented by Geo. W. Tryon, Jr.

Ten specimens of *Helix terrestris*, Ch. From Charleston, S. C. Presented by G. Mazyck.

Three specimens of *Microphysa Ingersolli*, Bland, Animas Valley, So. Colorado. Two *Pupilla alticola*, Ingersoll, Howardsville, Colorado. Presented by Ernest Ingersoll.

Two specimens *Dædalochila avara*, Say. From St. John's River, Fla. Two *Liostracus Dormani*, W. G. Binney, from Florida. Two *Helix Cumberlandiana*, Lea. From University Place, Franklin Co., Tenn. Presented by Chas. Duey.

Fifteen species of Marine Shells, from Santo Domingo and Turks Island, W. I. Presented by Wm. M. Gabb.

Respectfully submitted,

S. R. ROBERTS, *Recorder*.

REPORT OF THE CONSERVATOR OF ENTOMOLOGICAL SECTION.

In presenting this, the first annual Report of the Entomological Section of your Academy, the conservator of the same feels that it is difficult to render full justice to the Section at this time. The

Section as yet is in its childhood, and some time will be required to fully develop its vigor.

The American Entomological Society constitutes in its relation to the Academy of Natural Sciences the Entomological Section of the latter. Though working under different titles, they are essentially one and the same.

Under the terms mutually agreed upon by the two societies, the American Entomological Society held its first meeting in the building of the Academy on Feb. 14, 1876. After that meeting, the members of the Entomological Society took such action as was deemed necessary, culminating in a meeting held May 12, at which the Entomological Section of the Academy of Natural Sciences was fully organized, and entered upon the transaction of business as such. The American Entomological Society thereupon passed resolutions, directing that only two meetings should be held by it each year, said meetings to be held in June and December, for the transaction of business strictly belonging to it, and that all other stated meetings were to be those of the Section.

Under the above rule the Section has held thus far seven meetings, with an average attendance of seven members.

The meetings of the Section are held on the second Friday of each month.

During the past seven months, nine entomological papers have been presented for publication in the Transactions of the Society; seven of which have been reported upon affirmatively, and two are yet in the hands of committees.

Two members of the Academy have been elected members of the Section in addition to those originally constituting the same.

The conservator would report that the specimens in the collection of the Section are in good condition. He is not prepared to state at this time the actual number of specimens in the collection, the large number of undetermined specimens making it impossible for him to do so.

At a meeting of the American Entomological Society, held December 11th inst., the following was presented:—

"*Resolved*, That the sum of one hundred dollars from the funds of the Society be donated to the general fund of the Academy of Natural Sciences," which resolution passed by a unanimous vote. In accordance with the above resolution, an order on the treasurer of the American Entomological Society for $100 is herewith presented to the Academy.

The following have been elected to fill the several offices of the Section for the year 1877:—

Director	John L. LeConte, M.D.
Vice-Director	Geo. H. Horn, M.D.
Secretary	C. A. Blake.
Recorder	J. H. Ridings.
Treasurer	E. T. Cresson.
Conservator	James Ridings.
Publication Committee . . .	E. T. Cresson, J. L. LeConte, M.D., Chas. A. Blake, Geo. H. Horn, M.D., Chas. Wilt.

James Ridings, *Conservator.*

REPORT OF THE CONSERVATOR OF THE BOTANICAL SECTION.

The Conservator presents this first report since the organization of the Botanical Section, upon the condition of, the additions to, and the needs of the Academy's Herbarium. The Section has been so recently established, that such a report may be expected to be but imperfect, and to be regarded rather as preliminary than otherwise. But as much work has been done during the year by the Committee on Botany, appointed under the old bylaws of the Academy, aided by the volunteer efforts of other members, who will, it is hoped, continue to co-operate with the Section, it will be proper to embrace a retrospect of what has been done during the whole year.

And first, the Conservator would congratulate the members of the Section and of the Academy, as well as the scientific public, that the botanical treasures of the Academy have been exhumed from the dusty and dingy den in which they were entombed in the former building, and that they are now made really accessible to students. The removal was accomplished at the beginning of the year. Before attempting to re-arrange the collection, the leading Herbaria of the country were visited, and the details of their arrangements examined. For very valuable suggestions in this regard we are indebted to Prof. Gray, of Cambridge; and also to Prof. Eaton, of New Haven; and to P. V. Leroy, the Curator of the Torrey Herbarium, at Columbia College, New York. Our own Curators, availing themselves of these and other suggestions, have spared no pains or expense in fitting up for our department a series of shelves and cases which fully meet our present wants, and which are in every way suitable to the careful preservation of the plants, and for facility of comparison and study. It is due to Mr. Tryon to say that, fully appreciating our needs in this respect, he entered heartily into the plans, and, as Curator, gave them his careful supervision.

These cases were completed about the 1st of May, and the labor of transferring the plants from the old unwieldy portfolios to the new shelves was carried on and completed during the summer mainly by the aid of Messrs. Meehan, Burke, and Parker. Among the packages removed from the old building were enormous piles of duplicate specimens which had been accumulating for years, some of which had lain buried, suffering from the ravages of insects, and few of which had been carefully examined. These, by the labors of Messrs. Burke, Meehan, Schimmel, Leffman, and others, have been examined, the ruined plants thrown out, and the remainder brought into some kind of partial arrangement, which, when completed, will enable us to select from these stores such specimens as may be desirable for the Herbarium, and to render the remainder useful for purposes of exchanges. This labor our Committee on Duplicates will doubtless continue and complete.

The Committee on the Herbarium, at its last meeting, decided on the general arrangement of the collection on a plan similar to that adopted at the Kew Gardens, and at Dr. Gray's Herbarium at Cambridge. The Conservator is now preparing the necessary tablets for displaying the names of the Natural Orders, and the lists of the Genera in each order. When this work is completed, the ease of consulting the Herbarium will be vastly increased, and any one of the 9000 known genera may be turned to, as readily as to a word in the dictionary.

During the past year the following donations have been received for the Academy's Herbarium:—

185 lots of cones of Coniferæ, and acorns of Oaks. Presented by Josiah Hoopes.

31 species of Plants, collected near Peking, China, by Rev. S. Wells Williams, 1868-9. Presented by John H. Redfield.

171 species of Plants, from Norwegian Mountains, collected by Prof. Willhelm Bork. Presented by Dr. H. C. Wood.

Leaves of *Argyroxiphium Sandwicence*, from the volcanoes of Kileau, Hawaii, Sandwich Islands. Presented by J. A. Ryder.

Branch of *Pinus pungens*, bearing cones. Presented by Dr. Isaac Lea.

Specimen of *Gaylussacia brachycera*, *Gray*, from Millsborough, Sussex County, Delaware. Collected and presented by W. M. Canby.

Specimen of Rice Grass, *Paspalum*, from prairies, Sedgwick County, Kansas. Presented by Atchinson, Topeka, and Sante Fé Railroad Company.

Sample *Alfalfa*, raised by W. H. Egan, Sedgwick County, Kansas. Presented by Atchinson, Topeka, and Sante Fé Railroad Company.

Specimen of *Habenaria rotundifolia*, from N. Vermont, a new locality. Presented by Dr. A. Gray.

Several specimens of *Salix longifolia*, with abnormally developed buds, produced by the sting of an insect. From the banks of the Pecos River, Texas. Presented by Lieut. A. C. Markley.

Specimen of *Onoclea sensibilis*, L., Var. *obtusifolia*, Torr., from near Germantown. Presented by Isaac C. Martindale.

Bark from which Tapa cloth is made. From Samoan or Navigators' Islands. Presented by Dr. Ruschenberger.

Specimens of *Leonurus glaucus*, collected near the mouth of Wissahickon Creek. Presented by I. C. Martindale.

Hydnum ——? Presented by Mr. Whelen.

Cone of *Pinus coulteri*, *Cupressus*, n. sp., and *Pinus sabriniana*. From California. Presented by Mr. Begg.

A collection of Woods, Coffee, Cotton, Fibres, Bark, Seeds, Resins, India-rubbers, Leaf Tobacco, Sarsaparilla, Cone of *Aurocaria*, etc. From Brazil. Presented by Dr. Jose de Saldanha da Gama, of the Brazilian Commission.

Cypress Knee, from Arkansas. Presented by Dr. Lawrence.

Specimens of Cotton, Millet, etc., from Arkansas. Presented by Dr. Geo. W. Lawrence.

Four species of Ferns: *Asplenium pinnatifidum*, *A. trichomanes*, *A. montanum*, and *Trichomanes radicans*. Collected at

Rock Castle Springs, Kentucky. Presented by Miss G. H. Rule, through J. C. Martindale.

Cone of *Pinus Torreyana*, Parry, from Southern San Diego County, California (Pallner Collection, No. 368). Presented by John H. Redfield.

As regards the future needs of our Herbarium, both as to arrangement and as to perfecting the collection, the Conservator has but too recently entered upon his duties to speak fully. It is sufficient now to say that there is already apparent the need of an enormous amount of labor, both scientific and mechanical, and of considerable expenditure, to make our collection what it ought to be. The completion of the Order tablets, and the arranging of the plants in the new genus covers, will absorb much labor, but will require little expenditure beyond what has already been incurred. But we must look forward to the day when the whole of our large collection shall be properly mounted upon paper, as the only way to preserve the specimens from injury in handling, and from a still greater danger, that of confusion arising from misplacing of labels. There is great reason to believe that we have suffered very greatly from such misplacement in times past, and that many type specimens of Nuttall and others have become subjected to doubt, and thus deprived of value. But before this consummation can be properly reached, there is a vast amount of careful, conscientious, and critical scientific work to be done, especially in the general Herbarium, in the re-elaboration of the determinations, culling out of rubbish, and replacement of inferior specimens by better, and in cataloguing with reference to the supply of our deficiencies.

In all these departments there is plentiful room for the labor of all the young botanists of the Academy, and for all the knowledge of the older ones.

JOHN H. REDFIELD,
Conservator.

The election of Officers for 1877 was held in accordance with the by-laws with the following result:—

President . . .	W. S. W. Ruschenberger, M.D.
Vice-Presidents . .	Wm. S. Vaux,
	J. L. LeConte, M.D.

Recording Secretary .	Edw. J. Nolan, M.D.
Corresponding Secretary	Geo. H. Horn, M.D.
Treasurer . . .	Wm. C. Henszey.
Librarian . . .	Edw. J. Nolan, M.D.
Curators . . .	Jos. Leidy, M.D., Wm. S. Vaux, Chas. F. Parker, H. C. Chapman, M.D.
Councillors to serve three years	J. S. Haines, Geo. Vaux, Wm. H. Dougherty, Aubrey H. Smith.
Councillors to serve an unexpired term of two years	Jos. Wharton, Chas. P. Perot.
Finance Committee . .	Wm. S. Vaux, Aubrey H. Smith, Edw. S. Whelen.

ELECTIONS DURING 1876.

MEMBERS.

January 25.—Rev. W. Q. Scott, Dr. Henry M. Fisher, Dr. Alfred Whelen, Dr. W. F. Waugh, U. S. N., Edwin H. Fitler, Charles L. Sharpless, Charles H. Rogers, Dr. Wm. R. Cruice.

March 7.—Wm. Harris Kneass, James H. Windrim, Crozer Griffith, Jesse W. Starr, Wm. L. Abbott, Robert Wood, Thomas S. Root, Howard Spencer, James Ridings, Jas. W. McAllister, Charles Wilt, Wm. S. Pine, John Meichel, Charles A. Blake, James H. Ridings, Geo. B. Dixon, Geo. Biddle, Horace F. Jayne, J. Sergeant Price.

March 28.—John Akhurst, Theo. L. Mead, Stuart Wood, Dr. John Eckfeldt, Edward Tatnall, Jr., Benj. H. Smith, James M. Rhodes, John T. Lewis, Jr., John S. Martin, Henry Pemberton, Charles W. Trotter, Charles Roberts, Edward K. Tryon, Edward Potts, Pierre Munzinger, Dr. Washington Hopkins Baker, Rathmell Wilson.

May 2.—William Nelson, Rev. Charles A. Dickey, Dr. Robert Hess, George A. Piersol, John Wister, Oliver Bradin, Dr. Wm. B. Brewster, Dr. J. Henry C. Simes, Pliny E. Chase.

June 6.—Dr. Chas. E. Slocum, Edward Taylor, Maxwell Sommerville, Henry M. Laing, William Wharton, Jr., C. H. Cramp, Charles H. Rogers, A. R. Justice, Mrs. Gertrude A. Quimby, J. S. Helfenstein, Thomas J. Audenreid, Edward P. Borden.

June 27.—John Russell, Isaac C. Martindale, Arthur Erwin Brown, Dr. A. C. Lambdin, Geo. A. Wright, Harvey Fisher.

July 25.—E. O. Thompson, Dr. Albert E. Foote.

September 26.—Dr. Isaac T. Coates.

October 31.—H. F. Whitman, Edwin A. Barber, Dr. W. H. Forwood, U. S. A.

November 28.—Walter H. Ashmead, Louis F. Benson.

CORRESPONDENTS.

March 7.—M. Alphonse Pinart, Paris; Edward T. Stevens, Salisbury, England.

March 28.—Baron Ferdinand von Mueller, of Melbourne, Australia; Prof. Austin Flint, M.D., of New York.

June 6.—Prof. Wentzel Gruber, of St. Petersburg, Russia.

July 25.—José de Saldanha da Gama, of Rio Janeiro; Dom Pedro II., Emperor of Brazil; Capt. Luiz de Saldanha da Gama, of the Imperial Brazilian Navy.

August 29.—Dr. S. H. Linn, of St. Petersburg, Russia; Prof. Paul Groth, of Strassburg; Dr. James Hector, of New Zealand.

September 26.—Don Alvaro de la Gándara, of Madrid, Spain; Col. Juan J. Marin, of Madrid, Spain; Signor Alessandro Castellani, of Rome.

October 31.—Col. W. L. Ludlow, Eng. Corps, U. S. A.

November 28.—Dr. A. S. Packard, Salem, Massachusetts; W. H. Holmes, U. S. Geol. Surv.; Prof. Laurenço Malheiro, of Lisbon, Portugal.

CORRESPONDENCE OF THE ACADEMY.

1876.

January.—H. M. Hull, in reference to donations from the Tasmanian Commission.

Societa Toscana di Scienza Naturali, Pisa, requesting exchanges and transmitting publications.

American Association for the Advancement of Science;

Astronomischen Gesellschaft, Leipzig;

Natural History Society of Northumberland, Durham, and Newcastle-upon-Tyne; severally acknowledging receipt of publications.

Senckenbergische Naturforschende Gesellschaft, Frankfurt a. M.;

Royal Academy of Amsterdam; severally acknowledging receipt of, and transmitting publications.

Belfast Museum;

Observatory of Madrid;

Naturforschende Gesellschaft zu Emden;

L'Academie Royale des Sciences Suedoise de Stockholm;

Geological Survey of India, Calcutta;

Kaiserliche Akademie der Wissenschaften in Wien;

Royal Meteorological Institute, Utrecht;

Naturwissenschaftliche Gesellschaft zu Chemnitz;

Aertzlichen Verein, Frankfurt;

Université Catholique de Louvain; severally transmitting publications.

February.—Naturhistorisches Verein in Augsburg;

Senckenbergische Naturforschende Gesellschaft; severally acknowledging receipt of, and transmitting publications.

Royal Society of Edinburgh, acknowledging receipt of publications.

Naturhistorisches Verein in Passau;

New York State Library;

Konigliche Norwegische Universität zu Christiania; severally transmitting publications.

Smithsonian Institution, thanking the Academy for the privilege of storing its plates.

University Observatory, Oxford, inviting contributions to the library.

Commission Geologique de l'Empire du Brésil.

University of Norway, notice of the death of Dr. Wm. Boeck.

March.—Société Hollandaise des Sciences, à Harlem;

Geological Survey of India, Calcutta;

Gesellschaft Naturforschende Freunde; severally transmitting publications.

Naturforschende Gesellschaft zu Freiberg, acknowledging receipt of publications.

Dr. Alfred Günther, acknowledging receipt of diploma.

Jas. P. Holmes, Minneapolis, Min., requesting names of members collecting plants with a view to exchange.

April.—Dr. A. Flint, Jr.;

E. T. Stevens, Esq., Salisbury, Eng.; severally acknowledging election as correspondents.

Gesellschaft zur Beförderung der gesammten Naturwissenschaften, Marburg; acknowledging receipt of, and transmitting publications.

A. J. Phillips, in reference to Mr. Jno. S. Phillips' bequest to the Academy.

Société Impériale des Naturalistes de Moscou, acknowledging receipt of publications.

Naturforschende Gesellschaft in Danzig.

Naturwissenschaftliche Verein für das Fürstenthum Lüneburg.

Mannheimer Verein für Naturkunde; severally transmitting publications.

May.—Archæological Society of Ohio, inviting the Academy to participate in the International Convention of Archæologists.

Smithsonian Institution;

Buffalo Society of Natural History;

Bergen Museum; severally acknowledging receipt of publications.

Sammlung für Kunst und Wissenschaft, Dresden, transmitting publications through the German Embassy at Washington.

Musée Teyler; à Harlem;

K. k. zoologisch-botanische Gesellschaft Vienna; severally acknowledging receipt of, and transmitting publications.

F. W. Hutton, acknowledging receipt of exchanges for Moa skeleton from Otago Museum.

Robt. J. Stevens, Clerk of the House of Representatives, in reference to a memorial to Congress by the Academy.

A. Bohatta, Vienna, in reference to a proposed device in telegraphy.

Jesse W. Starr, acknowledging election as a member.

June.—Kaiserliche Mineralogische Gesellschaft zu St. Petersburg;

Königliche Sachsische Gesellschaft, Leipzig; severally transmitting publications.

Canadian Institute;

New York Academy of Sciences;

Yale College Library; severally acknowledging receipt of publications.

Baron F. von Mueller, Melbourne, Australia, acknowledging election as correspondent.

Museum of Comparative Zoology, presenting a collection of fishes.

Lyceum of Natural History of New York, announcing change of name to New York Academy of Sciences.

Chas. E. Slocum, in reference to election as member.

J. T. Audenried, acknowledging election as a member.

July.—Joseph Menges, Frankfurt a. M., in reference to being sent on an expedition.

Boston Society of Natural History, acknowledging receipt of publications.

A. E. Brown, acknowledging election as a member.

Chas. H. Stubbs, M.D., in reference to models of stones marking Mason and Dixon's line.

August.—E. T. Stevens, Esq., presenting work on Stonehenge.

M. C. Cooke, in reference to publication of a paper in journal.

Zoological Society of Philadelphia, acknowledging the receipt of two green snakes.

Akademie Royale de Lisbonne;

University Library, Cambridge, Eng.;

Belfast Natural History and Philosophical Society;

Edinburgh Geological Society; severally acknowledging receipt of publications.

Belfast Naturalists' Field Club;

Verein zur Verbreitung Naturwissenschaftliche Kentniss in Wien; severally transmitting publications.

September.—Leyden Astronomical Observatory;

Academie Royale des Sciences des Lettres et des Beaux-Arts;

French Minister of Public Works at the Exposition;

Naturforschende Gesellschaft zu Emden; severally transmitting publications.

Royal Geological Society of Ireland;

K. Hof und Staatsbibliothek, Munich;

Naturforschende Gesellschaft zu Bamberg;

Statistical Society, London; severally acknowledging receipt of publications.

Mexican Commission at the Exposition, in reference to publications.

Jno. Hitz, Consul-General, Switzerland, in reference to donations from the Swiss Commission.

October.—La Société des Sciences de Finlande;

L'Academie Royale Suedoise des Sciences de Stockholm;

Schweizerische Gesellschaft für d. gasammten Naturwissenschaften, Bern;

Société Zoologique de France;

Die Naturforschende Gesellschaft in Berlin; severally transmitting publications.

Canadian Institute;

Yale College Library;

Musée Teyler, à Harlem; severally acknowledging receipt of publications.

Société Nationale des Sciences Naturelles de Cherbourg, in regard to exchanges.

Dr. Isaac Lea, giving duplicate copies of his works on conchology to the Academy.

Dr. Isaac Lea, accompanying specimens.

Dr. Isaac Lea, in reference to depositing a meteorite, with analysis of the same.

Prof. Wentzel Gruber;

Prof. Alphonse Pinart; severally acknowledging election as correspondents.

C. B. Dyer, in reference to the disposal of his collections.

November.—Societa Toscana di Scienza Naturali, Pisa, in regard to exchange of publications.

Prof. W. G. Farlow, Boston, asking for the loan of a specimen of Æcidium pyratum.

Leeds Philosophical and Literary Society, stating inability to supply deficiencies.

Museum of Comparative Zoology, Cambridge, transmitting photograph of Professor Agassiz.

E. A. Barber, acknowledging election as a member.

A. A. Outerbridge, in behalf of Mr. Gilbert, of Demarara, in regard to a collection of reptiles.

Dr. R. M. Bertolet, in reference to depositing a collection of stone implements.

December.—Señor Carvalho de Borges, Brazilian Minister, acknowledging receipt of letter announcing the election of Dom Pedro II. as a correspondent.

ADDITIONS TO THE LIBRARY 1876.

Adams, A. Leith. On a Fossil Saurian Vertebra (Arctosaurus Osborni), from the Arctic Regions. Dublin, 1875. The Author.

Adamson's Histoire Naturelle du Sénégal, 1757. J. S. Phillips.

Agardh, Jacobo Georgio. Species genera et ordinis Algarum. Vol. III. Wilson Fund.

Agassiz, L., large Photograph of. Alex. Agassiz.

Aguas Potable de Mexico. Prof. Alfonso Herrera.

Altum, Dr. Bernhard. Forstzoologie. I., II., and III. 1872–73. I. V. Williamson Fund.

Annual Report of the Librarian of Congress for the year 1875. The Author.

An Outline of Japanese Education, prepared for the Philadelphia International Exhibition 1876, by the Japanese Department of Education. 1876. The Japanese Commission.

Bailey, L. W. and Edw. Jack. The Woods and Minerals of New Brunswick. J. Laidlow.

Bancroft, H. H. The Native Races of the Pacific States of North America. Vol. V. New York, 1876. I. V. Williamson Fund.

Bárcena, Mariano. Noticia Geologica de una parte del Estado del Aquascalientes. Mexico, 1876. The Author.

Baxter, J. H. Statistics, Medical and Anthropological, of the Provost-Marshal-General's Bureau. 2 Vols. Washington, 1875. The Author.

Belleville, E. La Rage au Point de Vue Physiologique. The Author.

Bentham, Geo. et J. D. Hooker. Genera Plantarum. Vol. II. Pars II. Londini, 1876. I. V. Williamson Fund.

Bernardino de Souza, C. F. Pará e Amazonas pelo encarregado dos Trabalhos ethnographicos. 3a Parte. The Brazilian Centennial Commission.

Lembrancas e Curiosidades do Valle do Amazonas. The Brizilian Centennial Commission.

Bernstein, Julius. The Five Senses of Man. New York, 1876. I. V. Williamson Fund.

Berzelius, lithographic portrait of. Dr. J. Lindahl.

Bianconi, G. La Theorie Darwinienne et la Creation dite Indépendante. Review. The Author.

Billings, E. Palæozoic Fossils. Vol. I. and II. Part I. Geological Survey of Canada.

Binkerd, A. D. Mammoth Cave, Kentucky. Cincinnati, 1869. John A. Ryder.

Binney's Terrestrial Mollusca. 3 vols. 4to. J. S. Phillips.

Binney, W. G. Notes on American Land Shells. Vol. II. Part IV. The Author.

Blainville's Manuel de Malacologie. 2 vols. 1825. J. S. Phillips.

Blanchard, E. Les Insectes. Nos. 1–4. Paris, 1876. I. V. Williamson Fund.

Blanford, W. T. Eastern Persia. Vol. I. The Geography and Narratives by Majors St. John Lovett, and Euan Smith, and an Introduction by Major-General Sir Frederic John Goldsmid. Vol. II. Zoology and Geology. By W. T. Blandford. I. V. Williamson Fund.

Bleeker, P. Atlas Ichthyologique des Indes Orientales Néerlandaises. Livr. 28, 29, and 30. Wilson Fund.

Blytt's Norges Flora. Christiania, 1861–74. I. V. Williamson Fund.

Bock, H. H. Kreüter Buch. Strazburg, 1551. J. H. Redfield.

Bois-Reymond, Emil du. Gesammelte Abhandlungen zur allgemeinen Muskel- und Nervenphysik. 1er Band. I. V. Williamson Fund.

Bolton, H. Carrington. Index to the Literature of Manganese, 1596 to 1874. The Author.

Borre, A. Preudhomme de. La Possibilité de la Naturalisation de la Leptinotarsa decemlineata. The Author.

Bosanquet, R. H. M. On a new form of Polariscope. The Author.

Botelho de Magalhæs, B. C. Theoria das Quantidades Negativas. The Brazilian Centennial Commission.

Botella y de Hornos, D. F. de. Descripcion Geologica-Minera de las Provincias de Murcia y Albacete. Madrid, 1860. The Geological Survey of Spain.

Boucard, Adolphe. Monographic List of the Coleoptera of the Genus Plusiotis of America, North of Panama.

Notes sur quelques Trochilidés.

Notes sur les Trochilidés du Mexique.

Catalogus Avium hucusque descriptorum. Londini, 1876. The Author.

Bouvier, A. Afrique Occidentale. Catalogue Geographique des Oiseaux. Paris, 1875. The Author.

Bowerbank, J. S. A Monograph of the British Spongiadæ. Vols. I., II., and III. I. V. Williamson Fund.

Bradley, F. H. Geological Chart of the United States. The Author.

Brandegee, T. S. The Flora of Southwestern Colorado. The Author.

Brauns, Dr. D. Der mittlere Jura in nordwestlichen Deutschland. Cassel, 1869. I. V. Williamson Fund.

Brazil. The Empire of Brazil at the Universal Exhibition of 1876, in Philadelphia. The Brazilian Commission.

Breve Noticia sobre a Provincia do Maranhao. The Brazilian Centennial Commission.

Brewer, W. H., Senero Watson, and Asa Gray. Geol. Surv. Cal. Botany. Vol. I. Polypetalæ and Gamopetalæ. Cambridge, 1876. I. V. Williamson Fund.

Brewster, Wm. Some Additional Light on the so-called Sterna Portlandica, Ridgway. The Author.

Briosi, Prof. Giovanni. Sulla Phytoptosi della Vita. Palermo, 1876. The Author.

Bronn, H. G. Klassen und Ordnungen des Thier-Reichs, 6er Band I. Abth. 1 Lief. II. Abth. 8, 9, 12, and 13 Lief. V. Abth. 11 and 12 Lief. 7er Band V. Abtheil 9 and 10 Lief. Wilson Fund.

Brown, Robert. The Races of Mankind. Four vols. in two. I. V. Williamson Fund.

Brühl, C. B. Zootomie aller Thierklassen. Atlas, Lief. 4 and 5. Wien. I. V. Williamson Fund.

Brusina, Spiridione. Secondo Saggio dalla Malacologia Adriatica.

Fossile Binnen-Mollusken aus Dalmatien, Kroatien und Slavonien.

Contribuzione pella Fauna dei Molluschi Dalmati.

Contribution a la Malacologie de la Croatie. The Author.

Bruylants, Gustave. Recherches sur les Hydrocarbures. Catholic University of Louvain.

Büchner, Dr. L. A. Uber die Beziehungen der Chemie zur Rechtspflege, 1875. The Author.

Buckley, S. B. Second Annual Report of the Geological and Agricultural Survey of Texas. The Author.

Buonanni, Recreatione dell' Occhio, 1681. J. S. Phillips.

Bursian, Dr. Conrad. Über den religiosen Charakter des griechischen Mythos, 1875. The Author.

Button, F. T. List of the California Land and Marine Shells for exchange. Oakland, Cal. The Author.

Canimhoa, L. Relatorio sobre Zootechnia. The Brazilian Centennial Commission.

Capron, Horace. Reports and Official Letters to the Kaitakushi, by Horace Capron and his Foreign Assistants. Tokei, 1875. K. Kuroda.

Carpenter, Horace F. A Catalogue of the Shell Bearing Mollusca of Rhode Island. The Author.

Carpenter, Wm. B. Introduction to the Study of the Foraminifera. By Wm. B. Carpenter, assisted by Wm. K. Parker and T. Rupert Jones, I. V. Williamson Fund.

Castro, Don Manuel Fernandez de. Ætobatis Poeyii. Madrid, 1873. The Author.

Catalogue delle Conchiglie componenti la Collezione Pigacci. Parte prima della Conchiglie viventi. Roma, 1866. T. A. Conrad.

Catalogue of H. C. Roeters van Lennep's Collection of Shells, 1876. The Publishers.

Catalogue of the West Virginia State Exhibit. W. Virginia Centennial Commission.

Catalogue of the Chinese Imperial Maritime Customs Collection. Chinese Centennial Commission.

Catalogue of the Austrian Department, Philadelphia Centennial Exhibition of 1876. The Commission.

Catalogue of recently added books, Library of Congress, 1873–75. The Librarian.

Catlow's Conchologist Nomenclator. Interleaved. 1845. J. S. Phillips.

Census of the Town of Madras, 1871. Madras, 1873. The Indian Government.

Centennial Exhibition, Philadelphia, 1876. Dominion of Canada, Province of Ontario. Catalogue of Exhibits in Education Department, 1876. J. Laidlaw.

Educational Institutions. Province of Ontario. J. Laidlaw.

Chemins de Fer de la Province de St. Paul. Brézil, 1875. Brazilian Centennial Commission.

Clark, S. F. The Hydroids of the Pacific Coast of the United States, south of Vancouver Island. The Author.

Clark, W. B. Mines and Mineral Statistics of New South Wales. N. S. Wales Centennial Commission.

Cole, Jas. E. The Mechanical Construction of Water. New York, 1876. The Author.

Conrad's New Fresh Water Shells. John S. Phillips.

Conrad's Unionidæ. Vol. I. J. S. Phillips.

Conrad's American Marine Conchology, 1831. J. S. Phillips.

Conrad's Tertiary Fossils. J. S. Phillips.

Cooke, M. C. Mycographia seu Icones Fungorum. Part I. Wilson Fund.

Cope, Edw. D. Article on Osteology.

Descriptions of some vertebrate Remains from the Fort Union Beds of Montana. The Author.

On the supposed Carnivora of the Eocene of the Rocky Mountains. The Author.

Cortazar, Daniel de. Memorias de la Comision del Mapa Geologico de España. Descripcion de la Provincia de Cuença. Madrid, 1875. The Author.

Descripcion fisica, geológica y Agrológica de la Provincia de Cuença. The Geol. Survey of Spain.

Cotton Manufacture in the United States. J. S. Phillips.

Coutinho, J. M. da Silva. O Cacáo na Exposicao universal de 1867. The Brazilian Centennial Commission.

Cox, E. T. Seventh Annual Report of the Geological Survey of Indiana, made during the year 1875. Indianapolis, 1876. G. M. Levette.

Cozzen's Geology of New York, 1843. J. S. Phillips.

Crépin, François. Materiaux pour servir a l'Histoire des Roses. Troisième Fasc. Gand, 1874–75. The Author.

Croft, Thomas. The Self-Propagating Nature of Centrifugal Force. Papeete, 1875. The Author.

Crosby, W. O. Report on the Geological Map of Massachusetts. Boston, 1876. The Author.

Cuences Carbonifer de Asturias. Geol. Surv. of Spain.

Curioser Botanicus, oder Sonderbahres Kräuterbuch. Dresden and Lipzig, 1745. Louis Godey through C. F. Parker.

Cuvier's Regne Animal. Twelve Numbers of Fishes and Mollusks. 3 Vols. Mollusks and 2 Vols. Zoophytes. J. S. Phillips.

Cuvier's Leçons d'Anatomie Comparée. 2d Ed. 1837. J. S. Phillips.

Cyon, E. Methodik der Physiologischen Experimente und Vivisectionen. 1 Vol. and atlas. I. V. Williamson Fund.

DaCosta's Elements of Conchology. 1776. J. S. Phillips.

Dale, T. Nelson. A Study of the Rhaetic Strata of the Val di Ledro in the Southern Tyrol. 1876. The Author.

Dana, Jas. D. Cephalization. Part V. The Author.

Davila's Catalogue. Vol. I. J. S. Phillips.

Dawson, Geo. M. Report on the Geology and Resources of the Region in the vicinity of the 49th Parallel. Montreal, 1875. Geol. Surv. of Canada.

Dawson, J. W. The Fossil Plants of the Devonian and Upper Silurian Formations of Canada. 1871. Geol. Survey of Canada.

Report on the Fossil Plants of the Lower Carboniferous and Millstone Grit Formations of Canada.

Figures and Descriptions of Canadian Organic Remains. Decades 2 to 4. Geol. Survey of Canada.

Descriptive Notices of the Models, Maps, and Drawings collected under the Auspices of the Ministry of Public Works. M. Lavoinne.

Descriptive Catalogue of a collection of the Economic Minerals of Canada. J. Laidlow.

Detailed Census Returns of the Bombay Presidency. Part III. Bombay, 1874. Indian Government.

Die Industrie des Königreichs Würtemberg. Prag, 1873. The Author.

Dillwyn's Catalogue of Shells. Vols. 1 and 2. J. S. Phillips.

Donayre, D. Felipe Martin. Bosquejo de una Descripcion fisica y geologica de la Provincia de Zaragoza. The Geological Survey of Spain.

Douglass, J. W. and John Scott. The British Hemiptera. Vol. 1. Hemiptera-Heteroptera. I. V. Williamson Fund.

Drechsler, A. Der Arabische Himmels—Globus. Katalog der Sammlung des K. mathem-phys. Salons zu Dresden. Royal Museum at Dresden.

Dunker und Zittel, Drs. Palæontographica; 21er Band, 7e and 8e Lief.; 22er Band, 7e Lief.; 23er Band, 8e and 9e Lief.; 24er Band, 2e and 3e Lief. and General Register, 1es Heft. Cassel, 1876. Wilson Fund.

Ecole des Ponts et Chaussées. Cours Preparatoires;
Élèves Externes;
Catalogue des Livres composant la Bibliothèque;
Catalogue des Modèlles, Instruments, &c.;
Collection de Dessins;
Programmes de l'enseignement interieur. From M. Lavoinne.

Edwards, A. Mead. The Microscope in Gynæcology. Newark, 1875. The Author, through Biol. and Micr. Section.

Emerson, Geo. B. A Report on the Trees and Shrubs growing naturally in the Forests of Massachusetts. Vols. 1 and 2. Second Edition. Boston, 1875. I. V. Williamson Fund.

Encyclopedia Methodique. Mollusca. Vols. 1 and 2. J. S. Phillips.

Encyclopedia Britannica. Vols. III. and IV. I. V. Williamson Fund.

Engelmann, Geo. Notes on Agave.
The Oaks of the United States. The Author.

Erlenmeyer, Dr. E. Ueber den Einfluss des Freihern Justus von Liebig auf die Entwicklung der reinen Chemie. The Author.

Esper's Pflanzenthiere. 1791. J. S. Phillips.

Faber, Carl. Der Bau der Iris. Leipzig, 1876. I. V. Williamson Fund.

Falkenberg, Dr. P. Vergleichende Untersuchungen über den Bau der Vegetationsorgane der Monocotyledonen. Stuttgart, 1876. I. V. Williamson Fund.

Featherstonhaugh, G. W. Geological Report of an examination made in 1834 of the elevated Country between the Missouri and Red Rivers. 8vo. Washington, 1835. I. V. Williamson Fund.

Ferussac's Histoire Naturelle des Mollusques. 5 Vols. Folio. J. S. Phillips.

Fialho, Anfriso. Don Pedro II. Empéreur du Brésil. Notice Biographique. Bruxelles, 1876. The Brazilian Centennial Commission.

Figuier, Louis. The Human Race. New York, 1872. Geo. W. Tyron, Jr.

Fischer, M., et H. Crosse. Mission Scientifique au Mexique et dans l'Amérique Centrale. Recherches Zoologique, 7me Partie. Etudes sur les Mollusques terrestres et fluviatiles. Paris, 1875. The Authors.

Fitzinger, L. J. Der Hund und seine Racen. 1e, 2e, and 3e Lief. Tübingen, 1876. I. V. Williamson Fund.

Fleming's History of British Animals. 1842. J. S. Phillips.

Foote, A. E. The Naturalist's Agency Catalogue. Part First. Minerals. The Author.

Freiesleben, J. C. Geognostischer Beytrag. 4 Volumes in Three. Freyberg, 1807. I. V. Williamson Fund.

Fries, E. Icones Selectæ Hymenomycetum Hungariæ. II. and III. Hungarian Academy of Sciences.

Fromentel, E. Études sur les Microzoaires. 3me Fasc. Paris. I. V. Williamson Fund.

Galvani, L. Collezione delle Opere. 2 Vols. 4to. From Acad. of Sciences of the Inst. of Bologna.

Gastinet, Mr. Memoria sobre a cultura do Cafezeiro no Yemen. The Brazilian Centennial Commission.

Geinitz, H. B. Die Urnenfelder von Strehlen und Grossenhain. Royal Museum at Dresden.

Geinitz und Marck, Drs. Zur Geologie von Sumatra. Royal Museum at Dresden.

Geol. Surv. of Canada. Report of Progress 1866 to 1875. 6 vols.

Gentry, T. G. Life-Histoiries of the Birds of Eastern Pennsylvania. Vol. I. Phila. 1876. The Author.

Gervais, Paul. Zoologie et Paléontologie Générales. 2me Série. Livr's 14, 15 and 16. Paris, 1876. Wilson Fund.

Giebel, C. G. Thesaurus Ornithologiæ. 5er Halbband. Leipzig, 1876. I. V. Williamson Fund.

Gill, Theo. Arrangements of the Families of Mammals, Fishes, and Mollusks. 3 copies of each. Smithsonian Institution.

Gillmore, Parker. Prairie and Forest: a description of the Game of North America. London, 1874. I. V. Williamson Fund.

Giudice, F. del. Dell Instituzione de Pompieri.

Universalita dei Mezzi di Previdenza, difesa e salvezza per la Calamita degl' Incendi. Academy of Bologna.

Goode, G. Brown. Classification of the Collection to illustrate the Animal Resources of the United States. Washington, 1876. The Author.

Gould's Report on the Invertebrata of Massachusetts. J. S. Phillips.

Gould, John. A Monograph of the Trogonidæ. Parts III. and IV. London, 1875. Wilson Fund.

The Birds of Asia. Parts 26 and 27. London, 1875. Wilson Fund.

The Birds of New Guinea and the adjacent Papuan Islands, including any new species that may be discovered in Australia. Parts 1 and 2. London, 1875–76. Wilson Fund.

Gray's Conchology of the Voyage of the Blossom. J. S. Phillips.

Greenhow's Oregon and California. 2d Ed. 1845. J. S. Phillips.

Grote, A. R. Check List of the Noctuidæ of America, North of Mexico. I. Bombyciæ and Noctuelitæ (Nonfasciatæ). Buffalo, 1875. The Author.

Gruber, Dr. Wenzel. Monographie über das Corpusculum triticeum. St. Petersburg, 1876. The Author.

Gumaelius, Otto. Om Malmgrens Aldersföljd och deras Användande säsom ledlager. Geol. Surv. of Sweden.

Gunther, Albert. Description of the Living and Extinct Races of Gigantic Land Tortoises. Parts I. and II.

Contribution to the Anatomy of Hatteria (Rhynchocephalus, Owen).

Description of Ceratodus. The Author.

Gurney, J. H. Rambles of a Naturalist in Egypt and other Countries. London. Mrs. E. P. Gurney.

Guthrie's Universal Geography. London, 1795. J. S. Phillips.

Haeckel, Ernst. Die Perigenesis der Plastidule. Berlin, 1876. I. V. Williamson Fund.

History of Creation. Vols. 1 and 2. I. V. Williamson Fund.

Ziele und Wege der heutigen Entwickelungsgeschichte. Jena, 1875. I. V. Williamson Fund.

Arabische Korallen. Berlin, 1876. I. V. Williamson Fund.

Haldeman's Fresh Water Univalve Mollusca. 2 Vols. 1842. J. S. Phillips.

Half Hours with Modern Scientists. Second Series. New Haven, 1873. John A. Ryder.

Hall, Chas. E. On Glacial Deposits in West Philadelphia. The Author.

Hanley, Sylvanus and Wm. Theobald. Conchologia Indica. Part 8. London. Wilson Fund.

Hanley's Young Conchologist. 1840. J. S. Phillips.

Harcus, Wm. South Australia: its history, resources, and productions. London, 1876. Samuel Davenport.

Same. Lorin Davenport.

Hartley, Walter Noel. Air in its relations to Life. I. V. Williamson Fund.

Hartmann, Dr. Robt. Die Nigritier. 1er Theil. Berlin, 1876. I. V. Williamson Fund.

Haughton, Rev. Samuel. On the Tides of the Arctic Seas. The Author.

Hayden, F. V. Report of the United States Geological Survey of the Territories. Vols. IX. and X. Department of Interior.

Another Copy of Vol. IX. F. V. Hayden.

Annual Report of the United States Geological and Geographical Survey of the Territories for 1874–1876. Department of the Interior.

Hector, Jas. Geological Sketch. Map of New Zealand. The Author.

Heer, Oswald. Flora Fossilis Helvetiæ. 1e Lief. Die Steinkohlenflora. Zurich, 1876. I. V. Williamson Fund.

Hemsley, U. B. Handbook of Hardy Trees, Shrubs, and Herbaceous Plants. 1873. I. V. Williamson Fund.

Hess, W. Bilder aus dem Aquarium. I. V. Williamson Fund.

Heude, R. P. Conchyliologie Fluviatile de la Province de Nanking. Fasc. 1. I. V. Williamson Fund.

Hewitson, Wm. C. Illustrations of Diurnal Lepidoptera. Parts IV. and VI. Lycenidæ. Wilson Fund.

Exotic Butterflies. Part 97, 98, and 99. London. Wilson Fund.

Hidalgo, J. G. Moluscos Marinos de España, Portugal y las Baleares.

Catalogo iconografico y descriptivo de los Moluscos, Terrestres de España, Portugal y las Baleares.

Moluscos del Viaje al Pacifico verificado de 1862 a 1865 por una comision de Naturalistas enviada por el Gobierno Español. Parte 1ra.

Univalvos Terrestres. Madrid, 1869. The Author.

Higgins, Henry H. Synopsis of an arrangement of Invertebrate Animals in the Free Public Museum of Liverpool, with Introduction. 1874. The Author.

Higgins, Thos. Sponges: their Anatomy, Physiology, and Classification. H. H. Higgins.

Hofmann, Karl B. Lehrbuch der Zoochemie. 1es Heft. Wien, 1876. Wilson Fund.

Hooker, J. D. The Flora of British India. Part IV. London. The Author.

Hooker, Sir Wm. Jackson, and John G. Baker. Synopsis Filicum. London; 1868. J. H. Redfield.

Houston, Edwin J. The Elements of Physical Geography, for the use of Schools, Academies, and Colleges. Philadelphia, 1876. The Author.

Hoysradt, Lyman H. Catalogue of the Phænogamous and Acrogenous Plants, growing without cultivation within five miles of Pine Plains, Duchess Co., N. Y. Torrey Botanical Club.

Hugo, M. le Comte Leopold. Extraits de deux lettres addressées a D. B. Boncompagni. The Author.

Hugo, Leopold. Astronomie géométrique. The Author.

Hummel, David. Sveriges Geologiska Undersökning Nos. 54, 55, 56. Om Sveriges Lagrade uberg jemförda med Sydvestra Europas. With Maps. Geol. Surv. of Sweden.

Hunt, T. Sterry. Chemical and Geological Essays. Boston, 1875. I. V. Williamson Fund.

Hutton. F. W., and G. H. F. Ulrich. Report on the Geology and Gold Fields of Otago. Dunedin, 1875. The Author.

Huxley, T. H. The Oceanic Hydrozoa. I. V. Williamson Fund.

Icones Fossilium Sectiles. Pp. 1–4, and Plates I.–XIX. Mr. Davis of the British Museum.

Ingersoll, Ernest. Special Report on the Recent Mollusca of Colorado. Department of Interior.

Jackson, W. H. Photographs of the Principal points of interest in Colorado, Wyoming, Utah, Idaho, and Montana. From Negatives taken in 1869, '70, '71, '72, '73, '74, '75. Folio, 1876. Dr. F. V. Hayden.

Jan, Prof. Iconographie générale des Ophidiens. 47me Livr. Wilson Fund.

Jay's Catalogue of Shells. 3d ed. 1839. Same, 4th ed. 1850. J. S. Phillips.

Jeffreys, J. Gwyn. On some new and remarkable North Atlantic Brachiopoda. Geo. W. Tryon, Jr.

Jenney, Walter P. The Mineral Wealth, Climate, and Rain-fall, and Natural Resources of the Black Hills of Dakota. Department of Interior.

Johnson's New Universal Cyclopedia. Vols. II. and III. I. V. Williamson Fund.

Jolis, Auguste C. De la Rédaction des Flores locales au point de vue de la geographie botanique. The Author.

Jordan, David Starr. Manual of Vertebrata of the Northern United States. Chicago, 1876. I. V. Williamson Fund.

José de Franca, Bacharel Joaquin. Relatorio sobre a Pintura e Estatuaria. The Brazilian Centennial Commission.

Kerr, W. C. Report of the Geological Survey of North Carolina. Vol. I. 1875. The Author.

Kidder, J. H. Contributions to the Natural History of Kergulen Island. II. Washington, 1876. The Author.

Kiener's Species Général et Iconographie des Coquilles Vivantes. 8 vols. J. S. Phillips.

King, Clarence, and J. D. Hague. U. S. Geol. Explor. of the 40th Parallel. Mining Industry, by James D. Hague. With Geological Contributions, by Clarence King. Washington, 1870. 1 vol. 4to. and folio atlas. Eng. Dept. U. S. A.

Klein's Echinodermatum. Gedani, 1734. J. S. Phillips.

Knauer, F. K. Fang der Amphibien und Reptilien und deren Conservirung für Schulzwecke. Wien, 1875. I. V. Williamson Fund.

Beobachtungen an Reptilien und Amphibien in der Gefangenschaft. Wien, 1875. I. V. Williamson Fund.

Amphibien und Reptilienzucht. Wien, 1875. I. V. Williamson Fund.

Kobelt, Dr. W. Rossmässler's Iconographie der Europäischen Land und Susswasser-Mollusken. IV. Band, 2–4 Lief. Wilson Fund.

Koehler, August. Practical Botany. New York, 1876. The Author.

Kokscharow, Nikolai v. Materialien zur Mineralogie Russlands. Vol. VI. pp. 345, to VII. 224. Atlas plates 83–87. I. V. Williamson Fund.

Kölliker, Albert. Entwickelungsgeschichte des Menschen und der Höheren Thiere. Zweite Auflage, 1e Hälfte. Leipzig, 1876. I. V. Williamson Fund.

Kramer, Franz. Phanerogamen Flora von Chemnitz und Ungegend. 1875. The Author.

Kuster, H. C. Systematisches Conchylien Cabinet von Martini und Chemnitz. 1er Band, Heft 81; 2er Band, Heft 20; 3er Band, Heft 37; 4er Band, Heft 18, 19, and 20; 9er Band, Heft 31; 248e, 249e, 250e, 251e, and 252e Lief. Nurnberg, 1876. Wilson Fund.

Lacordaire and Chapuis. Collection des Suites a Buffon. Insectes Coléoptères. Tome XII. Planches, 13 Livr. Wilson Fund.

Lamarck's Animaux sans Vertèbres. 2me ed., tome 5me, 8me, 1838. Same. 3me ed., tome 3me. 1844. J. S. Phillips.

Lamarck's Species of Shells, 1843. J. S. Phillips.

Lanza, Dr. Fr. Elementi di Mineralogia accompagnati da pratiche applicazione economiche industriali per uso dei iunaisi e delle scuole reali. 3d ed. Trieste, 1864. The Author.

Viaggio in Inghilterra e nella Scozia. Trieste, 1860. The Author.

Il progresso industriale Agronomico del Secolo applicato ai bisogni patri con illustrazioni intercalate nel testo per il Prof. Dr. F. Lanza de Casalanza. Trieste, 1870. The Author.

Dell' Antico Palazzo di Diocleziana in Spalato. Trieste, 1865. The Author.

Law, James. Principes de l'élevage des Animaux domestiques. The Author.

Lawrence, Geo. N. Descriptions of Five New Species of American Birds.

Description of a New Species of Jay of the Genus Cyanocitta; also of a supposed New Species of the Genus Cyanocorax.

Descriptions of four New Species of Birds from Costa Rica.

Descriptions of two New Species of Birds of the Families Tanagridæ and Tyrannidæ. The Author.

Lea, Isaac. A Catalogue of the published Works of Isaac Lea, LL.D.

Further Notes on Inclusions in Gems, etc. The Author.

Lea's Contributions to Geology. J. S. Phillips.

Naiades, etc., from Philosophical Transactions. 1 vol. 4to. J. S. Phillips.

Leakin, Geo. A. The Periodic Law. 12mo. New York, 1868. The Author.

Le Maout, Emm, and J. Decaisne. A General System of Botany. Translated and arranged by Mrs. Hooker and J. D. Hooker. London, 1876. I. V. Williamson Fund.

Les Voyages d'Etudes autour du Monde. Paris, 1876. The Author.

Lesley, J. P. Second Geological Survey of Pennsylvania, 1874, '75, '76. Reports A, C, K, M, D, and I. The Commissioners.

Letourneau, Chas. Bibliothèque des Sciences Contemporaines. La Biologie. Paris, 1876. I. V. Williamson Fund.

Linnæus, lithographic portrait of. Dr. J. Lindahl.

Little, Geo., 1st and 2d Reports of Progress of the Mineralogical, Geological, and Physical Survey of the State of Georgia, 1874–75. The Author.

Lockyer, J. Norman, and W. Chandler Roberts. On the Quantitative Analysis of Certain Alloys by means of the Spectroscope. The Author.

Lommel, Dr. Eugene. The Nature of Light. New York, 1876. I. V. Williamson Fund.

Lowe, Richard Thomas. A Manual of the Flora of Madeira. London, 1868. I. V. Williamson Fund.

Lucas, M. Felix. Étude Historique et Statistique sur les Voies de Communication de la France. Paris, 1873. M. Lavoinne.

Mackay, Angus. The Native Grasses. The Author.

Maestre, Don Amalio. Descripcion Geologica industrial de la Cuenca Carbonifera de San Juan de las Abadessas en la Provincia de Gerona.

Descripcion fisica y geologica de la Provincia de Santander. The Geological Survey of Spain.

Malezieux, M. Note sur les Élèves externes de l'École des Ponts et Chaussées. M. Lavoinne.

Marrat, F. P. On the Variations of Sculpture exhibited in the Genus Nassa. George W. Tryon, Jr.
Mastodon, four photographs of limbs and teeth of. C. W. Williamson.
Materials for the Geology of Russia. Vols. 1–5. 1869–73. St. Petersburg.
Marsh, O. C. Notice of a new Sub-Order of Pterosauria. Notice of a new Odontornithes. The Author.
Principal Characters of the Dinocerata. Part I. The Author.
Principal Characters of the Brontotheridæ. On some Characters of the genus Coryphodon, Owen. The Author.
Maury, W. F., and Wm. M. Fontaine. Resources of West Virginia. W. Virginia Centennial Commission.
McQuillen, J. H. Einfluss von Temperatur-Wechsel und Feuchtigkeit auf die Zähne.
Ueber die Parasiten in der Mundhöhle und in den Zähnen.
Ein Beitrag zur Chirurgie. The Author.
Introductory Lecture to the Winter Course of the Philadelphia Dental College, Session 1875–76. 1876. The Author.
Eröffnungs-Rede zum Winter-Semestre, 1875–76, am Philadelphia Dental College. The Author.
Meehan, Thos. Are Insects any Material Aid to Plants in Fertilization? The Author.
Meinicke, Dr. Carl E. Die Inseln des Stillen Oceans. 2er Theil. Leipzig, 1876. I. V. Williamson Fund.
Menke's Synopsis Molluscorum. 1828. J. S. Phillips.
Metric System of Weights and Measures. The Authors.
Michigan. The State of Michigan.
Catalogue of the Products of Michigan.
Chart and Key of the Educational System of Michigan. Michigan Centennial Commission.
Middendorff, Dr. A. v. Sibirische Reise. Band IV., 27 Theil. St. Petersburg, 1875. Wilson Fund.
Miller, Phillip. The Second volume of the Gardener's Dictionary. 2d ed. London, 1740. Isaac Burk.
Milne Edwards, M. Leçons sur la Physiologie et l'Anatomie comparée de l'Homme et des Animaux. Tome 11, 2e Partie. 1875. Wilson Fund.
Mitchell's New General Atlas, 1876. I. V. Williamson Fund.
Miscellaneous Pamphlets. Incomplete Volumes of Periodicals, etc. J. S. Phillips.
Miscellaneous Publications of the U. S. Geol. and Geogr. Surv. of Territories, No. 4. F. V. Hayden.
Mivart, St. George. Lessons from Nature, as manifested in Mind and Matter. New York, 1876. I. V. Williamson Fund.
Mollusca of the Voyage of the Sulphur. J. S. Phillips.
Montagu's Testacea Britannica, 1803. J. S. Phillips.
Monterosato, Msc. Di. Notizie intorno ai Solarii del Mediterranea.
Poche Note sulla Conchiglie Mediterranea.
Notizie intorno alle Conchiglie fossile di Monte Pellegrino e Ficarozzi.
Nuova revista della Conchiglie Mediterranea. The Author, through John B. King.
Moreira, Nicolau J. Brazilian Coffee.
Historical Notes concerning vegetable fibres. From Brazilian Centennial Commission.
Morelet's Mollusques du Portugal, 1845. J. S. Phillips.
Morton's Cretaceous Fossils of the United States. J. S. Phillips.
Mueller's Synopsis Testaceorum. J. S. Phillips.

Mueller, Ferdinandus de. Fragmenta Phytographiæ Australiæ. Vols. 7, 8, 9. Melbourne, 1869–75. The Author.

Same. Parts 5 to 10. I. V. Williamson Fund.

Müller, Albert. Ueber das Auftreten der Wanderheuschrecke am des Bielersee's. The Author.

Murray, Andrew. The Pines and Firs of Japan. London, 1863. I. V. Williamson Fund.

Netto, Dr. Ladislau. Investigaçoes historicas e scientificas sobre o Museo Imperial e Nacional de Rio de Janeiro. The Brazilian Centennial Commission.

Neville, G. & H. Descriptions of new Marine Mollusca, from the Indian Ocean. The Authors.

Newberry, J. S. Report of the Exploring Expedition from Sante Fé. N. M., to the junction of the Grand and Green Rivers of the Great Colorado of the West in 1859. With Geological Report. Washington, 1876. Eng. Dep., U. S. A.

Anothor copy. The Author.

Report of the Geological Survey of Ohio. Vols. II. Geology and Palæontology. Part II. Palæontology. Columbus, 1875. J. S. Newberry.

The Structure and Relations of Dinichthys. Columbus, 1875. The Author.

Newcomb, Simon. Reports of Observations on the Total Eclipse of the Sun, Aug. 7, 1869.

An Investigation of the Orbit of Uranus. Dr. F. A. Hassler.

New South Wales. Mineral Map and General Statistics of New South Wales.

New South Wales, its progress and resources.

Official Catalogue of the natural and industrial products of New South Wales, forwarded to the International Exhibition of 1876 at Philadelphia. N. S. Wales Centennial Commission.

Notes on Portugal. By E. A. G. W. C. Stevenson.

On the Forms and Structure of the Atoms and Molecules of Bodies. The Author.

Orsoni, Francesco. Ricerche Elettro-Dinamische. Noto, 1876. The Author.

Orton, James. Comparative Zoology. I. V. Williamson Fund.

Owen's Extinct Gigantic Sloth. 1842. J. S. Phillips.

Pabst, G. Cryptogamen Flora Flechten und Pilze. I. V. Williamson Fund.

Packard, A. S. Our Common Insects. I. V. Williamson Fund.

Monograph of the Geometrid Moths. F. V. Hayden.

Paléontologie Française. 2d Série. Végétaux. Terrain Jurassique. Livr. 20–21. Wilson Fund.

Paraná, 1875. The Brazilian Centennial Commission.

Parkinson's Organic Remains. 3 Vols. 4to. J. S. Phillips.

Peale, Franklin. Specimens of the Stone Age of the Human Race. Philadelphia, 1873. Titian R. Peale.

Penna, D. S. F. Noticia geral das comarcas de Gurupáemacapá. The Brazilian Centennial Commission.

Pfaff, Friedrich. Die Theorie Darwin's und die Thatsachen der Geologie. Frankfurt-am-Main, 1876. Wilson Fund.

Pfeiffer, L. Symbolæ ad Historiam Pelicorum. 1841. J. S. Phillips.

Novitates conchologicæ. 48 and 49 Lief. Cassel. Wilson Fund.

Monographia Heliceorum viventium. Vol. 7. Fasc. III. and IV., 1875. Vol. 8, Fasc. I. and II., 1876. Lipsæ. Wilson Fund.

Monographia Pneumonoporum Viventium. Supplementum Tertium. Fasc. I., altera. Cassellis, 1875. Wilson Fund.
Philadelphia Centennial Exhibition, 1876. Victoria, Australia. Official Catalogue of Exhibits, Essays, etc. Melbourne, 1876. J. H. Ryder.
Philippi's Abbildungen und Beschreibungen neuer oder wenig gekennter Conchylien. 1er Band. 1845. J. S. Phillips.
Photograph of prepared Indian Head. Chas. S. Rand.
Pickering, Chas. The Geographical Distribution of Animals and Plants. Part II. Plants in their Wild State. 1876. The Author.
Pisani, M. F. Traité élémentaire de Mineralogie. Paris, 1875. Wm. S. Vaux.
Platt, Franklin. Second Geol. Surv. of Pennsylvania. Report of Progress in the Clearfield and Jefferson District of the Bituminous Coal Fields of Western Pennsylvania. 1875. The Commission.
Poey, Don Felipe. Enumeratio Piscium Cubensium. The Author.
Powell, J. W. Dep. of Int. U. S. Geol. and Geog. Surv. of the Territories, 2d Div. Report on the Geology of the Eastern Portion of the Uinta Mountains and region of country adjacent thereto. With Atlas. The Author.
Prado, Don Casiano de. Descripcion fisica y geologica de la Provincia de Madrid. The Geological Survey of Spain.
Prantl, Dr. K. Untersuchungen zur Morphologie der Gefässkryptogamen. 1 Heft. Die Hymenophyllaceen. Leipzig, 1875. I. V. Williamson Fund.
Raddius, Josephus. Plantarum Brasiliensium Nova Genera et Species Novæ, vel minus cognitæ. Florentiæ, 1825. J. H. Redfield.
Rafinesque's Shells of the River Ohio, 1832. 2 copies. J. S. Phillips.
Ramsay, E. Purson. Catalogue of the Australian Accipitres. Sydney, 1876. The Author.
Rang's Manuel. 12mo. Atlas, 1829. J. S. Phillips.
Rauber, A. Ueber die Stellung des Hühnchens im Entwicklungsplan. Leipzig, 1876. I. V. Williamson Fund.
Rau, Chas. Early Man in Europe. New York, 1876. I. V. Williamson Fund.
Reeve, Lovell. Conchologia Iconica. Part 324–329. Wilson Fund.
Regel, E. Alliorum adhuc cognitorum Monographia. I. V. Williamson Fund.
Reglement du College Sadika. Tunis, 1875. J. B. King.
Relham, Richardi, Flora Cantabrigiensis. Editio Tertia. 1820. John E. Cook.
Report of the Commission to Investigate Affairs at the Red Cloud Indian Agency, 1875. From the Department of the Interior.
Reports on the Meteorological, Magnetic, and other Observations of the Dominion of Canada, 1875. The Meteorological Office.
Reuisch, P. F. Contributiones ad Algologiam et Fungologiam. Vol. I. Lipsiæ, 1875. I. V. Williamson Fund.
Riley, C. V. Notes on the Yucca Borer. St. Louis, 1876. The Author.
Rio, Dr. Martinez del. El ilustre Doctre Louis. Noticia Biografica. The Author.
Robinson, Chas. New South Wales; the oldest and richest of the Australian Colonies. N. S. Wales Centennial Commission.
Roehl, E. von. Fossile Flora der Steinkohlen-Formation Westphalens. Cassel, 1869. I. V. Williamson Fund.
Rolleston, Geo. Address to the Department of Anthropology (Biological Section) of the British Association. On, the People of the Long Barrow Period. The Author.

Rominger, C. Geol. Surv. of Michigan. Palæontology, Fossil Corals. New York, 1876. The Author.
Rossmässler's Iconographie der Europäischen Land und Süsswasser Mollusken. IV. Band. 1e Lief. Wiesbaden, 1875. Wilson Fund.
Iconographie der Land und Susswasser Mollusken, 1835. J. S. Phillips.
Rostafinski, J. Beiträge zur Kenntniss der Lange. Heft I. Leipzig, 1875. B. Westerman & Co.
Russ, Dr. Karl. Die fremdländischen Stubenvögel. 4e Lief. Hannover, 1876. I. V. Williamson Fund.
Rütimeyer, L. Ueber Pliocen und Eisperiode auf beiden seiten der Alpen. Basel, 1876. Wilson Fund.
Saldanha da Gama, Dr. José de. Apostillas para o estudo dos Systemas cristallinos de Naumann escriptas. The Brazilian Centennial Com.
Notes in regard to some Textile Plants of Brazil.
Catalogue of the Products of the Brazilian Forests. Brazilian Centennial Commission.
Sandberger, Dr. Die prähistorische Zeit im Maingebiete. The Author.
Sands, B. F. Reports of the Total Solar Eclipse of Dec. 22, 1870. U. S. Naval Observatory. Washington, 1871. Dr. F. A. Hassler.
Say's American Conchology. J. S. Phillips.
Schimper, W. Ph. Synopsis Muscorum Europæorum. Vols. 1 and 2. Editio Secunda. I. V. Williamson Fund.
Schlegel, H. Museum d'Histoire Naturelle des Pays-Bas. 12me Livr. 1876. Wilson Fund.
Schmidt, A. Atlas der Diatomaceen-Kunde. 1es–10es Heft. Ascherslaben, 1875. I. V. Williamson Fund.
Schmidt, H. D. Synopsis of the Principal facts elicited from a series of Microscopical Researches upon the Nervous Tissues. The Author.
Schulz, D. Guillermo. Descripcion Geologica de la Provincia de Oviedo. The Geol. Survey of Spain.
Schützenberger, P. On Fermentation. New York, 1876. I. V. Williamson Fund.
Scudder, S. H. Extract from the Bulletin of the Geol. and Geogr. Survey of Territories. Vol. II., No. 3.
A Cosmopolitan Butterfly.
Entomological Notes, V.
Synoptical Tables for determining N. A. Insects. Orthoptera. The Author.
Fossil Coleoptera of the Rocky Mountain Territories.
Fossil Orthoptera of the Rocky Mountain Territories. The Author.
New and Interesting Insects from the Carboniferous of Cape Breton. The Author.
Secchi, P. Angelo. Sulla Relazione dei Fenomeni Meteorologici colle variazioné del Magnetismo terrestre. 2a Edizione.
Misura della Base trigonometrica esequita sulla Via Appia del P. A. Secchi. Rome, 1858.
Sulla Grande Nebulosa di Orione. Firenze, 1868.
Studii intorno ai diametri Solari. Roma, 1874.
Bulletino meteorologico dell' Osservatorio del Collegio Romo. Vols. VI.–XVI. Roma, 1867–1875. Rev. Angelo Secchi.
Semper, Dr. C. Reisen im Archipel der Philippinen. 2er Theil. Wissenschaftliche Resultate. 2er Band, X. Heft. 3er Band, III. Heft. Wilson Fund.
Seven Topographical Maps of Brazil. The Brazilian Commission.
Sharp, R. B. Catalogue of the Birds in the British Museum. Vol. II. Catalogue of Striges. London, 1875. I. V. Williamson Fund.

Sibthorp, Johannes. Floræ Græcæ Prodromus; sive plantarum omnium enumeratio quas in Provinciis aus Insulis Græciæ. 2 vols. 8vo. Londini, 1813. John E. Cook.

Siebke, H. Enumeratio Insectorum Norvegicorum. Fasc II. University of Norway.

Simpson, J. H. Engineer Depart. U. S. A. Report of Exploration across the Great Basin of the Territory of Utah in 1859. Washington, 1876. The Department.

Smith, Geo. The Chaldean Account of Genesis. New York, 1876. Ward B. Haseltine.

Souverbie, Dr. et R. P. Montrouzier. Description d'espèces nouvelles de l'Archipel-Calédonien. The Authors.

Sowerby's Conchological Illustrations. 1841. J. S. Phillips.

Sowerby's Thesaurus Conchyliorum. Parts I.–XI. J. S. Phillips.

Special Catalogue of the Mexican Section of the International Exhibition, 1876. The Mexican Commission.

Spencer, Herbert. The Study of Sociology.
  Principles of Biology, 2 vols.
  Principles of Psychology, 2 vols.
  Essays, 1 vol.
  First Principles of Philosophy.
  Descriptive Sociology, Nos. 1 and 2. I. V. Williamson Fund.

Squier's Aboriginal Monuments. 1849. J. S. Phillips.

Sterne, C. Werden und Vergehen. I. V. Williamson Fund.

Stewart, Balfour. The Conservation of Energy. New York, 1874. J. A. Ryder.

St. John, O. Notes on the Geology of Northeastern New Mexico. Department of Interior.
  Another copy. Dr. Hayden.

Stoppani, l'Abbé Antoine. Paléontologie Lombarde. Livr. 51–53. Wilson Fund.

Strecker, Herman. Lepidoptera, Rhopaloceres, and Heteroceres, No. 13. Reading. The Author.

Stuart, James M. The History of Free Trade in Tuscany. London, 1876. The Cobden Club.

Sturm's Deutschlands Fauna. VI. Abth. Die Würmer. 1–8 Heft. Nurnberg, 1806. J. S. Phillips.

Supplement to Wood's Index Testaceologicus, 1828. J. S. Phillips.

Sutro, A. Five Pamphlets on the Sutro Tunnel. Adolph Sutro through W. H. Dougherty.
  Lectures on Mines and Mining.
  Report of the Commissioners and Evidence in regard to the Sutro Tunnel. Washington, 1872.
  The Bank of California against the Sutro Tunnel. 1874. A. Sutro, through Dr. Franklin Stewart.

Tatton, J. W. Plans of the Province of Nelson (New Zealand), showing the Mineral Deposits. Dr. James Hector.

Taunay, A. D'Escragnola. La Retraite de Laguna. Rio Janeiro, 1871. The Author.

Tavares, J. P. Memoria sobre a Sericicultura no Imperio do Brazil. The Brazilian Centennial Commission.

The Empire of Brazil at the Universal Exhibition of 1876 in Philadelphia. Same in German. Brazilian Centennial Commission.

The Medical and Surgical History of the War of the Rebellion. Part II. Vol. II. Surgical History. Washington, 1876. Surgeon General U. S. A.

The Penny Cyclopedia. Parts 67 and 80. J. S. Phillips.
The Photographs of the Cohoes Mastodon. Rev. Jas. Hall.
Thompson, C. G. Skandinaviens Hymenoptera. 4e Delen. I. V. Williamson Fund.
Thorpe's British Marine Conchology. 1844. J. S. Phillips.
Todaro, Augustino. Hortus Botanicus Panormitanus. Folio Tract, 1875. I. V. Williamson Fund.
Topinard, Dr. Paul. Bibliothèque des Sciences Contemporaines. L'Anthropologie. Paris, 1876. I. V. Williamson Fund.
Törnebohm, A. E. Geognostisk Beskrifning ofver Persbergets Grufvefält. Geol. Surv. of Sweden.
Trabalhos da commissao Scientifica de Exploraças. Introducçao, Seccao Botanica, 1o Folheto. The Brazilian Centennial Commission.
Trafford, F. W. C. Amphiorama ou la Vue du Monde. Lausanne, 1875. The Author.
Tremaux, P. Principe Universel du Mouvement et des Actions de la Matière. The Author.
Troschel, F. H. Das Gebiss der Schnecken. 2en Bandes, 4e Lief. Berlin, 1875. Wilson Fund.
Turton's Conchological Dictionary. 1819. J. S. Phillips.
U. S. International Centennial Exhibition of 1876. Catalogue of the Articles and Objects Exhibited by the U. S. Navy Department. 1876. The Navy Department.
Van Beneden, P. J. Animal Parasites and Messmates. New York, 1876. Wilson Fund.
Van Lennep, H. C. Roeter. Catalogue Alphabétique des Cones. B. Westerman & Co.
Vilanova y Piera, D. Juan. Essayo de Descripcion geognostica de la Provincia de Feruel. The Geol. Survey of Spain.
Vodges, A. W. A Monograph of American Trilobites. Part I. The Author.
Vollenhoven, S. C. Snellen van. Pinacographia. Part 2, Afl. 2. Part 3, Afl. 3. 'S. Gravenhage, 1876. I. V. Williamson Fund.
Wallace, A. R. The Geographical Distribution of Animals. 2 vols. London, 1876. I. V. Williamson Fund.
Wareg-Massalski, Urbain. Recherches sur les Acides Chloro-Bromo-Propioniques Glyceriques. Lovain, 1875. Cath. Univ. of Louvain.
Wedekund, Dr. Ludwig. Studien im Binären Werthgebiet. Carlsruhe, 1876. The Author.
Wheeler, Geo. M. Annual Report upon the Geographical Explorations and Surveys West of the 100th Mer. in California, Nevada, Nebraska, Utah, Arizona, Colorado, New Mexico, Wyoming, and Montana. 1875. Washington. The Author.
Same. Report. Vol. III. Geology. Vol. V. Zoology. Engineer Department, U. S. A.
Whitney, Henry M. The Hawaiian Guide Book. John A. Ryder.
Wiedersheim, Robt. Salamandrina perspicillata und Geotriton fuscus. I. V. Williamson Fund.
Wilder, Burt G. Note on the development and homologies of the Anterior Brain-Mass in Sharks and Skates. The Author.
Williamson, Wm. C. On Recent Foraminifera of Great Britain. I. V. Williamson Fund.
Wilson's American Ornithology. Vols. 1-3, 8vo. Phildelphia, 1828. J. S. Phillips.

Wisconsin, the State of.
Normal School System of Wisconsin.
College of Wisconsin.
History of Education in Wisconsin. Wisconsin Centennial Com.
Wood's Index Testaceologicus, 1828. J. S. Phillips.
Worthen, A. H. Geol. Surv. of Illinois. Vol. VI. Geology and Palæontology. 1875. The Director.
Wulsten, Carl. The Silver Region of the Sierra Mojada. Denver, 1876. The Author.
Wundt, Wilhelm. Ueber den Einfluss der Philosophie auf die Erfahrungswissenschaften. Leipzig, 1876. Wilson Fund.
Zacharias, Dr. Otto. Zur Entwicklungstheorie. Jena, 1876. I. V. Williamson Fund.
Zittel, Karl A. Handbuch der Palæontologie. 1 Band, 1 Lief. I. V. Williamson Fund.
Fauna der Aeltern Cephalopoden Fuehren den Tithonbildungen. Text and Atlas. I. V. Williamson Fund.

JOURNALS AND PERIODICALS.

NORWAY AND SWEDEN.

Christiania. Nyt Magazin for Naturvidenskaberne. 21de Binds, 1 and 2 Hefte, 1875.
Fordhandlinger i Videnskabs-Selskabet i Christiania, Aar 1874. University of Norway.
Stockholm. Kongliga Svenska Vetenskaps-Akademiens Handlingar. Ny Följd, Bandet 9–12. 1870–73.
Ofversigt of the same. 28–32. 1871–75.
Bihang of the same. Vols. 1 and 2; Vol. 3, Häfte I.
Lefnardsteckningar of the same. Band 1, Heft 3. The Society.
Trondhjem. Det K. Norske Videnskabers Selskabs Skrifter i det 19de. Aashundrede. 1875.
Aarsberetning, for 1874. The Society.

DENMARK.

Copenhagen. Mémoires de l'Académie Royale de Copenhagen. 5me Série. Classe des Sciences. Vol. XI., No. 2; Vol. XII., No 2. The Society.
Oversigt over der K. D. Videnskabernes Selskabs Forhandlinger, 1874, No. 3; 1875, No. 1. The Society.
Mémoires of the same. 5me Série. Vol. X., Nos. 1–9; Vol. XI., No. 1; Vol. XII., No. 1. The Society.
Videnskabelige Meddelelser fra Naturhistorisk Forening, 1874 and 1875. The Society.

RUSSIA.

Dorpat. Sitzungsberichte der Dorpater Naturforscher Gesellschaft. 4er Band, 1er Heft, 1875. The Society.
Archiv für die Naturkunde Liv-Ehst- und Kurlands. Herausgegeben von der Dorpater Naturforscher Gesellschaft. 2e Série. 5er Band. 1876. The Society.
Helsingfors. Bidrag till Kannedom af Finlands Natur och Folk utgifna af Finska Vetenskaps Societeten. Tjugondefjerde Häftet. 1875.
Ofversigt of the same. XVII. 1874–75.

Observations Météorologiques publiées par la Société des Sciences de Finland. Année 1875. The Society.

Acta Societatis Scientiarum Fennicæ. Tome X. 1875. The Society.

Moscow. Bulletin de la Société Impériale des Naturalistes de Moscou. Année 1875, Nos. 1–4. The Society.

St. Petersburg. Tableau Général méthodique et alphabétique des Matières contenues dans les publications de l'Acad. Imp. des Sciences. 1re Partie, 1872. The Society.

Bulletin of the same. Tome XX., No. 3, to tome XXI., No. 5, inc.

Memoirs of the same. Tomes XXII., Nos. 4 to 10; tome XXIII., No. 1. The Society.

Verhandlungen der Kaiserlichen Gesellschaft für die gesammte Mineralogie. Jahrg. 1862 and 1863. 2e Series, 1er–9er Band, 1867–1874. The Society.

Repertorium für Meteorologie. Herausg. von der K. Akad. der Wissen. Band V., Heft. 1. 1876. The Society.

Annalen des Physikalischen Central Observatoriums. Jahrgang 1874. The Observatory.

HOLLAND.

Amsterdam. Verslagen en Mededeelingen der K. Akademie van Wetenschappen. Afd. Natuurk. Deel XV.; Tweede Reeks, Deel VIII. and IX. Afd. Letterk. Tweede Reeks. Deel IV.

Jaarboek, 1873 and '74.

Catalogus van de Boekerij, 1en Deels, 1e Stuk.

Processen-Verbal. Afd. Naturerk, 1873–75.

Verhandelingen. 14 and 15 Deel. Afd. Letterk. 8e Deel. The Society.

Haarlem. Naturkundige Verhandlingen der Hollandsche Maatschappij der Wetenschappen. 3de Verz. Deel II., Nos. 3 and 4, 1874. The Society.

Archives Néerlandaises. Vol. X., Livr. 4 and 5; Vol. XI., 1re Livr. 1875–76. The Society.

Archives du Musée Teyler. Vols. 1 and 2, Vol. 4, Fasc. 1er, 1867–76. The Society.

Leiden. Annalen der Sternwarte in Leiden, 4er Band, 1875. The Observatory.

Utrecht. Nederlandsch Meteorologisch Jaarboek voor 1871. Uitgegeven door het K. Nederlandsch Meteorologisch Instituut. 23er Jahrg. 2e Deel. 1875. The Institute.

GERMANY.

Augsburg. Dreiundzwanzigster Bericht des naturhistorischen Vereins in Augsburg, 1875. The Society.

Bamberg. Ueber das Bestehen und Wirken des naturforschenden Vereins. 2er–4er Bericht 1854–59.

Fünfter, Neunter und Zehnter Bericht der naturforschenden Gesellschaft, 1860–61, 1870–74. The Society.

Berlin. Monatsbericht der K. P. Akademie der Wissenschaften zu Berlin. Juli, 1875–Juli, 1876, inc. The Society.

Mathematische Abhandlungen der K. Akademie der Wissenschaften zu Berlin. Aus dem Jahre 1874 and 1875. The Society.

Sitzungs-Berichte der Gesellschaft naturforschender Freunde zu Berlin. Jahrg 1875. The Society.

Monatschrift des Vereines zur Beförderung des Gartenbaues. 18 Jahrg. Jan.–Dec. 1875. Katalog der Bibliothek. 1875. The Society.

Botanischer Jahresbericht. Herausgegeben von Dr. Leopold Just. 2er Jahrg. 1e–3e Abth., 1874. I. V. Williamson Fund.

Zeitschrift der Deutschen geologischen Gesellschaft. XXVII., 2–4 ; Heft XXVIII., 1 Heft, 1876. The Society.

Zeitschrift für die gesammten Naturwissenchaften. Neue Folge, Band XI. and XII. The Editor.

Archiv für Naturgeschichte. 39er Jahrg. 5er Heft, 41er Jahrg. 3er, and 4er Heft. 42er Jahrg, 1er Heft, 1876. The editor.

Deutsche entomologische Zeitschrift, 1875, 2es Heft; 1876, 1es Heft. The Publishing Society.

Bonn. Verhandlungen des naturhistorischen Vereins der Preussichen Rheinlande und Westphalens. 31er and 32er Jahrg. 1874. The Society.

Archiv für mikroskopische Anatomie, 12er Band, 1es–4es Heft. 13er Band, 1es Heft, 1876. I. V. Williamson Fund.

Braunschweig. Archiv für Anthropologie. 8er Band, 3es–9er Band, 3es Vierteljahrshaft. I. V. Williamson Fund.

Bremen. Abhandlungen herausgegeben von naturwissenschaftlichen Vereine zu Bremen. 4 Bd., 4 Heft; 5 Bd., 1 Heft. Beilage No. 5. The Society.

XIX. Jahres-Bericht des Schwedischen heilgymnastichen Institutes, 1876. The Director.

Brünn. Verhandlungen des naturforschenden Vereins in Brünn. XIII. Band, 1874. Katal. der Bibl. The Society.

Buda Pest. A Magyar Tudomanyos Akadémia Ertesitöje. Hetodik Evfolyam 8 Szam; Nyolczadik Evfolyam, 17 Szam, 1873–75.

M. Tudom. Akad. Almanach, 1864–76.

Mathematikai és Termeszettudomanyi Közlemenyek vonatkozolag a hazai viszonyokra. VII.–X. Kötet, 1869–72.

Ertekezesek a Mathematikai Tudomanyok Köréböl. II. Kötet, 3 Szam; VI. Kötet, 6 Szam.

Jegyzeke a M. Tud. Akad. altat kiadott Könyveknek jelentekenyen leszallitott Arakon, 1875.

Név-és Targymutató a M. Tud. Akad. Ertesetö jének, I. VIII., 1867–74.

A. M. T. Akad. Evkönyvei XIV. Kötet, IV. and V. Darab.

Cassel. Malakozoologische Blätter. Bd. 22, Bg. 13 et seq., Bd. 23, Bg. 1 and 2, pp. 33–144. I. V. Williamson Fund.

Chemnitz. Fünfter Bericht der naturwissenschaftlichen Gesellschaft, 1875. The Society.

Danzig. Schriften der naturforschenden Gesellschaft. Neue Folge. 3en Bandes, 4es Heft. The Society.

Darmstadt. Notizblatt des Vereins für Erdkunde. I.–III. Jahrg, inc. The Society.

Dresden. Sitzungs-Berichte der naturwissenschaftlichen Gesellschaft Isis in Dresden. Jahrg. 1875. The Society.

Nova Acta Academiæ Cæsareæ Leopoldino-Carolinæ Germanicæ Naturæ Curiosorum. Tome 37, 1875. The Society.

Leopoldina. 10es Heft, 1874. The Society.

Mittheilungen aus dem K. zoologischen Museum. 1 Heft. Royal Museum at Dresden.

Mittheilungen über die Sammlung der K. mathem-physikalischen Salons. Royal Museum at Dresden.

XII. Jahresbericht des Vereins für Erdkunde, 1875. The Society.

Emden. 61er Jahresbericht der naturforschenden Gesellschaft, 1875.

Kleine Schriften of the same. XVII. Hannover. The Society.

Erlangen. Sitzungsberichte der physikalisch-medicinischer Societät. 7 Heft, 1875. The Society.

Frankfurt a M. Jahrsbericht uber die Verwaltung des Medicinalwesens Stadt Frankfurt a M. Herausgegeben von dem ærztlichen Verein. XVIII. Jahrg. 1874. The Society.

Der Zoologische Garten. XVI. Jahrg. No. 7, 1875. No. 6, 1876. XVII. Jahrg. Nos. 1–6. The Society.

Bericht uber die Senckenbergische naturforschende Gesellschaft, 1873–75. The Society.

Abhandlungen, herausgegeben von der Senckenbergischen naturforschenden Gesellschaft. 9er Band, 3es and 4es Heft, 1874–5. 10er Band, 1–4 Heft, 1876. The Society.

Freiburg. Berichte über die Verhandlungen der naturforschenden Gesellschaft. Bd. VI. Heft 4, 1876. The Society.

Göttingen. Nachrichten von der K. Gesell. der Wissenschaften und der Georg-Augusts-Universitäts aus dem Jahre 1875. The Society.

Hamburg. Verhandlungen des Vereins für naturwissenschaftliche Unterhaltung. 1875, II. Band. The Society.

Journal des Museum Godeffroy. Hefts IX., XI., and XII. I. V. Williamson Fund.

Heidelberg. Verhandlungen des naturhistorisch-medicinischen Vereins. Neue Folge. 1er Band, 3es Heft, 1876. The Society.

Jena. Jenaische Zeitschrift für Naturwissenschaft. Vols. 8, 9, and 10. The Society.

Königsberg. Schriften der physikalisch-ökonomischen Gesellschaft zu Königsberg. 14er Jahrg. 1 and 2 Abth. 15er Jahrg. 1 and 2 Abth., 1873–74. The Society.

Leipzig. Abhandlungen der math.-phys. Classe der K. Sächsichen Gesellschaft der Wissenschaften. X. Band, No. 7. XI. Band No. 5, 1874–75.

Bericht über die Verhandlungen of the same. Math.-physische Classe 1873, III. 1875, I. The Society.

Zeitschrift für Anatomie und Entwickelungsgeschichte. 1es Band 3es–6es Heft. 2es Band, 1 and 2 Heft, 1876. I. V. Williamson Fund.

Archiv für Anatomie, Physiologie und wissenchaftliche Medicin. Jahrg. 1875. Heft III.–VI., 1876, I.–III. I. V. Williamson Fund.

Morphologische Jahrbuch. Von Carl Gegenbaur. 1er Band 3 and 4es Heft, 1875. 2er Bandes and 2es Heft, 1876. I. V. Williamson Fund.

Preisschriften gekönt und herausgegeben von der Fürstlich Jablonowskischen Gesellschaft. XVIII. 1875. The Society.

Zeitschrift fur wissenschaftliche Zoologie. 25er Band, 2 and 3, and Supplementheft. 26er Band 2es–4es Heft; 27er Band, 1es–3es Heft. I. V. Williamson Fund.

Journal für Ornithologie. 23 Jahrg. Heft. I.–II. I. V. Williamson Fund.

Jahrbücher der wissenschaftliche Botanik. 10er Band, 3es Heft, 1876. I. V. Williamson Fund.

Luneberg. Jahreshefte des naturwissenschtlichen Vereins für das Fürstenthum Luneburg. VI. 1872–73. The Society.

Luxembourg. Publications de l'Institut Royal Grand Ducal de Luxembourg. Tome XV. The Society.

Mannheim. 36er–39er Jahresbericht der Mannheimer Vereins für Naturkunde, 1870–76. The Society.

Marburg. Schriften der Gesellschaft zur Beförderung der gesammten Naturwissenschaften zu Marburg. Band 10. 12e Abth.

Supplement. Heft I. zu Band X. Sitzungsbericht. Jahrg. 1874–75. The Society.

Metz. Bulletin de la Société d'Histoire Naturelle du Départment de la Moselle. 5e–10e, 13e. Cahier, 1848–1874. The Society.

Memoires de l'Académie de Metz. 55e Année, 1873–74. The Society.

München. Sitzungsberichte der mathematisch-physikal. Classe der K. B. Akad. der Wissenchaften zu München, 1874, Heft III.; 1875, Heft I. and III.

Abhandlungen der historischen Classe of the Same. 12er Bandes, 3e Abth.; 13er Bandes, 2e Abth. The Society.

Annalen der K. Sternwarte bei München. XX Band. The Observatory.

Almanach der K. B. Academie der Wissenschaften für das Jahr, 1876. The Society.

Neubrandenburg. Archiv des Vereins der Freunde der Naturgeschichte in Meklenburg. 29 Jahrg., 1875. The Society.

Passau. Zehnter Bericht des naturhistorischen Vereins in Passau für die Jahre 1871 bis 1874–1875. The Society.

Prague. Astronomische, magnetische, und meteorologische Beobachtungen an der K. K. Sternwarte zu Prag im Jahre 1875. The Observatory.

Regensburg, Flora. Herausgegeben von der K. B. botan. Gesellschaft, 1875. The Society.

Stettin. Entomologische Zeitung. Herausgegeben von dem entomologischen Vereine zu Stettin. 36er Jahrg., 1875. The Society.

Stuttgart. Wurttembergisches naturwissenschaftliche Jahreshefte. 22er Jahrg. The Editors.

Neues Jahrbuch für Mineralogie, Geologie, und Palæontologie. Jahrg 1875, 7es–9es Heft; 1876, 1es–3es Heft. The Editor.

Wien. Sitzungberichte der K. Akademie der Wissenschaften. Mathemat. naturwissen. Classe. 70 Band, 1e Abth. III., IV., und V. Heft; 2e Abth. III., IV., und V. Heft; 3e Abth. III., IV., und V. Heft; 71 Band, 1e Abth. I. und V. Heft; 2e Abth. I.–V. Heft; 3e Abth. I. und II. Heft.

Denkschriften of the same. 34er Band, 1875. The Society.

Verhandlungen der K. K. geologischen Reichsanstalt. Nos. 1–18. 1875.

Jahrbuch of the same, 1875. 25 Band, Nos. 3 and 4; 26 Band, Nos. 1 and 2.

Abhandlungen of the same. VI. Band, 2 Heft; VIII. Band, 3 Heft, 1875. The Society.

Festschrift zur Feier des fünfundzwanzigjährigen Bestehens der K. K. zoologisch-botanischen Gesellschaft in Wien, 1876. The Society.

Verhandlungen of the same. 25er Band. The Society.

Schriften des Vereines zur Verbreitung naturwissenschaftlicher Kenntniss in Wein. 14er Band, 1873–74; 16er Band, 1875–76. The Society.

Mittheilungen der anthropologischen Gesellschaft in Wein. VI. Band, Nos. 1–4. The Society.

Würzburg. Arbeiten aus dem zoologisch-zootomischen Institut zu Würzburg. 2er Band, 2–4 Heft, 1875; 3er Band, 1es Heft. I. V. Williamson Fund.

Verhandlungen der physikal-medicin Gesellschaft in Würzburg. Neue Folge, 9 Band, 1–4 Heft; 10 Band, 1–2 Heft, 1876. The Society.

SWITZERLAND.

Verhandlungen der Schweizerischen naturforschenden Gesellschaft. 57 und 58 Jahrsversammlung. 1873–75. The Society.

Basel. Mémoires de la Société Paléontologique Suisse. Vol. II. (1875.) I. V. Williamson Fund.

Verhandlungen der naturforschenden Gesellschaft in Basel. 6er Theil, 2es Heft, 1875. The Society.

Bern. Mittheilungen der naturforschenden Gesellschaft in Bern aus dem Jahren. 1874–75. The Society.

Genève. Bibliothèque Universelles et Revue Suisse. Archives des Sciences Physiques et Naturelles. Nos. 85, 88, 94, 135, 136, 157–168. 1865–71. The Editor.

Mémoires de la Société de Physique et de d'Histoire Naturelle. Tome XXIV., 1e Partie, 1874–75. The Society.

Lausanne. Bulletin de la Société Vaudoise des Sciences Naturelles. Nos. 44, 45, 46, 48, 75 and 76. 1859–1876. The Society.

Neuchatel. Bulletin de la Société des Sciences Naturelles. Tome X., 2d Cahier, 1875. The Society.

St. Gallen. Bericht über die Thätigkeit der St. Gallischen naturwissenschaftlichen Gesellschaft während des Vereinsjahres, 1874–75.

BELGIUM.

Bruxelles. Bulletins de l'Académie Royal des Sciences, des Lettres et des Beaux Arts de Belgique. 2me Série. Tomes 38, 39, and 40, 1874–75.

Mémoires couronnés et autres Mémoires. Collection in 8vo. Tomes 24, 25, and 26. Collection in 4to. Tome 39, 1876. 1re Partie.

Mémoires. Tome 41, Pts. 1 and 2, 1875–76.

Annuaire, 1875 and 1876. The Society.

Annales de la Société Malacologique de Belgique. Tomes 1–4 and 8, and Tome 9, Fasc. 1; Tomes 14me, 17me, and 18me.

Compte Rendu of the same. Serie II., Nos. 16–30. The Society.

Procès-Verbaux des Séances of the same. Tomes 3, 4, and 5. The Society.

Liége. Mémoires de la Société Royale des Sciences de Liége. Tome 14me, 1859. The Society.

Lourain. Société litteraire de l'Universite Catholique de Louvain Choix de Mémoires X., 1869.

Annuaire of the same. 1840, 1844–46, 1850, 1851, 1875, and 1876.

Twenty-eight Theses. The University.

Mons. Mémoires et Publications de la Société des Sciences, des Arts et des Lettres du Hainaut, 1857–60 and 1870. The Society.

FRANCE.

Amiens. Société Linnéenne du Nord de la France. Nos. 1–42. 1872–75.

Mémoires of the same. Années 1866–69, 1872–73. The Society.

Angers. Mémoires de la Société Académique de Maine-et-Loire. Tomes 29–32. 1874–75. The Society.

Auxerre. Bulletin de la Société des Sciences Historiques et Naturelles de l'Yonne. Année 1875. Tables Analytiques, 1875–76. The Society.

Besançon. Académie des Sciences, Belles Lettres et Arts. Séances publiques de 1874–75. The Society.

Bordeaux. Mémoires de la Société des Sciences Physiques et Naturelles. Tome X. Title, index, etc. Tome 1, 2e Série, 2e Cahier, 1876.

Extrait des Procès-Verbeaux des Séances, 1874–5, pp. 13–28. The Society.

Caen. Mémoires de l'Academie Nationale des Sciences, Arts et Belles-Lettres, 1864, 1865, 1869, 1872–75. The Society.

Cherbourg. Mémoires de la Société Nationale des Sciences Naturelles. Tome 19, 1875. The Society.

Lyons. Annales de la Société Linnéenne. Tomes 21 and 22. 1874 and 1875. The Society.

Annales de la Société d'Agriculture, Histoire Naturelle et Arts Utiles. 4me Série, Tome 6me and 7me, 1873–74. The Society.

Mémoires de l'Academie Impériale des Sciences, Belles-Lettres et Arts. Classe des Lettres. Tomes 8 and 16. Paris, 1859–74. The Society.

Nancy. Bulletin de la Société des Sciences de Nancy. Série II., Tome I., 6e Année, 1873, Fasc. III.; Tome II., Fasc. IV. Paris, 1876. The Society.

Orleans. Mémoires de la Société d'Agriculture, Sciences, Belles-Lettres et Arts d'Orleans. Vols. 1–9; Vol. 10, I.; Vol. 11, IV.; Vol. 12, III, and IV.; Vol. 13, III.; Vol. 15, I.–IV.; Vol. 16, I.–IV.; Vol. 17, No. 4; Vol. 18, Nos. 1 and 2, 1876. The Society.

Paris. Comptes Rendus des Séances et Mémoires de la Société de Biologie. 4me Série, Tomes II.–V.; 5me Série, Tome 1–3, 1867–73. The Society.

Comptes Rendus hebdomadaires des Séances de l'Academie des Sciences. Tomes 57–78. Juillet, 1865, Juin, 1874. Tables Générales, 1851–65. The Society.

Supplement to the same. The Society.

Nouvelles Archives du Muséum. Tome 10me, Nos. 1–4. Paris, 1874. The Society.

Bulletin de la Société Zoologique de France. 1re Partie, 1re Année. The Society.

Bulletin de la Société Botanique de France. Tome 21me, 1874, pp. 1–117; 22me, 1875, Nos. 1, 2, and 3. Revue Bibl., B.–E. Tome 23me, 1. The Society.

Bulletin de la Société Geologique de France. 2me Série, Tome 8me, 1850, to 3me Série, Tome 4me, No. 2, 1876.

Lists of the members of the same. The Society.

Annales des Sciences Naturelles. 6me Série. Zoologie, Tome II., No. 1–6; Tome III., Nos. 1–4; Tome IV., No. 3. Botanique, Tome I., Nos. 4–6; Tome II., Nos. 1–6. I. V. Williamson Fund.

Annales des Sciences Geologiques. Tome 6me, Cahier, 2me; Tome 7me, 1er Cahier. The Editors.

Annales des Mines. 7me Série, Tome IX., 1re. Minister of Public Works, France.

Archives de Zoologie Experimentale. Tome 4me, Nos. 3 and 4; Tome 5me, No. 1, 1876. I. V. Williamson Fund.

Journal de Zoologie, par M. Paul Gervais. Tome IV., Nos. 5 and 6; Tome V., Nos. 1–4. I. V. Williamson Fund.

Bulletin Mensuel de la Société d'Acclimatation. 3e Série, Tome II., Nos. 5–12; Tome III., Nos. 1–9.

Journal de Conchyliologie. 3e Série, Tome XV., Nos. 3 and 4; Tome XVI., Nos. 1 and 2.

Revue Scientifique. 5me Année, 2e Série, Nos. 20–51; 6me Année, Nos. 1–20. The Editors.

Toulouse. Bulletin de la Société d'Histoire Naturelles. 9me Année, 1874–75. The Society.

Mémoires de l'Académie des Sciences, etc. Tome VII., 7me Série, 1875. The Society.

ITALY.

Bologna. Rendiconto delle Sessioni dell' Academia delle Scienze dell' Istituto di Bologna, 1850–51 to 1872–74. Novi Commentarii. Vols. 1–10, 1834–1849. Memorie. Vols. I.–XII., 1850–1861; Serie III., Tomo II., Fasc. 3–4; Tomo V., Fasc. IV. The Society.

Cagnola. Atti della Fondazione Scientifica Cagnola. Vol. VI., Parte I. 1872. The Society.

Catania. Atti dell' Academia Gioenia di Scienze Naturali di Catania. Serie 3, Tomes VI. and IX. The Society.

Lucca. Atti della Reale Academia Lucchese di Scienze Lettere ed Arti. Tomes I., II., IV., XII., XIV., XVI., and two supplementary volumes, 1845 and 1861. The Society.

Milan. R. Istituto Lombardo di Scienze, Lettere ed Arti. Atti, Vol. 1, Fasc. 11–20, 1858–60.

Memorie, Vols. I.–V., Vol. XII., Fasc. 6; Vol. XIII., Fasc. 1.

Rendiconti. Serie II., Vol. VI., Fasc. 6–20; Vol. VII., Fasc. 1–16; Series III., Vol. IV., Fasc. 7. The Society.

Atti della Società Italiana di Scienze Naturali. Vols. XVI., Fasc. 3 and 4, 1874. The Society.

Naples. Atti del Reale Istituto d'Incoraggiamento alle Scienze Naturali economiche e technologiche. Seconda Serie, Tom. II. and IV. 1865 and '67. Tome VIII., Pt. 1, 1871. The Society.

Dei Lavori Accademici del R. Istituto d'Incoraggiamento alle Scienze Naturali, etc., de nell' Anno 1875. The Society.

Società Reale di Napoli. Atti dell' Accademia delle Scienze Fisiche e Mathematiche. Vol. V., 1873. Rendiconto, Vols. 9, 10, 11, 1870–72. The Society.

Pisa. Atti della Società Toscano di Scienzes Naturali. Vol. 1, Fasc. 1 and 2, 1875. The Society.

Torino. Bolletino Meteorologico ed Astronomico del Regio Osservatorio della Regia Universita. Anno VIII., 1875. The Society.

Atti della R. Accademia delle Scienze. Vol. X., Disp. 1a–8a, 1874–75. The Society.

Trieste. Bollettino della Societa Adriatica di Scienze Naturali. Nos. 1 and 6. Annata II., 1876. The Society.

Venezia. Atti del Reale Instituto Veneto di Scienze, Lettere ed Arti. Serie 5, Tome I., Disp. 1–6; Tome II., Disp. 6–10; Tomo III. The Society.

SPAIN.

Madrid. Anuario del Observatorio de Madrid, Ano XI., XII., XIII., XIV.

Observaciones Meteorologicas efectuadas en el Observatorio de Madrid, 1870–73.

Resumen de las Observaciones Meteorologicas efectuadas en la Peninsula, 1870–73. The Observatory.

GREAT BRITAIN.

Belfast. Proceedings of the Belfast Natural History and Philosophical Society, for the session 1874–75. The Society.

Annual Report and Proceedings of the Belfast Naturalist's Field Club. 1874–76. The Society.

Dublin. Transactions of the Royal Irish Academy. Vol. 24. Antiquities Part 9; Science Vol. 24, Part 14 to Vol. 25, Part 20. 1870–75.

Proceedings of the same. Vol. I., Ser. II., Nos. 1, 3–10, Vol. II., Ser. II., Nos. 1, 2, and 3, 1869–75. The Society.

Journal of the Royal Dublin Society. No. 44, Vol. VII., 1875. The Society.

Journal of the Royal Geological Society of Ireland. Vol. IV., Part 2, 1875. The Society.

Proceedings of the Dublin University Biological Association. Vol. I. 1875. The Society.

Edinburgh. Proceedings of the Royal Society of Edinbugh. Session 1874–75.

Transactions of the same. Vol. 27, Pt. 3. The Society.

Transactions and Proceedings of the Botanical Society. Vol. XII., Part 2, 1875. The Society.

Glasgow. Proceedings of the Philosophical Society of Glasgow, 1875–76. Vol. X., No. 1. The Society.

Leeds. Leeds Philosophical and Literary Society. Annual Reports for 1850–51, 1866–67, and 1874–75. The Society.

Liverpool. Proceedings of the Literary and Philosophical Society of Liverpool, No. 29, 1875. The Society.

Second Supplement to the Catalogue of the Liverpool Free Public Library. Reference Department, 1876. The Library.

London. Proceedings of the Zoological Society, 1832–36, 1840, 1843, and 1844. John S. Phillips.

Same. 1864, Pt. 3; 1871, Pts. 2 and 3; 1875, Pt. 2 to 1876, Part 3.

Transactions of the same. Vol. 9, Pts. 1, 5–9. The Society.

Proceedings of the Royal Geographical Society. Vol. 20, Nos. 1–6. The Society.

Journal of the Chemical Society. Aug. 1875, to Jan. 1876. The Society.

List of Officers and Fellows of the same. The Society.

The Quarterly Journal of the Geological Society. Vol. 27, Part 2, and Vol. 29, Part 4 to Vol. 32, Part 3. The Society.

The Journal of the Linnean Society. Vol. XV., Nos. 81–84, Botany; Vol. XII., Nos. 60–63, Zoology.

Additions to Library, 1874–75.

Proceedings, 1874–75.

Transactions, Second Series, Botany, Vol. I., Parts 2 and 3; Zoology, Vol. I., Parts 2 and 3.

General Index to Transactions. Vols. 26 to 30. The Society.

The Journal of the Royal Asiatic Society of Great Britain and Ireland. Vol. VIII., Part I. and II. The Society.

Palæontographical Society. Vol. 29. Issued for 1875. Wilson Fund.

The Journal of the Society of Arts. Vol. 23, 1875. The Society.

Proceedings of the Royal Institution of Great Britain. Vols. VII., Parts V. and VI. 1875. The Society.

The Journal of the Anthropological Institute of Great Britain and Ireland. Nos. 1–15. London, 1875–76. Dr. Jos. Leidy.

Ornithological Miscellany. Edited by Geo. Dawson Rowley. Part 1, No. 2, and Part 2, No. 2. Parts 3 and 4. I. V. Williamson Fund.

London, Edinburgh, and Dublin Philosophical Magazine. 4th series. Vol. 50, Nos. 333 and 334. 5th series, Vol. 1, Nos. 2–11. I. V. Williamson Fund.

The Journal of Anatomy and Physiology. Vol. X., Parts 2, 3, and 4; Vol. XI., Part I.

The Journal of Botany, British and Foreign. Nos. 155–166. I. V. Williamson Fund.
Curtis's Botanical Magazine. 3d Series. Nos. 373–382. I. V. Williamson Fund.
The Geological Magazine. Nos. 137–148. I. V. Williamson Fund.
The Annals and Magazine of Natural History. Nos. 96–107. I. V. Williamson Fund.
The Gardener's Chronicle. Nos. 98–102–105–150. The Editor.
Nature. Nos. 307, 316–318, 321–346, 348–367. The Editor.
Hardwicke's Science Gossip, 1875. Nos. 131–142. I. V. Williamson Fund.
The Popular Science Review. Nos. 58–61. I. V. Williamson Fund.
The Ibis. 3d Series, Vol. 5, Nos. 20, 21, and 22, July.
Notes and Queries. 5th Series, Parts 22–34. The Editor.
Quarterly Journal of Microscopical Science. New Series, Nos. 61–64, 1876. I. V. Williamson Fund.
The Monthly Microscopical Journal. Nos. 84–95. I. V. Williamson Fund.
Zoological Record. Vol. XI., 1874. Wilson Fund.
The Geological Record for 1874. I. V. Williamson Fund.
Trübner's American and Oriental Literary Record. Nos. 113–118. The Publishers.
Manchester. Twenty-fourth Annual Report of the Manchester Free Libraries, 1875–76. The Trustees.
Newcastle-upon-Tyne. Natural History Transactions of Northumberland and Durham. Vol. 5, Part II., 1875. The Society.
Watford. Natural History Society, 1876, List of Members, etc.
Transactions of same. Vol. I., Part 2, 1875. The Society.

UNITED STATES.

Albany. Transactions of the Albany Institute. Vols. VII. and VIII., 1876.
Proceedings of the same. Vol. I. and Vol. II., Part 1. The Society.
University Convocation, 1873–1874. Trustees of the University.
57th Report of the N. Y. State Library, 1875.
26th Report of the N. Y. State Museum of Natural History, 1872. The Trustees of the University.
Baltimore. Procceedings of the Maryland Academy of Sciences. May 3, 1876. Newspaper slip. Edw. Stabler, Jr.
First Annual Report of the Provost of the Peabody Inst. of Baltimore, 1857. The Institute.
Ninth Annual Report of same, 1876.
Buffalo. Bulletin of the Buffalo Society of Natural Sciences. Vol. III. Nos. 2 and 3, 1876. The Society.
Boston. Memoirs of the Boston Society of Natural History.
Proceedings of the same. Vol. 18, Parts I.–III., pp. 129–336. The Society.
The American Naturalist. Vol. X., Nos. 2–11.
Proceedings of the American Pharmaceutical Association, 1875. The Society.
Cambridge. Bulletin of the Museum of Comparative Zoology. Vol. I., Nos. 3, 4, 7, and 8; Vol. III., Nos. 11–16, 1876.
Memoirs of the same. Vol. IV., Nos. 9–10, 1876.
Illustrated Catalogue of the same. No. VIII. The Director.

Ninth Annual Report of the Trustees of the Peabody Museum of American Archæology and Ethnology, 1876. The Trustees.

Quarterly Journal of the Nuttall Ornithological Club. Vol. 1, Nos. 1–4. The Society.

Psyche. Vol. 1, No. 22. The Editor.

Chicago. Engineering News. Vol. III., No. 3.

Proceedings of the Annual Meeting of the Chicago Academy of Sciences, 1875. The Society.

Cincinnati. Proceedings of the Cincinnati Society of Natural History. No. 1, Jan. 1876. The Society.

Same. Charles Dury.

Davenport. Proceedings of the Davenport Academy of Natural Sciences. Vol. I., 1867–1876. D. S. Sheldon.

Same. The Society.

Hanover. Botanical Bulletin. Vol. I., Nos. 3–12; Vol. II., No. 1. The Editor.

Hartford. Fancier's Journal. Vol. 3, Nos. 3–24. The Editor.

Lansing. First published Transactions of the Lansing Scientific Association, Nov. 1875. The Society.

Milwaukee. Jahresbericht des naturhistorischen Vereins von Wisconsin für das Jahr 1876. The Society.

New Haven. The American Journal of Science and Arts, Dec. 1875. Vol. X., No. 60; Vol. XI., Nos. 61–71. The Editor.

Transactions of the Connecticut Academy of Arts and Sciences. Vol. III., Part I., 1876. The Society.

New York. Proceedings of the American Geographical and Statistical Society. Vol. 1., No. 2, to Vol. II., No. 4.

Journal of the same. Vol. II., Part 2, and Vols. III.–VI., No. 4.

Bulletin of the same from 1856 to 1874. No. 1, 1875–6.

Annual Record of Science and Industry, 1871–1874. I. V. Williamson Fund.

The Popular Science Monthly. Nos. 46–56. The Editor.

The American Chemist. Vol. 6, Nos. 4–12; Vol. VII., Nos. 1 and 2. The Editor.

Bulletin of the Torrey Botanical Club. Vol. VI., Nos. 3–22.

Supplement to Botanical Dictionary, 1876. The Society.

New York Medical Journal. Vol. 22, No. 6; Vol. 23, Nos. 1–6; Vol. 24, Nos. 1–5. The Editor.

Philadelphia Proceedings of the Academy of Natural Sciences. Part III. 1875. Part. I. and II., 1876. Publication Committee.

Journal of the same. Vols. 1–6. 8vo. Bequeathed by John S. Phillips.

Transactions of the American Entomological Society. Vol. 3, No. 2; Vol. 4, Nos. 3 and 4; Vol. 5, pp. 1–176. The Society.

Proceedings of the American Philosophical Society. Vol. 14, No. 95; Vol. 16, No. 97, 1876. The Society.

Memoirs of the Historical Society of Pennsylvania. Vol. XII. The Society.

The American Journal of Medical Sciences. Nos. 141–144. The Editor.

American Journal of Pharmacy. Vol. 47, No. 12 to Vol. 48, No. 11. The Editor.

The Medical News and Library. Vol. 33, No. 396; Vol. 34, Nos. 397 to 407. The Editor.

The Dental Cosmos. Vol. VI., Nos. 10 and 12; Vol. VII., No. 8; Vol. X., No. 3; Vol. XVII., No. 12, to Vol. XVIII., No. 11. The Editor.

The Penn Monthly. Vol. VI., No. 72, to Vol. VII., No. 83. The Editor.

The Gardener's Monthly. Vol. 17, No. 12. to Vol. 18, No. 11.

The Journal of the Franklin Institute. The Editor.

The Polytechnic Review. Vol. 1, No. 1.

Poughkeepsie. Proceedings of the Poughkeepsie Society of Natural Science. Vol. 1, Fasc. 1, 2, and 3. The Society.

Salem. Proceedings of the American Association for the Advancement of Science. 24th Meeting, 1876.

Memoirs, I., 1875. The Association.

Memoirs of the Peabody Academy of Science. Vol. I., No. IV., 1875. The Society.

Historical Collections of the Essex Institute. Vol. VI., Nos. 5 and 6, to end of Vol. IX.; Vol. X., Parts 2 and 3; Vol. XI., Part I. to Vol. XIII., Part II., 1864–76. Memoires of Henry Coit Perkins and Francis Peabody, and an Address by A. C. Godell, Jr. The Society.

Bulletin of the Essex Institute. Vol. 7, Nos. 6–12; Vol. 8, Nos. 1 and 2. The Society.

San Francisco. Proceedings of the California Academy of Sciences. Vol. V., Part 3, 1874. The Society.

St. Louis. The Transactions of the Academy of Sciences of St. Louis. Vol. III., No. 3, 1876. The Society.

The Western. New Series. Vol. 1, No. 12; Vol. II., Nos. 1, 2. The Editor.

Toledo, Ohio. The Scientific Monthly. Vol. 1, Nos. 6, 10, and 12. The Editor.

Troy. Proceedings of the Semi-Centennial Celebration of the Rensselaer Polytechnic Institute. Troy, 1824–74. The Institute.

Washington. Bulletin of the United States Geological and Geographical Survey of the Territories. Vol. II., Nos. 1–4. 2d Series. Nos. 1, 2, 5, 6. Department of Interior.

Same. Vol II., No. 4; No. 2, 2d Series. F. V. Hayden.

Descriptive Catalogue of the Photographs of the United States Geological Survey of the Territories. 2d Edition, 1875. Department of the Interior.

Bulletin of the United States National Museum. Nos. 1, 4, and 5. Department of the Interior.

Field and Forest. Vol. II., No. 5, 1876. The Editor.

Quarterly Report of the Chief of Bureau of Statistics. Nos. 3 and 4, 1875; Nos. 3 and 4, 1876. Treasury Department.

Report of the Commissioner of Education for the year 1874. The Department of the Interior.

Circular of Information of the Bureau of Education. Nos. 7 and 8, 1875. Department of Interior.

Monthly Report of the Department of Agriculture for October, 1876. The Department.

Report of the Chief of Engineers, 1875. Parts 1 and 2. War Department.

Report of the Commission to Investigate Affairs at the Red Cloud Indian Agency, 1875. Department of Interior.

Worcester. Proceedings of the American Antiquarian Society. Nos. 65 and 66, 1876.
Transactions. Vols. 5 and 6. The Society.

CANADA.

Halifax. Proceedings and Transactions of the Nova Scotian Institute of Natural Sciences. Vol. II. Dr. Honeyman.
Same. Vol. II., Part IV.; Vol. III., Part IV., 1869–74. Purchased.
London, Ca. The Canadian Entomologist. Vol. VII., Nos. 11 and 12; Vol. VIII., Nos. 1–10, 1876. The Editor.
Montreal. The Canadian Naturalist. New Series. Vol. VII., Nos. 7 and 8; Vol. VIII., No. 2. The Editor.
The Canadian Antiquarian. Vol. IV., No. 3; Vol. V., Nos. 1 and 2, 1876. The Editors.
Quebec. Le Naturaliste Canadien. Vol. 7, Nos. 11 and 12; Vol. 8, Nos. 10. The Editor.
Toronto. The Canadian Journal of Science, Literature, and History. Vol. XIV., No. 5; Vol. XV., Nos. 1, 2, 3. The Editor.
Annual Report of the Entomological Society of Ontario, 1875. The Society.

MEXICO.

Mexico. La Naturaleza. Tomo III., Nos. 17, 18, 19, 1875–76. The Editor.
Nueva Farmacopea Mexicana de la Sociedad farmaceutica di Mexico, 1874. Prof. A. Herrera.
Five numbers of the Gaceta Médica de Mexico, 1866 and 1867. Prof. Alfonso Herrera.

SOUTH AMERICA.

Rio de Janeiro. Archives do Museo Nacional do Rio de Janeiro. Vol. 1, 1o Tremestre, 1876. The Society.
Revista do Istituto Polytechnico Brasileiro. Tomo 1, Nos. 1 and 2; Tomo 2, No. 2; Tomo 3 and 4. The Brazilian Centennial Commission.
Archivos da Palestra Scientifica do Rio de Janeiro. Vol. I., 1858. Brazilian Centennial Commission.

AFRICA.

Alexandria. Société Kediviale de Geographie. Statuts et Discours par G. Schweinfurth, 1875. The Society.

ASIA.

Calcutta. Proceedings of the Asiatic Society of Bengal. Nos. 6 and 10, 1875.
Journal of the same. Part I., Nos. 2–4, 1875. Part II., Nos. 1–3, and extra number, 1875. Isaac Lea.
Memoirs of the Geological Survey of India. 8vo. Vol. XI., Pt. 2.
Records of the same. Vol. VIII., Parts 1–4, 1875, and Vol. IX., Part 1, 1876.

Memoirs of the same. 4to. Palæontologia Indica. Ser. IX., 4, 1875. Jurassic Fauna of Kutch. Vol. I., 2 and 3. The Survey.

Yokohama. Transactions of the Asiatic Society of Japan. From 13th Jan. 1875, to 30th June, 1875. The Society.

AUSTRALIA.

Brisbane. The Queenslander. Vol. X. New Series, No. 12, 1875. A. Mackay.

Tasmania. Monthly Notices of Papers and Proceedings of the Royal Society of Tasmania for 1874. The Society.

NEW ZEALAND.

Wellington. Transactions and Proceedings of the New Zealand Institute, 1875. Vol. VIII. The Society.

INDEX TO GENERA.

GENERAL INDEX.