PROCEEDINGS

OF THE

ACADEMY OF NATURAL SCIENCES

OF

PHILADELPHIA.

1878.

PHILADELPHIA:

ACADEMY OF NATURAL SCIENCES,

S. W. Corner Nineteenth and Race Streets.

1879.

Academy of Natural Sciences of Philadelphia,
February 17, 1879.

I hereby certify that printed copies of the Proceedings for 1878 have been presented at the meetings of the Academy, as follows:—

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" 105 to 120	. . . . June	4, 1878.
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EDWARD J. NOLAN,
Recording Secretary.

PHILADELPHIA.
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LIST OF CONTRIBUTORS,

With reference to the several articles contributed by each.

For Verbal Communications see General Index.

PROCEEDINGS

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1878.

JANUARY 1, 1878.

The President, Dr. RUSCHENBERGER, in the chair.

Thirteen members present.

The following papers were presented for publication:—

"Notes on the Natural History of Fort Macon, N. C., and Vicinity (No. 4)," by Elliott Coues, M.D., and H. C. Yarrow, M.D.

"On the Mechanical Genesis of Tooth-Forms," by John A. Ryder.

JANUARY 8.

The President, Dr. RUSCHENBERGER, in the chair.

Thirty-one members present.

The deaths of J. P. Kirtland, member, and Dr. Louis Pfeiffer, and Prof. C. Nees Von Esenbeck, correspondents, were announced.

JANUARY 15.

The President, Dr. RUSCHENBERGER, in the chair.

Twenty-six members present.

A paper entitled "Descriptions of New Species of Invertebrate

Fossils from the Carboniferous and Upper Silurian Rocks of Illinois and Indiana," by C. A. White, M.D., was presented for publication.

Boring of Corollas from the Outside by Honey-Bees.—Mr. Thomas Meehan referred to the practice of the humble-bee in boring the corolla instead of entering by the mouth, even when there might be no great difficulty in doing so. A few years ago it was not noticed that any flowers were despoiled of their sweets in this extraneous way, but it was now known that the list of plants so treated was very large, and the humble-bee in America had already lost considerable of its reputation as an agent in the cross fertilization of flowers. He had carefully watched the honey-bee for some years, but could never feel sure that it also bored the corollas in the same way, for though he had often seen them working from the outside, he suspected that they used the holes made by the humble-bee. Mr. Ryder, at one of our meetings, had insisted that the honey-bee did actually work occasionally in this way, and Mr. Meehan said he was thus led to go over the subject again, proving Mr. Ryder to be right. Late in the autumn, long after most other flowers were gone, and with no humble-bees about, scarlet sages, *Salvia splendens*, for nearly a week together, received the sole attention of the honey-bees, which worked among the flowers in great numbers, in all cases boring the corollas near the base from the outside.

In connection with this fact, he said that among the scarlet sages were a large number of the pure white variety, but the bees visited them precisely as they did the scarlets, going to either indiscriminately. As bees usually contrive to work on one kind of flower only so long as there were plenty of that one kind, the fact of their working on these two colors at once showed that they did not make use of color only as a guide to the flowers, but that they had intelligence enough to know the *Salvia splendens* as well as we would, by experience, no matter under what color the species might be represented; and the experiments we read of, in which the bees failed to make use of a fresh flower when its corolla was taken away, merely showed that the bee was not acting from an instinctive attraction by color, but had been deceived into the idea that the flower had faded away. Insects had evidently not only instinct, but were able to exercise a judgment created by experience. In a recent number of *Nature*, he said it was on record that a day moth, a *Macroglossum*, made an attempt to extract honey from the artificial flowers on a lady's bonnet, but it was so well able to profit by experience as not to make the attempt a second time.

He illustrated on the black-board the peculiar lever-like appendages or false anthers in *Salvia*, and said that these had been looked on as special arrangements for cross fertilization. When a bee entered it lifted the lever, and forced the true anther on the back of the insect, which thus carried pollen to another flower to be brushed against the stigma on entering. It was clear that, however reasonable this seemed hypothetically, it could have little foundation in fact in these long-tubed *Salvias*. An insect of the honey-bee size could not enter, and a smaller one that could, would not be large enough to reach the stigmas which were high up at the apex of the arch of the corolla. Only long-tongued moths could extract honey by way of the mouth; but as they thrust only their tongues into the flowers, keeping their bodies outside, the lever-like adaptation to the bodies of insects, as suggested by the prevailing hypothesis, had no force.

Cerebral Convolutions of the Negro Brain.—Dr. A. J. PARKER remarked that as yet our knowledge of the cerebral convolutions in the various races is very scanty. Gratiolet, Marshall, and a few other investigators, have published descriptions of single brains, and have pointed out certain peculiarities existing in them. Beyond this, however, little has been done, and the object of the present communication is to direct attention to some of the principal points noticed in the study of thirteen negro brains, and one mulatto.

Gratiolet, in his studies of the brain of the Hottentot Venus, noticed that in the normal position of the brain, the island of Reil was distinctly visible. Marshall afterwards found the same peculiarity in the brain of a Bushwoman, and suggests the probability that it is a characteristic of the Bosjes brain; citing the opinion of G. Cuvier that the Hottentot Venus was really a Bushwoman, and not a Hottentot. In studying the negro brain as it presents itself in this country, Dr. Parker had found the same condition well marked in nine cases, and perceptible in the remaining four. It would thus seem to be characteristic of the race rather than of the Bosjes alone. In the brain of a mulatto, the convolutions of which were exceedingly well developed, the same peculiarity was found, although not to so marked an extent as in the negro. Since it is thus capable of being transmitted when the race is crossed with another, it would appear to be a definite and strongly marked peculiarity. Although this condition of the negro brain is fœtal in its character, as was noted by Gratiolet and Marshall, it is not found in the adult brain of any monkey thus far described.

The Sylvian fissure, also, presents certain characteristics. In the white, this fissure ascends obliquely upwards and backwards. In the Bushwoman, Marshall found that it assumed at its anterior portion a horizontal direction, the posterior portion taking a direction nearly perpendicular to this. He also points out the same peculiarity in the figure given by Gratiolet of the Hottentot Venus. This peculiarity of the Sylvian fissure was also found in the negro brains which Dr. Parker had studied. In the mulatto it presented the same appearance as in the white brain. The length of the Sylvian fissure also varies, as was noted by Marshall in the brain of the Bushwoman.

Average length of Sylvian fissure in 19 white brains $= 3\frac{5}{8}$ in.
" " " " in 13 negro brains $= 3$ in.
Length of Sylvian fissure in mulatto $= 3\frac{1}{4}$ in.

The frontal convolutions, as a rule, are simpler and better marked in the negro than in the white. Gratiolet states that in the European the lower frontal convolution is the most clearly defined, while the upper and middle more often run into each other. In the Bushman, he says, on the contrary, the upper remains independent, while the middle and lower blend. In the negro brains of this country, this does not seem to be the case—at least in those which had been examined, the lower frontal convolution seemed to be as well defined as the upper.

The fissure of Rolando, or central fissure, is simpler, straighter, and less undulating in its course in the negro than in the white, and, consequently, the anterior and posterior central convolutions partake of the same character.

The interparietal fissure is present in the apes as a distinctly marked typical fissure, but in man, as exemplified by the white race, it is so broken up by bridging convolutions that its existence as a distinct fissure was not recognized until 1866, when its typical character was first pointed out by Turner, who gave to it the above name. It has been recognized as an important and typical fissure only by Pansch and Ecker. Bischoff states that it is present in the fœtus, and is typical; but that in the adult brain it does not present the characters given to it by Turner.

In Dr. Parker's studies of the white brain he had always been able to clearly distinguish this fissure. It is generally interrupted in its course by two or three bridging convolutions. In the negro, however, this fissure was found remarkably well developed, and much less tortuous than in the white. In five instances it was found entirely distinct, and not bridged over at any point, presenting in every respect the same appearance as found in the higher apes, except that its direction was more curved than in the latter. In six cases only one bridging convolution existed, and, in the remaining two, one well developed and another imperfectly developed were found. In the mulatto this fissure was continuous throughout its course, but much more undulating and tortuous than in the negro. A study of negro brains shows a distinctly ape-like character in regard to this fissure, and at the same time would seem to prove that it is present in the adult human brain as a perfectly typical fissure.

The superior and inferior parietal convolutions are simpler and less marked with secondary fissures in the negro than in the white. The anterior division of the inferior parietal convolution which lies between the lower end of the posterior central convolution and the upper end of the fissure of Sylvius, the supra-marginal lobule of Gratiolet, was described by him as peculiar to the human brain. It is, however, represented in the brain of the apes, although not expanded and developed into a lobule, as it is in man. A careful study of the negro brains at his disposal, had shown that even this excess of development is not absolutely characteristic of the human brain. In one negro brain the photograph of which was presented, this lobule is entirely absent, the brain showing a deficiency in this region greater in proportion than is found in the apes. The interparietal fissure runs directly into the upper end of the Sylvian, their place of union being directly back of the posterior central convolution; consequently there is absolutely no supra-marginal lobule developed. In the brain of the Bushwoman described by Marshall this lobule was present, relatively well developed, although smaller, according to this author, than is found in the European. It was marked by several secondary sulci. It was, however, better developed than in the Hottentot Venus, being larger, more complex, and projecting to a greater extent over the Sylvian fissure. In the brain above described it was, therefore, more ape-like than in either the Bushwoman or Hottentot Venus. In the remaining negro brains examined, this lobule presented itself in variously developed conditions. In two cases it was small, and not marked by any secondary fissures. The remaining brains approached more towards the condition as found in the white race, but were all less complex and smaller than is the case in the latter. In the mulatto it was as well developed as is ordinarily found in the white.

He then passed to the consideration of the occipital lobe, and here the negro brain displays its ape-like peculiarities to a greater extent than in any other portion of the cerebral surface. This lobe, as it is found represented in the apes, is comparatively simple. It is separated from the parietal lobe by a well-marked transverse fissure, the so-called perpendicular fissure; the mesial portion, corresponding to the fissure known in the human brain as the parieto-occipital, is called the internal perpendicular, while the lateral portion is known as the external perpendicular fissure. In most of the monkeys, such as *Cebus*, *Cynocephalus*, *Cercopithecus*, *Macacus*, etc., these two fissures are continuous; but in man and the higher apes, such as the Orang, Chimpanzee, etc., they are separated into two distinct fissures by the development of a bridging convolution, the so-called superior external transition or connecting convolution, the *pli de passage supérieur externe* of Gratiolet. The same condition is also found in *Ateles* and *Hylobates*. In man this convolution is largely developed, and alters, to a great extent, the appearance of this region as found in the apes. This convolution he had found invariably smaller, less developed, and simpler in the negro than in the white. In one negro brain it was so imperfectly developed that the internal and external perpendicular fissures were superficially continuous. The fissure corresponding to the external perpendicular is also better developed in the negro.

It has been asserted that the separation of the parieto-occipital fissure on the mesial surface from the calcarine, by means of the lower internal connecting convolution (*pli de passage inférieur interne*, Gr.), is characteristic of the ape as distinguished from the human brain. Huxley has shown, however, that in the brain of *Ateles paniscus* the parieto-occipital and calcarine join each other; and Bischoff has remarked the same circumstance as existing in *Hylobates*. In all other monkeys and apes, as far as present observation extends, the parieto-occipital is separated from the calcarine by this convolution. Bischoff states that this convolution is always present in man, but is deeply sunk within the depths of the parieto-occipital fissure. Ecker also describes this as represented in man as a deeply concealed convolution under the name of the *gyrus cunei*. That this entering of the parieto-occipital into the calcarine is not a characteristic always found in the brain of man was shown by the photograph of a negro brain, which showed this convolution as well developed as it is in the apes, presenting a width of nearly one-quarter inch superficially, and separating completely the parieto-occipital from the calcarine. This is the first human brain in which this complete separation has been pointed out. It is the mesial surface of the same brain in which was noticed the complete absence of the supra-marginal lobule, and these two points, and the large and simply marked occipital lobes, in connection with numerous other points, stamps this brain as the most ape-like of human brains yet described. It is the brain of an adult male negro about twenty-two years old. In another case the same condition was found, only less developed. It is an interesting fact, that these apé-like peculiarities occurred almost entirely on the right side of the brain, the left hemisphere resembling more nearly the white brain than the right. In the negro it would also appear that there is less departure from symmetry on the two sides of the brain than in the white.

Gratiolet states that the simplicity of the brain of the Hottentot Venus is more marked than in any normal European brain he has seen, and Marshall expresses the same opinion in respect to the brain of the Bushwoman. Dr. Parker's experience in studying the negro brain as it presents itself in this country had led him to the same conclusion, and he believed that the negro brain bears an unmistakably nearer relation to the ape type than does the white. It is interesting to note that in just those peculiarities which have been thought to distinguish the human brain from that of the ape, the negro brain presents itself as offering noteworthy exceptions; for instance, the absence of the supramarginal lobule or its imperfect development, the presence of the inferior internal connecting or bridging convolution visible superficially, and completely separating the parieto-occipital from the calcarine, etc.

JANUARY 22.

The President, Dr. RUSCHENBERGER, in the chair.

Thirty-six members present.

The death of Edward Tatnall, Jr., was announced.

Habits and Intelligence of Vespa maculata.—Mr. THOMAS MEEHAN exhibited young branches of *Fraxinus excelsior*, and of the common lilac, which had been stripped of their bark during the summer by the large yellow hornet. The insects had been carefully watched at the work. They visited these trees in large numbers, and carried the strips of bark away in their mouths. For what purpose they used the bark could not well be ascertained. It was generally supposed that they collected the matter from which their huge nests of paper-like material were made, from fences and other dead woody matter. He thought it remarkable that the insect should collect from plants of the same natural order only, as far as careful examination of other plants in the vicinity could decide. This hornet, he observed, was gifted with great intelligence; on an occasion he had observed one with a summer locust, several times its own size, endeavoring to rise with it from the ground and fly away, but failed from the great weight of the locust. It then walked with its prey about thirty feet to a tall maple, which it ascended to the top, and then flew off with its burden in a horizontal direction. There was more than instinct in this act. There was reasoning on certain facts and judgment accordingly, and the insect's judgment had proved correct.

JANUARY 29.

The President, Dr. RUSCHENBERGER, in the chair.

Forty-seven members present.

A paper, entitled "On the Association of Grossularite, Zoisite, Heulandite, and Leidyite, a new Species," by Geo. A. Koenig, was presented for publication.

The Mode of Recognition among Ants.—The following statements were made by Mr. McCOOK of certain tentative experiments upon two species of ants, as to the mode of recognizing each other, and distinguishing fellow formicarians from congeners of alien nests.

Every dweller within town walls is familiar with the little creatures popularly known (in some quarters at least) as the "pavement ants," and known in myrmecology under the name of *Tetramorium cæspitum*. Early in the spring, as soon as the season has gathered a comfortable degree of warmth, these insects are seen issuing from the gravel or soil of garden walks, or from the earthen seam that binds together the bricks of the pavement. Around the openings whence the ants issue, are seen small circular mounds of sand or soil which have been accumulated by the out-bringing, one by one, of the particles of earth. But the chief notoriety of these ants, not unlike their fellow-creatures of the *genus homo*, is due to their martial instincts. Hundreds, even thousands, of them are often seen waging battle with great ferocity and persistence. One battle, which was noted close by the wall, within the inclosure of a church on Broad Street and Penn Square, was prolonged for a period of two weeks and several days. At least the same spot, during that period, whenever observed, showed always the same phenomena of a battle-field, the contestants of which were apparently the same. Two points of great interest have arisen concerning these Amazonian emmets—for they are veritable Amazons, the warriors being composed wholly of the *workers* or *neuters*, who are undeveloped females.

First, why do they fight at all? They are of one species, apparently of one formicary or nest. The very first act upon issuing from the winter quarters is to engage in this war, which is often well nigh a war of extermination on both sides. Frequently throughout the season these hostilities are renewed. If the individuals be of one formicary, we may conjecture that this is nature's mode of either distributing the species from the home-centre, by causing the worsted party to emigrate; or, if the combatants be of separate, adjoining communities, a sort of emmetonian Malthusianism (if one may coin such a phrase), by which the surplus population is reduced and kept within due bounds, much to the future comfort of the survivors, and more to the satisfaction of man. This is, of course, only conjecture.

A second question arises, even more interesting and more perplexing, viz., How do the combatants recognize friend from foe? They are all alike—indeed *more* alike than "peas in a pod," as the proverb goes. Take a group of combatants into the hand, put them under a magnifier; the most careful observer will not note the slightest difference between the individuals of the two factions. Yet they do infallibly distinguish between the parties, recognizing at once members of their own formicary and with equal certainty those of the enemy. While watching an ant battle, we will frequently observe individuals running to and fro, challenging all whom they meet by their antennæ, which are kept in a continual motion, the tips describing parabola and circles. At the meeting these organs touch and embrace the face; if the parties be friends they pass on, if foes they straightway interlock mandibles and "fall to." Here one will see many scores of ants struggling together in a heap that is chaos to mortal eyes, but which seems to the emmet senses to present no difficulties in the way of recognition. Smaller groups are scattered over the battle-field; these are often aggregated as follows: two individuals in conflict are joined by a third, who applies her antennæ, distinguishes the enemy, and falls upon her. A fourth, fifth, many other ants, will sometimes thus be found massed upon one poor warrior, who is literally being torn limb from limb. Other groups are composed of several members of one faction and many of another. There are frequent instances of single combats, particularly on the margin of the battle-field, but toward the centre of conflict it appears to be quite the fixed habit of these groups to be composed as above. Evidently, anything like chivalry or "fair play" is rejected from the code of emmet honor. In all these cases, however, the power of recognition never seems for a moment to waver or even hesitate.

It occurred to Mr. McCook that this recognition was based upon a certain odor which *in different degrees of intensity* is emitted by the respective factions. Or, which seems less likely, upon the presence in the individuals of the combatants *of two distinct odors.* This degree of odor, or difference in odors, he supposed might be dependent upon some temporary difference in the physical condition, age, or environment of the antagonists. Supposing that there were any basis of truth in this theory, it further occurred to him that the presence of an artificial and alien perfume of sufficient strength to neutralize the distinctive animal odors, or degrees of odor, and environ the combatants with a foreign and common odor, would have the tendency to confuse the ants and disturb or destroy their power of recognition. In which case he conjectured that the result might be their pacification and reconciliation. He therefore made the following tests:—

First, he collected a number of combatants from a battle being fought upon a flower-border, close to a fence, at his residence, and placed them together in a glass jar upon some soil. He shook the jar quite vigorously several times, so that, if possible, the mechanical agitation might separate the combatants. The ants emerged from the soil to continue or to recommence their fight. When the surface of the earth was well covered with them, and the battle was again at its height, he introduced into the jar a pellet of paper saturated with cologne water. The effect was instantaneous. The ants showed no signs of pain, displeasure, or intoxication. Indeed, some ran freely over the paper. But in a very few seconds the warriors had unclasped mandibles, released their hold of enemies' legs, antennæ, and bodies, and after a momentary confusion began to burrow galleries in the earth with the utmost harmony. On the part of some there was the appearance of thus escaping from the artificial odor; but there was no renewal of the battle. The quondam foes dwelt together for several days in absolute unity and fraternity, amicably feeding, burrowing, and building. Thus the perfume of the cologne proved an eminent pacificator of the contending emmets, and so far verified the theory.

A second experiment was tried in another glass jar, with like result. There was one exception, two ants continuing to fight after the cologne had been introduced. After closer examination Mr. McCook found that one of them was nearly dead, and was holding fast an antenna of her enemy with a death grip, from which escape was impossible. Three days after this he decanted the contents of this jar, ants and soil, into jar No. 1, and the two parties fraternized completely.

A third experiment was made. A large number of the warring ants had been lifted into a box, partly filled with soil, which communicated by a glass tube with a smaller box. The larger box was about ten inches long and eight inches in depth and width; both boxes had sliding glass covers. The original purpose was to observe the battle at leisure, determine how long the creatures would fight, and also if eventually the parties might not separate and the defeated retreat to the smaller box. However, he concluded to follow up the above observations, and abandoning his first purpose, introduced cologne as before into that end of the box in which the combatants were principally engaged. The same effect followed. In less than two minutes every sign of hostility had ceased, except in the case of two pairs, in that end of the box, and of one small group and two single combatants in the opposite end. The two pairs proved to be in conditions similar to the exception above noted, and a small pellet of perfumed paper dropped in the opposite end of the box, dispersed the warriors there. Previous to this, occasional stragglers had passed along the connecting glass tube into the smaller box. Most of them seemed to be of one faction, only one of the opposition having entered, upon whom six or eight ants were expending their wrath. This was the only remaining centre of strife, when Mr. McCook replaced ants and earth upon their native territory. The battle was continuing there, between greatly diminished numbers of course, after the removal of the large battalions into the box, but the application of a feather dipped in cologne to the neighborhood of the warriors caused the instant cessation of controversy. The next day there were no ants found upon the surface, but digging two inches under ground, close by the fence, he observed a few. The battle was evidently over. There had been in the mean time a great change of temperature, from 96° Fahr. to 47°, and this may have had some effect in sending the ants underground.

Attention was next directed to our large Pennsylvania Carpenter ant (*Camponotus Pennsylvanicus*), and a series of experiments made of the same nature as the above. In his study was an artificial formicary of those insects, which had been sent to him from the Allegheny Mountains. The ants had been taken from a branch of an oak tree in mid-winter, and were sent frozen up within a section of the formicary. This section was about one foot in length and seven inches in diameter. The most of the ants were removed from the nest and placed in a glass bottle, to all appearance quite dead. On entering his study the following morning, Mr. McCook was surprised to find that the ants had revived in the heat of the room, had cut a clean tubular hole through the cork, and were crawling over the top and sides of the bottle, just ready for an emigration. They were deposited in a large glass jar, and were the subjects of various experiments, until the death of the queen, eight months thereafter. Among these were the following, by way of further testing the theory above stated concerning the recognition of alien ants. First, Mr. McCook placed in the formicary, which at the time consisted of a piece of the original branch-nest planted upon several inches of soil, some individuals of the same species taken from the trees in Logan Square, Philadelphia. These were instantly attacked, and were beheaded, that being the favorite mode of dealing with enemies among these Pennsylvania Camponoti. Individuals (still alien but of the same species) were then thoroughly covered with the perfume of cologne and put into the formicary. They, too, suffered decapitation. Individuals were now taken from members of the formicary, subjected to the cologne fumigation, and restored to the nest. They were welcomed home unharmed. The whole formicary was then strongly perfumed by means of cotton pellets soaked in cologne, and alien ants of the same species (from Logan Square), which had been treated in the same way, were put into the midst of their mountain congeners. The result which had followed in the previous experiments, appeared once more. The intruders were not attacked with quite the same promptness, but in the end they were brought to the mandiblar guillotine, and their carcasses deposited in or rather on the cemetery which these insects are nearly always sure to establish when there are numerous deaths among them or on their premises. Thus the results of these experiments upon the mode of recognition among ants of *C. Pennsylvanicus*, point to a conclusion directly the reverse of that indicated by similar observations with *Tetramorium cæspitum*. Mr. McCook hopes when a favorable opportunity again presents to continue this line of observations. The results are put on record, inconclusive as they appear, not only because they seem to be in themselves interesting and valuable, but in order to stimulate inquiry among others in the same direction, and to invite suggestions and information which other observers may be able to make.

Dr. C. N. Peiree was elected a member of the Council in plaee of Dr. R. S. Kenderdine elected Curator.

Messrs. S. Fisher Corlies and Clarence S. Bement were elected members of the Finance Committee.

Griffith E. Abbot, George Wolf Holstein, Frank H. Rosengarten, John K. Valentine, James Huneker, Albert H. Smith, M.D., John A. Ryder, and Charlotte Uhlen Olsen, M.D., were elected members.

The following were eleeted Correspondents: John McCrady of Sewanee, Tenn., Charles T. Minot of Roslindale, Mass., Henry Hicks of London, J. W. Hulke of London, Thomas Belt of London, H. G. Seeley of London, W. T. Thistleton Dyer of London, Archibald Geikie of Edinburgh, James Geikie of Edinburgh, Charles Barrois of Lille, M. E. Jannettaz of Paris, Emil Sauvage of Paris, Ch. Velain of Paris, Edmond Pellat of Paris, H. Filhol of Paris, Michael Vacek of Vienna, and Karl von Seebaeh of Göttingen.

The following papers were ordered to be printed :—

NOTES ON THE NATURAL HISTORY OF FORT MACON, N. C., AND VICINITY. (No. 4.)

BY DR. ELLIOTT COUES AND DR. H. C. YARROW.

When the present series of papers was projected, it was intended that they should give a full account of the zoology of the locality, as studied by the writers during their successive residence at Fort Macon. Dr. Coues was Post-Surgeon at the Fort during 1869 and 1870, being succeeded in the winter of 1870–71 by Dr. Yarrow, who took up the work immediately and continued it until 1872.

Dr. Coues has already published two papers in these Proceedings (1871, pp. 12–49, and pp. 120–148), one on the Mammals, Birds, and Reptiles, the other on various Invertebrates, chiefly Mollusks. More recently, Dr. Yarrow has published (1877, pp. 203–218) a third paper, on the Fishes, giving the joint results of our respective collections—though it should be added that the observations are entirely those made by Dr. Yarrow, he having been furnished by Dr. Coues with simply a list of the species collected by the latter, as identified by Mr. F. W. Putnam, of Salem.

The present paper, No. 4 of the series, supplies many omissions in the first article, on the Mammals, Birds, and Reptiles—more particularly the latter. The series of papers may be completed by another communication, supplementing Dr. Coues's article on the Invertebrates (No. 2) with the results of Dr. Yarrow's more extended observations on several classes of the lower animals.

The writers are indebted to Prof. E. D. Cope, for identification of some of the Reptilia and Batrachia given in the present article.

I. MAMMALS.

Ursus americanus, Pall.
Black Bear.

Common on the mainland near Fort Macon; and is also found abundantly in a large marshy piece of ground not far from Croatan, a station on the North Carolina Railroad. Numbers are taken during the fall and spring in large iron spring traps, their meat and fur finding a ready market at New Berne, N. C. Some skins seen show small patches of light grizzled fur resembling somewhat that occasionally seen in specimens of *U. americanus* from the Rocky Mountains.

Delphinus globiceps, Cuvier.

Black-fish. Round-head Grampus.

But a single specimen observed, this having been taken at a porpoise-fishing on Shackleford banks, six miles from Fort Macon. The fishermen stated that it was rarely seen or captured.

Vespertilio (Vesperus) fuscus, P. de Beav.

Brown Bat.

Does not occur abundantly, a few only being seen near wooded portions of Bogue banks.

Sciuropterus volucella (Pall.), Geoff.

Flying Squirrel.

This species is quite common in the woods in the southern extremity of Bogue banks, and is also found in similar localities on the mainland.

Tamias striatus (L.), Bd.

Chipmunk.

Very common on islands and mainland.

Mephitis mephitica (Shaw), Bd.

Common Skunk.

Not abundant on the islands, but extremely common on the adjoining mainland. No case heard of in this locality regarding the rabies which is occasioned by the bite of its western congener.

II. BIRDS.

Ampelis cedrorum (V.), Bd.

Cedarbird.

Abundant in wooded portions of the islands, more so on mainland.

Hylotomus pileatus (L.), Bd.

Pileated Woodpecker. Woodcock.

Common in woods of islands and mainland; several specimens secured.

Campephilus principalis (L.), Gray.

Ivory-billed Woodpecker.

Information was received from an apparently respectable source of the occurrence of this species, whose appearance was described with tolerable exactness, but the statement is given for what it may be worth, no specimen having been seen.

Melanerpes erythrocephalus (L.), Sw.
Red-headed Woodpecker.

Quite common in woods, especially at Harker's Island, eight miles northeast from Fort Macon. This island is also celebrated for the numbers of mocking birds found there.

Antrostomus vociferus (Wils.), Bp.
Whippoorwill.

Occasional; but few seen.

Coccygus americanus (L.), Bp.
Yellow-billed Cuckoo.

Occasional.

Cygnus americanus, Sharpl.
American Swan.

A single specimen was seen by Dr. Yarrow, Dec. 18, 1871, near Harker's Island, but the people of the vicinity state, the species is not uncommon. This individual was noticed swimming in the midst of an enormous "raft" of red-head ducks (*Fuligula ferina americana*).

Fuligula vallisneria (Wils.), Steph.
Canvas-back Duck.

This species has been observed but once, four individuals having been noticed near Harker's Island, but we are informed it is quite common in the vicinity of Cape Lookout, fifteen miles from Fort Macon. The flesh, according to our informant, has not the richness of flavor which characterizes the Canvas-back of the Chesapeake.

Oedemia fusca (L.), Sw.
Velvet Scoter.

Occasional, few having been observed.

Mergus cucullatus, L.
Hooded Merganser.

Abundant in Bogue and Cove Sounds.

Mergulus alle (L.), V.
Sea Dove.

The occurrence of this species so far south is interesting. It is occasionally found on the beach after severe storms. The first specimen observed was secured in December, 1871, and others were subsequently taken. A number of the older residents of the locality, to whom the specimens were shown, stated that they had never seen or heard of such a bird previously.

III. REPTILES.

TESTUDINATA.

Thalassochelys caouana, Linn.
Loggerhead Turtle.

Extremely numerous; numbers are taken in peculiar nets set in Cove Sound.

Aspidonectes ferox, Schw.
Soft-shelled Snapper.

Tolerably common in fresh-water streams of mainland.

Chelydra serpentina, Linn.
Snapping Turtle.

Common in muddy creeks of mainland.

Cistudo clausa (Gmelin), Cope.
Box Turtle.

Common in woods of islands and mainland.

Although a number of other species of Testudinata were observed, none were collected or identified.

SAURIA.

Alligator mississippiensis, Gray.
Alligator.

In a former paper, by Dr. Coues, this reptile is stated "to be of common and regular occurrence in the adjoining swamps of the mainland," but since the publication of this fact, the species has been discovered to be quite common in the fresh-water ponds of the wooded portion of Bogue banks, within six or seven miles of Fort Macon. A number of these ponds are to be found, and in them numbers of alligators, for which reason the residents of the island fear to bathe in their waters. In the latter part of December, 1871, Dr. Yarrow procured a full grown female, eight feet long, with six or eight of her young.

Anolis principalis (Linn.), Holbr.
Green Lizard. Scorpion. Chameleon.

This species abounds near Fort Macon and upon the mainland, frequenting generally the wooded portions, and may readily be caught and partially tamed, Dr. Yarrow having been able to keep fifteen individuals over eight months in a common box, the bottom and sides being lined with green sods, the top covered with a pane of glass. These little reptiles became domesticated to such an extent as to feed from the hand when flies or ants were offered, and would also take a drop of water in the same manner. Unfortunately a scarcity of flies and ants necessitated a diet of grasshoppers, which produced diarrhœa, and all the specimens perished from this cause.

The natives of the "banks" have a great dread of these harmless and beautiful creatures, calling them "scorpions," and it requires considerable persuasion to induce them to touch one.

Their habits are somewhat peculiar, and were observed during their captivity with great care. In the act of copulation the male mounts the back of the female and entwines his tail with hers, and then seizes hold of the skin at the back of her neck; in this position they will remain for hours, apparently asleep, and in awakening resume the procreative act. During the day they are of a vivid green color, but as night or darkness approaches, they lose the bright green color, which becomes a rusty-brown, this change taking place gradually in spots and patches. This loss of bright color is also produced by cloudy weather. This species fights fiercely with *Cnemidophorus* 6-*lineatus*, and invariably conquers even with opponents of twice their size. Under the influence of anger the under part of the neck is puffed out, and the green color is then extremely bright. They shed their skins frequently during confinement, and cease taking food during this period, but, unlike the serpent, while undergoing this process, their eyesight is not affected. In one individual, who had suffered the loss of a portion of his tail—a full inch and a half—it was replaced by new growth within six months.

Oligosoma laterale, Say.
Ground Lizard.

Common, both on island and mainland. Generally appears towards evening.

Eumeces fasciatus, Linn.
Blue-tailed Lizard.

Occasionally met with in wooded portions of Bogue banks.

OPHIDIA.

Candisona miliaria, Linn.

Spotted Rattler. Ground Rattlesnake.

A few individuals of this species are said to have been seen on Bogue banks, none, however, observed or secured by the writers, but they are quite common on Shackleford banks, a few miles from Fort Macon. It has also been taken on the mainland. It is a fact worthy of remark, that, while on Bogue banks, rattlesnakes and moccasins are extremely abundant, this is the only venomous species found on the neighboring island of Shackleford.

Ancistroden piscivorus, Lac.

Water Moccasin.

Very numerous in woods of Bogue banks and on the mainland near wet and marshy places. Several specimens of enormous size secured. They are deemed so formidable by the residents, that, during the warm months of the year, no inducement will cause a visit to certain localities where these reptiles "use." In this connection it may be mentioned that Dr. Yarrow was informed by several individuals, that both moccasins and rattlesnakes had been seen a number of times swimming from the mainland to Bogue Island.

Ophibolus getulus sayi, Holbrook.

King Snake. Corn Snake. Thunder Snake.

Very common on islands and on mainland. This serpent is called "king snake" by the residents, who state that it frequently destroys both rattlesnakes and moccasins, eating its victims after the conflict is over, and for this reason it is held in great esteem and carefully protected. The fight which takes place between *Crotalus* and *Ophibolus* has been seen by several persons, and was described as follows: So soon as the rattlesnake sees his enemy, he endeavors to escape, if possible, and failing to effect his retreat, instantly throws his body into coils. The king snake approaches swiftly, and moves around the rattlesnake in a circle, gradually drawing nearer and nearer, the rattlesnake following his motion with his head. This circular movement of his antagonist appears, finally, to disconcert him, for after a time it is noticed his movements are less energetic, and finally, in an unguarded moment, *Ophibolus* throws himself with lightning rapidity upon him and chokes him to death, pulls his body apart, and devours him. In captivity they are very gentle, and it requires very severe provocation to induce one to bite. Several specimens which were kept in a large box could not be induced to eat either mice, frogs, or toads, but as several fine specimens of *Ophiosaurus ventralis* (Daud.), kept in the same box, soon disappeared, it was easy to account for the apparent want of appetite. In fact, a large male was found in the act of devouring one of the "glass snakes." It is believed that other species of *Ophiboli*, such as *O. doliatus* and *triangulus*, live upon the islands as well as the mainland, but none have been noticed.

Cyclophis vernalis, De Kay.
Green Snake.

This species is very common on the islands and mainland, and according to the writers' experience is, contrary to the generally accepted statement, extremely irritable in captivity, biting fiercely if disturbed.

Coluber quadrivittatus, Holbrook.
Chicken-snake.

Very numerous in woods of islands and mainland.

Coluber guttatus, Linn.
Spotted Racer.

Same remarks apply as to the preceding species.

Heterodon platyrhinus, Latr.
Sand Viper. Hog-nose Snake. Puff Adder. Blowing Adder.

Uncommon on islands, a single specimen only having been captured on Bogue banks, Nov. 1871. Thought to be poisonous by residents.

Dromicus flavilatus, Cope.

This new and interesting species was discovered by Dr. H. C. Yarrow, in the month of Nov. 1871, on Bogue banks some eight miles south of Fort Macon, near marshy ground; and a second individual was seen some months later at the same place, but was not captured, as it escaped into the water. The specimen was forwarded alive to Prof. E. D. Cope, who at once declared it new to science, and described it in the Proceedings of the Academy of Natural Sciences of Phila. for 1871, p. 223. At this time some doubts were expressed as to whether a second specimen would ever be secured, but the diagnosis of this eminent herpetologist has lately been confirmed by the discovery and capture of another specimen by Mrs. A. D. Lungren, of Volusia, Florida, as recorded in Am. Nat., Sept. 1877, p. 565.

IV. BATRACHIA.

Rana temporaria sylvatica (Linn.), Lec.

Wood Frog.

Uncommon, but few having been seen on islands; more frequently met with on mainland.

Hyla versicolor, Le Conte.

Tree Frog or Toad.

Very common on islands and mainland.

Scaphiopus holbrooki, Harlan.

Solitary Spade Foot.

A single specimen only seen in woods of Bogue banks, but it is doubtless found in the mainland. Its nocturnal habits may account for its apparent scarcity.

Plethoden cinereus erythronotus (Green), Cope.

Red-backed Salamander. Mud-puppy.

Common. Residents fear it, as they do most of the lizards and salamanders.

Amphiuma means, Linn.

Mud Snake. Congo-snake.

This species occurs, without doubt, but it has not been noticed by the writers.

Siren lacertina, Linn.

Has been occasionally observed by those engaged in digging ditches.

DESCRIPTIONS OF NEW SPECIES OF INVERTEBRATE FOSSILS FROM THE CARBONIFEROUS AND UPPER SILURIAN ROCKS OF ILLINOIS AND INDIANA.

BY C. A. WHITE, M.D.

The fossils herein described are a part of an important collection that has been sent to me for study by Mr. William Gurley, of Danville, Illinois, at which locality a large part of the collection was made. Others were obtained by him, and by Mr. William Gibson, from well-known localities, and some new ones, in both the States mentioned in the title. The frequent discovery of new forms and interesting types in districts, the fossils of which have been studied by so many able paleontologists, shows the extraordinary profusion and variety of invertebrate life during paleozoic time, in that great region of which the States of Illinois and Indiana now form a part. Collections of this kind also suggest many important questions to the philosophical paleontologist, which, however, it is not the purpose of the author to discuss in the present paper.

RADIATA.

ACTINOZOA.

Genus BARYPHYLLUM, Edwards and Haime.

Baryphyllum fungulus, White.

Corallum depressed, discoid; inferior surface plain, or slightly concave, the principal, as well as some of the secondary septa appearing through the obscurely developed epitheca; periphery moderately sharp, upper or calycular surface gently convex; septal fossett only slightly developed; septa numerous but distinct; the principal septum opposite the septal fossett much stronger than any of the others; the other primary and secondary septa both of about equal strength, sharp upon their edges and slightly sinuous and irregular in their course. The irregular disposition of the secondary septa, peculiar to the genus *Baryphyllum*, is well-marked in this species.

Diameter, 10 mm.; height, $2\frac{1}{2}$ mm.

Only a single example of this species has been discovered, slight imperfections of which obscure the centre of the under surface and also, in part, the septal fossett.

This species differs conspicuously from *B. Verneuilianum*, Edwards and Haime, the species upon which the genus was founded, and which was obtained from the Devonian of Perry County, Tennessee (see Monog. Polypiers Fossiles des Terr. Paleozoiques), in the much greater number of secondary septa as well as in other details.

Position and locality. Shales of the age of the Niagara Group, township of Waldron, Shelby County, Indiana.

ECHINODERMATA.

Genus PLATYCRINUS, Miller.

Platycrinus Bonoensis, White.

Body of the ordinary cup-shape, moderately deep; base shallow basin-shaped, concave at the middle of the under side, or appearing to be so in consequence of the presence of a moderately broad and strong circular ridge surrounding the central portion, and not extending outward quite to the borders of the base. First radial pieces about as long as wide, having the shape and characteristics of outline usual in cup-shaped bodies of this genus, scarcely more convex than the general convexity of the body; facet for the articulation of the second radial pieces shallow; second radial pieces very small, and transversely subrhombic in outline. Upon the second radial pieces the rays divide into two secondary rays, the first piece of each articulating upon the second radial, but also abutting, in part, upon the upper border of the first radial. The secondary rays consist of two pieces each, upon the uppermost of which they again divide, the outer arms of each division from that point upward continuing simple to the end, while the two inner subdivisions of the ray again divide into two arms each, upon the second piece above first division, beyond which all the arms of the whole ray, six in number, are simple, making 30 arms for the whole body. The arms are moderately slender, comparatively short, and for the first two or three pieces above the last bifurcation they consist of single wedge-shaped pieces; but above that they are made up of the usual double interlocking series of pieces. The only examples yet discovered have their arms so closely folded together that the pinules are hidden from view.

With the arms thus folded the whole animal had an obovate form. The stem, near the body, is moderately strong, and slightly elliptical in outline of transverse section. Surface nearly smooth, or faintly corrugated. The part of the body above the calyx unknown.

Height of body to the top of the first radials, 8 mm.; greatest breadth, 10 mm.; height from the base of the body to the top of the arms, 26 mm.

This species resembles *P. æqualis*, Hall, as figured by Meek and Worthen in Volume V. of the Illinois Geological Reports; but it differs from that species in having the base concave instead of protuberant, in the proportions of the body, the comparative shortness of the arms, and in wanting the peculiar geniculation of the pieces of the double series composing the arms. It resembles *P. lævis*, Miller, as figured by de Koninck and le Hon on plate VI. Recherches sur les Crinoïdes du Terraine Carbonifère de la Belgique, but it differs in having only two, instead of three primary radial pieces to each ray, and also in other details of structure.

Position and locality. Subcarboniferous limestone, probably equivalent with the Keokuk limestone, Bono, Lawrence County, Indiana.

Genus **SCAPHIOCRINUS**, Hall.

Scaphiocrinus Gibsoni, White.

Body of medium size, or comparatively small; calyx roughly cup-shaped; plates moderately thick and protuberant, especially the radials and the first anal; base small, nearly or quite covered by the upper joint of the column; subradial plates comparatively large, tumid; first radials broader, but scarcely larger than the subradials; sutures between the plates of the calyx impressed, especially at the points where the angles meet, and where there is a pit-like depression which increases the tumid appearance of the plates, and gives the calyx a somewhat shrivelled aspect; anal space comparatively large. The postero-lateral rays consist of three pieces, including the first radials, and upon each of the third radials the first bifurcation takes place, and above this the posterior secondary branch only bifurcates, and this third bifurcation takes place on the eighth piece above the second bifurcation; giving five arms for each of the postero-lateral rays, beyond all the bifurcations. All the pieces of the rays, including those of both the primary and subordinate divisions, have a tendency to become angular upon the back, especially at the upper side. This, together with the apparent corrugation of the calyx and the zigzag articulation of the joints of the arms near their upper ends, gives the whole specimen a good degree of asperity of aspect. Pinules strong and somewhat angular, one arising from each joint of the arms and subordinate divisions of the rays, upon alternate sides. The other rays are not fully known, but they apparently bifurcate in nearly the same manner as the postero-lateral ones. Column moderately large, composed of irregularly alternating larger and smaller pieces. The whole surface of body, arms, and column distinctly granular.

Breadth of body, 7 mm.; height from base to top of first radial pieces, 4 mm.; height from base of body to the top of the arms, 35 mm.

This species resembles *S. æqualis*, Hall, as figured in Vol. V. of the Illinois Geological Survey, more nearly than any other known to me, but it differs from that species in the much greater proportionate length of the arms, as well as their number, and the manner of their bifurcation, besides the difference in the character of the surface. A conspicuous difference is seen in the divisions of the rays; *S. æqualis* having eight arms by the ultimate division of each postero-lateral ray, while the species under discussion has only five. In the former species also, the joints of the upper part of the arms lack that zigzag arrangement that they have in the latter; and the general asperity of aspect of the latter is wanting in the former.

The specific name of this species is given in honor of Mr. William Gibson, from whom I have received many fine fossils for examination.

Position and locality. Subcarboniferous strata, probably equivalent with the Keokuk limestone, Crawfordsville, Indiana.

Mr. Gurley's collection also contains an example from Bono, Lawrence County, Indiana, that seems to belong to this species.

Scaphiocrinus Gurleyi, White.

Body of medium size or somewhat less; calyx roughly cup-shaped; subradial, first anal, and first radial plates prominent, the sutures being deeply impressed; base nearly covered by the last joint of the column; subradial and first anal plates as large as, or a little larger than, the first radials; the anterior, and the two antero-lateral rays only are known. These rays consist of three pieces each, including the first radials, already mentioned as a part of the calyx, and upon the third one the first bifurcation takes place, each division being once more bifurcated at varying distances from the first. In the anterior ray the second bifurcation takes place upon the eleventh piece from the first. In the antero-lateral rays, the second bifurcation takes place upon the ninth piece of the anterior branch of each of those rays from the first bifurcation, and upon the seventh piece, of the posterior branch. Near the tips of some of the arms there is still another bifurcation, the divisions of which being small, may easily be overlooked, or confounded with the coarse pinules. The pinules are large, long, and angular, each piece of all the divisions of the arms above the first bifurcation of the rays bearing one, which are arranged upon alternate sides. The backs of all the divisions of the rays are rounded, and have little or no tendency to become angular, except perhaps toward the extremity of the arms.

Column composed of irregularly alternating larger and smaller pieces. Surface granular.

Height of body from base to the top of the first radials, 3 mm.; breadth at top of the first radials, 4 mm.; height from base to top of arms, 28 mm.

The calyx of this species closely resembles that of *S. Gibsoni*, especially in the tumidity of the subradial and first anal pieces, and in the character of the column; but it differs very materially from that species in the number of arms and the character of their bifurcations, as well as in the surface markings and other details.

The specific name is given in honor of Mr. William Gurley, its discoverer.

Position and locality. Subcarboniferous strata, probably equivalent with the Keokuk limestone, Crawfordsville, Illinois.

Genus **LEPIDESTHES**, Meek and Worthen.

Lepidesthes Colletti, White.

General form apparently ovate. Interambulacral areas very narrow, linear, slightly convex from side to side, composed of four or five rows of small plates, which rows apparently do not decrease in number, except, perhaps, at either extremity. Ambulacral areas broad, partaking of the convexity of the body, lance-oval in outline, and five or six times as broad as the interambulacral areas are. Ambulacral areas made up of very numerous small rhombic plates, the transverse diameter of which is a little greater than the vertical; their lateral angles moderately acute, and interlocking so that they appear to be arranged in oblique rows; size of the plates nearly uniform throughout the field, except that they all become a little smaller near both the upper and lower extremities of the body. The number of vertical rows of these plates in each field is apparently 18 or 20. Each ambulacral plate has two distinct round pores near each other and near the upper angle of the plate. Surface granules small, more distinct upon the interambulacral than upon the ambulacral plates.

Only one specimen of this species has been discovered, and this is in a crushed condition. The original height was about 45 millimetres, and its transverse diameter probably considerably less.

The crushed condition of the specimen causes some doubt as to the true number of longitudinal rows of interambulacral plates, but they evidently do not exceed five. There seems to be only four rows to each area, one row of comparatively large plates, with two rows of smaller ones on the right-hand side of it and one row on the left. This want of bilateral symmetry suggests the possibility that one row on the left-hand side of the row of large plates has been forced beneath the others by pressure, but a careful examination fails to reveal any evidence of it.

This species is clearly distinguished from *L. Coreyi*, M. and W., the only other known species of the genus, by the very much narrower interambulacral areas, the different and varying proportions of the plates composing the former areas, as well as some other important but less conspicuous differences.

The specific name is given in honor of Hon. John Collett, of Newport, Indiana, whose effective labors in the geology of that State are well known and highly valued.

Position and locality. Subcarboniferous strata, probably equivalent with the Keokuk limestone, Salem, Washington County, Indiana.

MOLLUSCA.

POLYZOA.

Genus PTILODYCTIA, Lonsdale.

Ptilodyctia triangulata, White.

Corallum apparently ramose, transverse section triangular, the three sides being either flat or concave, usually the latter, and poriferous; the three edges sharp; the laminar axis consisting of three divisions which end respectively at the three edges, and meet at the centre of the corallum; pores well developed, but not arranged in the regular order that is common in this genus, nor are they bounded by any longitudinal or transverse lines or ridges.

Their mouths are moderately prominent, slightly oval, the direction of the longer diameter subject to no regularity. The breadth of the sides of the corallum varies from 3 to 5 millimetres; full length unknown.

This species differs from typical forms of *Ptilodyctia*, in having three flat or concave sides instead of two convex ones; in the axis being consequently tripartite, and in the irregular disposition of the pores upon the surface.

Position and locality. Coal-measure strata, Danville, Illinois.

CONCHIFERA.

Genus ASTARTELLA, Hall.

Astartella Gurleyi, White.

Shell small, not very gibbous, subtetrahedral in outline; anterior end truncated from the beaks obliquely downward and forward to about mid-height of the shell, where the front is sharply rounded to the somewhat broadly rounded base; posterior border broadly convex, and joining both the basal and dorsal margins by more abrupt curves; dorsal margin comparatively short, nearly straight; beaks small, umbones not elevated nor very prominent. An indistinctly defined umbonal ridge extends from each of the umbones to the postero-basal margin, behind which the shell is slightly compressed. Surface marked by concentric furrows, which are separated by sharp linear ridges.

Length of an example of average size among those of the collection, 7 millimetres; height from base to beaks 4½ millimetres.

This species differs from *A. vera*, Hall, with which it is sometimes associated, in its smaller size, in the slight prominence and want of elevation of the umbones, the greater proportional projection of the front beyond the beaks, and in being wider behind than in front, the reverse being the case with *A. vera*. The specific name is given in honor of Mr. William Gurley, in whose collection only I have seen the species.

Position and locality. Coal-measure strata, Danville, Illinois.

Genus **NAUTILUS**, Breynius.

Nautilus Danvillensis, White.

Shell moderately large, umbilicus deep, but not very broad, showing all the volutions; volutions apparently four, increasing rapidly in size, very slightly embracing, subtrihedral in cross section, the two sides of the volution forming two sides of that outline, while the inner side of the volution forms its third side; sides of the volution plain, nearly flat or slightly convex; dorsum very narrow, concave, and marked at either edge, where it joins the side, by a row of longitudinally compressed nodes. The sides are rounded abruptly into the umbilicus, which is unusually deepened by the diameter of the volutions being greater at the inner side than elsewhere. Septa plain, somewhat deeply concave dorso-ventrally, but less so transversely; siphuncle subcentral, a little nearer to the dorsal than the ventral side. Surface smooth, except the ordinary lines of growth and the two rows of dorsal nodes before referred to. Shell thin.

The specimens being imperfect, the exact form of the aperture is not accurately known, but the lines of growth show the lateral margins to have been sigmoid, and the dorsal margin concave. These lines also indicate that the aperture was oblique to the diameter of the plane of the shell, the dorsal portion retreating, and the ventral projecting.

Transverse diameter of a volution of less than full adult size, from edge to edge of the umbilicus, 4 centimetres; dorso-ventral width of its sides, 5 centimetres; breadth of dorsum, 16 millimetres; the full diameter of plane of the largest example discovered, about 13 centimetres.

The narrow concave dorsum, with its two rows of compressed nodes; the plain, flattened sides of the volutions and their greatest diameter being adjacent to the umbilicus, are characters that distinguish this species from all others known to me.

Position and locality. Coal-measure strata, Danville, Illinois.

ARTICULATA.

VERMES.

Genus SERPULA, Linnæus.

Serpula Insita, White.

Permeating an earthy carbonaceous layer of the coal-measure strata at Newport, Vermilion County, Indiana, are abundant fragments of a very small serpula, which evidently burrowed in the mass when it was in the condition of mud. Also sessile upon the surface of some embedded shells are some nearly perfect examples of the same species. The species of this genus are usually so devoid of characteristics that clearly separate them from each other, that a distinctive diagnosis is difficult or impossible. This species is not likely to be mistaken for any other, in consequence of its very small size, and because no other is known in the rocks of that age in that region. It is named for the convenience of fully classifying all the collections of fossils which are yielded by the rich strata of the coal-measures of Illinois and Indiana, as well as the adjoining States. This species may be characterized as minute, sessile or free, tortuous, subcylindrical.

FEBRUARY 5, 1878.

The President, Dr. RUSCHENBERGER, in the chair.

Thirty-two persons present.

The deaths of Andrew Murray, a correspondent, and of Dr. Chas. L. Cassin, U. S. N., a member of the Academy, were announced.

Note on Calycanthus Floridus.—Mr. THOMAS MEEHAN said, though this plant has been under culture for many years, the fruit was rarely seen. In correspondence with a leading author, it had been suggested that the plant might be incapable of self-fertilization, and that, being so far from its native place, the special insect arranged to be the agent in fertilization had not followed it. Since that time Mr. Meehan had obtained seeds from the Cumberland Mountains in Tennessee, and plants from these had flowered on his grounds, many of them producing fruit in the greatest abundance, while the old plants still remained as barren as they ever were. It was therefore clearly a case in which insects had no agency one way or the other. There was, he said, in plants two distinct forms of force—the vegetative and the reproductive; the one growing out of and dependent on the other, and yet to a certain extent antagonistic; and that these forces had their lines especially in the petaloid and staminoid verticils, and this resulted in producing some individual plants abundantly productive of fruit, while others were almost or wholly barren. This was the case with most species of plants. The lines were never exactly drawn between these forces. In the case of the Calycanthus, the earliest individual introduced to culture happened to be one that favored the vegetative side, and in which the reproductive had but little power, and this individual, as often happens in nurseries, had been propagated from by cuttings or offsets and widely distributed. It was in this direction that we had to look for the explanation of many similar experiences, and not merely to the necessity for cross-fertilization.

He further called attention to the carpellary structure of the capsules of the Calycanthus exhibited. It was not formed of a single verticil of primary leaves, but of many, as might be seen by the traces of the veins of the original leaves on the capsule. In most species of plants of this character the action of the reproductive over the vegetative force is so powerful, that the transformation is complete, and the casual observer could scarcely believe that a seed-vessel was but a mass of metamorphosed leaves. In this case we might say that the vegetative force had achieved considerable headway before the reproductive force had been able to bend the other to its own purposes.

Distinctive Characters of Teeth.—Dr. HARRISON ALLEN proposed to distinguish the buccal from the palatal side of human upper molars by the presence of a sulcus upon the latter surfaces and its absence from the former. The bicuspid teeth were found to present crowns having an anterior and posterior limiting ridge upon their grinding surfaces. These ridges are inconstant in the molars, notably upon the posterior edges of their crowns. Upon the anterior edges they, as a rule, are seen, and recall the peculiarity of the similar teeth of *Cynocephalus* and *Semnopithecus*. When a human molar exhibits the antero-palatal cusp united to the antero-buccal cusp by a well-pronounced limiting ridge it was thought to be an instance of reversion of the human to the quadrumanous type.

FEBRUARY 12.

The President, Dr. RUSCHENBERGER, in the chair.

Thirty-one persons present.

The following papers were presented for publication:—

"Notes on North American Caridea in the Museum of the Peabody Academy of Sciences at Salem, Mass." By J. S. Kingsley.

"Additions to Mr. Cooke's paper on the Valsei of the United States." By W. C. Stevenson, Jr.

The deaths of George T. Barker, Thomas P. Remington, and Wm. Welsh, members of the Academy, were announced.

FEBRUARY 19.

The President, Dr. RUSCHENBERGER, in the chair.

Thirty-three persons present.

Foliaceous sepals in Hepatica.—Mr. MARTINDALE exhibited a specimen of *Hepatica triloba* which he had collected near the mouth of the Wissahickon Creek, in April, 1877, all the flower stalks of which had produced leaves in the place of sepals similar in shape to those usually produced on the leaf stalks, but only about one-half their size; and then spoke of the causes of this change of condition. He stated that investigators in the study of this branch of the vegetable kingdom had long since attributed any deviation from the normal character as due, not to a want of vitality, but to a superabundance of vitality, and claimed that this specimen was a fair illustration, and a confirmation of that theory, it being the largest specimen he had ever seen. The great abundance of roots, the presence of a large number of leaves of the preceding year, which had remained attached to the plant throughout the winter, the true leaves of the season just becoming visible, and which appeared to be of greater abundance than those of a former year's growth, all gave evidence of the presence of an unusual amount of vitality. No flowers had been produced at all, at the same time the flower stalks which had produced leaves were exceedingly numerous. This morphologic change gave evidence of still another: as these leaves upon close examination were found to be covered with a fungoid growth of a low type, the tendency of which may have been to dwarf or disturb the full and free exercise of the vital force of the plant.

Mr. Thomas Meehan observed that he was not prepared to say that extra vigorous growth in a plant had any relation to morphological changes in the parts of the inflorescence, but he regarded with great interest the specimen exhibited, because he believed the normal change of leaves to sepals would not have been interfered with but for the presence of the minute fungus. As in the cases which he had in the past brought to the notice of the Academy, where *Euphorbia prostrata* and *Portulaca oleracea* became erect when attacked by an *Æcidium*, he thought the present an illustration that varying phases of nutrition governed form. We know from many observations that interference with nutrition had an influence on morphological changes. The calla (*Richardia Æthiopica*) which under one system of culture produced all leaves, under others had some of them changed to its white spathaceous flowers, and a ringed branch would often cause what would otherwise have been leaves and branches to become flowers and fruit. It was a great point gained to perceive the agent in the change, though the precise law influencing the agent was still obscure.

On Citrine or Yellow Quartz.—Prof. Leidy made remarks on citrine or yellow quartz with the hope of eliciting more accurate information as to its origin. Cut as a gem it is common, and is sold by the jewellers (almost to the exclusion of the true mineral) for topaz. The cut specimens of citrine occur in all shades, from a pale straw-yellow to the richest orange hue, often with a brown tinge more or less deep. Uncut specimens of the mineral of equal quality in color are rare in mineralogical collections. Pale yellow citrine is derived from many localities, but the best and deeper colored varieties are said to come from Brazil. In the museum of the Academy there is a pebble of pale yellow citrine, about the size of a fist, presented from the Brazilian collection, at the close of the late International Exhibition. In the display of quartzes of the Brazilian collection no darker specimens of the citrine were observed.

Some authorities refer to citrine as probably being produced by burning amethyst or smoky-quartz (*Kluge: Handb. Edelsteinkunde*, 374; *Lange: Halbedelsteine*, 30). Prof. Leidy exhibited clear, colorless specimens of quartz, cut and in the natural crystal, which he said were amethysts and smoky-quartz, which had been submitted for a short time to a moderate red heat, resulting in the total expulsion of all color. Smoky-quartz of the darkest hue, from Paris, Maine; Hot Springs, Arkansas; and Pike's Peak, Colorado, have the color completely dissipated after a short exposure to moderate red heat. Perhaps heating under peculiar circumstances may convert the usual color of amethyst into the yellow of the citrine, but specimens heated in the ordinary manner did not indicate such a change.

February 26.

The President, Dr. Ruschenberger, in the chair.

Thirty-two persons present.

The deaths of Prof. Andreas Retzius and of Dr. O. A. L. Mörch, correspondents, were announced.

Papers entitled "Distribution of Spiders by the Trade Winds," and "The Basilica Spider (Epeira basilica)," by the Rev. H. C. McCook, were presented for publication.

J. Gozzardini, Bologna; G. Meneghini, Pisa; Antoine Stoppani, Milan; Francisco Coello, Madrid; J. J. Steenstrup, Copenhagen; F. Steenstrup, Copenhagen; R. Brough Smyth, Melbourne; Edouard Van Beneden, Liege; and Jules Künckel d'Herculais, Paris, were elected Correspondents.

The following papers were ordered to be printed:—

ON THE ALKALI OF THE PLAINS IN BRIDGER VALLEY, WYOMING TERRITORY.

BY E. GOLDSMITH.

Whilst visiting Fort Bridger, Wyoming, Prof. Leidy observed on the plains in the vicinity an efflorescent salt, called there alkali. It appears as a dirty-gray powder; amorphous not only to the naked eye, but also beneath the microscope.

The flame reaction shows the presence of soda and potassa. Heated in the closed tube it blackens and emits some water having an alkaline reaction. Water dissolves part of it, and leaves a dark-colored residue. In the watery solution I recognized lime, potassa, soda, sulphuric acid, and a trace of chlorine and ammonia. The insoluble part consists of silica, colored by oxide of iron.

After two grammes were perfectly exhausted with distilled water, the water expelled and the remaining mixture of salts dried on steam, I obtained 0.551 gramme = 27.55 per cent.; the insoluble part is the difference, or = 72.45 per cent.

Upon separating the lime, and changing the sulphates of potassa and soda into their respective chlorides, I obtained a dry mixture of 0.448 gramme of chlorides, from which was extracted 0.08389 gramme of chloride of potassium; hence, by subtracting 0.36411 gramme of chloride of sodium and computing these chlorides into sulphates, we get approximately:—

	Sulphate of soda	= .442 gram.	=	22.10	per cent.
	" potassa	= .098 "	=	4.90	" "
By difference,	" lime	= .011 "	=	.055	" "
The soluble part,		= 0.551 "	=	27.55	" "
Adding the insoluble part,		= 1.449 "	=	72.45	" "
Sum,		2.000 grams.	=	100.00	" "

Alkaline Incrustations.—At the Mineral Springs, Pioneer Valley, W. T., Prof. Leidy found a material which, if carefully picked out from some loose powder mingled with particles of vegetable matter, appears as a white soft substance, which easily crumbles between the fingers. Its aspect is like that of an incrustation of recent date, derived from a watery solution, of which the solvent quickly evaporated. It is irregular in shape; some pieces are formed on one side, similar to cauliflower; no crystalline particles are seen by ordinary inspection. Beneath the microscope, however, a few prismatic crystals were observed.

The flame reaction indicated soda and potassa.

Heated in the tube, closed at one end, it changes to black, showing that the substance contains some organic matter; it also gives water.

If heated on coal before the blowpipe, it is all absorbed.

In water, the substance is soluble, with the exception of a small quantity of flocculent matter, which seems to be silica.

The watery solution is alkaline to test-paper. The solution seems to contain no other bases than those named above, but partly combined with chlorine, partly as sulphates and carbonates. No attempt was made to determine the organic matter.

I found that 0.727 gramme lost on steamhead 0.006 gramme = 0.82 per cent. of water. 1.4035 gramme gave 1.2605 gramme sulphate baryta = 0.4327 gramme = 30.83 per cent. of snlphuric acid. 0.7445 gramme gave 0.5875 gramme of chloride of silver = 0.1452 gramme = 19.50 per cent. of chlorine. 1.000 gramme of the substance gave, after the sulphates had been converted into chlorides, 0.8865 gramme of a mixture of chloride of sodium and chloride of potassium, from which I separated 0.1948 gramme of chloride of potassium; hence 0.8865 — 0.1946 = 0.6919 gramme of chloride of sodium.

From the data, the computation in regard to the affinities was carried out with the following results:—

Na Cl . . .	32.14	per	cent.	
$\dot{Na}\,\dddot{S}$ . . .	36.21	"	"	
$\dot{Na}\,\ddot{C}$ . . .	6.52	"	"	
$\dot{K}\,\dddot{S}$ . . .	22.71	"	"	
$\ddot{Si}$ . . .	0.21	"	"	
$\dot{H}$ . . .	0.82	"	"	
Organic matter, . . .	1.39	"	"	by difference.
	100.00			

In the result of this analysis, it is demonstrated that four distinct alkaline salts are contained in the mixture in which the potassa sulphate is remarkable. From the small quantity of water found, I infer that the atmosphere must be extremely dry in that particular locality.

Two other mineral specimens from the same locality were obtained by Prof. Leidy. Both were of the same general character. They are uneven, rough, and formless. Throughout the mass small irregular holes are seen, which probably were produced by carbonic acid gas. Both specimens were analyzed and found to be of the same composition. They are impure carbonate of lime, containing some soda and potassa, and are colored by oxide of iron.

ON THE MECHANICAL GENESIS OF TOOTH-FORMS.

BY JNO. A. RYDER.

During a study of the osteology of the mammalia, the views herein advanced were first conceived as a rational explanation of the origin of the shapes of dental structures, as they exist in the different groups. More mature deliberation has only served to strengthen the conviction that the inquiry is in the right direction, since no body of facts with which I am acquainted are more beautifully and intimately interrelated than those which I have here so imperfectly presented. It is hoped that a better appreciation of what might, without violence to commonly received ideas, be called evolutional teleology, may be attained by pursuit of similar inquiries in other directions.[1] This attempt to unravel a portion of the complex interrelations of the parts of organic beings, so as to show how their metamorphoses may be effected by mechanical means, it is believed, may not strike the mind of the reader as altogether futile, nor the title as quite so presumptuous, as would at first appear, after all the facts have been weighed. The interpretation of the rationale of the differentiation of structures in a mechanical way is not entirely new, since Lamarck, in his "Philosophie Zoologique (1809), and latterly Mr. Spencer, with greater philosophical grasp, have both shown that efforts exerted to overcome resistances are retroactive and induce modifications in the parts of organisms.[2]

[1] Am. Naturalist, 1877, p. 603. Nature, vol. 17, 1877, p. 128.

[2] It may be observed here that the nomenclature of tooth-forms adopted throughout is that proposed by Prof. E. D. Cope in his memoir, entitled "On the Homologies and Origin of the Types of Molar Teeth of Mammalia Educabilia (Journ. Acad. Nat. Sci., Philada. 1874). The names are not intended as characterizing groups or orders in the system, but rather as distinguishing distinct classes of teeth, which may exist in the same or nearly the same form in several distinct orders or families of the class. The definitions of terms remain the same, except those of the words *isognathous* and *anisognathous*, which I use so as not only to indicate respectively parity and disparity in transverse diameter of the crowns of the upper and lower molars, but also the parity or disparity in width transversely, from outside to outside, over both maxillaries, including the bony palate and the width across both rami of the submaxillary. This additional signification

Tooth-forms and Jaw-movements of the Groups.—It may be stated in general terms that the primates are bunodont and relatively isognathous, consequently the lateral movement is limited. This type of dentition is affirmed to be generalized, or, in other words, to be present in several diverse groups; first occurring in earlier forms and in the young of many, previous to or during the protrusion of the teeth from the gum, prior to or about the time they become functional. Man is usually not perfectly isognathous, the nearest approaches to it that I have observed were in the skulls of a Slavonian and an Anglo-Saxon. *Cynopithecus* and *Macacus* are anisognathous, and the South American howler monkeys and marmorets even more so. The American primates seem to present the anisognathous extreme, and the Old World forms the isognathous. Another fact of interest here is the shape of the glenoid cavity. In the gorilla it is more like man's than in any primate I have examined; deeply excavated transversely, with a prominent transverse ridge bordering the excavation anteriorly. This form of glenoid cavity entirely disappears in the howlers, in which it is a comparatively plane surface; the superior surface also of the condyle is flattened and expanded transversely, as in selenodont ungulates, which agrees with the presence of the rudimentary crescentic cusps and the anisognathism. The chimpanzee has a relatively plane glenoid surface, and in man the depth of the excavation of the cavity is greater even in the Australian, the lowest modern type of human skulls.

The dentition of *Feræ* is bunadont, usually somewhat anisognathous, the tubercles are laterally compressed, with edges so sharp as to constitute a very effective apparatus for cutting the tough tendons, ligaments, and bones of their prey. The mandibular articulation is the most perfectly ginglymoid in the class, and hence also admits of the least lateral movement. All the lateral movement observable is that which is effected by the lateral sliding of the cylindroid condyles in the glenoid cavities; the effect is, however, widely different from the lateral movement observed in ungulates. In these the distal end of the mandible moves through the greatest space, while in *Feræ* all points of the

slightly changes the proposed grouping in the memoir referred to, but it also has the greater advantage of making words already in use serviceable and analogous in meaning to *prognathous* und *orthognathous*, as first used by Retzius in craniography.

jaw in sliding sidewise pass through the same distance. A few of the group retain the simple haplodont type of tooth, *e. g.*, *Rosmarus*.

The passage from the archetypal bunodont tooth to the scissors-like (carnassial) sectorial arrangement is plainly exhibited, by selecting a series beginning with *Ursidæ*, and continuing with *Amphicyon*, *Procyonidæ*, *Melinæ*, *Cercoleptes*, *Mustelidæ*, etc., and ending with the *Felidæ*, as the extreme of specialization.

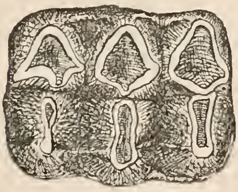
Amongst the *Ungulata*, the most conclusive evidence is found in confirmation of the law of dental modification here enunciated. The numerous living and extinct species present a remarkable chain of dental forms, gradually departing from the bunodont type, and passing into the excessively modified selenodont, accompanied with increased mobility of the mandible in a lateral direction and increased anisognathism.

The *Toxodontia* present a ptychodont type of dentition, are very anisognathous, and the condyles approach in form those of the selenodont ungulates; they in all probability moved their jaws laterally. The enamel patterns are reversed in opposite series.

The Hyracoidean dentition is tapirodont, with an apparent tendency towards the selenodont, anisognathous with condyles transversely expanded, which may be regarded in connection with the truncate crowns of the molars and plane condyles as evidence of extensive lateral movement.

The *Proboscidea* are regarded as trichecodont, a careful examination, however, reveals that the inner tubercles above and the outer ones of the inferior molars of some of the extinct forms (*Trilophodon* and *Tetralophodon*) were slightly selenodont (Fig. 1), anisognathous; molars tuberculate, in few cross crests; condyles more like that of selenodont ungulates, with lateral motion. In *Elephas* and *Loxodon* the jaw-movement is from behind forwards; condyles more rodent-like, isognathous; molars with flat crowns; tubercles becoming obsolete from wear, and blended into numerous transverse plates.

Fig. 1.



Right upper molor of *Mastodon*.

The *Sirenia* are trichecodont and bunodont. The trichecodont form (*Manatus*) seems to have some lateral motion, as there is some degree of anisognathism. The teeth of the Dugong when young are bunodont, as is shown by a specimen in the collection of the Academy.

The toothed cetaceans have a type of dentition more or less nearly haplodont (*Zeuglodon* presents two rooted molars and premolars, with a simple, compressed serrated crown).

The *Mysticete* are without true teeth, jaws greatly modified, rami separate, keratose laminæ (baleen) and surrounding soft parts acting as a prehensile apparatus in connection with the movement of the creature through the water.

In the insectivorous group *Chiroptera*[1] the dentition approaches, in some respects, that designated as symborodont. It is anisognathous, but differs in the bats from the symborodont greatly in the manner in which the teeth of opposite series fit into each other; it is also met with in nearly as marked a form in some marsupials (*Didelphys*), and in *Insectivora* (*Talpidæ*, etc.). The anterior V-like cusp of the inferior molar series is longer than the posterior, the former fits into an acute or triangular space partially separating the upper molars on the inside, the latter fits

[1] The following tables are of interest as exhibiting a gradual reduction of molars and premolars in this group. They are taken from an abstract of an elaborate paper by W. Leche in *Weigmann's Archiv f. Naturges*, xliii., Pt. 5, 1877, 353. I have not seen the original in *Lund's Universitets Arsskrift*, tome xii., 1876:—

I. Showing gradual loss of posterior molars in the Phyllostomata and Desmodina—

Brachyphylla,		m. $\frac{3}{3}$ (fully developed upper 3d m.).
Sturnira, etc.,		m. $\frac{3}{3}$ (rudimentary upper 3d m.).
Artibeus,		m. $\frac{2}{3}$.
Chiroderma,	pm. $\frac{2}{2}$	m. $\frac{2}{2}$ (fully developed upper 2d m.).
Pygoderma,		m. $\frac{2}{2}$ (rudimentary upper 2d m.).
Diphylla,		m. $\frac{1}{2}$.
Desmodus,		m. $\frac{0}{1}$.

II. Showing gradual loss of middle premolars in the Vespertilio series—

Vespertilio,	pm. $\frac{3}{3}$	$\left(\frac{\text{pm. } 1+2+3}{\text{pm. } 1+2+3}\right)$	
Plecotus,	pm. $\frac{2}{3}$	$\left(\frac{\text{pm. } 1+3}{\text{pm. } 1+2+3}\right)$	m. $\frac{3}{3}$
Vesperugo,	pm. $\frac{2}{2}$	$\left(\frac{\text{pm. } 1+3}{\text{pm. } 1+3}\right)$	
Vesperus,	pm. $\frac{1}{2}$	$\left(\frac{\text{pm. } 3}{\text{pm. } 1+3}\right)$	

into a similar space or groove, between the V-like cusps of the upper molars. The condyles are elongated transversely and somewhat ginglymoid in respect to articulation, and do not admit of much lateral movement.

The foregoing remarks render further notice of the dentition of *Insectivora* unnecessary, or see St. G. Mivart's papers.[1]

Amongst Rodents a greater variety of dental forms is to be found than in any other order of the class with the exception of the marsupials; frequently haplodont, ptychodont, or bunodont, and, sometimes, even approaching the selenodont form. It is very likely that the very common opposite arrangement of the folds of enamel in the opposite series has had the same origin as those in the selenodont system. In many species the dentition is peculiar, and has no parallel in other orders. What is now referred to is the curious pattern met with in such genera as *Arvicola*, *Fiber*, and *Neotoma*, where the figure formed by the enamel covering of the triangular dentine columns stands reversed in respect to those of their fellows of the opposing series. The various grades of anisognathism and isognathism here find their fullest expression; indeed, the multiformity in this and other features is such as to be worthy of more extended study than can be devoted to them without a complete collection of jaws and teeth of recent and fossil species.

The dental system of *Bruta* is usually haplodont, though in the extinct *Hoplophoridæ* and *Mylodontidæ*, it was ptychodont in form, but not in structure, since there was no enamel to be folded. In the former group (*Glyptodon*) the teeth were inclined forwards in the lower series, and backwards above, as observed in Arvicoline rodents, which with their form in section gives us a hint as to the origin of that form.

The marsupials, other than the insectivorous ones, present the tricheeodont and a type simulating the selenodont in *Phascolomys*. A remarkable form is observed in *Stereognathus*, as described by Owen, where the crescentoid middle tubercles have the convex side directed backwards, and the concave forwards in the molars of the mandibles, which arrangement, as he observes, is not found in any other living or extinct species of mammal.

[1] Journ. of Anat. and Physiology, vol. i., 1867, pp. 280-312; Ib. vol. ii. pp. 117-154.

Differentiation of Dental Systems.—By what Professor Cope calls "synthesis of repetition,[1] the origin of the various types of mammalian dentition is rationally accounted for, by supposing an additional modicum of growth force as duplicating the primitive dental body, in lateral, longitudinal, or oblique directions. In all the ruminating ungulates the repetition of tubercular structures is now tending to take place on those sides of the teeth most subject to the severe impacts incident to mastication, as is shown by the appearance of rudimentary tubercles (cingules) upon the outside of the molar teeth in the mandible, and upon the inside in the molars of the maxillary. Another kind of differentiation has taken place in the incisors of the horse, as I have attempted to show in a previous paper,[2] where the duplication has taken place from the posterior side, in accordance with the generally prevalent acceleration going on in the whole dental system, and to account for which I cannot forbear suggesting that the severe wear to which these structures have been so long subject, together with the peculiarities of mandibular motion, have conspired to produce the following changes: the elongation of the teeth, their consequently deeper implantation in the mandible, and the fusion of the fangs or roots into the simple, persistently growing, rootless columns. This gradual elongation and fusion of the roots of the teeth is well seen in the series of horses' teeth which Prof. Huxley presents in his third lecture in New York. There are also instances amongst Artiodactyls, the great *Edentata* (*Megatherium*), many herbivorous rodents, elephants, etc., in all of which it is noticed that the later forms are invariably possessed of the longest teeth growing from more or less distinctly persistent pulps, or some arrangement which is equivalent. These forms with the long molars have almost invariably been herbivorous with lateral motion of the mandible, while the short unmodified tubercular form of molar tooth with fangs has been preserved in those types in which the food was already pre-

[1] Proc. Am. Philos. Soc., 1871, p. 242.

[2] Proc. Acad. Nat. Sci., Phila. 1877, p. 152. I have since observed an instance in an incisor of *Cynopithecus*, where the prominent cingulum on the posterior face of the tooth came very near being functional, so as to inclose an area homologous with the "mark" or cul-de-sac in the incisors of the horse, proving conclusively to my mind that such has been the origin of the complex incision of the latter animal.

pared for assimilation, or was relatively soft as in the *Suina* and some rodents (*Sciurus* and *Mus*). In all rodents, the incisors grow from persistent pulps, no matter whether the molars grow from such pulps or not, showing again that strains have here played the part of directive agents, controlling growth force.

Methods of cusp duplication may be tabulated as follows:—

1. Interstitial; developing connecting ridges (possibly this appearance is often due to compression of the cusps).
2. Lateral; either palatal or buccal, internally above, and externally below (*Cervus*, *Bos*).
3. From behind; by the successive addition from behind of transverse rows of cusps or greatly flattened and expanded single ones. As in *Mastodon*, *Elephas*, *Hydrochoerus*, and *Potamochoerus*.

Whilst such changes in cusp growth are going on, the external cementum layer thickens as modern and domesticated forms are approached; the last (living) term in a given phylum of herbivorous ungulates usually having it thickest.

Prof. Harrison Allen's views on cusp duplication, as expressed in an article in the *Dental Cosmos*,[1] "On the Nomenclature of the [human] Teeth," are worthy of notice in this connection. His views, which are very clearly stated, may be summarized and somewhat expanded, so as to include other mammalia, as follows:—

1. That the cusps are the initial (embryological, and, therefore, palingenetic) elements of the teeth from which the fangs or roots are produced by the gradual thickening of the dentinal structures.

2. That the development of bicuspid (premolar), quadricuspid (molar) teeth is effected by the repetition of the unicuspid form (incisive or haplodont), *i. e.*, by the functional development of Cingules,[2] or rudimentary cusplets at the base of the crowns of unicuspid, bicuspid, quadricuspid, etc, forms, often forming cingula, that are frequently broken up into small, more or less distinctly defined tubercles.

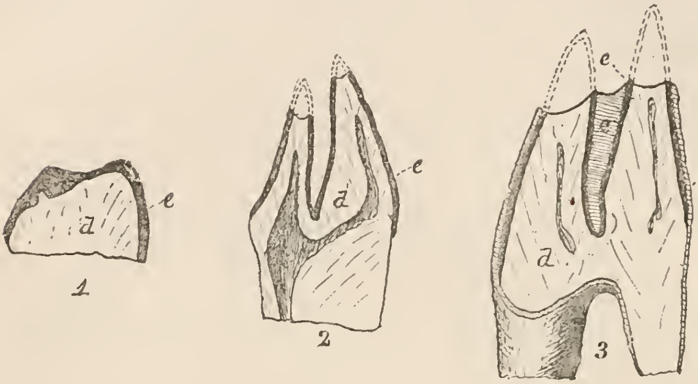
Several instances occur amongst the mammalian orders exhibiting greatly elongated cusps. In the cases of the Ungulates and Proboscidians the steps of the process can be pretty easily traced. In the former the primary form is the simple cone, which gradu-

[1] Vol. xvi., 1874, pp. 617–623.

[2] A convenient term, proposed by Prof. Allen.

ally becomes more and more compressed, and at the same time produced (Fig. 2), the acute fore and aft edges of which are turned

Fig. 2.

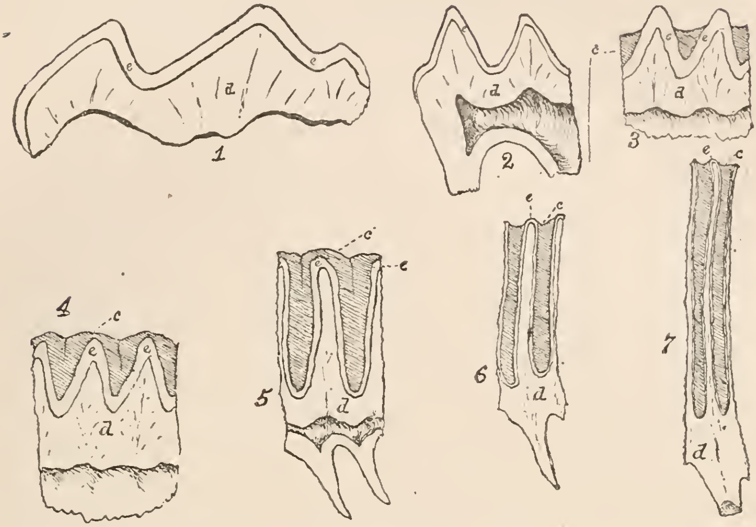


1. Transverse vertical section of rear upper molar of *Sus erymanthius*.
2. Same of *Tragocerus amaltheus*.
3. Same of *Bos taurus* (Altered from Gaudry). *d*. Dentine; *e*, enamel; and *c*, cementum. The dotted lines at the apices of the cusps of 2 and 3 show the portion worn away.

either outwards or inwards, as the teeth happen to be upper or lower molars, while as the apical portion of the cusp is worn off the characteristic crescentoid pattern becomes apparent.

In the Proboscidians we probably encounter a successional series of tooth forms in which the individual cusps were short and distinct, with little cementum in *Mastodon*, but as the surviving group of true elephants is approached both the recent species and the extinct species allied to them exhibit a great production of the tubercles, while, as we should expect, they at the same time become much more numerous. The enamel is the only considerable covering of the crowns in the cusped forms, whereas in the forms with lamellate teeth the transverse sulci (valleys), are gradually deepened and filled with cementum, which constitutes about half of the mass of the teeth in some instances. In the milk dentition of *Loxodon africanus* evidence of the original bi-tuberculate condition of the lamellæ (tubercles) still remains where their apices are not yet worn; and I believe that evidence is not wanting to show that this is the case in all the true elephants. The gradual elongation of the individual cusps of Proboscidians is shown in the following seven diagrams (Fig. 3), selected and reduced from Plates I., II., and III. of Falconer and Cautley's *Fauna Antiqua Sivalensis*.

Fig. 3.



1. Longitudinal and vertical section of the crown of a lower molar of *Dinotherium magnum*.
2. Same of two cross-crests of an upper molar of *Mastodon ohioticus*.
3. Same of two cross-crests of a lower molar of *Elephas ganesa*.
4. Same of three cross-crests of *E. insignis*.
5. Same of a cross-crest of *E. planifrons*.
6. Same of a lamellum or cross-crest of *E. hysudricus*.
Same of *E. indicus*.

d, Dentine; *e*, enamel, and *c*, cementum.

As we have seen, the increase in mass and length of the food triturating organs (teeth) of herbivora have increased as we ascend through the successive geological horizons, have uniformly been broadened to present a more available crushing surface, and have, in many special cases, diverged from the ancestral type, apparently because certain strains operate in a way entirely new, owing to the necessary, voluntary, or intelligent assumption of new habits of life. I would add the following from unpublished MS. upon another subject: "When the various groups of terrestrial running birds and mammals, and also the saltatory, or leaping mammalia, are considered, the evident strengthening and modification of certain toes, resulting in their specialization and reduction, is so apparent, that to deny the agency of strains as a very potent cause, is simply to ignore the plainest principles of physical development, where to accelerate that development, gradually increasing resistances must be overcome so as to acquire increased strength, as illustrated in the training of oarsmen, gymnasts, lifters, and pugilists. The peculiarities of muscular development, induced by peculiar strains incident to the pursuit of certain trades, is a further illustration."[1]

As it is by the duplication of tubercles in various directions, their fusion, suppression, or atrophy, enlargement or hypertrophy, and total suppression, that the various types of teeth and dentition seem to have arisen, some of the causes of these changes may next be considered. But in order fully to appreciate the potency of such causes as may be suggested, it will be well to take a glance at some of the dental systems of the mammalia to see if there is any evidence of plasticity of the teeth. What favors the idea of plasticity more than anything else is the constant reversal of the forms of the tubercles in opposite molar series, as in Artiodactyls and Perissodactyls, the reversal of the plan of the foldings wherever the ptychodont type prevails, as in rodents and *Toxodontia*, as though forced into those shapes by some force always acting in a definite direction. The fact that the component cusps of the molars of almost all rodents and ruminants are, in the former, transversely, and, in the latter, longitudinally compressed, as though pressures operating in these respectively opposite lines of mandibular movement had induced the compression, is strong presumptive evidence in favor of the doctrine of plasticity of dental structures. I would not so strongly insist upon plasticity in the adult as in the young animal, when the teeth first appear, and when in many cases they are very perceptibly flexible, though very brittle. The evidence which is, however, most striking of all is the gradual derivation of the crescentoid type of cusp, apparently from the conical type. This crescentic form is constantly intensified as the pliocene is approached through the previous geological horizons, as though some force relatively uniform in degree and persistence had been in operation throughout a great length of time, effecting but slight changes towards

[1] A German surgeon, to whose papers I cannot now refer, became expert in indicating the occupation of tradesmen by a study of the differences of development induced by different trades in the superficial muscles.

the later type in a single generation, but entailing that slight change upon offspring through the law of heredity, and these two processes again indefinitely repeated until the sum total of perhaps infinitely slight differentiations effected in this way, amounts to the difference of form we note to-day between the ancient bunodont and modern selenodont.

Zoologists, previous to this time, seem to have paid little or no regard to the mandibular movements of animals as the proximate causes of tooth modification. Although most of the reasoning in favor of such a view is of the *a posteriori* kind, there is not wanting in other facts of biology the obvious relation between cause and effect, which is here appreciable only as an effect, for which it is entirely warrantable to assume a cause discoverable, and capable of a rational interpretation. Indeed, until the appearance of the palæontological works of such pioneers as Owen, Leidy, Falconer, and others, it was scarcely possible that anything suggestive of a constantly active modifying force should have crossed the mind of the zoologist. It was from their work, in connection with some studies in recent osteology, that I was led to commence making observations upon the various living groups, as represented more particularly in the collection of the Philadelphia Zoological Society,[1] with especial reference to the kind of mandibular movement peculiar to the different orders, and I was not disappointed to find my surmises substantiated by the actions of the living animals. I observed that there were several distinct kinds of mandibular movement, each kind corresponding to some very distinct type of tooth, which led to the observance of other classes of facts, whose import, until then, I had not comprehended. I noticed, too, that in some cases the movements were different at different times in the same animal, and in some that the kind of movement during rumination was characteristic of a single species, as in the camel.[2] I also noticed that the lamas and vicuguas had peculiar movements, which seemed to be transition forms, imperfectly bridging the gap between that characteristic of the camel and the ordinary type of ruminants.

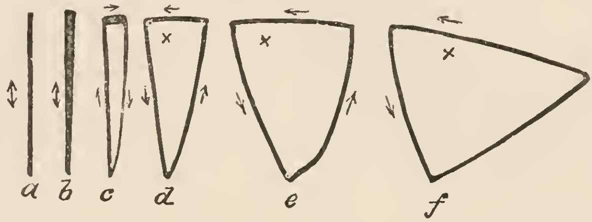
[1] I take this opportunity of making an acknowledgment for the facilities so kindly afforded to me for study by Mr. A. E. Brown, the Superintendent of this institution.

[2] This feature is as characteristic of the *Tylopoda* as the synchronous forward movement of both legs one side in walking.

In no case, however, did the movement depart from the kind characteristic of the species, family, or order, so as to invalidate any conclusions which might be drawn from them as conditioning changes in tooth-structure. Due allowance was also made for the different kind of food which, in special instances, the creatures under consideration were compelled to eat in confinement, due to removal from their native wilds.

The varieties of mandibular movement observed are diagrammatically shown in Fig. 4, which were obtained by selecting and

Fig. 4.

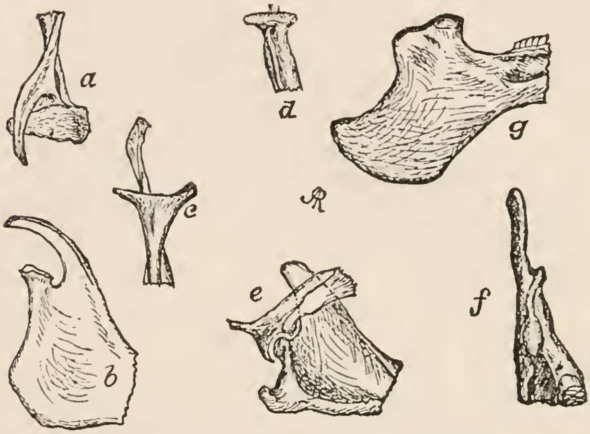


watching some point on the end of the mandible, or of the lower lip while the jaws were in motion, and the various figures which were thus described by the point chosen were found to be in various animals very nearly those marked *a*, *b*, *c*, *d*, *e*, and *f* in the diagram. The end of the mandible in carnivora was found to describe that at *a*, this was also noticed as the characteristic figure described by the pigs, and, for theoretical reasons, is assumed to be characteristic of the *Hippopotamus* and the earlier types of ungulate mammalia. In the feline section of the carnivora no other kind of mandibular movement would be possible, since, as has been noticed, the descent of the anterior and posterior bony borders of the glenoid cavity is such as to grasp the cylindroid condyle so as to constitute the most strongly marked type of ginglymoid mandibular articulation in the class, though there is some approach towards it in the bats. The gradual departure from this extreme type of mandibular articulation through the dogs, hyenas, and bears does not affect the kind of figure which a certain point at the end of the jaw will make in these cases. The movement which produces *a* is that made in simply opening and closing the mouth, and the whole process of mastication is effected in this way in dogs, cats, pigs, hippopotami, bats, opossums, and all other bunodonts or their immediate allies. The figure *b*, showing slight lateral movement, is that made by *Phacochœrus*, which is one of the few pigs in which the teeth become worn perfectly plane on the crowns, the surface of which is at right angles with the vertical axis of the tooth. That at *c* is the figure described by the tip of the mandible of the Tapir while feeding on hay and fresh grass, showing that the texture of the aliment makes no change upon the jaw movement. Fig. 4, *c*, may also be regarded as typical, with slight modification (a little oblique), of the kangaroos and phalangers; the molar teeth of which, also, strongly remind one in some respects of those of the tapir. At *d* a theoretical form is shown, so as to fill the gap between *c* and *e*, and which, no doubt, was exhibited at some stage of the transition from *c* to *e*, *Anchitherium* might be suggested as a probable case. That at *e* is the figure observed in many species of both ruminants and non-ruminating creatures. Several of the *Cervidæ* and the rhinoceros were observed to describe this kind of a figure, and from its prevalence amongst ruminating animals, which I had the opportunity to notice, I suspect that it is the commonest form. The figure at *f* is that described by the giraffe, camel, and ox, in which the extreme in respect to the degree of lateral excursion is also reached.

In respect to the movement of other groups, such as the rodents, for instance, the movements were made with such rapidity that it was with great difficulty that the form of the figure described by some fixed point at the end of the mandible could be seen plainly enough in the absence of a more perfect recording apparatus than the eye of the observer. Enough was made out, however, to show that the motions were often similar to those in the ungulates; this was especially observed in the rabbits and guinea pigs, where an alternate movement of the mandible was made first towards one side and then towards the other, as in the camels. In *Geomys*, *Arvicola*, *Fiber*, and numerous other rodents, the motion of the mandibles when in contact, is believed to be from before backwards, on account of the direction of the flexure of the molars, and the absence of cross-crests on their crowns. In the elephants, however, it seems to be from behind forwards, just the reverse of that noticed amongst some of the rodentia with the absence of cross-crests, as in most of the latter.

It was this absence of cross-crests in the rodentia, together with the isognathism of the modern elephants, and the presence of salient cross-crests, with a well-marked anisognathism in *Trilophodon*, *Tetralophodon*, *Stegodon*, and *Dinotherium*, that has led me to infer that the mandible was moved from side to side in these genera, just the reverse of what is the fact in the former.

Fig. 5.



a. Condyle and posterior portion of ramus of the mandible of Giraffe from above.
b. Same, external view.
c. Same, posterior view.
d. Same of wild cat, inferior view.
e. Wild-cat, side view.
f. Same of *Hydrochœrus* (water-hog), superior view.
g. Same as *f*, from the side.

As some points in relation to the condyle and mandibular articulation were discussed at the outset, I have thought it advisable to figure some of the most distinct forms of this part, as seen in widely separated groups. Fig. 5 represents the condyles of the mandibles of the giraffe, wild cat, and water hog. At *a*, *b*, and *c*, one of the condyles of the giraffe is seen from the above side and from the rear, respectively; it is seen to be greatly elongated transversely, and internally concave from side to side, perfectly flat upon the outer two-thirds of its articular face. We may associate this type of condyle with the kind of figure described by the movement of this creature's mandible in Fig. 4, *f*, or, we may state it as a principle, that, where the condyle is greatly elongated transversely and very flat, there is great lateral excursion, during mastication, with selenodont molars, and a great degree of anisognathism. It must not be forgotten, however, that the type of condyle found to exist where the lateral movement of the mandible is not so extensive, is also less flattened and not so much elongated transversely, as will be seen in the Tapir (see Fig. 4, *c*, for diagram of the movement). In the rhinoceros (Fig. 4, *e*) the condyle is also less modified on account of the lesser lateral movement.

In the cats the characteristic cylindroid condyle (Fig. 5, *d*), and the processes that partially clasp it anteriorly and posteriorly, are shown in Fig. 5, *e;* again enforcing the relation subsisting between condylar structure and jaw movement, Fig. 4, *a*. Here again, as in the previous case, the structure is modified, as we pass from the most specialized carnivorous group, cats, to the less specialized dogs and seals, where the anterior and posterior processes from the anterior and posterior boundaries of the glenoid cavity are less salient. The idea has suggested itself to me from seeing the different modes in which the two groups, cats and seals, feed, that the differences in the structure of the mandibular articulation may have something to do with the manner in which they tear their food into pieces small enough to swallow. The cats hold the prey with the fore-feet, the incisor and canine teeth are fastened upon some part, while the paws, with the aid of the retractile claws, hold the prey securely down; the head is then raised and thrown back, and in this way the tough ligaments, tendons, integuments, and muscles are torn apart into pieces sufficiently small to be further acted upon by the molars and swallowed. The seals, on the other hand, fasten the teeth upon their prey (if a fish, always head first), and with sudden lurches of the head and body sidewise, with surprising velocity, the fish is torn in two by means of the suddenness of the movement, the free end being thrown several feet away, which is, however, very soon recovered, and, if too large to swallow whole, is treated as before. Now in the first case the strain incident to pulling back the head by a number of powerful muscles, while the prey is held with the paws, must tend to pull the condyles of the jaw out of the glenoid cavities, which is prevented by the nature of the mandibular articulation. In the case of the seals the method involves no forward pull upon the jaws, but a principle in natural philosophy is taken advantage of, by which, with no more expenditure of force, the same end is attained as by the cat. The sudden lurches give the mass of the fish a great momentum, which is suddenly arrested, resulting in its breaking in two, when, with little chewing, the piece held by the teeth is swallowed, the throat seeming to be surprisingly dilatable. By what process a seal was ever capable of fathoming any principle of physics is more than I propose to explain, but such are the facts. It may be added that what holds in respect to habits of tearing the food in the cats, also holds in respect to the bears, weasel family, and raccoons, and in a less degree in the dogs and hyenas.

The condyle in the *Hydrochœrus* is exceedingly elongated, the antero-posterior diameter of the condyle proper exceeding twice its transverse diameter, which fits into a groove-like glenoid cavity, looking somewhat as though it had been cut out with a rabbet plane. The sides of the groove are vertical, and at right angles to the bottom; it is also longer than the condyle proper, which is not by any means neatly adapted to fit it as is usually the case. So marked is this artificial appearance that the first time I beheld it I made a careful examination to see if some one had not been carving it into what I thought was a fanciful shape, as a trick to deceive. When the reversed inclination of the teeth above and below is noticed, together with the insertion of the muscles, it is plain that the condyle has a reciprocating motion in this groove (glenoid cavity), which goes a great way in explanation of the shapes of the teeth of certain aberrant groups of rodents. Indeed I am satisfied, from the manner in which certain rodents feed, and the way in which their scalpriform incisors are inserted with the direction of their curve, that no other arrangement would answer, since the jaw could not be sufficiently retracted, as in the case of the beaver, to take between his incisors the great breadth of chip which he is able to cut at one bite.[1] I have measured single tooth marks of this animal in wood $1\frac{3}{8}$ in. long.

Relation of the Lateral Excursion of the Mandible to Anisognathism.—As I have previously remarked that anisognathism was an invariable accompaniment of lateral movement, it now remains to substantiate this assertion by the following table. Bunodonts, which stand first, may be set down as unmodified, while sym-

[1] See Morgan, "The American Beaver and his Works," Lippincott & Co., Phila., 1868, p. 176.

borodonts, selenodonts, and tapirodonts, may be regarded as representing the extremes of dental metamorphosis due to the persistent action of the forces exerted in mastication by these latter, and which have been operative since the appearance of the herbivora, the time of which I do not propose to indicate even approximately.

	Upper molar series.		Lower molar series.	
	Anterior.	Posterior.	Anterior.	Posterior.
BUNODONTS.[1]	mm.	mm.	mm.	mm.
Hippopotamus amphibius	.16	.101	.15	.107
Chœropsis liberiensis	.078	.07	.74	.069
Babirussa alfurus	.059	.04	.052	.039
Sus indicus	.068	.043	.068	.049
Dicotyles torquatus	.049	.043	.049	.038
Phaehœrus æthiopicus . . .	.069	.055	.065	.047
SELENODONTS.				
Titanotherium prouti . . .	.253	.117		
Helladotherium duvernoyi . .	.206	.104		
Anthracotherium magnum . .	.08	.034	.056	.034
Sivatherium giganteum . . .	.219	.139		
Equus caballus	.127	.085	.095	.062
Gazella euchore	.062	.031	.039	.024
Connochætes gnu	.089	.047	.059	.041
Alcelaphus eaama	.081	.052		
Capra hircus	.06	.035	.037	.028
Ovis montana ♂	.072	.045		
Ovis aries	.069	.044	.049	.031
Cariacus columbianus	.068	.045	.049	.033
Cervulus sp.	.059	.038	.046	.03
Alce malchis ♂	.137	.088	.103	.058
Antilocapra americana	.072	.049	.052	.034
Rangifer tarandus	.091	.069		
Cervus canadensis	.115	.075	.085	.058
Camelus dromedarius	.112	.052	.095	.042
Auchenia glaama	.073	.031	.05	.028
Camelopardalis giraffa . . .	.123	.077	.089	.047
Bos taurus	.137	.103	.099	.077
Oreodon major	.081	.047		
Rhinoceros indicus	.158	.09	.124	.081
TAPIRODONT.				
Tapirus americanus	.096	.055	.087	.05

[1] The measurements were made from the external borders of the crowns of the molars of one side to the external borders of the crowns of those of the other side, at the anterior and posterior ends of both the upper and lower series.

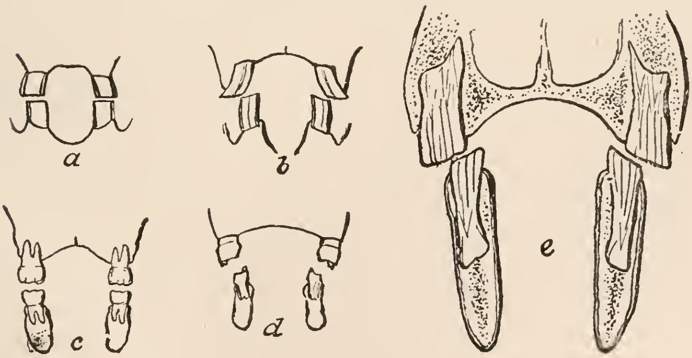
	Upper molar series.		Lower molar series.	
	Anterior.	Posterior.	Anterior.	Posterior.
TRICHECODONTS.	mm.	mm.	mm.	mm.
Manatee australis	.037	.039	.034	.03
Halmaturus dorsalis	.033	.022	.028	.02
Petrogale penicillatus	.028	.018	.023	.018
Phalangista vulpina	.025	.022	.022	.017
Hypsiprymnus cuniculus	.02	.015	.017	.012
RODENTIA.				
Sciurus, sp.	.014	.012	.013	.01
Spermophilus, sp.	.0135	.011	.012	.011
Cynomys ludovicianus	.021	.019	.018	.016
Arctomys monax	.027	.0225	.026	.023
Tamias, sp.	.008	.007	.007	.006
Hydrochœrus capybara	.055	.024	.057	.033
Castor fiber	.032	.024	.027	.019
Geomys bursarius	.01	.0015	.0105	.009
Mus rattus	.008	.0075	.009	.008
Neotoma	.01	.009	.01	.009
Sigmodon hispidus	.0085	.007	.008	.007
Fiber zibethicus	.013	.013	.013	.013
Hystrix cristata	.027	.026	.026	.024
Lepus cuniculus	.023	.021	.018	.015
Cœlogenys paca	.027	.026	.026	.023
Lagostomus trichodactylus	.027	.022	.029	.015
Dasyprocta, sp.	.022	.022	.018	.016

I append a series of similar measurements of primates, to further enforce the idea that selenodont cusps are an accompaniment of anisognathism and lateral movement. The anisognathous extreme is put first in *Aluatta*, or howling monkey, as an example; the isognathous last, as in man.

	Upper molar series.		Lower molar series.	
	Anterior.	Posterior.	Anterior.	Posterior.
	mm.	mm.	mm.	mm.
Aluatta, ♂	.043	.03	.039	.025
Cynopithecus, ♂	.046	.041	.042	.036
Gorilla, ♀	.055	.054	.048	.048
Chimpanzee	.064	.06	.055	.051
Australian, 1327. ♂, Port Philip, New South Wales	.067	.06	.067	.048

At Fig. 6, diagrammatic, transverse sections through the jaws of several genera of mammals are shown: *a*, shows the isognathous arrangement in *Fiber zibethicus; b*, the anisognathous arrangement in *Lepus cuniculus.* These two show the extremes in rodents; in the first, the teeth of both sides are perfectly parallel; in the latter, neither are they parallel, nor are the series of molars in opposite sides of the upper and lower jaws separated by the same interval. *Fiber*, in some respects, calls to mind the dentition of bunodonts, while *Lepus* reminds one of the selenodont system. The differences are here to be regarded as arising, in a large measure, from the strains incident to mastication, as the contact of the upper and lower molar teeth of *Lepus* always takes place first upon the outer portion of the crown of lower ones, and the inner portion of the crown of the upper ones; and after contact the movement of the jaw is from within outwards, causing the upper molars to be pressed outwards, and the lower molars inwards, eventually causing the upper series to recede from each other, and the lower series to approach each other, probably carrying the rami along in the changes. Nor does the change stop here. The molars are apparently curved outwards above and inwards below from the same cause.

Fig. 6.



Cross-sections through the maxillary apparatus of: — a. *Fiber.* b. *Lepus.* c. *Dicotyles.* d. *Cervus.* e. *Equus.*

The movement in *Fiber* is totally different, though at times there are indications of lateral movement. It seems to be from before backwards, or a reciprocating movement.

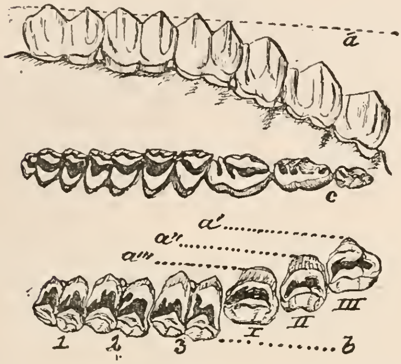
In Fig. 6, *c*, we have a diagram of a transverse section of the jaws of *Dicotyles*, where, as in *Fiber*, the series are nearly parallel in both jaws, and nearly exactly isognathous; the jaws open and close without a particle of lateral motion. The food, in such a case, is pounded as in a mortar, with a chopping motion of the jaws. The anisognathous arrangement is represented in Fig. 6, *d*, of *Cervus*, and *e* that of the horse; both have extensive lateral motion, with corresponding anisognathism; the teeth are also, to some extent, inclined outwards above, and inwards below, as observed in regard to the dentition of *Lepus*. The method of trituration is also very different from *Dicotyles*. It is here ground as in a mill, the reversed enamel patterns of the opposing molar series simulating most closely some of the mechanical devices used by man as grinding mills. The lower jaw, with its molars, however, represents the millstone, and the upper the "bedstone" or surface upon which it acts with the glenoid cavity as the point from which its oscillations are propagated.

From the preceding tables of measurements the work of constructing a series showing the relation of mandibular movement to anisognathism would be an easy task; the movements would in every case have to be observed, and in all cases where I have been enabled to do so I have found this relation to subsist. We are met, however, by a most anomalous type of anisognathism amongst the cavys, especially in *Cœlogenys paca*, where the interval between the molars of opposite sides is greater for the lower series than for the upper. The molars are, however, extensively curved outwards above and inwards below. Indeed, the degree of this curvature is more extensive in the molars of this animal than in those of any other mammal with which I am familiar. What the original relative position of these teeth may have been in their ancestry I do not know; but it is plain that, if this curvature had not taken place, the process of mastication could not be accomplished at all, since, if the teeth were straight, they could scarcely be brought into adequate contact by even the most extensive lateral mandibular movement with which we are acquainted. It seems to me to be a fair inference that they were isognathous, as most of the earlier forms seem to have been, and that some cause—most probably the strains incident to mastication—has been operative in inducing the change to the present form.

There is evidence in the enamel foldings to show that the same kind of strains were operative here as elsewhere.

A matter which has considerable interest in this connection, is what I have ventured to call *displacement due to strains.* The evidence is met with all through the anisognathous artiodactyla and periosodactyla. The relative position of the molars and premolars in *Cervus* is shown in Fig. 7, *a;* the molars, 1, 2, 3, are directly behind each other; they seem to have been shoved from the line a' through a'' and a''' until their outer borders have reached the line b; the premolars, I., II., III., have meanwhile been left with their inner faces touching respectively the lines a', a'', a'''. The outer faces of the premolars are parallel to the line b, as though the displacing force had acted equally upon the anterior and posterior portions upon the inner side. This displacement is uniformly the greatest in the later forms, most anisognathous, and with greatest lateral excursion of the mandible. In the molars of the mandible, c, no such displacement occurs as noticed in the upper molars; the reason seems to be that the lower teeth, confined as they are to the narrow ramus, cannot undergo such displacement. The force of the mandible always acting to push the upper teeth outwards, since they always first come into contact upon the inner border of the crowns of the upper molars and the outer of the lower ones, would also react powerfully, during mastication, upon the lower molars, tending to push them inwards, and approximate the series (rami) of opposite sides. The molar series of the mandible of the giraffe are, as a whole, slightly convex internally; the reverse of the upper series, which is convex externally. The reversal of this convexity is in keeping with every other character. The displacement seems to be greatest where the masticatory muscles

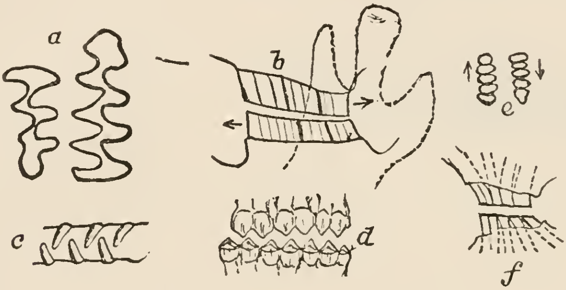
Fig. 7.



Upper figure, external view of upper molars of *Cervus*. Middle figure, lower molar series of right side of same, not displaced, and lower figure, left upper molars of same, greatly displaced.

can act with the greatest force—that is, nearest the articulation of the mandible with the skull. Amongst rodents having a reciprocating motion of the mandible this displacement of one part of the series, while others remain undisturbed, is not very great where only the backward and forward reciprocating movement is present, but sometimes lateral movements are also executed which causes displacement in two directions in both upper and lower molar series. Usually the changes could not be called displacement, but rather a bending or deflection of the teeth in two directions, either backward and outward, or forward and inward. The first condition is usually found in the upper molars, and the second in the mandibular molars of rodents.

Fig. 8.



a. A last upper and a first lower molar *Arvicola.* *b.* Diagram of molars of *Fiber*, showing plane triturating surface of molars. *c.* Undifferentiated haplodont teeth of *Delphinus.* *d.* Diagram of an opposing series of one side of *Cervus*, showing the mode of intercalation of cross-crests. *e.* Upper and lower molar series of *Geomys*, showing the first upper and last lower molars more compressed. *f.* Side view of dentition of *Geomys*, showing the implantation and opposite inclination of opposing series.

The obliteration of the transverse crests of the teeth of rodents with reciprocating motion of the mandible is shown in Fig. 8, *b* (*Fiber*); also the opposite inclinations of the upper and lower molars, apparently due to the reciprocating movement and the strain incident to the teeth in the execution of such movement during mastication. The same opposite inclination is observed in the molars of *Geomys* at *f*, but more pronounced. The greater flattening of the columnar molars, anteriorly in the upper series, and posteriorly of the lower series at *e* and *f*, is due apparently to the same cause. At *d*, Fig. 6, the molars of *Cervus* are shown with their deep transverse valleys and cross-crests, showing the persistence of this arrangement where the mandibular movement is entirely lateral. At *c* the alternating, interlocking, haplodont teeth of *Delphinus* are shown almost entirely prehensile, not having attained the specialization of molars. The recent proboscidians, with their numerous transverse enamel plates, are simply the more compressed, transverse crests of *Trilophodon* and *Tetralophodon* in greater numbers. The crests, in a young state of the teeth, are present, but are afterwards worn off to a common level from the movement of the mandible from behind forwards.

The curious analogy of the method in which the succession and wear of the molars and cross-crests takes place in ungulates and proboscidians is worth noticing; in the former, the first and most anterior true molar is most worn; in the latter, the anterior cross-crests in both mastodons and elephants are the first to be worn, the heel or posterior part of the tooth remaining frequently totally unused. The succession of molars, vertical and horizontal, secures the same results in both. The first true molar of ruminants is the first to be protruded; its anterior pair of cusps, as well as those of its fellows behind, are most worn and longest, so that a mere increase in the number of transverse pairs of cusps heterochronously protruded, would give us practically the same result as the horizontally succeeding molars of proboscidians.

I cannot dismiss this subject without a reference to the skull of an Australian in the Morton collection of the Academy of Natural Sciences of Philadelphia, No. 1327, with 35 teeth, 34 of which are normally arranged, there being a supernumerary molar on each side above. If these had been repeated in the mandible, the dentition would have been as low as that of the South American monkeys. As it is, it is lower than the gorilla and chimpanzee in this respect, and shows the tendency of even primates to revert towards the primitive formula of 44 teeth prevalent in eocene times.[1] The jaws are massive, with a most pronounced pithecoid squareness in front, its prognathism being in marked contrast with the beautiful orthognathous skull of the European. The point, however, which has a practical bearing, is the fine state of the teeth and their massiveness as compared with the teeth of the

[1] In a skull of *Ateles geoffroyi* from South America, I have observed that there were ten teeth in the upper left-hand maxillaries, a number which, if it had been repeated all round, would have given forty teeth as the formula, which is within four of the archetypal forty-four. Lemurs have the thirty-six, in common with the lower South American monkeys.

higher races. The incisors are fully twice the mass of those of the present man, and the molars show an almost equally great development. In explanation of this we have not far to look. We are informed by various authorities[1] that these people were totally ignorant of boiling, but that everything was roasted, or even eaten raw, which involved more work for the teeth than falls to their lot now-a-days, and which must powerfully react upon their development. If, as we believe, and as the facts warrant us in believing, that the dental armature becomes more massive as strains become more frequent and severe through the passage and survival of herbivorous types from eocene to modern times, it is almost equally certain that, in the event of the introduction of cookery, with its constantly increasing refinements, there must be a diminished amount of strain upon the teeth, tending to cause atrophy or degeneration.

Cusp-Shaping Forces.—We now come to the consideration of the way in which the cusps of the teeth have been modified by the various mandibular movements, culminating in the crescentoid form and its modifications. We have assumed, as we have had evidence for doing, that many of the parts associated in the function of mastication were greatly modified and brought to their present shape by mechanical resistances incident to the performances of such function, our next purpose will be to show that a similar process has been silently and powerfully at work in the shaping of the cusps. I am aware that some of the points taken might be called anatomical platitudes, but I believe also that these same have never yielded the meaning they were capable of yielding, except to one who would coordinate the peculiarities of structure in special cases with their correlative influence upon habit. But in order to induce changes in the mechanical arrangements of the active and passive elements of organic structures some change in a creature's surroundings must take place over which it has no control. Such changes may be specified as meteorological, climatic, floral, faunal, geologic, and telluric. It is scarcely worth while to point out the antagonistic relations which life sustains

[1] Herbert Spencer, Sociological Tables, Pt. I. A., Tab. IV.; and, bearing more or less directly upon this point, see Dr. E. Lambert's paper on the Morphology of the Dentary System in the Human Races, in Bull. l'Acad. Royale de Belgique, 46e Année, No. 5, 1877; Abstr. in Am. Journ. Science, vol. xiv. 1877, p. 323.

to its surroundings since geology and palæontology afford such abundant evidence of the constant struggles on the part of life to cope with the altered conditions. To all acquainted with the leading facts of geographical distribution of animals and plants it is well known that some of the most intimate relations exist between flora and fauna, fauna and fauna, flora and fauna and climate, how that elevation due to geologic changes affects climate, and how that telluric changes (orbital), preponderating over all else, should modify all the others, as Prof. Croll[1] would have us believe.

I believe that the changes in these great elements of surrounding conditions may have been adequate to produce either the annihilation or the divergence and survival of organic types. Those creatures which were not in harmony no doubt were often destroyed in affecting the readjustment, because in some the adjustments could not be brought about quickly enough to prevent the fatal waste of efforts in overcoming greatly unbalanced relations. Those that overcame this readjustment survived with modifications. Then, again, there may have been no sudden modifications, but slow changes to which organisms could readily adapt themselves; and, again, there is no telling how much intelligence may have had to do in the struggle, yet there is very little that can be predicated in respect to this by brain-bulk, because if such instances as the beaver, the bee, and the ant are cited, it is at once seen that, even supposing the bulk of brains to augment as recent times are approached, it is not altogether safe to lay too much stress upon brain-mass as an index of intelligence.

The divergence of the educabilian orders of mammalian vertebrates from a forty-four toothed bunodont type with five toes is held by the most eminent authorities. The prevalence of these two characters in eocene mammalia with their gradual disappearance through later forms is one of the strongest arguments in favor of the theory of descent. The gradual increase in the length of the diastemata between molars and incisors from none at all in many eocene forms to the immense interval between the two in such forms as the horse and giraffe is the first point. Another is the prevalent departure from primeval pentadactylism towards monodactylism, or its equivalent, by the fusion of one or more

[1] Climate and Time, Jas. Croll. London, 1875.

parts into a single one, as, for example, the horse and artiodactyl ruminants. The tendency to monodactylism, it is believed, is due to the strains incident to locomotion affecting the growth and nutrition of these parts. It would, therefore, seem that, considering the weight of opinion upon the origin of diastemata and monodactylism, that the teeth should likewise, as characters of secondary morphic and systematic value, and so admirably conditioned for great modification, manifest very sensibly the influence of such conditioning forces.

If environments affect choice of food, etc., it must follow, as a necessary consequence, that different methods of prehension and comminution must be employed in different animals to correspond with the nature of the food, which would effect corresponding dental differentiations. These, in turn, make further differentiations, which are successively fixed by the law of heredity, less difficult in succeeding generations, until extremes are reached. This is just what we have tried to show in the two extreme types of mandibular movement, vertical and lateral, and that the former passes gradually into the other just as it can be shown that the bunodont type of tooth gradually passes into the selenodont. Two or three stages of cusp modification are sometimes observed in the same tooth, while as many as six or eight or more tooth modifications may be counted in the teeth of the whole series.

Odontomorphic Centres.—While making measurements of the skulls in the collection of the Academy some curious facts were elicited. It was observed, that, if a pair of dividers were taken, placing one point on the glenoid cavity of the skull or condyle of the mandible, the curvature of the cross-crests and intervening valleys of the molars of the same side would exactly coincide with that produced by a sweep of the free point of the dividers across them. The same rule was found to hold good in regard to the other side of the skull. We were not long, however, in finding that this rule was not universal among selenodonts; that there were some in which such a coincidence could not be obtained by the method described. It was then observed in these other cases that, if one leg of the dividers was placed on the posterior end of the basi-sphenoid bone, opposite to and midway between the glenoid cavities, for the superior molar series, and midway between the condyles for the mandibular molars, the arc described by the point of the free leg would now coincide in the curvature with the cross-crests and bottoms of the valleys of the molars of both sides when produced across their crowns.

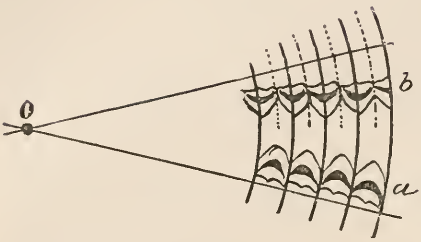
It is proposed for convenience to designate the teeth, the cross-crests of which coincide in curvature with arcs described respectively from the right and left glenoid cavities as centres, for the molars of these sides respectively, as *biaxial;* and those where the centre of this coincident arc is medial on the basi-sphenoid bone, or midway betwixt the condyle, as *uniaxial.* The centres may be named odontomorphic, or tooth shaping, since they are the fulcra which control the forces which slowly modify the shapes of the teeth and their component tubercles. The biaxial molar is by far the commonest. I have observed it in the following orders: Edentata, Sirenians, Proboscidians, Rodents, Perissodactyles, Artiodactyles, Hyracoidea, and Marsupials. The following is a list of some of the observed genera of both classes:—

Biaxial.	*Uniaxial.*
Ovis.	
Alce.	Tragulus.
Cervus.	Hyomoschus.
Antilocapra.	Moschus.
Alcelaphus.	Amphitragulus.
Antilope.	Leptomeryx.
Gazella.	
Auchenia.	
Camelus.	
Sivatherium.	
Bos.	
Titanotherium.	
Equus.	
Tapirus.	
Phalangista.	
Phascolomys.	
Trilophodon.	
Nototherium.	
Megatherium.	
Hyrax.	
Dasyprocta.	

It will be observed that the *Tragulidæ* monopolize the uniaxial plan, though *Cervus columbianus* is very nearly uniaxial.

In Fig. 9, representing diagrammatically the mechanism of mastication in selenodonts, the curvilinear path of the excursion of the mandibular series of molars, as well as the reversal of the selenoid

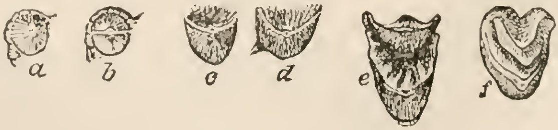
Fig. 9.



Ideal diagram, showing the mode in which the lower molar series, *a*, sweeps over the upper series, *b*. The movement being constantly regulated from the mandibular articulation, or odontomorphic centre, O.

cusps of the upper and lower series respectively with the ideal odontomorphic centre, O, in the mandibular articulation, the gist of the whole matter of tooth modification becomes plain. It is observed that opposite those parts which have the greatest transverse diameter, or which are strongest of the opposing series, *b*, impinge upon their fellows, *a*, of the opposite series at the weakest points, or those parts having the least transverse diameter, and *vice versa*. It looks as though the strains incident to mastication has pressed the sides of the cusps of the teeth flat, and curved their cornu outwards in the upper series, and inwards in the lower, by the oft-repeated excursion in one direction. The action of the parts in life appears to be constant, that is, the molars of the mandibles of the right side always moving outwards when crushing the food, and the same of the side opposite. The movements are often, for many minutes in succession, made in the same direction, then in the other. It is found, upon careful observation, that the animal chews upon one side at a time, changing to the other apparently for the purpose of resting. This also accords with the observations of physiologists, that the salivary glands of opposite sides in ruminants and other herbivora perform their function alternately with greater vigor, depending for their periods of activity and repose upon the alternate use and disuse of the teeth of the corresponding side in mastication.

Fig. 10.



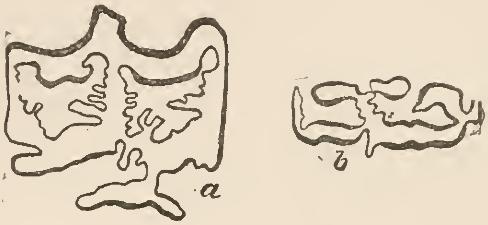
A series of tubercles are sketched in Fig. 10, showing the gradual transition from the unmodified bunodont, *a*, to the extreme selenodont, *e* and *f*. The cusp, *a*, is the type observed in the early Miocene genus *Entelodon*, or in *Pliolophus* of the Eocene; *b*, an external cusp of an upper molar of *Leptochœrus*; *d*, an external cusp of an early ruminant (*Oreodon*); *e*, outer and inner anterior cusps of a young *Cervus*, shortly before protrusion from the alveolus; and *f*, a premolar of *Coryphodon*. A host of additional examples might be given to enforce the idea meant to be conveyed, but which would simply be repeating with another series of species what has already been indicated, and which can be fully confirmed by reference to works of Leidy, Kowalewsky, and Cope on Tertiary mammalia.

I am aware that *Coryphodon* is an early form, occurring in the Eocene formation, and is perhaps not as well chosen a case to illustrate the modern extreme as might have been selected. This is, however, a superficial objection, since the crowns are very short, with the short roots characteristic of the mammalia of early periods. It seems to be simply a case in which the modifications took place with greater rapidity than in later species. If the whole order of ungulates did not concur in the evidence which they yield, an objection might be raised, but in all of them the reverse direction of the cornu of the cusps of opposing series is the same; in all the mandibular movement is either lateral, or becoming so; almost every family of them shows a progressive intensification of these characters, and it would seem that no further evidence were needed to show that *the necessary actions of an animal modify most profoundly the form of even the very hardest of its tissues.*

It is proposed to close the discussion with the consideration of a few special cases of the various methods of cusp-blending, wear, and flexure. In all the selenodont mammals the flexure of the cornu of the inner cusps and their lengthening in the upper molars and the outer below is greatest, evidently due to the fact that the strains incident to mastication are more powerfully exerted upon these, and less powerfully upon their fellows on the opposite side of the tooth. The deep flexure of the enamel layer, vertically and medially on the inner side of the upper molars and the outer of the lower ones, is another fact to be noted in many instances as due to the same causes. The jutting outwards of the cornu of the external cusps of the upper molars, and inwards of the internal ones in the lower series, is another fact capable of a similar explanation.

I apprehend that the plicate enamel layers in the dentition of the horse, of *Sivatherium*, and to some extent in the ox and deer, may be accounted for in the same way; for in these the plication is most marked at such points as are manifestly, according to our theory, subject to the severest strains. In Fig. 11, *a*, the enamel

Fig. 11.



pattern of the upper molar of *Equus excelsus*, and *b*, the enamel pattern of an undetermined species of horse (both from Leidy), show this plication of the anterior and posterior transverse enamel walls of the islands in a marked degree. The plication is greatest in a line parallel with the direction of the strains exerted during mastication. Another circumstance is the greater inclination of the inner cusp of the upper molars outwards, and of the outer ones below inwards, which is so common amongst selenodont ungulates, that I think it is almost without exception. The great width also of the posterior molars in selenodont mammals may be accounted for in a great measure by supposing molar force as adequate cause of such increased transverse diameter. This view is supported in a measure by the relatively equal transverse diameter of the molars at both ends of the series in bunodont, isognathous mammals. There seems to have been a phylogenetic metamorphosis of molars and premolars, which proceeded with greatest rapidity nearest the mandibular articulation, where the modifying forces were also applied with the greatest mechanical effect. The mandibular masticatory apparatus of mammals may be regarded as levers of the third class, in which the glenoid cavity is the fulcrum, the muscular force exerted by the masticatory muscles the power, and the resistance of the food to the teeth in crushing it the weight. Since the coefficient of muscular force is 104 pounds per square inch of transverse section,[1] it is easy to surmise what would be the tendency of the exertion of the force of many square inches in section of masticatory muscle upon the jaws and teeth in mastication. It would manifestly not be consumed in the mere comminution of the food, but it must also react upon the structures which were directly subjected to the resulting strains, viz., the teeth. In a mammal as large as the rhinoceros the area occupied by the mandibular teeth is about 5 square inches, while the maxillary teeth occupy about 10 square inches, as I have roughly estimated from a skull nearly adult; the ratio then of the triturating surfaces of the upper and lower series is about as one is to two. These ratios increase apparently as anisognathism increases, and conversely become equal as isognathism prevails; that is, we may select a perisodactyl, such as the rhinoceros, or an artiodactyl, such as *Bos*, to represent one extreme, and the universal pig as the other.

It will be observed that I have made no attempts at constructing phylogenetic tables, a favorite pursuit with some recent naturalists; this is because I am not satisfied in regard to the value of characters as indicating affinities. I appreciate these most thoroughly, but believe that modifications may be greatly accelerated or retarded by alterations in surroundings over which a modifiable organism has no control, so that the differential effects (generic and specific characters of systematists), produced in a given time, may differ greatly in value—their true value being estimated in terms of force—some requiring but half as much time for their production as others. The possible morphological effects of like mechanical conditions are illustrated in turtles and glyptodons, where the rigid exoskeleton has caused the originally segmented axial skeleton to show a strong tendency to revert to the primitive homogeneous condition without losing its osseous character. The exoskeleton has in fact partially assumed the part taken by the chitinous envelope in the organization of the *Articulata*. We may regard the relations here pointed out as the complementary principle demonstrating Spencer's theory of the segmentation of the vertebral axis,[2] because it must be allowed that opposite conditions must produce opposite effects.

[1] Animal Mechanics, Dr. Saml. Haughton. London, 1873, p. 71; The Principle of Least Action in Nature (Three Lectures), London, 1871, p. 10.
[2] Principles of Biology, New York, 1867.

Appendix on the Atrophy and Hypertrophy of Incisors.—Without stopping to consider the archetypal or normal forms, the principal groups which manifest the extremes of modification of the incisive elements may be tabulated as follows :—

Rodentia. Tæniodonta.	Hypertrophied incisors with special functions.
Proboscidea.	Greatly hypertrophied, becoming weapons of offence and defence ; function assumed by a proboscis.
Dinocerati. Rhinocerotidæ.	More or less atrophied ; function assumed by the lips, or a short proboscis.
Ruminantia.	Upper incisors absent ; function partially assumed by the tongue and muscles of the neck.
Edentata.	No incisors ; function partially or entirely assumed by the tongue.

As is now believed,[1] the great specialization of the median incisors of rodents is due to the severe work to which they are persistently applied during the phylogeny of the group, but the extreme of hypertrophy is reached in the *Proboscidea*, where it has been so extensive as to render the teeth useless in the performance of their primary function, which has been exchanged for a new one, viz., a defensive function, while the primary one has been assumed by the greatly developed proboscis used both as a drinking horn and as a hand to grasp and wrench vegetable aliment from its attachment and convey it to the mouth. A fact which points to the conclusion that the tusks of the elephant were once functional incisors is the presence of more or less rudimentary bands of enamel on the tusks of several fossil species, apparently the remains of what once were functional parts of these teeth. The difference in shape of the nasal opening, and indeed of the whole anterior portion of the skull of *Dinotherium* and the same parts in the Elephants and Mastodons, renders it very certain that there was a wide difference between the two in the shape, and perhaps also in the length of proboscis. But such differences alone will not account for the evolution of the long prehensile proboscis, nor is the shortness of the neck (cervical portion of the vertebral column), and the accompanying elevation of the mouth from the level of the ground, any help, because these are both effects depending for their origin upon the initiation of the development of such a proboscis. It is, therefore, necessary that we

[1] Tome's Dental Anatomy, Philada., 1876, p. 250.

look in the direction of some earlier and more generalized form as a starting-point from which it is possible to derive the organ so characteristic of Proboscidians. In this position I find I am in accord with Prof. Cope, who has stated his views upon this matter more or less distinctly at several places in his extensive writings.[1] My reasons, based wholly on teleological evidence, for not believing the *Dinocerata* to be in the direct ancestral line which culminated in the elephants, is the presence in the former of a variable number of pairs of horns, and in *Dinoceras* the great pair of upper laniary teeth are written down as canines by Profs. Leidy, Cope, and Marsh, which, with the absence of upper incisors, gives us no probable beginnings that may be regarded as homologous with the tusks of *Elephas*. However, the tusks of *Proboscidea*, as now known from fossil forms, have been extensively modified in size, situation, and direction of curvature. We may state the modifications as to implantation of the tusks (incisors) in the various forms, thus:—

Dinotherium, I. $\frac{0-0}{1-1}$

Mastodon Angustideus,
M. longirostris,
M. productus, etc. } I. $\frac{1-1}{1-1}$

Elephas, sp. I. $\frac{1-1}{0-0}$

From the tenor of the foregoing facts, I am led to conclude that, with the disappearance of the primary functions of the incisors in Proboscidians, and their assumption of a secondary defensive one, the proboscis was gradually developed, while the mouth, as it became more elevated from the level of the ground by the shortening of the neck and the assumption of the long, gravigradous pillar-like limbs, were assisting factors in the process. Whatever was the cause of the incisors becoming weapons of defence was the cause of the initiation of a process of development of the external nasal organ, resulting in its present structure and importance. There was probably no organ so directly available as what was then a rudimentary proboscis, seeing that all other parts (limbs), probably by reason of the animal's bulk, must sub-

[1] U. S. Geolog. Surv. Terr., 6th Annual Report, Washington, 1873, p. 647; U. S. Geograph. Surv. W. of the 100th Meridian, vol. iv. 1877, p. 282.

serve purposes of locomotion. Further, after once having reached that stage which made the incisors available as weapons, we can understand how the violent uses to which these parts were and are put only served to carry the hypertrophy still further.

The *Dinocerata* and *Rhinocerotidæ* present a case where the partial assumption of the incisive function by a very flexible and powerful lip has reacted upon the development of the incisors, causing them to become rudimentary. I infer from the rather elevated and thickened nasal bones of the *Dinocerata* that these creatures had a long protrusible upper lip, if not a short proboscis, and the observed correlation between such osteological conformation and protrusible lip in living forms is still further evidence; so is the fact that, in a form (*Palæosyops*) allied to the genus *Titanotherium*, the nasals are strongly produced as in the Tapir, to which it is also allied. I think it improbable that *Dinocerus* possessed a prehensile tongue, a view contradicted by the relatively immobile upper lip, with two or three exceptions, of the *ruminantia*, that are similarly without upper incisors. The horse with his prehensile upper lip has not been considered, but we find, upon observation, that the power he exerts with it is very feeble, and acts rather as a collecting apparatus for the purpose of bringing herbage within reach of his incisors, the most complex, with one exception, in the whole mammalian sub-kingdom. The proboscis of the Tapir is likewise only a grasping instrument, and seems to be used solely for the purpose of fetching its aliment within reach of the incisors, which are well developed. It may also be observed that the earlier and more unspecialized forms of hornless rhinoceroses had narrower nasal bones with the incisors more fully developed, with probably less effective grasping lips, similar to the horse.

In the ruminants the absence of the upper incisors seems to me to be correlated with the prehensile tongue, the lower incisors acting as a knife edge, while a bunch of herbage is held fast by bringing the premaxillary pad above down upon it so as to bind it firmly against the lower incisors, when it is readily severed from its attachment by tossing the head forwards and upwards.

The *Bruta* or *Edentata* are by far the most remarkable group illustrating the interdependence of incisors and a prehensile apparatus, which, in this case, seems invariably to be the tongue. In the edentulous ant-eaters of both continents all the teeth are aborted. A bird-like character is assumed in one instance (*Myremecophaga*), in which the pyloric end of the stomach becomes gizzard-like, small pebbles being found within. The extinct and recent sloths, as well as armadillos, have long prehensile tongues, which, it is believed explains their want of incisors. Brehm says (*Thierleben*) the tongue of the living sloth is used like a hand, and Owen thinks the tongue of *Megatherium* was prehensile. From what I have seen of living armadillos I have reason to believe that the *Hoplophoridæ* were similarly possessed of prehensile tongues. The well-developed hyoids of this group, as Prof. Burmeister[1] has represented them, would also favor this view. It may be objected to our explanation that no fossil *Edentata* have been found *with* incisors, which should be the case if our theory is the correct one; to this we may reply that so far no *Edentata* have been described from South America older than early pliocene, so that we may look with some degree of confidence for the future discovery of forms with the required incisors or their rudiments from the eocene or miocene of that great continent. A group so sharply defined as the *Edentata* will then have shared the fate of some of the others which were considered as isolated, with irreconcilable chasms intervening, until, thanks to the labors of American palæontologists, such have been in a large measure filled up. That the want of incisors in existing edentates is no proof of their absence in the forms from which they were derived, receives some support from the fact that rudimentary teeth have been found in the embryos of toothless whales, and also, as should be expected in embryo, *Trionychidæ*, a low group of the *Testudinata*, if, as has been held, these latter are remotely allied to the toothed crocodilians.

The following summary of the views arrived at in the foregoing pages is offered:—

1. That the earliest and simplest type of mammalian jaw-movement was that in which the mouth was simply opened and closed, without mandibular excursion, and coexistent with the simple haplodont or bunodont molar.

2. That the development of the various kinds of excursive mandibular movement has apparently been progressive.

[1] Anales del Museo Publico. Buenos Ayres, 1866–73.

3. That as the excursive movements have increased in complexity there has been an apparent increase in the complexity of the enamel foldings, ridges, and crests.

4. From the fact that the foldings, etc., have apparently been modified in conformity to the ways in which the force used in mastication was exerted, it is concluded that the various modes of crest and tubercular modification are related as effects to the diverse modes of mandibular movement.

5. It is apparent from the facts presented throughout the context that the mandibular articulations, and correlatively the whole skull, have probably been modified in shape by the movements made by the jaws and the forces exerted in executing them.

6. From the fact that incisor teeth are partially or entirely absent or relegated to another function in forms which have long prehensile tongues, mobile, prehensile lips or proboscides, it is held to be probable that such disappearance of the incisive dental elements is due to the assumption of their function by the prehensile organs indicated.

ON THE ASSOCIATION OF GROSSULARITE, ZOISITE, HEULANDITE, AND LEIDYITE—A NEW SPECIES.

BY PROFESSOR GEORGE A. KÖNIG.

On Crum Creek, just above Chester, Delaware County, Pennsylvania, the gneiss formation has been kept opened for many years by the quarries of Messrs. Deshong. The gneiss shows here a granitoid structure, with just enough of mica to produce a very straight fracture, combining thus the toughness of granite with the easier workability of the gneiss. The stratification strikes nearly north and south, while the dip is almost vertical. Seams of coarse-grained granite are frequent in the granitoid gneiss, carrying, occasionally, crystals of Orthoclose, black Tourmaline, and Beryl of unusual size and beauty. In the eastern part of the quarry, the structure of the gneiss is schistose, in fact, the rock is more properly called mica schist, the feldspathic element receding considerably. This rock is interstratified with seams of gray quartz, and in blasting one of these seams recently, near the foot of the cliff, which is here about forty feet high, Mr. A. O. Deshong observed minerals, the like of which the quarry had never produced before. I am much indebted to Mr. Deshong's liberality, who placed this entire material in my hands. Through the falling of top rock the spot is now covered; but it will be reopened in the spring, and more materials of interest may be expected by mineralogists. Some of the specimens have a very pleasing appearance through the contrast of the green, brownish-yellow, and rose color of the associated minerals.

1. *Grossularite.* *a. Yellow Variety.*—In well-defined crystals, some two centimetres and more in diameter. Form chiefly the rhombic dodecahedron, ∞ O in combination with 2O2. One crystal entirely embedded in quartz is elongated, and easily mistaken for a tetragonal form. Mostly granular massive. Color from brownish- to amber-yellow. Lustre vitreous; fatty on the fracture. Transparent. $H=6$. Spec. gr. $=3.637$ at 20° C.

Chemical Characters.—The mineral fuses at 3 to a brownish or slightly greenish glass. With soda and borax in O.Fl manganese reaction. Not acted upon by hydrochloric acid, either before or after ignition. The white powder turns straw-color when ignited.

				Quotient.	
SiO_2	= 39.80	Si	= 18.53	0.662	0.662
Al_2O_3	= 21.16	Al	= 11.29	0.206	0.225
Fe_2O_3	= 3.14	Fe	= 2.19	0.019	
FeO	= 0.72	Fe	= 0.56	0.010	
MnO	= 1.80	Mn	= 1.39	0.025	0 642
CaO	= 34.00	Ca	= 24.29	0.607	
MgO	= trace				
Ignition	= none				
	100.62				

These quotients furnish the ratio:—

Si : Al : Ca = 2.940 : 1.00 : 2.853.

Or

$$Ca_3 \, Al \, Si_3 \, O_{12}.$$

b. *Greenish Variety.*—Not observed in crystals. Massive granular. Color light grass-green to nearly white, the two varieties seem to pass into one another. I observed some striated planes, and thought they might belong to the following species of Zoisite, but fragments placed in the flame did not show intumescence, and fused like the yellow variety. Lustre on fracture less fatty than in the yellow variety. Highly transparent. H = 6. Spec. gr. 3.238.

Chemical Characters.—Fuses at 3, and with the fluxes gives strong manganese reaction. Not materially attacked by hydrochloric acid either before or after ignition.

Composition according to an analysis made by my assistant, Mr. R. B. Chipman.

			Quotient.	
SiO_2	= 39.08	Si	= 0.6504	0.6504
Al_2O_3	= 23.26	Al	= 0.2248	0.2298
Fe_2O_3	= .80	Fe	= 0.0050	
FeO	= .86	Fe	= 0.0119	
MnO	= 7.60	Mn	= 0.1071	0.6279
CaO	= 28.50	Ca	= 0.5089	
Ignition	= 0.32			
	100.52			

Ratio:—

Ca : Al : Si = : 2.733 : 1.00 : 2.834.

If the iron were all ferrous the ratio would become very nearly 3 : 1 : 3, as in the preceding variety, and it seems highly probable that such is the case, considering the difficulty in the way of a correct determination of ferrous iron in this instance, and the small quantities involved. Neither of these varieties has been identified in the United States by analysis.

Andradite and Pyrope are the usual varieties known in the American gneiss formation.

2. *Zoisite.*—Massive, cryptocrystalline, and in aggregation of small prismatic crystals. In the latter condition the specimen is friable between the fingers, as the individual crystals are but loosely cemented together. The shape of the crystals resembles very much that of Pyroxene. The striations on the prismatic faces are not noticeable; but an oblique cleavage seems to be present. I could not obtain satisfactory measurement. The prismatic angle was found approximately = 107°. The prism was terminated in one crystal by two brachydomes too small for measurement.

Color rose-red to pale pink. Strong vitreous lustre. H = 6 Spec. gr. = 3.642

Chemical Characters.—Swells up in the O.Fl, and fuses at 4 to 4.5 to a white enamel. With soda and borax in O.Fl manganese reaction. Not acted upon by hydrochloric acid either before or after ignition. When heated in the closed tube the rose-color disappears, and the mineral seems gray, yielding a small quantity of water. Upon cooling, the rose-color reappears with its former intensity.

The mean of two closely-agreeing analyses gave me:—

				Quotient.	
SiO_2	= 40.70	Si	= 19.00	0.679	0.679
Al_2O_3	= 33.30	Al	= 17.78	0.326	0.341
Fe_2O_3	= 2.40	Fe	= 1.68	0.015	
FeO	= 0.70	Fe	= 0.57	0.100	0.366
MnO	= 0.43	Mn	= 0.307	0.005	
CaO	= 19.70	Ca	= 14.06	0.351	
MgO	= 0.15				
Ignition	= 2.40	H_2O	= 2.40	0.12	
	99.78				

Producing the ratio:—

R : Al : Si = 1.07 : 1.00 : 1.991.

Or,

$$Ca\,Al\,Si_2\,O_8.$$

And taking the water into consideration we obtain:—

$$(Ca\,Al\,Si_2\,O_8)_3 + H_2O.$$

Is the water essential in the composition of Zoisite? Rammelsberg does not consider it so; and yet all analyses of this mineral show its presence. To me it seems to be essential, as I connect it with the remarkably distinct intumescence of Zoisite. Intumescence surely is caused by the escape of gas or vapor while the substance is in a semi-fluid state; it is but another form of exfoliation.

Minerals, with eminent basal cleavage and water of hydration or of crystallization, exfoliate, as the vermiculites, and to a lesser degree Heulandite; minerals possessing less cleavage, or none at all, exhibit intumescence. This phenomenon, as yet unexplained, is quite worthy of a thorough investigation.

It is possible, that in this, as also in other instances, a hydrated product of alteration is interlaminated with the really anhydrous mineral, thus producing apparent intumescence of the whole. This is merely a suggestion.

3. *Heulandite.*—This Zeolite occurs in cavities or upon either the Garnet or the Zoisite, in the usual form and combinations. A sufficient quantity for analysis could not be collected, but the pyrognostic characters were found to be those of heulandite. It has an olive-green color, probably from an admixture of the following mineral. It is evidently a product of alteration.

4. *Leidyite.*—On the quartz, but particularly on the Garnet and Zoisite, I found a mineral substance having the following characters: Not crystallized, but probably crystalline, massive in small lumps, or as a thin botryoidal incrustation. In the cavities it forms delicate stalactites, and leaf-shaped films pending from the sides. It is very soft (H = 1) Touch unctuous, lustre waxy. Color fine grass-green, olive-green, and greenish-gray, sometimes a bluish-green. Streak white. When crushed in the mortar, takes a silky lustre, as it parts into fine white scales.

Chemical Characters.—In O.Fl swells up and boils, fusing at 4 to a light yellowish-green glass. Reacts for iron, and slightly for manganese with soda and borax. Heated in closed tube yields water and turns yellowish-brown. Dissolves readily in strong *cold* hydrochloric acid. The solution precipitates auric chloride (ferrous iron). Not soluble after ignition. I was able to collect a little over two decigrams of critically pure material from the largest stalactite. The analysis gave—

				Quotient.	
SiO_2	= 51.40	Si	= 23.94	0.855	
Al_2O_3	= 16.82	Al	= 9.51	0.173	0.173
FeO	= 8.50	Fe	= 6.61	0.118	
CaO	= 3.15	Ca	= 2.19	0.054	0.248
MgO	= 3.07	Mg	= 1.84	0.076	
H_2O	= 17.08				
	100.03				

This gives the ratio for

$$R^{ii} : R^{vi} : Si = 1.43 : 1.00 : 4.942.$$
$$= 1.5 : 2 : 5.$$

This corresponds to the oxygen ratio

$$4\tfrac{1}{2} : 10.$$

But it is much more probable that one atom of hydrogen enters into the molecular equivalent to $\frac{1}{2}$ atom R^{ii}, producing thus a saturated bisilicate.

The mineral has then the general formula

$$R^{ii}_2 \, Al \, Si_5 \, O_{15} + 5H_2O.$$
$$R^{ii}_2 = \tfrac{7}{20}Fe + \tfrac{3}{20}Ca + \tfrac{5}{20}Mg + \tfrac{5}{20}H.$$

I place this mineral in the system with the bisilicate Zeolites for these reasons:—

1. Similar behavior before the blowpipe.
2. Association and like origin.
3. Similarity of chemical composition, particularly with Heulandite. Both minerals are formed by metamorphosis of Grossularite and Zoisite.

Named after the distinguished comparative anatomist, Dr. Joseph Leidy, of Philadelphia.

ADDITIONS TO MR. COOKE'S PAPER ON "THE VALSEI OF THE UNITED STATES."

BY WM. C. STEVENSON, JR.

In Mr. M. C. Cooke's paper[1] there are forty specimens grouped under "sporidia uncertain." The following are measurements of Schweinitzian specimens, occurring under these names, in the herbarium of the Academy of Natural Sciences.

As only the Schweinitzian specimens were examined, other references are omitted in this list.

The marginal numbers correspond to those in the original paper.

95. **Valsa Bignoniæ,** Schw. Am. Bor. 1310.

Sporidia olive-brown, uniseptate, .0159 × .0078 mm.

96. **Valsa scoparia,** Schw. Am. Bor. 1318.

Barren.

97. **Valsa pugillus,** Schw. Am. Bor. 1322.

Evidently a *Sphæronema.*

98. **Valsa scutellata,** Schw. Am. Bor. 1344.

Barren.

99. **Valsa frustrum-coni,** Schw. Am. Bor. 1329.

Barren.

100. **Valsa ciliata,** Schw. Am. Bor. 1349.

Sporidia naviculoid, biseptate, .0127 × .005 mm.

102. **Valsa umbilicata,** Schw. Am. Bor. 1385.

Sporidia, oval, hyaline, .0062 × .005 mm.

103. **Valsa divergens,** Schw. Am. Bor. 1393.

Sporidia subelliptical, granular, .0127 × .007 mm.

104. **Valsa juglandicola,** Sch. Am. Bor. 1328.

Sporidia allantoid, hyaline, .0062 × .002 mm.

105. **Valsa rubincola,** Schw. Am. Bor. 1329.

Sporidia allantoid, hyaline, .009 × .002 mm.

[1] Published in Proceedings of the Academy of Natural Sciences for 1877, pages 110–127.

106 **Valsa allostoma,** Schw. Am. Bor. 1332.

Sporidia allantoid, hyaline, .009 × .0031 mm.

107. **Valsa oligostoma,** Schw. Am. Bor. 1333.

Barren.

108. **Valsa amorpbostoma,** Schw. Am. Bor. 1334.

Barren.

109. **Valsa radicum,** Schw. Am. Bor. 1335.

Barren.

110. **Valsa conspurcata,** Schw. Am. Bor. 1336.

Sporidia allantoid, hyaline, .0062 × .002 — .0012 mm.

111. **Valsa modesta,** Schw. Am. Bor. 1337.

Sporidia allantoid, hyaline, .0078 × .0032 mm.

112. **Valsa comptoniæ,** Sch. Am. Bor. 1353.

Immature; asci long, linear.

113. **Valsa variolaria,** Schw. Am. Bor. 1371.

Sporidia allantoid, hyaline, .0078 × .0032 mm.

114. **Valsa conseptata,** Schw. Am. Bor. 1373.

Sporidia allantoid, hyaline, .0083 × .0032 mm.

115. **Valsa papyriferæ,** Schw. Am. Bor. 1375.

Large number of asci filled with granular matter, apparently immature. No definite sporidia present.

116. **Valsa ceanothi,** Schw. Am Bor. 1376.

Sporidia allantoid, nucleated, .0217 × .0062 mm.

117. **Valsa indistincta,** Schw. Am. Bor. 1377.

Sporidia reniform, hyaline, .0062 × .0045 mm.

118. **Valsa quadrifida,** Schw. Am. Bor. 1378.

Sporidia allantoid, hyaline, .0093 × .0032 mm.

119. **Valsa scabriseta,** Schw. Am. Bor. 1394.

Sporidia subelliptical, hyaline, .0062 × .0203 mm.

120. **Valsa expers,** Schw. Am. Bor. 1396.

Sporidia allantoid, nucleated, .0189 × .0062 mm.

121. **Valsa rimicola,** Schw. Am. Bor. 1397.

Not in sufficient quantity for complete examination.

122 **Valsa rhizina,** Schw. Am. Bor. 1398.

Sporidia allantoid, hyaline, .0093 × .0032 mm.

123. **Valsa halseyana,** Schw. Am. Bor. 1319.

Barren.

124. **Valsa lixivia,** Schw. Am. Bor. 1327.

Sporidia brown, uniseptate, strongly constricted at septum, .0253 × .0127 mm.

125. **Valsa tortuosa,** Schw. Am. Bor. 1350.

Unsatisfactory.

126. **Valsa deformis,** Schw. Am. Bor. 1355.

Sporidia allantoid, hyaline, .0062 — .0083 × .0015 mm.

127. **Valsa clopima,** Schw. Am. Bor. 1360.

Examination unsatisfactory.

128. **Valsa leucopia,** Schw. Am. Bor. 1365.

Sporidia subelliptical, hyaline, .0223 × .0062 mm.

129. **Valsa sphinctrina,** Schw. Am. Bor. 1370.

Barren.

130. **Valsa aperta,** Schw. Am. Bor. 1381.

Sporidia allantoid, hyaline, .0189 × .0062 mm.

131. **Valsa vasculosa,** Schw. Am. Bor. 1382.

Sporidia cuneate, nucleated, .0189 × .0127 mm.

132. **Valsa pusilla,** Schw. Am. Bor. 1391.

Barren.

133. **Valsa abnormis,** Schw. Am. Bor. 1392.

Barren.

NOTES ON THE NORTH AMERICAN CARIDEA IN THE MUSEUM OF THE PEABODY ACADEMY OF SCIENCE AT SALEM, MASS.

BY J. S. KINGSLEY.

The following paper is merely preliminary to a proposed monograph of the North American shrimps. I would here return thanks to Prof. S. I. Smith, of Yale College, for many favors received.

CRANGONIDÆ.

CRANGON Fabricius.

Crangon vulgaris Fabr.

I find this species in collections made by Dr. Packard at Fort Macon, N. C. I should be inclined to call the *Steiracrangon Allmanni* of Kinahan (Proc. Roy. Irish Acad. 1862, vii. p. 71, pl. iv.) as this species, there being no constant character to separate them; but Rev. A. M. Norman, in the Report of the British Association for the Advancement of Science for 1868, p. 265, pronounces them unquestionably distinct. The only characters given by Kinahan for the separation are the sulcation of the sixth and seventh abdominal segments, a feature which I have found in undoubted specimens of *C. vulgaris* from our own coast. Nor can the bathymetrical distribution, mentioned by Norman, affect the case, as *C. vulgaris* is common in seventy fathoms. I am also inclined to consider *C. nigricauda* Stm., *C. nigromaculata* Lockington, and *C. alaskensis* Lockington, as *C. vulgaris*, but will not decide until the examination of larger series of specimens from the west coast. Dekay (N. Y. Fauna, Crustacea, p. 25) has this astounding statement concerning this species (under the name *C. 7-carinata* Say), "eyes sessile, and resting on the concave surface of the peduncle of the inner antennæ."

HIPPOLYSMATA Stimpson.

? **Hippolysmata cubensis.**

Hippolyte cubensis, Von Martens, Wiegmann's Archiv für Naturgeschichte, 1872, p. 136, pl. v. f. 14.

I refer this with a doubt to this genus, though Dr. V. Martens gives nothing in regard to the mandibles and external maxillipeds. The genus *Hippolyte* is northern in its range.

Hippolysmata intermedia, n. s.

Carapax with antennal and branchiostegal spines, rostrum horizontal, extending to base of the third joint of antennular peduncle, shorter than in *H. wurdemanni* Stm., and longer than in *H. cubensis;* the carina extending back to the posterior portion of the carapax; six or seven toothed above, three or four teeth being on the carapax, and three on the rostrum; below with three teeth, the first being directly under the last on the upper margin. Antennular spine extending slightly beyond the basal joint of peduncle; third joint two-thirds as long as preceding, flagella nearly as long as the body, the outer thickened for a fourth of its length, and exhibiting traces of a division. A spine on the outside of the basal joint of antennæ, antennal scale narrow, regularly tapering, extending over half its length beyond the rostrum; flagellum longer than the body.

External maxillipeds elongate, pediform, extending beyond the antennal scale, the carpal joint reaching the tip of antennal peduncle. Feet of first pair reaching the extremity of the antennal scale, fingers half as long as palm; hand, carpus, and meros subequal. Feet of second pair elongate, filiform, carpus multiarticulate. Telson narrow, tapering, the apex acute.

Length.	Carapax.	Rostrum.	2d pair.
25 mm.	6 mm.	3 mm.	19 mm.

Fort Jefferson and Tortugas, Fla., W. H. Jacques.

This species differs from *H. cubensis* in the longer rostrum and carapax, the antennular flagella, and in the fifth pair of feet not being longer than the others; from *H. wurdemanni* in the shorter rostrum and the arrangement of the rostral teeth, and the presence of a branchiostegal spine.

TOZEUMA Stimpson.

Tozeuma carolinensis, n. s.

Elongate, compressed, carapax with sub-ocular and branchiostegal spines; rostrum narrow, slender, curving upwards very slightly, a half longer than the carapax, not extended as a carina on the carapax, a small spine on each side at the base; upper margin smooth, rounded, lower with many small teeth. Basal spine of antennulæ slender, extending beyond the first joint of the peduncle; first joint as long as the two following which are equal; flagella short, the upper and outer the larger, neither reaching the tip of antennal scale. Basal joint of antennæ with a small spine beneath; antennal scale narrow, lanceolate, nearly as long as carapax, peduncle short, flagellum a third as long as the body without rostrum. External maxillipeds short, last joint twice as long as the preceding one. Feet all short, first pair very short, stout, carpus with a spine above, hand inflated. fingers curved, closing completely. Feet of second pair slender, reaching to the tip of antennal peduncle, meros joint as long as the first two joints of the carpus, first joint of carpus as long as the other two, third a half longer than the second; hand hirsute, as long as the last articulation of the carpus. Remaining feet simple; dactyli curved, propodi spinulose beneath. Dorsum of abdomen smooth; sixth segment as long as the two preceding; telson elongate, slender, acute.

Length.	Carapax.	Rostrum.
51 mm.	10 mm.	15.5 mm.

Fort Macon, N. C., A. S. Packard, Jr.

This species differs from *T. lanceolatum* Stm., from China, the only other species that I know of. in the shortness of the rostrum and antennæ, the want of spines on the dorsal surface of the abdomen, etc.

ATYIDÆ.

ATYA Leach.

Atya punctata, n. s.

Compressed, carapax and abdomen everywhere thickly punctate, rostrum short, depressed, carinate above and below, tip acute, lateral angles obtuse, the sulci separating the median from the lateral carinæ deep. Antennular spine falling short of base of second joint, acute; peduncle granulate above, third joint two-thirds as long as second; outer flagellum shorter than the inner, inner three-fourths as long as carapax. A spine on the basal joint of antennæ beneath; antennal scale longer than antennular peduncle, extremity ovate, external margin nearly straight, with a short acute spine. External maxillipeds slender, extending beyond the antennal peduncle. Feet of the first two pairs subequal; meral joints compressed, longitudinally sulcated. Feet of the third pair cylindrical, stout, covered with tubercles interspersed with hairs. These tubercles on the upper surfaces show a tendency to arrange themselves in longitudinal rows, and on the carpus become somewhat spiniform. Ischium three times as long as meros, meros and carpus of the same length, the former being somewhat the stouter; dactylus short, stout, smooth above, a single row of spines beneath, apex acute. Fourth pair of feet resembling the third in ornamentation and proportions of joints, but shorter and more slender. Fifth pair still shorter and more slender, carpus twice as long as meros and slightly longer than the ischium; otherwise not differing from the two preceding. Telson, with the sides straight, extremity truncate; a slight sulcus above, which, in the posterior portion, is divided by a median carina; on each side a row of aculei.

Length.	Carapax.	Third pair feet.
59 mm.	18.5 mm.	28 mm.

Hayti, Dr. D. F. Weinland.

This species differs from *A. scabra* in the longer feet of the first pair, the three last pair more slender, the more tuberculate character of the ornamentation, and in the proportionate length of the joints. The second abdominal segment is also more dilated. From the short description of *Atya occidentalis* Newport, in the thorax and abdomen being punctate; from the *A. tenella* Smith, in the larger feet of the third pair; and from *A. rivalis* in the more obtuse lateral teeth of the rostrum.

Atya occidentalis Newport, Annals and Magazine of Natural History, 1847, vol. xix. p. 159. Von Martens, Archiv für Naturgeschichte, 1871, p. 135.

Specimens in the museum of the Peabody Academy which I refer to this species differ from the foregoing species in having the distal portion of the basal joint of antennular peduncle armed with short bristles or spines; inner flagellum three-fourths the length of carapax. Legs of third pair much larger than the others; meral, carpal, and propodal joints tuberculate, without hairs; meros longer than three succeeding joints, rounded, triangular in section; carpus and propodus subequal; dactylus short, claw-like, basal portion greatly thickened and armed with small spines beneath. Fourth pair with meros as long as carpus and propodus; carpus shorter than propodus, dactylus as in third pair. Meros and carpus each with a single spine beneath. Meros and propodus of fifth pair subequal; propodus a half longer than carpus. Telson as in *A. rivalis* Smith.

Length.	Third pair of feet.
57 mm.	31 mm.

Whether this be the *A. occidentalis* of Newport, cannot be determined from his short description, but it presents no conflicting characters.

ATYOIDA Randall.

Atyoida glabra, n. s.

Compressed, rostrum slender, short, extending slightly beyond the base of the second joint of antennular peduncle, horizontal, rounded above, not angulated on the sides, no lateral carinæ; below with two to four teeth near the tip. Peduncle of antennæ unarmed, last two joints nearly equal; outer flagellum about half as long as the carapax; inner more slender, three times as long as the outer. Antennal scale longer than the antennular peduncle, extremity ovate, outer margin straight and armed with a small, stout, acute spine; flagellum nearly as long as the body. External maxillipeds slender, pediform, extending a little beyond the peduncles of the antennulæ. First two pairs of feet smooth and naked; the first as long as the maxillipeds, the second extending to the tip of the antennal scale. Meral and carpal joints of remaining pairs armed below with spines; dactyli short, stout, also with spines. Two posterior pairs subequal. Abdomen smooth, compressed, the sides being higher than is usual in this and allied genera. Telson narrow, sides straight, extremity arcuate-truncate, with numerous small spines; dorsal surface without a furrow, but furnished with rows of small aculei.

Length.	Length of Carapax.	Height of Carapax.	Height of abdomen.
22 mm.	6.5 mm.	3.2 mm.	5.3 mm.

Polvon and Corcuera, west coast of Nicaragua, J. A. McNiel.

PALÆMONIDÆ.

ALPHEUS Fabr.

Alpheus normanni.

Alpheus affinis Kingsley, Bulletin U. S. Geological and Geographical Survey of the Territories, 1878, vol. iv. p. 195.

The specific name *affinis* being already preoccupied in this genus (Guise, Annals of Natural History, 1854, 2d series, vol. xiv. p. 275), it is necessary to apply a new one to the Panama form, and I therefore dedicate it to the Rev. A. M. Norman, of England, who called my attention to the oversight.

PANDALUS Leach.

Pandalus franciscorum, n. s.

Carapax with a minute pubescence; antennal and branchiostegal spines acute; rostrum a fifth longer than the carapax, extending a fourth its length beyond the antennal scales, considerably recurved, ten or eleven teeth above, of which five are on the carapax, and the remainder on the basal portion of the rostrum; distal half of the rostrum above smooth, the apex being minutely bifid or trifid; below with seven to nine teeth, the posterior being the largest. Third joint of antennular peduncle a third longer than the preceding; flagella about as long as the carapax. Basal joint of antennæ with a spine on the outside, and another below; antennal scales long and proportionately narrower than in *P. borealis* Kroyer; flagellum longer than the body. External maxillipeds falling short of the extremity of the antennal scale. Second pair of feet unequal, the shorter extending further forward than the external maxillipeds. Posterior pairs stout, armed with spines below. Fifth and sixth abdominal segments with a spine at the infero-posterior angle. Telson narrow, a shallow furrow on its upper surface, apex obtusely triangular.

Length.	Carapax.
110 mm.	52 mm.

San Francisco, Cal., W. G. W. Harford.

THOR,[1] nov. gen.

Carapax with antennal spine, rostrum short, toothed above; antennulæ biflagellate, outer branch very stout. Mandibles without palpi, bifurcate, apical process narrow; proximal process stout with one acute and one obtuse tooth, and a pubescence of minute curved hooks, reminding one of the basal joints of the limbs of *Limulus*. External maxillipeds pediform, exopodite present. Feet of the first pair short, stout; of the second elongate, slender; carpus five annulate. Telson elongate, triangular.

This genus differs from all the *Alpheinæ* with which I am acquainted in the absence of mandibular palpus, and from the *Palæmoninæ* in the relative size of the first two pairs of thoracic feet, and in having the carpus of the second pair annulate.

[1] Thor, a Scandinavian deity.

Thor floridanus, n. s.

Carapax with a small antennal spine; rostrum shorter than the eyes, five toothed above, the first being over the orbits, beneath smooth and rounded. Antennulæ with basal joint large, basal spine long, acute, reaching nearly to third joint; second and third joints very short, the second with a slender, acute spine on the outside. Inner flagellum slender, slightly longer than the basal joints; outer about as long as the basal joints, stout, ciliated on the apex and inner margin. Antennæ with a spine on the basal joint, antennal scale reaching as far as the outer branch of antennular flagellum, its inner margin slightly concave, flagellum half as long as the body. Mandibles robust, apical process with five terminal teeth. External maxillipeds slender, pediform, reaching the tip of antennal scale, the penult joint the shortest, antepenult three, and last joint four times as long as the penultimate, the last joint terminated with slender spines. First pair of feet short, stout, meral and carpal joints subequal, the latter with minute spines on the inner margin; hands subcylindrical, the dactyli occupying two-fifths their length. Second pair of feet elongate, filiform, carpus five annulate, third and fourth joints the shortest, equal, fifth, second, and first increasing in length in the order given, the first being as long as the third and fourth together; hand as long as the third and fourth articulations of the carpus, with the fingers occupying two-fifths of its length; meral joint as long as the first four articulations of the carpus. Dactyli and distal portions of the propodi of posterior pairs of feet spinulose beneath. Telson elongate, triangular, apex truncate, spined.

Length.	Carapax.
13 mm.	3.9 mm.

Key West, Florida, A. S. Packard, Jr.

PONTONIA Latreille.

Pontonia domestica Gibbes, Proceedings of the American Association for the Advancement of Science, 1851, iii. p. 196.

In addition to the brief description of Gibbes, I would add the following characters, derived from specimens in the collection of the Boston Society of Natural History from the Bahamas (Dr. H. Bryant).

Antennal spine short, acute; rostrum extending nearly to last joint of peduncle of antennulæ. Third joint of antennular peduncle but slightly longer than the second; flagella very short, the outer branch the longer and stouter, basal spine short, obtuse. Antennal scale broad, extending as far as antennular peduncle; extremity arcuate-truncate. Feet of the first pair slender, carpus a half longer than the hand. Palm of the second pair a half longer than the fingers; thumb with two teeth, finger with only one, points of fingers crossing. Telson twice as long as broad, margins slightly arcuate as in *P. margarita*, Smith.

Length.	Carapax.
26 mm.	10.4 mm.

ANCHISTIA Dana.

Anchistia americana, n. s.

Rostrum rather broad, nearly reaching the extremity of the antennal scale, upper margin straight, seven to nine toothed, above the first tooth more remote from the second than the second from the third, two to three teeth below. Branchiostegal and hepatic spines present. Basal joint of antennulæ broad, as long as the two following which are equal. Upper and outer flagellum shorter and stouter than its fellow, and bifid for about a fourth of its length; inner and longer flagellum about as long as the peduncle. Basal joint of antennæ with a spine on the outside, antennal scale lanceolate, extremity rounded; flagellum as long as the body. Feet of the first pair slender, elongate, the middle of carpus reaching the tip of the antennal scale; meros and carpus equal, hands about two-thirds the length of the carpus, fingers shorter than palmar portion. Second pair of feet very elongate, resembling those of the proposed genus *Macrobrachium* Spence Bate, being longer than the whole body; meros very slightly longer than the carpus, carpus about half as long as the hand, the distal portion enlarged, hand cylindrical, fingers slender, somewhat curved downwards, not completely closing, with a few small teeth. Remaining feet slender, the posterior pair reaching the extremity of the rostrum. Telson narrow, triangular, truncate, terminated with bristles.

Length.	Carapax.	Second pair of feet.
20 mm.	4.5 mm.	25 mm.

Key West, Florida, A. S. Packard, Jr.

This species quite closely resembles the description of *Palæmon fluvialis* Streets, from the fresh waters of Mexico.

PALÆMONETES Heller.

Palæmonetes paludosa.

Hippolyte paludosa Gibbes. Pro. Amer. Assoc., 1851, p. 197.
Palæmonetes exilipes Stimpson, Annals N. Y. Lyceum Nat. Hist. 1871, x. p. 130. Smith, Rep. U. S. Fish Commission, 1872-3, p. 641, pl. i., f. 1. Forbes, Bulletin Illinois Museum Nat. Hist. 1876, No. 1, p. 5 and 20.

I believe the species described by Stimpson to be the one mentioned previously by Gibbes, especially since the description of this author agrees, as far as it goes, with specimens of *P. exilipes* from various localities, that it comes from the fresh waters of South Carolina, from whence Stimpson's types were procured. Professor Gibbes says, "The specimens were not quite perfect, having lost some of their feet and antennæ," which would explain their reference to the wrong genus.

PENEIDÆ.

SICYONIA H. Milne Edwards.

Sicyonia dorsalis, n. s.

Body small, slightly compressed, carapax minutely punctate. Dorsal crest of the carapax with a tooth at about the middle, and a second near the anterior border. Hepatic spine slender, antennal shorter and stouter. Rostrum horizontal, short, extending slightly beyond the eyes and nearly to the second joint of antennular peduncle, three-toothed above, extremity acute, below entire. First joint of peduncle of antennula terminating exteriorly in a spine, second three times as long as the third; flagella short, hardly equalling the last two joints of peduncle. Antennal scale broad, regularly tapering, as long as antennular peduncle. External maxilliped falling short of the extremity of antennal peduncle. Feet slender, round; those of the third pair reaching slightly further than the external maxillipeds. Abdomen sharply carinate above, sides punctate, sculptured, protuberant parts rounded. Third to sixth segments with a spine at the postero-inferior angle. Telson narrow, acute, with a shallow groove on the dorsal surface.

Length.	Carapax.	Rostrum.
38 mm.	9.5 mm.	3 mm.

Fort Jefferson, Fla., Lieut. W. H. Jacques, U. S. N.

Is quite different from the two species *S. brevirostris* Stm. (*S. cristata* Saussure), and *S. lævigata*, Stm., before known from this coast.

PENEUS Latreille.

Peneus brevirostris, n. s.

Compressed, sutures of carapax well marked, carina with a sulcus on each side extending nearly to the posterior margin of the carapax; rostrum short, horizontal, apex a little depressed, scarcely exceeding the eyes, ten-toothed above, of which the first four are on the carapax itself, distal fourth smooth; below with two teeth near the tip. Flagella of antennulæ very short. Antennal scale about as long as antennular peduncle, laminate portion extending beyond the spine at the antero-lateral angle; flagellum longer than the body, spines at the base of the first two pairs of feet slender. Third pair of feet the longest, extending to the apex of the antennal scale. Abdomen compressed, fourth to sixth segments with a dorsal median crest. Telson short, regularly tapering to an acute tip, a deep and narrow longitudinal furrow above. Inner caudal lamella longitudinally bisulcate.

Length.	Carapax.	Rostrum.
42 mm.	10 mm.	5 mm.

Estero at Realijo, W. Coast of Nicaragua (salt water), J. A. McNiel.

March 5, 1878.

The President, Dr. Ruschenberger, in the chair.

Forty-one persons present.

The following papers were presented for publication:—

"Recovery of all the Faculties in a Pigeon from which the Cerebral Hemispheres had been removed." By J. H. McQuillen, M.D.

"The Electric Constitution of the Solar System." By Jacob Ennis.

A Hippopotamus Tusk.—Prof. Leidy stated that in the Mozambique Collection of the International Exhibition, he had noticed a hippopotamus tooth remarkable for its size. It was an inferior canine, with a spiral turn, apparently from impeded growth, perhaps due to the loss of the opposing tooth. It measured 42 inches long in the spiral. The insertion was 16 inches, and the diameter 4 inches.

On Amœba.—Prof. Leidy remarked that the first notice of an Amœba was of a large species, described by Rösel, under the name of *Proteus*, in the Insecten-Belustigung, Nurnberg, 1755 It was called by Linnæus *Volvox chaos* and *Chaos protheus*, and by Pallas *Volvox proteus*, and subsequently by Müller *Proteus diffluens*. As the latter generic name was preoccupied, Bory called the animal *Amiba*. Ehrenberg, in the Infusionsthierchen, describes a small species as *Amœba diffluens*, and refers all those previously described to the same. His supposed new and large species, which he describes as *Amœba princeps*, is really the same as Rösel's *Proteus*. The true name of this should be either *Amœba chaos* or *Amœba proteus*, the former according to strict rules of zoological nomenclature, though the latter would appear more appropriate as serving to perpetuate the name given by the discoverer of the first known rhizopod.

Black Barite from Derbyshire.—Prof. George A. Koenig communicated the results of an examination made on a specimen labelled "Manganese from Derbyshire," in the collection of the Academy. The mineral is jet-black in color, exhibiting metallic lustre. Lamellar structure without distinct forms. Strong cleavage. Cleavage pieces gave the angles of barite. Specific gravity = 4.345.

Boiled with hydrochloric acid the black color disappears, leaving a white substance. The analysis gave

$$
\begin{aligned}
BaSO_4 &= 96.40 \\
Mn_2O_3 &= 3.10 \\
H_2O &= 0.25 \\
\hline
& 99.75
\end{aligned}
$$

It presents an interesting illustration of how a comparatively small amount of one mineral may mask the most striking physical properties of a mineral species.

March 12.

The President, Dr. Ruschenberger, in the chair.

Nineteen persons present.

March 19.

The President, Dr. Ruschenberger, in the chair.

Thirty-two persons present.

March 26.

The President, Dr. Ruschenberger, in the chair.

Thirty-one persons present.

The following papers were presented for publication:—

"Staffellite from Pike's Peak, Col." By E. Goldsmith.

"Stibianite, a New Mineral." By E. Goldsmith.

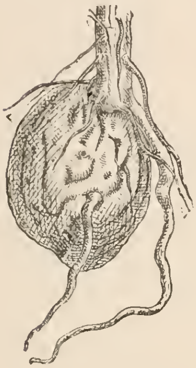
The death of Henry Adams, Correspondent, was announced.

A Louse of the Pelican.—Prof. Leidy exhibited a portion of the pouch of a pelican, with several groups of large lice adhering to the lining membrane. The specimen, suspended in alcohol, had been presented to him some years since by his late friend Prof. Jeffries Wyman, who obtained it, while in Florida, from the white pelican, *Pelecanus trachyrhynchus.*

Later, Dr. Elliott Coues, U.S.A., had submitted to his inspection specimens of the same louse, which he had obtained from the interior of the pouch of a white pelican, from the Red River of the North.

The louse pertains to the *Mallophaga* or Fleece-eaters, and appears to be an undescribed species. The name of Menopon perale was given to it. It is $2\frac{1}{4}$ lines in length, and of a chestnut-brown color. The head is broader than long, semilunar, with a black spot on each side in advance of the pair of eyes. Prothorax narrower than the head, with a lateral conical point. Abdomen nearly twice the length of the head and thorax together; terminal segment rounded, and with a tuft of hairs on each side. Mandibles strong and black.

Expansive Force of Root Growth.—Mr. THOMAS MEEHAN exhibited a one-year-old peach tree with the stone yet attached. The stone had lost the usual power of dividing into two portions, and remained tightly closed; but the plumule had forced its way through at the base, while the radicle appeared to have made its way entirely through the side of the hard shell. Mr. Meehan referred to other cases of a similar character, already recorded in the Proceedings of the Academy, notably those of the stolons of couch grass, which pushed through several potatoes, making a sort of necklace; and the case of the survey lawsuit where, by the thickening of the roots of a tree growing on a rock, the surveyor's mark on a tree trunk had, after many years, been elevated several inches, the effect of this growth being to lift a tree of many tons weight. This peach-stone case seemed remarkable not so much for its expansive as its penetrating force, which, as suggested by Dr. Rothrock, may have been aided by an absorbent and solvent power.



The following papers were ordered to be published:—

THE ELECTRIC CONSTITUTION OF THE SOLAR SYSTEM.

BY JACOB ENNIS.

The zodiacal light, the aurora borealis, the corona of the sun, and the tails of comets, are all different forms of the same thing. They are electrical brushes, precisely the same as the electric brushes which in the night are seen to fly off from a highly charged electric machine. On the electric machine the electric fluid is developed by friction. On our great globe, on the sun, and on the comets, the electric fluid is developed by evaporation. Put a little saline water in a metallic vessel shaped like a watch crystal, then if heated, or if a hot pebble be dropped in the water, the vapor arising will be charged with the electric fluid. All the waters of our globe are more or less saline, and the ocean is very much saline, and the rising vapors are charged with electricity. A gill of water is changed into about 30 gallons of electrified vapor. All around our globe the average rainfall is about 36 inches a year. This shows the amount of water evaporated; and the amount of vapor and of the electric fluid rising daily high up in our atmosphere, is great beyond conception. A very small portion of the electric fluid comes down as lightning. The brilliant light and the loud explosions are simply indications of the resistance offered by the dense lower atmosphere to the downward progress of the electric fluid. But high up the air is very rare, and the electric fluid easily rises upwards; therefore the higher regions of the atmosphere are always highly charged with electricity. Ordinarily the ground is negative, and the air is positively electrified. As a balloon mounts up, a cord let down, say a hundred yards, shows that its lower end is always negative and the upper positive. This is proof that the upper strata of the air are more highly charged than the lower. As those upper strata float toward the poles they carry thither an ever-increasing accumulation of the electric fluid. What becomes of this fluid? It cannot descend to the ground through the dense atmosphere; there are no thunder showers in those polar regions, therefore it goes upward through the rare air to the top of the atmosphere, and from thence it is driven off in the form of auroral streamers constantly far away into empty space as electrical brushes.

But what repels this vast daily accumulation of electricity away from our planet off into empty space? The answer is that electricity alone can repel electricity; and in this case the repelling electricity is seen in the corona of the sun. The corona of the sun consists of brushes of electricity. They are so vast that they rise up visibly to our eyes at this great distance a million of miles. How much further they would be visible if our standpoint were nearer, we cannot say. They are caused there, as here, by the evaporation from the intense heat of the sun. They are so powerful as to drive the tails of comets, also electric brushes, in the direction away from the sun. They drive away from the direction of the sun our zodiacal light, and our aurora borealis, and aurora australis, all three of which must be regarded as the perpetual tail of our planet, in many respects similar to the tail of a comet; for the tails of some comets are so short and rare as to be either invisible or almost invisible at our distance.

Our auroral streamers and our zodiacal light are perpetual; they never cease, because evaporation never ceases. There is a zone all around our globe toward the Arctic Circle where the aurora borealis is seen every night. In Europe this zone lies in about 70 degrees of latitude, but in America it comes lower down, as far as about the latitude of 58 degrees. As we go northward from Philadelphia we see the northern aurora more and more frequently. It is easy in summer to go to Quebec, and from there in a steamer up the Saguenay River to Grand Bay and Chicoutimi, where very seldom a night passes without being cheered more or less by the electric lights along the northern sky.

The evidence is complete that an auroral display is a display of electricity. It runs along the telegraph wires, and messages have been dispatched and carried to their destination by the auroral power. During the display of September 2, 1859, it was estimated by telegraphic experts that "the intensity of this power was equal to that of 200 cups of Grove's battery on a line 230 miles long." I need not stop here to detail how telegraph operators have been stunned, how their apparatus has been melted, and how their work has been suspended by an electric storm on their wires coming from the aurora.

When there are extraordinary auroral displays they appear first in Europe and then in America; they travel from east to west around the globe like the dark cone of the night; they are on the dark side of the globe, and the auroral streamers, sometimes 500 miles high, point away from the sun, like the tails of comets, driven by the sun's electric repulsion. This is illustrated by the hours in which they appear. In lower latitudes, say of 40 degrees, where the zone around the globe from east to west is very long, the aurora appears in the earlier part of the night, and the electric fluid is all driven off generally before midnight. But far to the north, where that zone is shorter, the appearances of the auroras are more often at midnight and later.

The following table shows the times of the appearance of many auroras in Canada, and other stations further north, at Carlton Fort, Athabasca, and Point Barrow, ranging from 48 to 71 degrees of latitude.

Hours.	No. of auroral displays.	Hours.	No. of auroral displays.
6 P. M.	61	1 A. M.	323
7 "	137	2 "	267
8 "	220	3 "	240
9 "	261	4 "	182
10 "	328	5 "	133
11 "	358	6 "	81
Midnight	330		

When MM. Lottin, Bravais, and their companions spent the long night of 70 times 24 hours at Alten Bay, in West Finmark, latitude 70, they saw 64 auroras, and perceived some half dozen more by the magnetic needle when the clouds hid the sky. The aurora was not continuous during the long night, but once in 24 hours when the night overshadowed the same meridian in temperate latitudes. If in these lower temperate latitudes the aurora occurred in the daytime, it could not indeed be seen on account of the light of the sun, but it could be perceived by the magnetic needle.

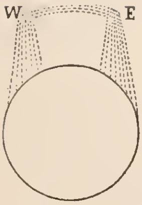
Not only the nightly auroral streamers, often 500 miles long, pointing away from the sun like the tails of comets, but also the eleven years periodicity of great auroras, corresponding with the eleven years periodicity of great solar spots, declares the connection between the sun and our auroras. Then indeed the auroral electricity may be felt on the telegraph wires in the daytime; that is on the sun side of the earth, because by unwonted solar activity the electric fluid is hurried away from the solar to the night side of the earth, and it is felt in its passage; then, in those seasons of extra large auroras, the tall streamers are seen to arise not only from the north, but all around from the east and the west, and less strongly from the south. Their upper limits seem to come nearly together a little south of the zenith in our latitude, and the near meeting of their tops forms a circle called the auroral corona. This circle is broken, or nearly broken, on the south side, because the streamers rising up from the distant southern latitudes are too far off to be plainly seen. While looking up to the centre of the corona we are really looking out of the far end of a tube—an auroral tube composed of electric streamers. These streamers seem to approach one another, and make the far end of the tube very small, but really they do not approach. Their apparent convergence is like the seeming approach of the two rails on a railroad when the eye can see them far away. These tall auroral streamers, which apparently converge and form the corona, must be several thousand miles high.

Now we can understand why the zone of constant auroras is far this side of the poles, and why the explorers and the whalers in the extreme north have to look southwardly to see the auroras. The polar regions on our globe are not in the direction away from the sun; their zenith is at right angles or perpendicular to the sun's radiations, and the solar electric repulsion drives all the terrestrial electricity away down to lower latitudes.

Now we can understand also why the earth's atmosphere extends so high. Mathematicians have declared that, according to Mariotte's law, it can extend upward only about 40 miles, but the passage of meteors through the air, and their bright ignition, prove that our atmosphere reaches as high as 200 miles. When we stand on an insulated stool charged with electricity, we know how our hairs all stand on end, and reach far out from our heads. Pith balls and tufts of down tied to the ends of threads on the prime conductor of an electric machine, all fly off at the full lengths of the threads. So it must be with the particles of air, only in a far greater degree, because they are so much lighter. The atmosphere, especially its upper surface, is like the prime conductor of an electric machine. This great machine rotating in the sun's rays, is constantly receiving an inconceivable amount of electricity from evaporation, and it must necessarily lift the top of our atmosphere far up—we cannot tell how high.

The Zodiacal Light.—Now first we can understand also the cause of zodiacal light. At the belt of calms in the equatorial region, where the trade winds meet from the north and from the south, there is much evaporation, and as the warm, moist air rises, the vapor is condensed, and it descends in rain. Some, though comparatively little, of the electricity comes down as lightning. During three rainy seasons within the tropics, I heard and saw much thunder and lightning among the clouds, but I never heard of a lightning stroke reaching the ground, though such instances may possibly have rarely occurred without my knowledge. Therefore on the equatorial zone the electricity must accumulate on the top of the atmosphere. This it must the more naturally do because above the unstable strata of the atmosphere, which moves north and south, there is a much taller stable stratum which remains always in the same latitudes. On this curious subject see the latter part of my paper on Meteors, in the Proceedings of the American Association for the Advancement of Science, for 1871. This accumulation of electricity on the equatorial region must meet the same fate as the accumulations near the polar regions. It must be driven off by the solar electric repulsion, and point with tall streamers away from the sun and form the zodiacal light. The zodiacal light has the same color and appearance as a large streamer of the aurora borealis, being brighter below and paling off slowly to the top, the point above where it fails to impress the eye being undefined and uncertain. It is more steady than the aurora, but when watched attentively it is seen on some nights to be broader, or taller, or better defined than on others. Pulsations can sometimes be seen in it, cloud-like movements running upward as in the aurora. Its greater steadiness can be accounted for by the greater steadiness and calmness of the equatorial regions. And the aurora too appears more steady when seen nightly from high northern latitudes than when seen in its extraordinary convulsions from low latitudes. At the equator the zodiacal light can be seen at all times in the year, both in the west in the evening, and in the east in the morning, and sometimes making the complete arch of the heavens. When in great auroral convulsions we see the tall streamers rising up from all around the horizon, I suppose the southern streamers arise from this equatorial region, and that the zodiacal light and aurora are united.

Fig. 1.



The adjoining figure shows a section at the equator of our globe and the departing streamers which form the zodiacal light, the morning or eastern one at E., and the evening or western one at W. At the equator on clear nights they are seen to be continuous by a faint arch all across the sky. The great authority on this subject is the work of Rev. George Jones, Chaplain in Commodore Perry's Expedition to Japan, in 1853–5, printed by the U. S. Government in 1856.

It may be thought that the electric repulsion from the sun should be seen on an ordinary electrometer. But our electrometers are deeply immersed in the bottom of our electric atmosphere, and this being near, overpowers the distant influence from the sun, the same as our moon is controlled by the feeble gravity of the earth, and not by the more powerful gravity of the sun. The sun's electric repulsion is seen in giving a general external direction to the earth's electrical envelop, and not in causing small differences among interior objects.

The Corona of the Sun.—At total eclipses a whitish irregular ring, nearly as broad as the sun's diameter, appears around the sun. It has been compared with the "glory" which in catholic pictures appears around the heads of saints. This is the corona. It is doubtless an effulgence, a constant streaming forth of electricity, like the aurora borealis, or like the zodiacal light, from every part of the sun's surface. It cannot be an atmosphere except in its very lowest border, for some comets have passed through it with their speed unaltered and their bodies unaffected. This impunity could not have happened to such large and extremely rare bodies, with such velocities, through any atmosphere. As it cannot be an atmosphere, we can think of it as nothing but an outflow of electricity, an electrical brush, or as thousands of them united. But what can be the source of this outflow of the electric fluid? We must refer it to the same cause as that from our earth—evaporation. As evaporation from the sun is millions of times greater than from our earth, so the evolution of electricity may be in proportion. On earth the best image of the sun is the crater of a volcano, and no displays of thunder and lightning are equal to those seen and heard in the ascending volcanic emanations. Among our electric machines there is none so powerful as the one which goes by evaporation. The vapor most highly charged with electricity issues from many small orifices in the sides of a tube. The electric fluid in this case has been supposed to arise from the friction of the vapor against the sides of the orifices; but this conjecture is loose and unsatisfactory. Even if it be true in whole or in part, there is something like it in the sun. The great mass of the sun consists of molten, liquid matters, with a specific gravity one-fourth heavier than water or ice. This is the great source of light and heat. Around this is an envelop of flames from 2000 to 4000 miles high. This height is ascertained by the depressions of the spots, which are solids partially cooled, and floating like cakes of ice on water. This tall envelop of flames is the so-called photosphere, having suspended in it many different solar elements, and the thousands of their fixed spectroscopic lines are dark, because the chief light of the sun comes from the incandescent liquid below. In that liquid chemical action is going on with inconceivable force, and its products are not only heat and light, but red vapors. From the vast amounts of some of these vapor jets, we must suppose that large bubbles of vapor, several hundred miles in diameter, are formed thousands of miles down in the interior of the sun. They must be subject to enormous hydraulic pressure, and in the same proportion they must be ejected upwards with enormous velocities, some more and others less, depending on their sizes and the depths from which they come. Some rise as high as 20,000 or 30,000 miles. Others mount up to 70,000, and some few have been seen to reach 100,000, and according to Prof. Young even 200,000 miles, with velocities proportioned to their heights. The propelling power of these jets has never before been published. They seem to be innumerable, and the red vapor, after rising, falls back like the waters of a fountain. Sometimes the vapor at our distance is invisible in the solar atmosphere where it condenses into visible clouds, and down from the bottom of the clouds some spectroscopists have perceived appearances like the fall of rain from a shower-cloud. What this vapor is composed of we need not now inquire. It is generally said to be hydrogen gas, because some of the hydrogen lines appear in its spectrum. But this cannot be, because it is red, and hydrogen is a colorless invisible gas. It is not permanent, but condenses and falls; whereas hydrogen is a permanent gas, and must accumulate indefinitely on the solar surface unless it takes fire and burns, of which there is not the least appearance. Hydrogen has only four fixed lines in its spectrum, but Prof. Young has seen nearly 300 in the red vapors of the sun. Probably, therefore, it is a complex vapor consisting of several elements; and, like our vapors here, it may be a source of electricity. Like a hydro-electric apparatus, it may also generate electricity by the friction as the huge bubbles rise up so swiftly from the deep interior of the sun.

In appearance and in action there is a perfect identity between our aurora borealis and the corona of the sun. The lower portions of both are white without any variations of tint. Above their bases begin their radiations—tall streamers reaching upwards. The streamers are brightest below, and gradually pale off towards their tops, and these tops vanish away in space so as to be undefined. In both the largest and brightest streamers reach out the furthest, because they are the fullest and most copious jets or brushes of the electric fluid. Taking them altogether the line of their contours above is a very broken jagged line. Hence around the sun the contour of the corona is often not circular but trapezoidal and otherwise irregular. Between the bright radiations of the corona there are darkish lines extending outwards, not really dark, but faint spaces less brightened by the rays. Wider spaces between the rays are called "rifts;" the same as there may be deep depressions, nearly vacant spaces, in our auroras between two tall streamers. These radiations and rifts in the solar corona have been photographed.

The same rapid changes in our aurora are seen in the solar corona. Sometimes the corona is large, and then it is so bright that the eye can scarcely endure its splendor. It then extends far outward, and is very irregular in its exterior contour—the streamers in some places are seen to rise a million of miles high. At other times the corona is small and pale, and without radiations, or such radiations as are easily perceptible. Then its form around the sun is circular, and nearly even in contour. Prof. Newcomb, describing the total eclipse of 1870, said, "Instead of the gorgeous spectacle I witnessed in the total eclipse of 1869, I saw only the most insignificant corona." Speaking of the "great changes in brilliancy," he says, "the corona of 1869 seemed to me many times more brilliant that that in 1870." "The light of the latter seemed everywhere as soft and diffused as the zodiacal light." Still even then, other observers, probably with clearer skies, could detect rays, as Prof. Eastman and Capt. Tupman. Professor Harkness, writing of the eclipse of 1870, said, "I do not think the corona more than half or two-thirds as extensive as that I witnessed in 1869. On that occasion it had a well-marked trapezoidal form, but this time it seemed to me more nearly circular." "Otto Struve, observing at Leipsic, in 1842, found the corona so bright that the naked eye could scarcely endure it. Mr. Airy has been fortunate enough to witness several total eclipses, and he testifies that the corona was much brighter in some than in others. The experience of the officers of this observatory is the same." Here the aurora borealis shows precisely the same differences at different times. It may be large, bright, distinctly radiated, with a rough, uneven contour; or it may be small, faint, without radiations, and perfectly circular on its top.

Not only from year to year, but even during the brief period of a total eclipse, the corona of the sun changes before the eye. In this respect also it is identical with our aurora borealis. Streamers in both shoot up almost with the velocity of light. I have seen in one aurora strong undulations, like white clouds, fly up from our northern horizon to the auroral corona, south of the zenith, in the fraction of a second. The great comet in 1843 passed around the sun in about two hours, and its tail, more than 100,000,000 miles long, must have swept around through an arc of 300 degrees in that short period. It could not have swung around like a stiff lever from the comet; for that, considering the small mass of the comet, would have been contrary to the laws of matter and of motion. It must have darted off from the comet every instant 100,000,000 miles, with the velocity of light. Nothing but electricity can do this. Now the conviction fastens itself on our minds, that the streamers of the solar corona must be capable of the same out-darting velocity. What happens on our own globe and on the comets may happen in the sun. Hereafter observers of total eclipses will watch attentively to see the movements in the solar streamers.

Already we have a beginning in these facts. Captain Tupman, in his report to Professor Harkness about the eclipse of 1870, writes as follows: "The first part of the corona that attracted my attention was a ray or enlargement at the right upper quadrant, a little to the right of the very bright protuberance, A; but by the time you had done with the polariscope, which could scarcely have been ten seconds, the left and lower parts, B to C in the figure, were the brightest and the largest; and so they remained until near the end of the totality, when the part, D, in the right lower quadrant, almost if not quite rivalled them. The ray, D, did not enlarge suddenly, but very gradually indeed. The upper part of the corona was throughout the faintest. The extreme right was also faint until quite at the end of totality, when it brightened a little. No part increased in brilliancy without extending itself further from the moon at the same time, so as to become a more or less pointed ray." Just, in fact, as it should do if it were the action of electricity. A copious outgush of the electric fluid would enlarge and brighten the ray and extend it far outward as an electric brush. The evidence is strong that the corona of the sun varies, like the aurora borealis, not only from year to year, but even during the short space of a total eclipse.

I have now brought together the chief facts about the corona of the sun. They are like those of the aurora borealis. The aurora is well known to be electric. And all the facts of the corona are perfectly explained by the same theory. Regarding the corona as being a great electric brush, we have also an explanation why the aurora and the zodiacal light point, like the tails of comets, away from the sun. They are driven off by the sun's electric repulsion. If the sun's electric brush extends off on every side a million of miles from our stand-point, then if we stood nearer, say at the orbit of Mercury, we would likely be able to see them extend twice as far. The power, the repulsive force, of such an enormous mass of electricity is beyond our estimation by any reasoning, *à priori*. Facts alone must teach us how far its repulsive force may extend, and such facts we see in the diurnal and in the eleven years' periodicity of the aurora, and in the diurnal periodicity of the zodiacal light. Such facts we see much more impressively in the directions of the tails of comets driven off by the mighty repulsion of the solar corona. To the comets we will now attend.

The Tails of Comets regarded as Electric Brushes.—Here on our earth some materials evolve much more electricity than others. Tin, zinc, and mercury, duly mixed, are found to be the best for friction machines; and a like selection of acids and metals is necessary for the galvanic battery. The materials of the sun and of the comets are very different from ours, and, therefore, they evolve much greater quantities of electricity. The fixed lines in the solar spectrum are innumerable, and indicate hundreds, probably thousands, of simple elements in the sun. Only about a half dozen of them are terrestrial, and some of these, such as the iron, may have fallen in the sun as meteors. Thousands of solid meteors strike our earth annually, and the iron ones occasionally weigh thousands of pounds. More and heavier meteors must fall in the sun. The materials of comets we know to be very different, because they are such light bodies, and they are easily evaporated and dilated by solar heat. A comet at a distance appears large, but nearer the sun it seems smaller, because much of its mass is so dilated by solar heat as to be invisible. As the cometic and the solar elements are so different from the terrestrial, it is not strange or singular that their evaporation gives out more electric fluid than the saline waters of our ocean.

Comets present appearances so different from the other celestial bodies, that they have been a terror to the world, and even scientific men have regarded them as totally different in their natures from the other stars. But they are precisely similar to the other stars; the only difference being that they carry some few ordinary principles to excess. Their bodies are solid and very small; in modern times they have repeatedly occulted the stars. Their atmospheres are unusually large. They are easily evaporated and dilated by the sun's rays; and in this evaporation they evolve unusual amounts of the electric fluid. This is all. These few facts explain all their wonders without exception.

From their smallness they do not make their appearance in the outer regions of the solar system. Donati's comet in 1858, so magnificent when near, was first seen by the telescope as a faint nebulosity at only half the distance of Jupiter, whose diminutive moons are so easily seen with the smallest telescope. As they approach the sun their peculiar elements are easily evaporated; from this evaporation their electricity is evolved, which, rising up through their atmospheres, produces light; the same as it produces light in our own atmosphere. from the mild glow of the aurora to the brilliant lightning. When first visible they are a faint nebulosity. On coming nearer to the sun, their evaporation is so rapid, and their electric outflow is so abundant, that they are the most splendid objects in the heavens, and often they have been seen in the daytime, even in the close neighborhood of the sun. These facts show that very little of their light is the reflected radiance of the sun. It is chiefly their own independent luminosity springing from electric excitement.

This light is seen to arise from the side toward the sun, and, therefore, from the most heated and evaporated side. It rises narrowly fan-shaped; very narrow and bright below, and spreading and paling upwards through the cometic atmosphere. It is then, by the repulsion of the sun's corona, driven backward all around like a fountain away from the sun, and it forms the tail, which generally spreads and becomes fainter, until it is lost by dispersion. Its resemblanee to our auroral streamers is then complete. In the summer of 1874, when Coggia's comet appeared in our northern horizon, with its large, broad tail projecting straight upward, I was on Monnt Desert Island, far up the coast of Maine, where the auroral streamers rise beautifully almost every night. The rise of those streamers, and the rise of the comet's tail, were identical in every particular. Both were of the same color and tint; both were brighter below and gradually paled off upwards. Their tops had the same indefinite ending, and both plainly lengthened and shortened while attentively watched. Tremulous waves ran upwards through them both—whitish, cloud-like appearances—as if they were special gushes of the electric fluid hastening to escape, and carrying out the tops of both to a further distance. The same cloud-like impulses pass through our artificial auroral tubes. But they are plainer to our view in our near auroral tubes, less plain in the aurora brushes, and faintest of all in the tails of comets. These three gradations depend on the distance. I remarked that the general brightness of the comet's tail, so many million miles off, was about equal to that of the aurora borealis, so comparatively near; proving that the amount of the electric fluid from the comet must have been inconceivably the greater.

It is a cardinal faet that the tails of comets do not occult the stars. If their tails were vapors of any kind, the occultations would be decided and constant; therefore the apparent vapor rising up from the sunny side of the comet is really the electric fluid.

The tail of a comet must be a hollow tube, because it springs from the sunward side, and falls back around on every side. like the waters of a fountain, and its own self-repulsion hinders it from coming together. Hence there appears a dark line through the centre of the tail, because from there, less electric light meets the eye than from the borders whose edges are turned towards us. The dark line cannot be the shadow of the nucleus, because a shadow cannot curve as did Donati's comet.

The fan-shaped jet of light arising through the front of the comet's atmosphere is not always steady, but breaks out at different places, "as from points of least resistance." Hence the tail is sometimes described as unsteady, and to "sway to and fro like a willow branch."

Auroral arches arise over our northern horizon and hover there for a while, occasionally two or three above one another, and then dart off in streamers. Exactly the same luminous arches rise in front of the comet, and the streamers then become the tail. But there is this difference. The streamers of the aurora rise from the convex side of the arch; those of the comet are driven backward by the solar corona, and seem to depart from the concave side.

The head of a comet is solid, with perhaps some exceptions, and the bright glow of light all around it is called the nucleus. The broader and paler atmosphere is called the coma or hair. But some writers call the tail the coma. In the coma or atmosphere there may be clouds, as in our own; and these clouds have been seen to be lit up by the electric passage. A comet may have many tails, as many as six. This is because in the solid nucleus there may be many points of least resistance, out of which the streams of vapor and electricity flow.

The greatest wonder about comets is the length of their tails; some of them are 120,000,000 miles long and even more. The diameter across the tail has been known to be 15,000,000 miles. But is it possible that there could have been so much electric force in a comet as to send out such an electric brush? We may as well ask how it is possible for our sun to send out such a mass of heat and light uninterruptedly during hundreds of millions of years? The answer is, that the materials of the sun and of comets are so very different from those in our earth. The enormous heterogeneity of matter should be more studied by the scientific men of our day. This neglect is now their great fault. All matter was once many billion times more rare than hydrogen; not dilated by heat, but by its own native repulsion. This we know from the teachings of the nebular theory. Even yet hydrogen is a million and a quarter times less condensed than platinum. What differences there may be in the heat-giving power, or in the electric-producing power, of the materials of other celestial orbs, we are perfectly unable, *à priori*, to tell. All that we know is from what we see.

The electric composition of these great tails becomes manifest from the way they go around the sun. Some great comets go around the sun in about two hours, as that of 1843, the tail all the while pointing away from the sun. Its outer end could not have swung around like a stiff lever through a space of 700,000,000 miles in so short a time. That would have been inconsistent, as I have already said, with the laws of matter and of motion. The tail must, therefore, have darted out continuously from the comet as an electric brush, and it must have been repelled in its direction away from the sun by the sun's more powerful electric mass. There is something clearly defined and decided in the huge tail pointing away from the sun in its approach, and then apparently swinging around with the velocity of lightning, and on its departure pointing away from the sun again. The electric theory of the constitution of the solar system explains the wonder clearly and easily, and nothing else can.

Evaporation explains why the tails of comets have become shorter on successive visits. The tail of Halley's comet was first described as being excessive. In 1682, it was 30° in length; in 1835, its greatest length was only 20°. For the first two months in 1835 it had no tail. It began on October 2d. On the 5th, it was 4° or 5° long. On the 15th, it had gained its greatest length, 20°. On the 29th, it was only 3°. Afterwards, at its perihelion passage, it had no tail. The explanation is that all these elements, whose evaporation evolved the electric fluid, had turned into vapor before perihelion, and then there could be no further evaporation with evolution of the tail. But a condensation of much of that vapor must again take place in the cold outer region away from the sun; and this recondensed material must furnish another tail on its next visit—a smaller tail, however, for a portion of the vapor must be carried away with the electric fluid, and scattered into distant space. When comets have no tails, it may be that they have never possessed any of those peculiar elements on whose evaporation the tail depends, or that by repeated visits to the sun all their powerful electric elements have been lost.

The electric theory explains the various forms of the tail. That of 1843, which was more than 100,000,000 miles long, appeared like a straight cylinder of light with very little difference in thickness through the whole length. I remember it well. It was very near the sun, whose large electric mass and powerful repulsion drove off the smaller mass in right lines. The sun was the great prime conductor fully charged, and the comet was only like a small highly-charged pith ball. The tail of Coggia's comet, being much further from the sun, was more spreading and fan-like. On account of greater distance, the sun's force was less, and the self-repulsion widened the tail. The tail of Donati's comet was spreading on account of the distance from the sun, and gracefully curved. This curving was because the comet was moving nearly at right angles to the direction toward the sun, and as the tail was not repelled out rapidly, it fell behind the comet in its progress. In our figure S represents the sun, and C the comet moving in the direction of the arrow, and getting in advance of the extreme end of its tail.

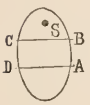
Fig. 2.

Our theory tells why some comets have been split in two or three parts, and finally into thousands of meteors. Although they are solid bodies, their cohesion is very slight. With a cotton string I tied in a bundle a handful of the downy tufted seeds of the milk-weed, *Asclepias incarnata*, which is abundant here. The other end of the string I connected with the prime conductor of a large electric machine. On turning the crank my bundle was soon dissipated, torn by electric repulsion into many parts, which flew away. The repulsion was too strong for my tying. So it may be too strong for the weak cohesion of a comet. It may divide the comet first into two parts, and then into shreds, which may form meteor streams like those of August and November. When Biela was divided into two, it is significant that each part was still a perfect comet, having a head, a nucleus, and a tail. The two alternated several times in brightness, according as the electric fluid was liberated more freely from one than from the other. In a thunder-storm we see the lightning leap suddenly from cloud to cloud. This violence is from the resistance of the air. But the two portions of Biela were in a vacuum, and a pale band of the electric fluid was seen to pass from the brighter to the fainter portion, the same as we see it pass through an exhausted auroral tube.

The two parts of Biela continued steadily to separate as though driven apart by their electric repulsion. Before their disappearance the distance between them was 160,000 miles, and by their next return that distance had grown to be 1,250,000 miles. On the night of the 13th and 14th of November, 1857, the officers of the Observatory at Washington counted 3000 meteors in an hour. Professor Newcomb calculated that on an average every meteor occupied as its own territory 900,000 cubic miles. The gravity of the sun could separate them only in one direction; but their nearly even diffusion every way seems like the work of electric repulsion. The meteors of the August stream are still more widely dispersed.

We can now see how comets may shorten their periods without the theory of a terrible ponderable resisting medium existing everywhere. That is a most violent theory, and threatens to break down the entire solar system on the sun. Let the curve A, B, C, D be the elliptic orbit of a comet, and S the sun in a focus. Let the comet on its approach move any distance from A to B in a day, and an equal distance from C to D in the same time on its departure. The electricity of the sun repels the comet, because both are clothed with electricity; the same as a charged prime conductor repels a charged pith-ball. For simplicity of conception let the repulsive influence from the sun move just as fast as the comet in these two regions of its orbit; that is, from B to A, and from C to D, in one day. Then on its approach the comet must suffer resistance in moving from A to B; but it finds no influence at all in moving from C to D. The same principle must apply nearly all around the orbit. Whatever the difference between the velocity of the comet and that of the repulsive force from the sun, it must remain true that from aphelion to perihelion the comet must lose more velocity from the electric repulsion of the sun than it gains by that repulsion, in moving from perihelion to aphelion. Therefore, upon the whole, the comet must suffer resistance from the electric repulsion of the sun, and its period must be shortened. This resistance is all the more effective from the great size and small mass of the comet. Encke's comet, which gave rise to the "resisting medium" theory, is highly electric, as is shown in the drawings of Professor Asaph Hall, made on its return in 1871, printed in 1872. For one, I am happy in being relieved from the dangerous, cumbersome, and highly improbable "resisting medium" theory.

Fig. 3.



It has before been surmised by some that the solar corona is electric. Others have thought that the tails of comets are electric. The aurora has been proved to be electric. But no one has conjectured the origin of these electricities, except that evaporation has been regarded as one of the origins of terrestrial atmospheric electricity. No one has assigned evaporation as the cause of the solar corona. Sir John Herschel believed the tails of comets to be vapors of some kind, raised by the heat of the sun, and driven away by some unknown repulsion from the sun. But his vapors were not the electric fluid, and his repulsion was not electric repulsion. See his "Outlines." No one has said that the zodiacal light is electric, and that this and the auroral streamers, always like comets, point away from the sun. No one has regarded all these phenomena as emanating from a common cause: the solar heat causing evaporation. No one has supposed that the far distant solar corona, by mere electric repulsion, drives off the tails of comets, the auroral streamers, and the zodiacal light. A highly-charged electric machine affects a delicate electrometer far off on the opposite side of a wide room; but this wonder, until now, was not fruitful in originating our theory. Now, first, all these distant facts have been brought together, and they are seen to form a harmonious system. A new spiritual influence is found to pervade our entire solar system. If, in this system, the solar repulsion drives off the tails of comets 120,000,000 miles with nearly the velocity of light, why should it not reach, like gravitation, to the nearest fixed stars? What and where is to be the end of this new advancement?

April 2.

The President, Dr. Ruschenberger, in the chair.

Twenty-six persons present.

The death of Dr. Charles Pickering, a correspondent, was announced.

Toilet Habits of Ants.—Rev. H. C. McCook stated that the agricultural ant—and the remark applies to all other ants of which he had knowledge—is one of the neatest of creatures in her personal habits. He thought he had never seen one of his imprisoned harvesters, either *barbatus* or *crudelis*, in an untidy condition. They issue from their burrows, after the most active digging, even when the earth is damp, without being perceptibly soiled. Such minute particles of dirt as cling to the body are carefully removed. Indeed the whole body is frequently and thoroughly cleansed, a duty which is habitually, he might almost venture to say invariably, attended to after eating and after sleep. In this process the ants assist one another; and it is an exceedingly interesting sight which is presented to the observer when this general "washing up" is in progress. In the evening, when the gas-lamp upon his table is lit, and he had leisure from professional duties to watch his insect friends, he had many times kept them under notice for protracted periods. They crowd against the glass, and gather in groups upon the earth close up to it and cleanse themselves, cleanse each other, and sleep. The first operation is conducted as follows: The ant to whom the friendly office is being administered (the cleansed, she may be called) is leaning over upon one side as we begin the observation. The cleanser (as we may name the other party) is in the act of lifting the fore leg, which is licked, the mouth passing steadily from the tarsus up to the body; next, the neck is licked, then the prothorax, then the head. The cleanser now leaves, and the cleansed begins to operate upon herself as will be described hereafter. This process may be seen throughout the entire group. We take another couple; the cleanser has begun at the face, which is licked thoroughly, even the mandibles being cared for, they being held apart for convenient manipulation. From the face the cleanser passes to the thorax, thence to the haunch, and so along the first leg, the second and third in the same manner, around to the abdomen, and thence up the other side of the ant to the head. A third ant approaches and joins in the friendly task, but soon abandons the field to the original cleanser. The attitude of the cleansed all this while is one of intense satisfaction, quite resembling that of a family dog when one is scratching the back of his neck. The insect stretches out her limbs, and as her friend takes them successively into hand, yields them limp and supple to her manipulation; she rolls gently over upon her side, even quite over upon her back, and with all her limbs relaxed presents a perfect picture of muscular surrender and ease. The pleasure which the creatures take in being thus "combed" and "sponged" is really enjoyable to the observer. He had seen an ant kneel down before another, and thrust forward the head, drooping, quite under the face, and lie there motionless, thus expressing as plainly as sign-language could her desire to be cleansed. He understood the gesture, and so did the supplicated ant, for she at once went to work. If analogies in nature-studies were not so apt to be misleading, one might venture to suggest that our insect friends are thus in possession of a modified sort of emmetonian Turkish bath!

The acrobatic skill of these ants, which had often furnished him amusement, was fully shown one morning in these offices of ablution. The formicary was taken from the study where the air had become chilled, and placed in an adjoining chamber upon the hearth, before an open grate fire. The genial warmth was soon diffused throughout the nest, and aroused the occupants to unusual activity. A tuft of grass in the centre of the box was presently covered with them. They climbed to the very top of the spires, turned around and around, hanging by their paws, not unlike gymnasts performing upon a turning-bar. They hung or clung in various positions, grasping the grass-blade with the third and fourth pairs of legs, which were spread out at length, cleansing their heads with the fore legs or bending underneath to comb and lick the abdomen. Among these ants were several pairs, in one case a triplet, engaged in the cleansing operation just described. The cleanser clung to the grass, while the cleansed hung in a like position below, and reached over and up, submitting herself to the pleasant process. As the progress of the act required a change of posture on the part of both insects, it was made with the utmost agility.

The ants engaged in cleansing their own bodies have various modes of operating. The fore legs are drawn between the mandibles, and, as far as could be ascertained, also through or along the lips, and then are passed alternately back of the head, over and down the forehead and face, by a motion which closely resembles that of a cat when cleansing with her paw the corresponding part of her head. Sometimes but one side of the head is cleansed, in which case the foot used is drawn through the mandibles or across the teeth of one mandible after every two or three strokes upon the face. These strokes are always made downward, following thus the direction of the hairs. The hairs upon the tibia and the tarsus seem to serve the purpose of a brush or comb, and he had thought that the object in drawing the leg through the teeth or between the mandibles is to straighten up the hairs, and thus increase their efficiency for service. Not only the fore pair, but also the other legs are passed, as above described, through the mouth. The second and third pairs are also and oftener cleansed by the fore legs as follows: the ant throws herself over upon her side, draws up the middle and hind legs, which are interlocked at the tarsi, and then, clasping them with one fore leg, presses the other downward along the other two. The fore legs alternate in this motion. When the legs of one side are cleansed, the ant reverses her position, and repeats the process. When the antennæ are cleansed they appear to be taken between the curved spur at the extremity of the tibia and the tibia itself, as one would clasp an object between the base of the thumb and the hand, and are drawn toward the tip of the flagellum, evidently with some pressure. He had thought that he could notice this spur also used as a brush or scraper in the general application of the fore leg to the body. It seems to have an articulation at its junction with the tibia.

The cleansing of the abdomen places the ant in a grotesque attitude. The hind legs are thrown backward and well extended, the middle pair nearly straight outward from the thorax, and less extended, so that the body is able to assume a nearly erect posture. The abdomen is then turned under the body and upward toward the head, which is at the same time bent over and downward. The body of the ant thus forms a letter C, or nearly a circle. The fore feet have meanwhile clasped the abdomen, and the work of brushing has begun. The strokes are directed upward toward the apex of the abdomen, and the foot passes around and beneath the under part, which is now toward the sternum. The apex is frequently licked by the tongue, and the feet are occasionally passed through the mouth (not simply between the mandibles), after which they again are applied as before. Evidently moisture is conveyed from the mouth and rubbed upon the abdomen. He had so frequently observed this action that he could hardly be mistaken in the glossy appearance which showed the presence of moisture upon the surface. Occasionally the leg is rubbed over the head after being drawn through the mouth, and so again to the abdomen. Usually the abdomen is held a little distance from the sternum, but he had seen it pressed up close against the breast, while the outer (upper) part was being cleansed. One ant was seen cleansing its abdomen while hanging by the hind legs from the roof of the formicarium. The abdomen was thrown up and between these legs, just as a performer on the turning-bar throws his body and legs upward and between the arms. The head was reached upward from below to the apex of the abdomen, while tongue and fore feet were engaged upon it in the usual way.

The amount of time devoted to these toilet duties is very great with his imprisoned ants, but is probably not so great in a state of nature. No doubt with ants, as with men, an artificial condition of society gives inducement to a larger devotion to personal appearance. He had not been able to give them much attention during the day; but when they are transferred to the neighborhood of register or fire-place, and thus are made unusually comfortable, they at once begin their ablutions. Invariably, at night, when the gas-lamp is lit and placed near the glass formicaries, the heat and light, both of which appear to be grateful to them, tempt them out, as already stated, and they begin operations. So also after eating, and when awaking from sleep. In short, whenever they are in a particularly comfortable state they express their satisfaction by making their toilet.

Notes on Acer rubrum.—Mr. THOMAS MEEHAN observed that polygamous plants were defined as those which had hermaphrodite and male and female flowers on the same or separate plants, and, in some of our text-books, the red maple was given as an illustration. But though the red maple had full-sized anthers in the early stage of the female flowers, the stamens were never fully developed, or were polleniferous, so far as his experience extended. According to his observations, the casual observer might be pardoned for supposing what are really but female flowers are hermaphrodite; for, on the bursting of the petals, the centre of the flower seems a mass of perfectly formed anthers. At this particular stage of the inflorescence, the appearances in the male and female flowers are exactly alike, except that in the female flowers the apices of the two pistils are visible in the centre of the mass of stamens in the one case, while they are wholly absent in the other. But, with the expansion of the petals, all growth in the stamens ceases in the pistillate flowers. They remain in this unfinished condition, while the pistils continue to elongate and the ovaria to enlarge, eventually drying up and falling away. In the male flowers, however, the filaments lengthen to one-fourth, and occasionally in some trees to half an inch; and, when the proper time comes, the anther cells burst and the pollen escapes. Why the stamens should be advanced to this stage in the female flowers to be suppressed just before their full development does not appear. It is an interesting problem awaiting further investigation, but it leaves us with the fact that the flowers are none of them truly hermaphrodite. The red maple is really a diœcious plant.

Mr. Meehan then proceeded to examine the average proportion of the sexes among individual trees. On a tract on which were 144 trees, apparently ten to fifteen years old, he found 34 of them not yet in flowering condition; of the remaining 110, 41 were females and 69 males, showing about one-third more males than females. He had examined a large number of trees of mature age, but so far as he could ascertain there was no attempt to change the sexual characters, but each tree was male or female throughout its life. In all that has so far been said of the structure and behavior of the flowers, those of the silver maple, *Acer* *dasycarpum*, correspond, but in the permanency of the sexual character the silver maple departs here. It is not uncommon to find trees originally female, at some time sending forth male branches. So far as his observations have gone, no male tree ever produces female branches, nor does a branch once producing male flowers return to a female condition. Notes were made to ascertain whether the mere vegetative vigor or the early or lateness of flowering had anything to do with the sexual conditions; but though some trees were nearly a week later in opening their flower buds than others, and some trees were weak and starved looking, while others were vigorous, these varieties were as equally divided among those of one sex as the other.

It was further noted that the male flowers were fragrant, while the female flowers were inodorous, in this respect similar to the willow. The male flowers of the willow are eagerly sought for by bees which collect pollen from them. So far he had found no bees visiting these, though in the warm April days some of the last to be in blossom attract small sand wasps to them. It is probable that bees may under some circumstances visit the flowers, though under this season's observation they had not done so. As it appeared that in many cases bees and insects were attracted to flowers by their odor, and that the visits resulted in cross fertilization, it was worthy of inquiry by those engaged in this special study what purpose was served by this sweet attraction in cases like this of the maple and willow. Can it be that the red maple or its ancestors were once truly hermaphrodite, and that when the sexes were separated, and the species become anemophilous, fragrance remained as the hereditary remains of a past usefulness?

The following papers were ordered to be published:—

THE BASILICA SPIDER AND HER SNARE.

By Rev. Henry C. McCook.

In the month of July, 1877, I was encamped upon the hills of the Colorado River, a few miles southwest of Austin, studying the habits of the Agricultural and Cutting Ants of Texas. A limited portion of time was given to observations upon spiders, in the course of which the object of this sketch was discovered. Her snare was hung about two feet from the ground, upon a bush which stood in the midst of a grove of young live-oaks. This snare had the composite structure imperfectly represented in Fig. 1. The general form of the snare was that of a pyramid, the upper part of which, *r*, was a mass of right lines knotted and looped, and crossing in all directions. Within this mass was suspended an open silken dome, *d*, constructed of a vast number of radii, crossed at regular intervals by concentrics after the manner of the snare of the common orb-weaving garden spider. The radii were about $\frac{1}{16}$th of an inch apart at the bottom or circumference of the dome. The concentrics extended entirely and with equal regularity to the summit. They did not cross the radii in circular lines, but presented that notched appearance which is observed in the webs of some orb-weavers, particularly those whose snares are horizontal, as for example, Hentz's *Epeira hortorum*. The meshes formed by the radii and spirals had thus much the shape of the meshes in a fisherman's net. (See Fig. 9, *n*.) The diameter of the dome was from 7 to 8 inches at the base, the height nearly the same. It was suspended in the midst of the mass of right lines by silken guys of like character, which thoroughly steadied the delicate structure, and perfectly preserved its form. Beneath the dome, from two to three inches removed, was a light sheet of cobweb, *c*, irregularly meshed of waving and straight lines. It had a decided convexity upward, and was supported like the dome above it, and of which it seemed to be a protecting curtain, by silken threads or guys, so stretched as exactly to meet this purpose.

Of the many specimens of spinning-work which I have noted and studied, I have never seen one so beautiful as this. It was with real regret that this rare piece of spider architecture was destroyed, after it had been sketched, in order that the architect, herself one of the most beautiful of her order, might be collected for the cabinet. The species has been named *Epeira basilica*, her architecture having suggested the dome-bearing temples of the earlier Christians of the Eastern Church.

Fig. 1.

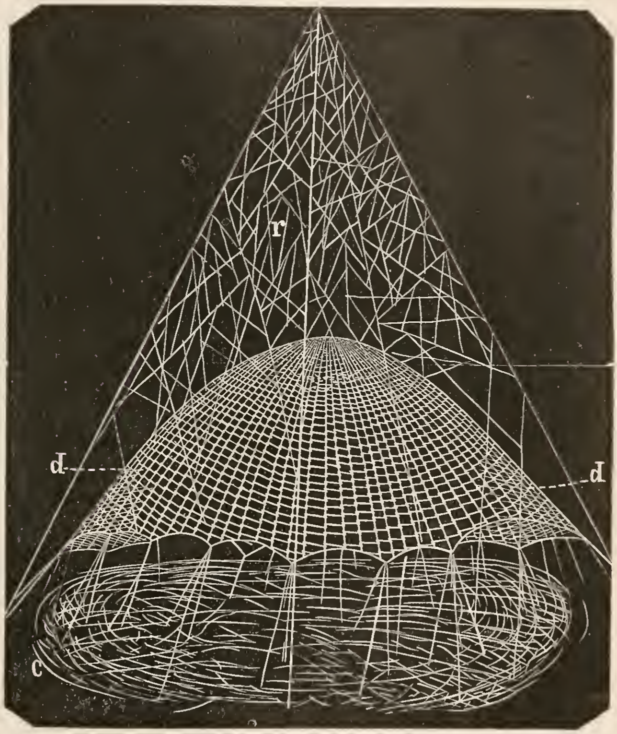
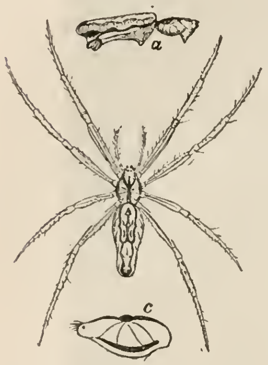


Fig. 1. Snare of *Epeira basilica*. d. Dome; c. Curtain beneath; r. Retitelarian snare.

It would be an interesting study to the architect of human habitations, to uncover the principles upon which this silken basilica was reared. He would doubtless find admirable adaptation of means to ends; he would be likely to meet methods quite familiar to himself, and perhaps stumble upon some of which he is yet ignorant. He certainly would have occasion to marvel that a structure so stable could be wrought out of such fragile material as spider silk, and that the delicate dome could be so poised in the midst and by the help of silken threads as to preserve its perfect form. Perhaps he would rise from the study with a higher appreciation of the qualities and character of despised Arachne.

Nor would he find the creature herself unworthy of admiration as she hangs inverted within and just below the summit of the dome. The term beautiful is rarely associated with individuals of her order, but it may properly be used in this case. The fore part of the body, cephalothorax, is of a golden-yellow color, bordered and marked with blackish bands. The legs are a delicate green, having the thighs marked by blackish longitudinal bands, and blackish annuli at the joints. On the back of the abdomen the colors within the blackish marginal lines are as follows: At the base, next the cephalothorax, a snowy white; the middle lobes are a light yellow, the lower lobes and the cruciform figure (showing white in the illustration), are a golden-yellow. The bands and markings on the side of the abdomen, a view of which is given at *a*, Fig. 2, are in the following order from the top, viz., crimson, white, dark-green with light-green edges, blackish to dark green, yellow. Even the most fastidious lady would find it hard for her nerves to prompt a cry of "horrid spider!" against a creature bearing such delicate colors and dwelling in such a fairy-like domicile. In sooth, the ill reputation of spiderhood is had from those forms that affect the neighborhood of man, as cellars, out-houses, and kitchen walls. These are among spiders what vultures are among the birds. If one would see the graceful forms and beautiful colors, he must follow the creature to her favorite haunts in groves, woods, by streams and among meadow grasses, where he shall find many a species that may rival even the butterflies in brilliancy of coating.

Fig. 2.



Epeira basilica, magnified. *a*. Profile; *c*. Cephalothorax.

Fig. 3.

Eyes of *E. basilica*, magnified.

However, the special point of interest about the Basilica spider is neither its architectural skill nor its fair colors. Its chief importance in the mind of the araneologist is that it seems to form a perfect link between the orb-weaving and the line-weaving spiders in the characteristic spinning-work of the two groups. The main object of this paper is to exhibit this fact.

Some of the orb-weavers (*Orbitelariæ*) have associated with their geometrical snare the characteristic snare of the line-weavers (*Retitelariæ*), which is a mass of right lines knotted together at various angles, and forming at once the home and the snare of the animal. The web of the labyrinth spider, *Epeira labyrinthea* Hentz, is an example of this, common to at least our Eastern States. Another of these composite webs is that of the *Epeira globosa*, Keyserling, Fig. 4, a description of which is appended to this paper.[1] The curious manner in which the snares of the *Orbitelariæ* and *Retitelariæ* blend may be sufficiently shown by Fig. 5, which illustrates the spinning-work of this spider, as compared with Figs. 1 and 6.

Fig. 4.

Epeira globosa. Female. Length, .25 inch.

It will be remembered that the simple characteristic web of the orb-weaver is the vertical geometric orb represented at Fig. 5, *o*. In that example, however, there is a slight variation, as seen at *f*, in a break in the radii, leaving what is known as a free radius. The bell-shaped den of thick white silk, *d*, within which the spider constantly dwells, is not peculiar to this species; most of the orb-weavers have a similar tent, or some floss-upholstered crevice, hole, or leafy nest, within which they conceal themselves frequently or habitually. But *Epeira globosa* exhibits two other remarkable additions to the simple orb. First, there is an open but quite distinct tube, *g*, attached to the mouth of the den, *d*, from which it reaches almost to the centre, *c*, of the orb to which the free radius is fastened. The free radius runs through or along the "floor" of this tube, is continually kept taut, and is clasped at the upper end by the fore feet of the spider. An insect struggling in the orb thus communicates the motion to the vigilant creature in the den, who dashes along her covered gangway, *g*, to seize her prey. This gangway is at times imperfect, shortened, or even wholly omitted, but is frequently found as in the figure, which was drawn from nature. In this bell-shaped den and connecting tube one may see a germ or modification, or suggestion,

[1] See Proceedings Acad. Nat. Sciences, Phila., p. 201, 1876.

of the dome-shaped sheet-web of the *Linyphioidæ*. See Figs. 6 and 7.

Fig. 5.

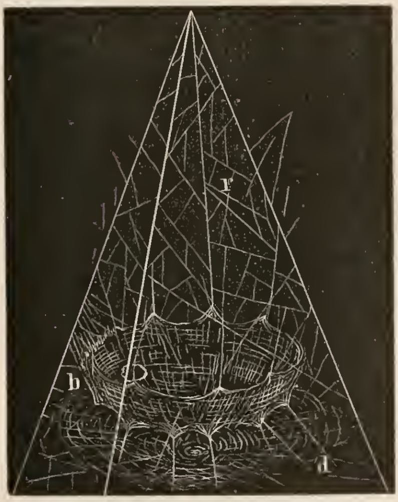
Snare of *Ep. globosa*. d. Den; g. Gangway; m. Mass of right lines above; f. Free radius; o. Orb; c. Central.

The second addition to the typical orb web is the mass of right lines, *m m*, which surrounds the den and the gangway, and incloses the upper part of the orb. This is an exact retitelarian snare, as will be readily recognized by any ordinary observer of the cobwebs (for the most part of the *Theridioidæ*), which form the bulk of those infesting the angles of our kitchen, chamber, and outhouse walls. It is probable that the purpose of this snare is to suspend and keep in poise the dwelling place, *d*, and to protect the spider therein and on the gangway from the assault of invading wasps and other enemies of the order. At least I have not observed it to be used by the adult spider for the capture of prey, the orb being the chief dependence for that. These lines appear also to serve the young spiderlings for a sort of play-ground and foraging field for small insects.

We have thus our first distinct connecting link between the spinning work of orb-weavers and line-weavers, established at the typical web of the latter as shown especially in the snares of the family *Theridioidæ.*

The second and most noteworthy link, which indeed constitutes in the web of *E. basilica* a complete inter-blending of the groups, is at the snares of the *Linyphioidæ.* The genus *Linyphia* is one of the largest and most important genera of the line-weavers. In order to show the steps by which the two groups approach each other in habit, some explanation of the spinning work of the *Linyphiæ* is necessary. Their webs differ from the *Theridioidæ* substantially in the addition of a sheet-like web to the web of right lines; indeed the right lines take a subordinate or subsidiary place, and the sheet appears to be the real snare. There are three common variations of form. First, a plain sheet of thin silk, attached to the under part of leaves, or suspended between twigs, as in the web of *Linyphia costata.* Second, the web represented at Fig. 6, the snare of *Linyphia communis.* It is composed of a mass of right lines, *r*, to which is suspended a bowl-like sheet, *b*, beneath which again is a dish-shaped sheet, *d*, of more open spinning work with the concavity upward as in the bowl. The snare from which the figure was drawn (Aug. 15, 1877, Delaware Co., Pa.) had a total height of from 12 to 14 inches; the diameter of the bowl was 6 to 7 inches, its depth $1\frac{1}{2}$ to 2 inches. The spider hung, inverted, to the lower surface of the bowl, and was thus protected from assault by the underlying dish, *d*.

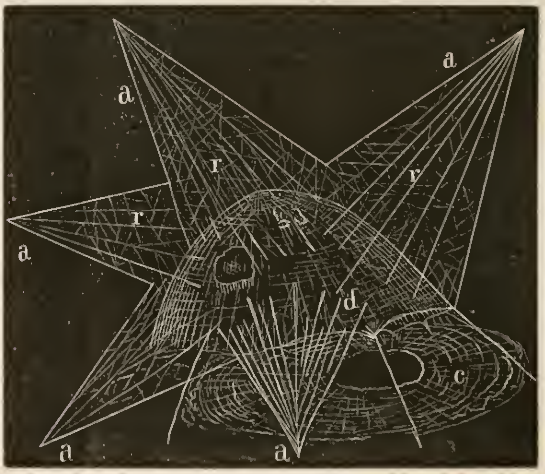
Fig. 6.



Snare of *Linyphia communis.* b. Bowl; d. Underlying dish; r. Snare of right lines.

A third variation is that of the beautiful snare of *Linyphia marginata* (*L. marmorata* of Hentz), which is in form precisely that of Fig. 6, except that the bowl becomes a dome; that is, the sheet, *b*, has the concavity downward instead of upward, and the dish, *d*, undergoes the same change. In other words, the web of *L. marginata* has the exact form of the Basilica spider's web, except that in the latter the dome (*d*, Fig. 1) is constructed of open, regular meshes, formed by the intersection of radiating ribs of silk by notched concentrics. In the former (*L. marginata*), this bowl is woven of irregularly placed threads into a thin sheeted web. The lower curtains, *c c*, and the upper retitelarian web, *r r*, are substantially the same in both. That is to say, the typical character of the orb-weaver's snare, viz., regular radiating lines regularly crossed by spiral lines, appears in the web of *Ep. Basilica* without any other change from a fixed generic Linyphian web. Fig. 7 represents the snare of *L. marginata* as drawn from an example suspended within an opening in a pile of pine boards at Bellwood, in the Allegheny Mountains. The snare commonly has the pyramidal form of Fig. 6 when hung among bushes, weeds, and grasses, its most natural site.

Fig. 7.



Snare of *Linyphia marginata*. a a, r r. Retitelarian snare, branched; d. Dome; c. Lower curtain.

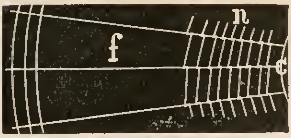
We may trace this interesting analogy from another point in the group of orb-weavers, and find yet further coincidences. It will be noticed that the typical orb of the *Orbitelariæ*, as represented at *o*, Fig. 5, is vertical, while the corresponding section of the web of the Basilica spider Fig. 1, *d d*, may be properly described as horizontal. That is to say, if a horizontal orb attached at the circumference in the usual way, were to be lifted up by a thread fastened in the centre, it would assume the shape of the dome in the web of the Basilica spider. In point of fact, this effect might be produced from the characteristic snares of certain species of the orb-weavers, which, as has already been stated, are placed in a horizontal plane, at times more or less inclined by the stress of circumstances. Our most common examples of these species are the Stilt spider (*Epeira grallator*), and the Orchard spider (*Ep. hortorum*). Fig. 8 represents the snare of the latter.

Fig. 8.

Snare of *Epeira hortorum*.

The diameter of the orb is quite habitually from seven to nine inches. The spider, one of the most beautiful of the order, hangs inverted at the open central space, Fig. 9, *c*, whose diameter is about the length of her body. Next to the open central is a series of concentrics which are most frequently ten in number. They are closely drawn, the ten covering a space of one-half to one-third of an inch. These concentrics have the same notched arrangement as the spirals in the dome of the Basilica spider. (See *n*, Fig. 9 compared with Fig. 1.) Next follows a free space, *f f*, about one inch in width, beyond which are spirals, in number usually about thirty, which cross the radii at right angles in the usual way. The number of radii generally about corresponds with that of the spirals, and at the circumference they are from one-sixteenth to one-thirty-second of an inch apart. Beneath the orb, reaching downward sometimes ten inches, is a mass of retitelarian lines, Fig. 8, *r r*, which for the most part extend under but two sides of

Fig. 9.



Section of horizontal snare of Orchard spider. c. Central; n. Notched spirals; f. Free space.

the orb. The spinning work of this mass is much more open than the corresponding objects, *c c*, in the Linyphian webs above described, but the resemblance is marked. If one were to fasten the thread to the central point of the orb in the orchard spider's web, Fig. 8, and gradually lift it until the orb should assume the dome shape, he would have a snare very strongly resembling that of the Basilica spider. The difference would be in the absence of the retitelarian web above and around the dome, and the presence of the peculiar arrangement of the spirals just noted.

We have thus traced the analogy between the spinning work of this species of the orb-weavers, and that of the line-weavers, in these several particulars; *first*, in the dome-shaped snare and dwelling place; *second*, in the mass of retitelarian lines placed around and above the dome; *third*, in the sheet-like curtain underneath the dome. Our *E. basilica* is seen to possess all the characteristics of the families of the *Retitelariæ*, viz., right lines and sheet-web in exact detail, and dome-shaped web in outline. It also is seen to possess the chief characteristic of the *Orbitelariæ*, viz., the geometric web, or radiating lines regularly crossed by concentrics; to combine, moreover, in its dome structure the vertical and horizontal forms of the geometrics, and to have the notched arrangement of the spirals peculiar to webs of some species. The Basilica spider may therefore be regarded as well nigh, if not completely, bridging the space between the spinning economy of these two great groups or sections of the *Araneæ*.

It may be added that there is a close resemblance in structure between certain of the orb-weavers and line-weavers. This is so striking in Koch's genera *Meta* and *Zilla*, that they have been classed with both sections. While, therefore, at one point we find the sections closely approaching each other in structure, in another we see them inter-blending in habit. A comparison between the structures of the two creatures, *L. marginata*, and *E. basilica*, whose spinning works have such marked likenesses, shows, however, no such close structural resemblance.

ARANEÆ.

ORBITELARIÆ.

EPEIRINÆ.

1. **Epeira basilica,** n. sp. ♀. Fig. 2, p. 126. Length of body .28+ inch.

The cephalothorax is oval, longer than broad; color livid yellow, with irregular black bands around each margin, and a medial band, black, extending to the eye-space; the base is rounded, the grooves and indentation distinct. Beneath the sternum is a long oval, pointed toward the abdomen, wide black bands at the margin, inclosing a scalloped, yellow medial band, in which are two parallel rows of blackish dots, of three each. The head is slightly elevated beyond the thoracic juncture, but gradually depressed toward the eye-space. The eyes are in two semicircular rows, Fig. 3, the inner row concave toward the front, the outer convex. The lateral eyes are in contact, the foremost being much the smaller. The four medial eyes form a quite regular parallelogram, somewhat longest longitudinally; these and the two inner lateral eyes are about equal. The eyes of the hind row are separated from each other by about the same distance. The distance between the anterior middle eyes is slightly less than between the posterior middle. The distance from the margin of the clypeus to the anterior middle eyes is about equal to one-half the distance between the anterior and posterior middle eyes. The falces are conical, vertical, slightly inclined inward, of a livid yellow color, touched with black at the tips. The maxillæ are gibbous, hairy at the edges, blackish. The lip is black, subtriangular, almost semicircular, rounded at the base into a concavity in the sternum. The palpi are yellow, with green annuli at the joints, the radial and digital joints well armed with long bristles, shorter, and more numerous at the tips which are armed with a strong pectinated claw. Legs 1, 2, 4, 3, the difference in the length of the 1st, 2d, and 4th pairs being very small; the 2d pair, if anything, a little the longest; the length of these is about $\frac{7}{16}$ of an inch; of the 3d pair about $\frac{5}{16}$ of an inch. The femur has numerous spinous bristles, arranged in spirals on the first two pairs, longest beneath, and numbering six. On the tibia and metatarsus are three spirals of long spines, each spiral having four spines. Short comb-like bristles continue to the claws along the metatarsus and tarsus. The claws are of the typical *Epeira* number and form.

The color of the legs is green, with blackish rings at the joints; there are two blackish longitudinal bands or lines on the thigh, which are somewhat wider and more distinct on the first two pairs of legs. The abdomen is three-sixteenths of an inch in length, subcylindrical, overhanging the cephalothorax slightly, and at the apex, protruding above the spinning mammulæ. It is formed and marked as in the figure. The colors are as follows: above or on the back waving lines, crimson, except toward the apex, where they are blackish, inclose a lobed band, white at the base, yellowish at the middle lobes, and golden at the apex where it terminates in a cruciform figure. On the sides the order of color is, a crimson band; white; light green with dark green edges; yellow. Beneath, the abdomen is blackish with yellow dots and spots.

Habitat: Texas, near Austin.

2. **Epeira globosa**, Keyserling. Fig. 4, p. 127.

Verhandlungen des zoologisch-botanischen Vereins, XV. 1865, p. 820.

Length of body, ♀, one-fourth inch; ♂, three-sixteenths inch; width of abdomen of ♀, one-eighth inch.

The cephalothorax is of a uniform livid yellow color, convex, nearly smooth, cut off squarely at the base, rounded on the sides, highly compressed in front, the medial indentation deep. The head is prominent, slightly elevated, hairy. The eyes are in two transverse rows, the anterior row decidedly convex toward the front, the posterior nearly straight. The four intermediate eyes form a parallelogram of which the anterior side is longest by about one-half. The two anterior middle eyes are separated from each other by a distance at least twice as great as that which separates the two corresponding posterior eyes, and from these latter by a distance about equal to that which divides themselves from the margin of the face; they are black, as are also the lateral eyes, and are placed on tubercles. The lateral eyes are in contact, the hinder one the larger. The distance between the front lateral eye and the anterior intermediate is about one-half greater than the space between the two intermediate. The falces are conical, vertical, toothed; brownish, deepening into blackish toward the fang. The lip is triangular, but rounded on the base; the sternum is heart-shaped, the maxillæ rounded on the sides and cut squarely at the tip. These last three parts are of a chocolate-brown color except a broad medial yellowish longitudinal band in the sternum. The legs are in order of length 1, 2, 4, 3, are armed with spines and bristles, and have three claws of the usual epeiroid structure. In color they vary, according to age, from olive green to livid yellow, with anuli, quite black on the tibia and metatarsus. The palpi are colored like the legs, and have a strong pectinated claw. The abdomen is hairy, reticulated, overhangs the cephalothorax. It is of an olive green or livid, and strongly marked on the back with a butterfly-like figure, white, with black edgings ; a line of white spots extends along the sides on either side, beneath a black lateral band above the venter. Across the base of the abdomen in front extend two rows of black dots, the lowest the shorter.

The ♂ does not greatly differ from the ♀, but is smaller. The digital joint is a prominent bulb, covered with curved bristles, convex externally, less convex within, and compressed toward the tip. Just within the palm is a straight spine, pointing outward.

This spider makes a composite snare, as described and figured above, Fig. 5, being a vertical orb, with a free radius, and surrounded above with a snare of right lines.

Habitat: Eastern Pennsylvania and New Jersey. Probably the entire Atlantic coast.

NOTE ON THE PROBABLE GEOGRAPHICAL DISTRIBUTION OF A SPIDER BY THE TRADE WINDS.

BY REV. HENRY C. MCCOOK.

While examining and classifying the collection of spiders in the Academy of Natural Sciences of Philadelphia, I discovered a number of specimens of the large laterigrade *Sarotes venatorius*, Linn., from various localities, as represented upon the accompanying tables and chart (Fig. 1). Starting with the specimens in my private collection, the line of distribution was traced from Santa Cruz, Virgin Isles, to Cuba, to Florida, across Central America, Yucatan and Mexico, across the Pacific Ocean by way of Sandwich Islands, Japan, and Loo-Choo Islands, and thence across the continents of Asia and Africa to Liberia. The line thus indicated extends from the extreme eastern limit of North America to the extreme western coast of Africa, thus girdling the globe, with the exception of 54° of longitude. This excepted area expresses substantially the width of the Atlantic Ocean.

It occurred to me when this fact became apparent, that this line of distribution is within the belt of the North Trade Winds; and further, that there might be some connection between the two facts and the fact that the laterigrade spiders, to which group this animal belongs, are among those which are most addicted, in the earlier stages of growth, to the interesting habit of migrating from point to point. This is done by means of fine threads, emitted from the spinnerets in sufficient bulk to overcome the specific gravity of the body. In other words, they belong to the ballooning species.[1] The suggestion which thus arose led me to refer to a competent authority as to the general course and limits of the North Trades. These are roughly indicated in the chart, Fig. 1, by the two upper lines of arrows, marked (at the ends) *A A* and *B B*. In the Atlantic Ocean the North Trade Winds prevail between latitude 9° N. and 30° N.; in the Pacific between 9° N. and 26° N. We now may turn to the chart in which the following geographical points (shown by a *dot* and *figures*) are represented by our spider. The specimens which have been examined, in the

[1] For some observations of this habit, in full, see an article, by the writer, in Proceedings of the Academy of Nat. Sci., Philadelphia, 1877, p. 308.

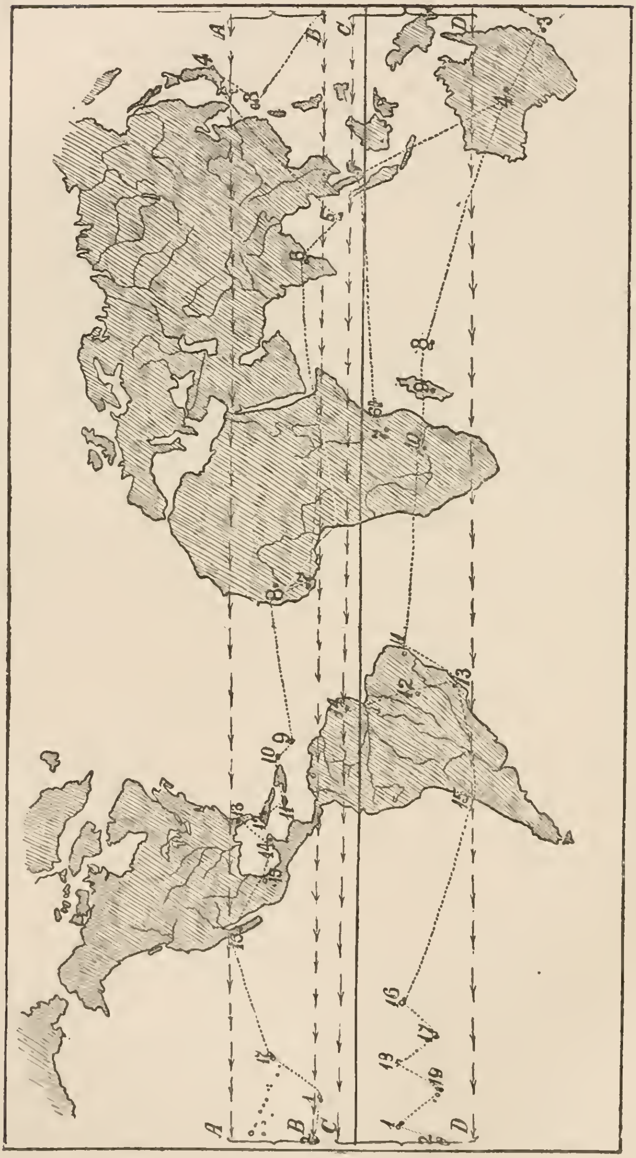
Academy and my own collections, whose habitats are personally known, are marked by an asterisk (*). The species is credited to the other localities named on the authorities given therewith.

A comparison of this table with the chart will at once show that the dotted lines in the latter, which indicate the limits of the geographical belt over which (so far as the specimens in hand and described can determine) *Sarotes venatorius* is distributed, correspond, with remarkable general exactitude, with the belt over which the North Trades blow. It is not, therefore, an improbable conjecture that this distribution has been accomplished by means of those winds and the habit of aerial flight above referred to. It is, of course, supposable that commerce, following largely the same belt, may have originated or aided this distribution. But it is hardly necessary to resort to this hypothesis, when there is one quite as probable, and wholly natural, and operative *before* the general diffusion of inter-continental communication by ships. This last-named condition the facts in the history of the spider seem to require.

Some of these facts are, (1) the early discovery of the species as already widely distributed; (2) its presence at so many different insular points nearly or altogether contemporaneous with their first visits by commercial nations; (3) the existence of the species or its close allies among the fauna of the tropical interiors of continents far distant from coast lines; (4) and finally the variations, chiefly in color, which have been observed, and which would seem to require for their development a longer period than that which has transpired since the commencement of commercial communication with the localities in which the variations have been wrought. While one may not conclude with absolute certainty from these facts, they certainly warrant the theory that the Huntsman (*venatorius*) spider has become cosmopolitan by the action of nature independent of the aid of man.

I was so impressed by the above chain of facts, and so confident of the inference therefrom, that I ventured to predict that corresponding results would follow a comparison of specimens collected from all other quarters; that is to say, they would be found to lie within the belt of the North or South Trade Winds. The only specimens at hand were those cited above, and from Zululand and Surinam. But I was enabled to pursue the matter fur-

Fig. 1.—Chart of Distribution of Sarotes venatorius.



A A, *B B*, belt of North Trades. *C C*, *D D*, belt of South Trades.

ther by reference to the locations of various specimens given in the descriptions of a number of naturalists. I was greatly aided in this by references kindly sent me by Mr. Wm. Holden. Some of the localities thus obtained have been tabulated above, and others were found to correspond with the points represented by specimens examined. So far then the conjecture was verified.

The two lower arrow lines in the chart, *C C* and *D D*, give a general view of the course and limits of the South Trades, which prevail in the Atlantic Ocean between latitude 4° N. and 22° S., and in the Pacific between latitude 4° N. and 23½° S.[1] It is of course understood that these limits are not stationary, but follow the sun, moving northward from January to June, and southward from July to December; an oscillation which is also indicated in the zone of distribution. They are, however, substantially as above given, and may be compared with the following table, which shows the southern geographical distribution of this species according to the authorities cited therein.

Table of Distribution North of the Equator.

	Locality.	Latitude.	Longitude (Gr.).	Authority.
1.	Palmyra Island,	6° N.	163° W.	*
2.	Pelew Islands,	7°–8° N.	134° E.	L. Koch.
3.	Loo-Choo Islands,	25°–29° N.	128° E.	*
4.	Japan,	30°–40° N.	130°–140° E.	*
5.	Nicobar Islands,	6°–10° N.	96°–97° E.	Böck.
6	Tranquebar, India,	12° N.	80° E.	Fabricius.
7.	Liberia, Africa,	5°–9° N.	10° W.	*
8.	Senegal, Africa,	17° N.	16° W.	Walckenaer.
9.	Martinique, N. America,	15° N.	61° W.	
10.	Santa Cruz,	18° N.	65° W.	*
11.	Jamaica,	18° N	77° W.	Walckenaer.
12	Cuba,	20°–23° N.	74°–85° W.	*
13.	Florida,	30° N.	81° W.	*
14.	Yucatan,	20° N.	82°–91° W.	*
15.	Mexico, Jalapa,	20° N.	97° W.	*
16.	California,	?	109°–117° W.	L. Koch.
17.	Oahu, Sand. Islands,	20° N.	155°–160° W.	*

[1] An error appears in the chart in the location of the southern limit of the South Trades. The arrow line should not run directly westward from Valparaiso, Chili (15), but from a point 10° above it, passing just south of Friendly Isles (19).

Table of Distribution South of the Equator.

	Locality.	Latitude.	Longitude (Gr.).	Authority.
1.	Viti Levu, Fejee Islands,	16° S.	180° W.	L. Koch.
2.	New Caledonia,	20°-22° S.	163°-162° E.	"
3.	Sidney, Australia,	33° S.	150° E.	Böck.
4.	Australia,	11°-30° S.	105°-115° E.	L. Koch.
5.	Singapore,	2° N.	104° E.	Walck.
6.	Zanzibar, Africa,	6° S.	40° E.	Gerstaecker.
7.	S. E. Equatorial Africa,	10°-20° S. (?)	30°-50° E.	Blackwall.
8.	Mauritius,	20° S.	56° E.	Walckenaer.
9.	Madagascar,	8°-26° S.	43°-50° E.	Vinson.
10.	Zulu-land,	20° S.	28° E.	*
11.	Pernambuco,	7° S.	37° W.	
12.	Brazil,		37°-70° W.	Simon, Walck.
13.	Rio Janeiro,	23° S.	50° W.	Walck.
14.	Surinam,	6° N.	55° W.	*
15.	Valparaiso, Chili,	33° S.	70° W.	L. Koch.
16.	Tahiti, Huaheine, Soc. Is.	18° S.	150° W.	L. Koch.
17.	Rarotonga, Cook's Isls.	22° S.	162° W.	"
18.	Upolu, Navigator Is.	13½°-14½° S.	168°-173° W.	"
19.	Tongatabu, Friendly Is.	20° S.	172°-176° W.	"

This table shows a distribution corresponding with the limits of the South Trades, with, in three cases, viz., Sidney (3), Surinam (14), and Valparaiso (15), a slight oscillation in accord with a fact above stated. Thus was entirely fulfilled the expectation with which I entered upon its preparation. It might with equal confidence be predicted that *Sarotes venatorius* may be found distributed throughout the South Pacific Islands within the same general belt; moreover, that it may be found among the fauna of the chain of small islands between the Sandwich Islands and Asia, viz., Philadelphia, Drake and Massachusetts Islands, Anson and Magellan Archipelagoes; also of the Cape Verde and St. Helena Islands, off the west coast of Africa. These have all doubtless been stations in the line of migration, the latter across the Atlantic Ocean as the Antilles have been; the former across the Pacific, as the Sandwich Islands, Loo-Choo Island, and Japan have been, and as Mauritius and Madagascar Islands have been across the Indian Ocean. Perhaps a more diligent search might even now prove that this cosmopolitan species has already been collected at some of the above points.[1]

[1] It will be observed that the tables show that the missing points in the South Pacific Islands have been actually bridged over. After the presenta-

There seems nothing improbable in the theory suggested to explain the series of facts here presented. There are not, indeed, many recorded observations of the distances to which spiders are carried out to sea in their aeronautic flights. But before a strong, steady wind, or in cases of storms, it is possible that the greatest distances which appear in the tables could be overcome. An observation of Mr. Darwin is the only one in point to which I can refer.[1] At the distance of sixty miles from land, while the Beagle was sailing before a steady, light breeze, the rigging was covered with vast numbers of small spiders with their webs. The little spider, when first coming in contact with the rigging, was always seated upon a single thread. While watching some that were suspended by this filament, the slighest breath of air was found to bear them out of sight. I have observed similar single-threaded "balloons" sailing at a considerable height above the surface of the earth, and know no reason why, with a favorable breeze, they might not have been carried hundreds of miles. That they were carried at least sixty miles, as Mr. Darwin's testimony shows, and that before a light breeze, gives great probability to such a conjecture. It is to be noted, moreover, that the spiders arrested by the Beagle's rigging were evidently moving on when so stopped, and some of them when arrested soon resumed their flight across the main.

The purpose in nature of such a remarkable habit as these well-known facts exhibit is, doubtless, to secure the distribution of species throughout wide regions. The buoyant filament of spider-gossamer serves the tiny arachnid the same good office that is rendered the thistle-seed by the starry rays of down surrounding it.

It may not be without interest, and may, perhaps, have some bearing upon the above theory of distribution, to remark that the genus (or a closely allied genus) to which *Sarotes venatorius* be-

tion of this communication as above, and the preparation of the chart, I received from Mr. Wm. Holden, of Marietta, Ohio, a number of references from Koch's descriptions of Australian spiders, to which I did not have access, which enabled me to verify in this particular also the prediction made. The tables and chart have been corrected in accordance with the facts thus kindly supplied, but the above paragraphs have been permitted to stand as they were originally written and communicated to the Academy.

[1] Voyage of the Beagle, vol. iii. p. 187.

longs is probably one of the oldest known forms of the spider fauna. Thorell[1] places the now existing genus *Heteropoda* (*Ocypete*, Koch, *Oxypete*, Menge), from which *Sarotes* has been divided, among those which are represented in the amber spiders. This amber is a fossil vegetable resin, which is met with in various brown-coal strata, and is copiously thrown by the waves on the southern coasts of the Baltic, especially the coast of Prussia and the Kurische Haaff. This amber belongs to the tertiary ("oligocene") period, and in it numerous spiders are found, generally well preserved. How far any supposed contiguity or closer approach of continents now separated might have facilitated or occasioned the world-round distribution of our Huntsman spider, is a point upon which geologists may more properly express an opinion.

The question, what variation of species, if any, occurs in the course of this distribution, is of great interest. The specimens examined by me show no variations which may not be accounted for by differences in age, or which may not come within the range of those ordinary natural differences which all animals more or less exhibit. Most of the specimens, however, had been so long in alcohol as to obliterate any differences in color which might have existed. The normal color is a uniform tawny yellow, varied upon the cephalothorax by a circular patch of blackish or blackish-brown color covering nearly two-thirds of the space; and, further, by a white or whitish marginal band quite or nearly girdling the same. In some of the specimens this circular patch seems to have been more or less of a brownish color. The eminent naturalist Gerstaecker[2] speaks of this species as distributed over a large part of Africa, Asia, and South America. Specimens were examined by him from Dafeta, Mombas, and Zanzibar. In these there was some variation in the coloration of the maxillary palpi: on the one hand, from a light rust-color to brownish-red and pitch-brown; on the other hand, to a more or less sharp division or limitation of the light yellow color of the anterior and posterior borders of the cephalothorax. There was also a browning of the region about the eyes. Gerstaecker very justly observes that this indicates that on this sort of differences not as many

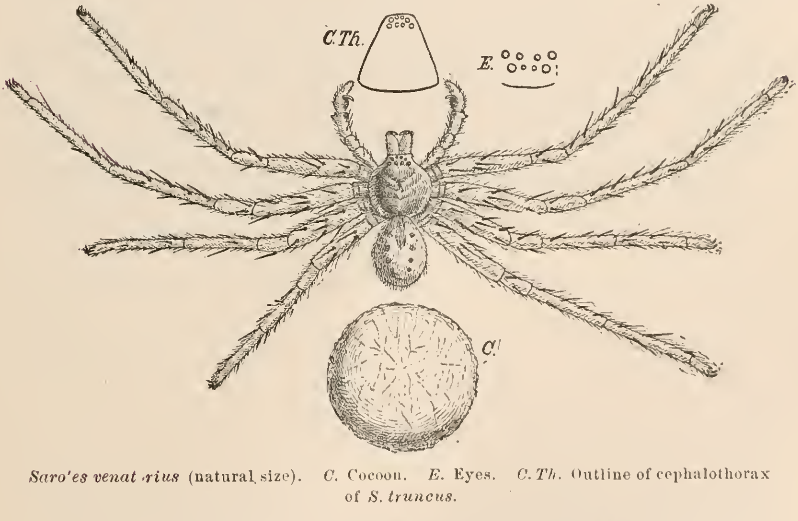
[1] European Spiders, p. 231, Nov. Acta. Reg. Soc. Sci. Upsal. 1870. I have not the work of Koch and Berendt, to which Thorell refers.

[2] Von der Decken's Travels in East Africa, III. ii. p. 482.

specific characters can be established as upon the more stable differences in the relative size of the eyes and legs.

A female, closely resembling the male which is here figured, was sent to me from Vera Cruz (Virgin Isles) by Mr. F. G. Sherman. It was taken in or near the house by one of the colored servants, who (says Mr. S.) handle the spiders readily and with impunity. The *cocoon*, Fig. 2, *C*, was inclosed in the box. It is of a pink color; is drawn about natural size, being over three-fourths of an inch in diameter. Cocoons of the same description were sent me by Mr. Jno. F. Folsom from Cuba, together with a large number of young spiderlings. These had evidently escaped from the cocoon, after immersion in the spirits. They are three-thirty seconds of an inch long; whitish color, with reddish-brown annuli or regular markings upon the legs, and two rows of dots of the same color on each side of the medial line of the abdomen.

Fig. 2.



Saro'es venat rius (natural size). *C.* Cocoon. *E.* Eyes. *C. Th.* Outline of cephalothorax of *S. truncus*.

The male, Fig. 2, was received from Archibald McIntyre, Esq., who brought it from Florida in the winter of 1874–75. It was observed for the space of five or six weeks hanging listlessly to the wall in the angle of the ceiling. It then moulted, moved, and was captured. The length of body is about three-quarters of an inch; the abdomen being somewhat shrivelled, its length is somewhat uncertain. One of the 4th pair of legs is shorter, imperfect, showing that the original leg had been lost in combat or by some accident, and that a new leg had thus far been restored by nature. The fact that both these specimens—the only ones in hand of whose habits I have any account—were found in the house would seem to indicate a fondness for such domicile, that might make more easy the distribution of this species by means of ships. Moreover, Latreille records,[1] as a fact communicated to him, that in certain parts of the tropical regions of the New World, this animal, instead of being looked upon with aversion, as are the most of its order, is regarded with positive pleasure by proprietors of homes, on account of the service rendered in the destruction of cockroaches and other noxious insects. For this purpose the spider is not only preserved, but is introduced within the house. Mr. Holden has information of the same fact in connection with this or an allied species in the Sandwich Islands. It may be said that the general habit of the entire group of laterigrades is, however, quite different from that of house-spiders. They chiefly inhabit trees and shrubbery, upon the leaves or bark of which they lie in wait and seize their prey as from ambush. The spider is probably rare, at least not abundant, in the United States. It has frequently been described in European journals; but, as it has a place among our spider fauna, a description is herewith appended, together with a synonymicon of the most important references.

ARANEÆ.

LATERIGRADÆ.

THOMISOIDÆ.

PHILODROMINÆ.

Sarotes venatorius (Linn.), 1767.

1767. *Aranea venatoria*, Linn., Syst. Nat. (12 ed.) I. ii. p. 1035, No. 33.
1789. *Aranea venatoria*, Linn., Syst. Nat. (13 ed.) I. p. 2960, No. 33.
1793. *Aranea regia*, Fabr., Entom. Syst. II. p. 408, No. 4.
1804. *Heteropoda venatoria*, Latr., Nouv. Dict. d'H. N. (1st ed.) XXIV. p. 135.
1805. *Thomisus leucosius*, Walck., Tabl. d. Ar. p. 36, No. 28, pl. 4, fig. 33.

[1] Nouv. Dictionnaire d'Hist. Nat., ed. 1819, tom. 34, p. 33, art. *Thomise*.

1806. *Thomisus venatorius*, Latr., Gen. Crust. et Ins. I. p. 114.
1806. *Thomisus leucosius*, Latr., Gen. Crust. et Ins. I. p. 113.
1810. *Aranea regia*, Epit. Entom. p. 111.
1829. *Thomisus leucosius*, Latr., Cuvier, Regne Anim. IV. p. 256.
1833. *Sarotes regius*, Sund., Conspect. Arachn. p. 28.
1836. *Thomisus leucosius*, Duges, Regne Anim. Arachn. p. 60.
1837. *Olios leucosius*, Walck., H. N. d. Ins Apt. I. p. 566, No. 5.
1842. " Lucas, H. N. Cr. Ar. et Myr. p. 395, No. 3.
1845. *Ocypete draco*, C. Koch, Die Arachn. XII. p. 44, f. 983.
1850. " C. Koch, Uebersicht, V. p. 37.
1851. *Olios leucojus* (*leucosius*), Böck, Verh. z-b. Ges. Wien, XI. p. 389.
1863. " " Vinson, Ar. Reun. Maur. et Mad. p. 98, No. 3, pl. ii. f. 3.
1864. " " Simon, H. N. d. Araign. p. 410.
1866. " " Blkw., Ann. Mag. Nat. Hist. 3d ser. XVIII. p. 457.
1870. *Heteropoda venatoria*, Thor., On Europ. Spid. p. 178.
1873. *Olios regius*, Gerst., in C. von der Decken, Reisen in Ost. Afr. III. ii. p. 482.
1875. *Sarotes regius,* Koch, Die Ar. Austr. pp. 660, 675, 854, Tab. 56, f. 1, 2.

Length of body, five-eighths inch. Spread of legs, five inches.

Cephalothorax slightly convex, large, broad, broadest through the middle part, rounded on the sides, slightly truncated at the base, very little compressed in front. The caput is but little elevated; is truncated at the face. The color of the spider is a uniform tawny, except upon the cephalothorax, where a broad, brownish, and black band flows down about two-thirds the distance from the medial line to the margin. The margin of the cephalothorax is again of a tawny color, the band running around in front, narrowing toward the face, which it crosses just above the articulation of the falces, the color being whitish on the face. The head and eye-space are touched with black, or are tawny. At the indentation the blackish band divides by a tawny line which follows the cephalic juncture around to the face. The eyes, Fig. 2, *E*, are arranged in two rows of four each, the front row being the shortest. The two central front eyes are the smallest of all, and are placed upon an elevation narrowing towards the front. These are nearer to each other than are the two posterior middle eyes, from which they are separated by a space somewhat larger than that which separates the front eyes and the margin of the face. The lateral front eyes are the largest of all. Viewed from the front they are nearly in a straight line (subrecta); but viewed from above they are slightly curved backward. The back row of eyes is about equally (perhaps even less) curved backward. They are more nearly equal in size, but the lateral eyes are larger than the middle ones. A whitish line below the eyes joins the face with the falces, which articulate nearly upon a plane with the face. They are conical, covered with bristles, rather blunt at the end, but cut away upward and toward each other. They have about six teeth. Lip is oval, cut squarely at the tip. Maxillæ are gibbous, lean toward the lip slightly, are rounded at the end, scalloped at the middle of the outer edge, tipped with thick tooth-like hairs. Sternum cordate, tawny color, hairy. Palpus of female (Santa Cruz) long; the joints armed with about five strong, short spines each, the terminal joint ending with a thick brush of bristle-like hairs, imbedded within which is a five-toothed claw. The palpus of the male has on the outside of the digital joint a black, double-toothed, or notched, horn-like projection. In the palm of the terminal bulb is a black cushion, from or below the end of which projects a pinkish, spine-like organ. On the end of the radial joint without is a black, corneous projection, curved at the extremity.

Feet, order of length, 2.4.1.3, the difference between 4.1. not very marked.

On the upper part of the thigh (femur) are arranged eight black spines, six in pairs along the upper side; two along the very top, one of these two being in a row with the 2d pair, the other standing alone near the joint of the patella. This last is shorter by about one-half, and bent more than the others. A pair of short and slight spines on the sides of the patella. On the tibia are nine spines, eight arranged in pairs below or on the under sides, the last two near the joint of metatarsus being shorter and bent; the remaining spine is between the 1st and 2d pairs, and above. There are five spines on the metatarsus, three shooting out well together near the joint of the tibia. The under sides of the tarsus and metatarsus are covered with a thick scopula. The claws are two—long, strong, curved toward the end, toothed at the base, apparently the inner claw having more teeth. A pad or brush completely underlies the claws. Abdomen much shrivelled, but evidently oval, tawny, hairy, and marked as nearly as may be as in the figure.

Habitat. Florida.

Sarotes truncus, n. sp.?

In the collection referred to in the above paper was found one specimen which differs so widely from other individuals in the shape of the cephalothorax that it is probably entitled to be classified as a new species. The cephalothorax, Fig. 2, *C. Th*, is truncated at the base, which is the widest part, being three-eighths of an inch wide, which is also the length of the medial line of the cephalothorax. The sternum is an almost regular decagon. The eyes and other parts correspond generally with those of *S. venatorius* as described. The view of the eyes in the figure is from above.

Female. Japan.

APRIL 9.

Mr. GEORGE W. TRYON, Jr., in the chair.

Twenty-two persons present.

The following papers were presented for publication:—

"Transition forms in Crinoids, and description of five new species," by Charles Wachsmuth and Frank Springer.

"On a new Species of Sponge," by Alpheus Hyatt.

Vegetative Repetition of Cerebral Fissures.—Dr. A. J. PARKER remarked that in studying the cerebral fissures, as found in the brains of different animals, we find them divided into several groups. These are called primary, secondary, tertiary, etc., according to their constancy and degree of importance. The primary fissures comprise those fundamental, deep, and important clefts, which appear earliest in the development of the embryo, and are to be found represented in all brains where marked fissuration exists. They correspond in position and bear definite relations with deep and important structures. The secondary fissures come next in importance. They appear in the embryo after the primary, and comprise those fissures which give the general character of fissuration to groups of brains. Tertiary fissures, etc., are the smaller, less important ones which branch off from the primary and secondary, or mark more or less deeply the various separate convolutions formed by the other fissures. These fissures give the special character to each brain, and enable us to point it out as belonging to this or that genus or species of animals. The constancy in appearance and position of these fissures follows the same order as given above; that is, the primary are the most constant in appearance and position, the secondary next, whilst the tertiary, etc., are the most variable; many of the minor branches of this latter group being present or absent, even in the same species of animal. With reference to the cause of development of these fissures three views are held.

According to one view, which is the one that has had most currency until within recent years, and which is still supported by many, such as Ecker. etc., the fissures of the cerebral cortex are due to mechanical causes entirely, being produced by the cranial contents developing more rapidly than the cavity of the skull, the brain folding itself in order to accommodate itself in bulk to the space allowed by its rigid bony environment. In this case, therefore, the fissures represent merely lines of least resistance to the compressing forces, and have no structural significance. According to the second view, fissures represent lines of retarded growth; that is, along these lines of the cerebral cortex, growth takes place less rapidly than in the surrounding portion, and these lines are, therefore, gradually converted into deep grooves or fissures. The third view is a compound of the other two. According to this, the principal fissures are produced by retarded growth, whilst many of the undulations and minor furrows are produced by compression.

Whichever view we adopt, the question still presents itself, are we to regard each fissure as produced by a distinct and separate process of formation, or are some of them only repetitions of fissures previously formed? In studying the cerebral fissures as presented in the brains of different animals, especially amongst the Carnivora and Ungulata, it had appeared to him that many of the fissures should be regarded in the latter light, that is, as vegetative repetitions. Viewed in this way, many difficulties with regard to the identification of homologous fissures in different brains disappear. According to the mechanical theory, a deep and distinct fissure having been formed, there would be a tendency to produce other fissures following the same general direction, having the same general appearance, and depending for their formation on the one originally laid down. According to the view that fissures are the result of retarded cerebral growth, we may expect to find, especially in lower forms of brains in which much fissuration exists, vegetative repetitions of the same lines of retarded growth. In either case, the fissures which appear after the original fissure, and which follow its general contour, should be considered as belonging to one group with that fissure, and to be of secondary importance in relation to it. Hence, in many cases, instead of seeking for fissures separately homologous to each other, we will be obliged to consider certain groups to be homologous to certain other groups, the number of separate fissures of which may be more or less numerous. Owen, in founding his nomenclature of the cerebral fissures in the Carnivora and Ungulata, gave a distinct and separate name to each fissure, and he endeavored to point out the homologue of each of these in different brains. If, however, we are to regard, as he should presently attempt to show, that at least some of these fissures are entirely secondary and to be considered as merely vegetative repetitions, then we must not seek, nor is it possible to find, homologues for each fissure, even in closely related brains.

Dr. Parker then proceeded to point out some of the fissures in the brain of the Carnivora and Ungulata, which appeared to him to be of the above nature.

If we take the brain of a carnivorous animal, as the domestic cat for instance, and examine the upper mesial surface of one of the hemispheres, we will find three fissures lying nearly parallel to each other, one above the other and proceeding postero-anteriorly. The upper two of these extend from the posterior extremity of the hemisphere, whilst the lower one begins a little anterior to the middle. It is the anterior extremity of this fissure which extends in a transverse direction on to the lateral surface of the hemisphere, and is known under the name of the crucial fissure. The whole fissure is called frontal by Owen. The middle fissure he terms the super-callosal, and the upper, the marginal fissure. This represents the state of things very nearly as found in the brains of all of the Carnivora. In some cases, however, he had found only two fissures instead of three, the frontal being continuous with the super-callosal; there being, however, a decided indication of a tendency towards separation at the anterior portion of this fissure. Thus in two specimens of *Coati nasica*, the frontal fissure was a branch of the super-callosal, a notch, however, indicating where the proper super-callosal would end. In two specimens of the brain of the lion, the frontal fissure was barely separated from the super-callosal, and in examining other brains of Carnivora intermediate stages were met with, from the condition as in *Coati nasica* where the two fissures were continuous to the state as found in the cat and ocelot where they are widely separated. It would appear, therefore, that the frontal fissure is of the nature of a separated anterior extremity of the super-callosal; and as such he had regarded it, considering it as a repetition of that fissure. The marginal fissure lies directly above the super-callosal, is similar in appearance and follows the same direction, but is not as deep or well marked, and appears in the embryo after it. This fissure should also, he thought, be considered in a secondary light to the super-callosal and to be a repetition of it. In some of the carnivora, as in the specimens of the brain of the lion, a fourth fissure makes its appearance in this region; lying between the super-callosal and marginal fissures, and similar in appearance and relations to them. He had, therefore, considered all of these fissures as belonging to one group, of which the super-callosal is the type, and the remaining fissures more or less numerous as vegetative repetitions of this fundamental and typical furrow. In a paper on the morphology of the cerebral convolutions, not yet published, he had called this fissure the mesial occipito-frontal, from its arising in the occipital region and proceeding forwards into the frontal lobe; whilst the remaining furrows he proposed to call the first, second, third, etc., repetitions of this fissure, designating the typical fissure by the letters *mof*, and its repetitions by mof', mof'', mof''', etc., respectively. The bearing of this will be rendered more evident, if we now compare these fissures as found in the Carnivora with the same as found in the Ungulata. In the Ungulata a fissure is found on the mesial surface of the hemisphere which is the homologue of the mesial occipito-frontal of the Carnivora. It takes its origin in the posterior or occipital region and proceeds forwards into the frontal lobe. Besides this, there are one or two other fissures present lying parallel with it which may be considered as repetitions of it. In these brains, however, the marginal fissure, which in the Carnivora lies on the mesial surface, appears on the lateral surface of the brain, together with a number of fissures more or less numerous, similar to it, and which are not represented in the brain of the Carnivora. It is this collection of fissures that gives to this region of the brain the complex character, and extensive fissuration which it presents. The brain of the Peccary, *Dicotyles torquatus*, seems to occupy a position in reference to these fissures, midway between the brain of the Carnivora and the brains of the other Ungulata. In the brain of this animal, we find on the mesial surface a distinct and well marked mesial occipito-frontal fissure, extending from the occipital region forwards and encircling the corpus callosum just as the fissura calloso-marginalis does in man, of which it is the homologue. A short distance posterior to its central point, a small fissure forks off from it, still remaining continuous with it. No other fissures are found on the mesial surface proper, but at the edge of the hemisphere, where the lateral and mesial surfaces join, a distinct and well marked fissure is found which follows the direction of the mesial occipito-frontal fissure and corresponds to the marginal fissure of the Carnivora; which he had regarded as a repetition of the mesial fissure, and designated as *mof′*. On the lateral surface in this brain there are no other fissures which can be considered as repetitions, but as we advance through a series of ungulate brains, this tendency to repetition in this region becomes exceedingly marked, and so numerous that they cover a considerable portion of the lateral surface of the brain. In *Dicotyles*, as we have seen, there is only a single fissure present, but these gradually increase in number until in some brains as many as five can be distinguished. In the Caribou and Sheep, two may be seen. In the Giraffe, Malay Tapir, and Llama, etc., three may be distinguished, and in the Horse he had counted as many as five. It is to this repetition of the same fissure that the exceedingly convoluted appearance of this portion of the ungulate brain is due, and not to the production of fissures which are to be considered as of the same importance as the other fissures of the hemispheres. Thus, although the brains of the Ungulata are much more convoluted than the brains of any of the Primates, except man and a few of the higher apes, still they must be regarded as of a lower type, since this more highly convoluted aspect is produced, not by a greater number of distinctive fissures, but to a great extent by simple vegetative repetition of fissures, which are found represented in these primate brains by a single furrow. Thus, the five fissures as found in the Horse, taken together are equivalent to the three as found in the Tapir, Giraffe, Llama, etc., to the two in the Sheep and Caribou, to the single fissure as found in *Dicotyles;* and finally they are all to be considered as vegetative repetitions of the mesial occipito-frontal fissure. In the Primates, this fissure is represented by the fissure calloso-marginalis, and here the same tendency is also shown, as we ascend from the lower groups towards Man, to split up into two or more similar fissures. Among the *Lemuridæ*, as *Propithecus*, *Indris*, *Avalis*, *etc.;* in the *Platyrrhini*, as *Hapale*, *Chrysothrix*, *Ateles*, *Cebus*, *etc.;* and in the *Cynomorpha*, as *Macacus*, *Cynocephalus*, *etc.;* this fissure is represented by a single continuous furrow. In the *Anthropomorpha*, as the Chimpanzee and Orang, this fissure becomes much broken in its character; and in Man it consists of several distinct parts, which are similar in appearance and relations to each other. He had noticed in some brains as many as five or six of these separate and distinct fissures following each other regularly along the course of the calloso-marginal fissure. They tend in appearance towards the shape of an elongated figure four. He had observed that this repetition is especially regular, and well marked in the brain of the negro. The calloso-marginal fissure is described as terminating posteriorly a short distance behind the central fissure, appearing as a slight notch on the lateral surface of the hemisphere. Directly back of this, a small fissure is present, situated on the præcuneal lobule, which has been regarded as a distinct and unimportant fissure merely marking this lobule. From a study of a number of brains, he had been led to consider this as the posterior portion of the calloso-marginal fissure detached from it, just as the anterior portion splits up into several parts. In the Orang and Chimpanzee this also appears to be detached, but in the lower forms the calloso-marginal fissure extends back without any break in its continuity. In the human embryo the calloso-marginal at the sixth month is represented by a continuous fissure, and it is only in the latter stages of development that it breaks up into separate parts. The fissures of the occipital lobe in those Primates in which it is fissured, appear also to be repetitions of pre-existing fissures. In the lower forms of the *Simiadæ*, the occipital lobe appears perfectly smooth and without any fissuration whatever. It is separated from the rest of the hemisphere by two well marked fissures. These arch, the one above and the other below the posterior extremity of the calcarine fissure on the mesial surface, and extending over on to the lateral surface run towards each other, and are separated only by a small narrow convolution, the *troisieme pli de passage externe* of Gratiolet. The two fissures together form an arch, which cuts off, on the posterior lateral surface of the hemisphere, a conical-shaped mass, the apex of which is directed forwards and downwards. These two fissures taken together he would term the primary occipital arch, and it constitutes the anterior boundary of the occipital lobe. This lobe is entirely smooth in many of the lower forms of the *Simiadæ*. Thus, in *Macacus cynomolgus* no fissures are present, but, as we ascend, this lobe becomes gradually more and more fissured. These fissures, when they appear, follow the direction of the primary occipital arch, so that a secondary arch appears within the first. This arch, in the same manner as the primary, extends around the upper and lower branches of the posterior extremity of the calcarine fissure. It might be well seen in many of the photographs to which he directed attention, especially in *Macacus nemestrinus* and in *Cynocephalus pors.* Sometimes this secondary arch is interrupted at one or two places by small convolutions, just as the primary arch is by the various *plis de passage*, but the separate portions still preserve the same relations as before. In the higher Apes these arches become more undulated. This is also the case in *Ateles.* In Man they become very much contorted and broken up, and it becomes difficult to recognize the relations between these detached portions and the parts of the primary arch which also become much separated. In the negro, these fissures remain more nearly in the state in which they are found in the higher Simians, and the correspondence between the two arches can be more clearly distinguished. The fissures of the occipital lobe should not, it appeared to him, be considered as of the same significance as the fissures of the other lobes, or as the fissures of the primary arch, but of secondary importance, and he would regard them as repetitions of the two branches of this arch.

In the temporal lobe Ecker has described a fourth temporal fissure in addition to the three usually recognized. This fissure is, however, as he admits, but slightly developed and often absent. He would regard this fissure in the same light as the fissure of the occipital lobe, viz., as a repetition of one of the temporal fissures. These constitute the most important fissures which he had been led to consider as of secondary significance, since they merely follow lines of development already laid down by a preceding furrow, and do not partake of the nature of independent fissures to the same extent as many others, although they may appear by their length and depth to be of equal morphological significance.

The following papers were ordered to be printed:—

STIBIANITE, A NEW MINERAL.

BY E. GOLDSMITH.

In the Academy's collection I noticed a mineral without a name, but having on its label the words "Victoria, Australia." On inquiry, I received the information from the Curator in charge that said specimen had been presented by the Australian Centennial Commission.

The mineral is massive, having the general aspect of a piece of rough feldspar. It is somewhat porous, and occasionally a shining face of a crystal is observed in the mass. The color is reddish-yellow, but not very uniform. In powder, it is pale yellow; its lustre is dull.

Hardness = 5. Specific gravity = 3.6686.

Blowpipe reactions: On coal, with carb. of soda, it affords antimony, a white incrustation, and on the removal of the flame, the peculiar ascending cloud.

Phosphorsalt dissolves it without any coloration in the oxidizing and reducing flame.

Heated in a tube closed at one end it affords some water. Hydrochloric acid, aqua regia, caustic potassa, and sulphide of ammonium dissolve the antimony compound, but not the gangue. The solution of the substance in caustic potassa indicated, on the addition of a solution of nitrate of silver, the absence of antimonious acid. A solution of sulphate of copper shows, on the other hand, the presence of antimonic acid. The solution formed in hydrochloric acid afforded, on the addition of iodide of potassium, a strong liberation of iodine. All these reactions are proofs that the antimony is in its highest state of oxidation; that is to say, the mineral contains only antimonic acid = SbO^5.

Quantitative analysis, 0.6227 grm. lost on heating the substance below a red heat, 0.0287 gram. = 4.60 per cent. of water.

Mr. W. H. Dougherty determined the water as	4.46	per cent.
He also ascertained the amount of gangue to be	13.55	" "
and the antimonic acid, from SbO^4, to be	81.21	" "
	99.22	

It is evident from these ascertained values that the purity of the mineral is not more than 85.67 per cent., and on recomputing this value to hundred, will give for

$SbO^5 = 94.79$ per cent. contains $O = 23.40$.
$HO = 5.21$ " " " $O = 4.62$.

The oxygen ratios are: $4.62 : 23.40 = 1 : 5.06$, from which the formula SbO^5HO is derived.

It is generally believed, and probably with good reason, that those oxides of antimony were derived from stibuite, which may also be the case in this instance, as a small patch of stibnite was noticed on the specimen examined.

STAFFELLITE, FROM PIKE'S PEAK, COL.

BY E. GOLDSMITH.

On a specimen of the well-known Amazon stone from Pike's Peak, an incrustation from 4 to 6 millimetres thick was shown for inspection, by Mr. Foot, to the members of the Mineralogical Section. It was given to me for determination, and the results are as follows:

On the upper surface it appears rather flatly mammillary massive, chalcedony or agate-like. If broken with the hammer, the fresh fracture has a silky lustre, due to a microcrystalline structure, which is clearly seen if a thin splinter of it is placed beneath the microscope, having mounted an objective of $1\frac{3}{4}$ inches. The fracture, which is somewhat splintery, but smooth, has a pale gray color; on the upper surface, where the mineral had been exposed, the color appears leek-green, and is rough to the touch.

Hardness = 3.5 Specific gravity = 2.959.

Blowpipe reactions: in the forceps, it swells up at first, then decrepitates; the color of the flame is orange-yellow.

Hydrochloric acid dissolves it with slight effervescence of carbonic acid gas to a perfectly clear solution. In the solution was found lime and phosphoric acid, and also some soda.

The quantitative analysis was performed on 0.500 gram. of substance. I obtained 0.6405 gram. of sulphate of lime, anhydrous = 52.74 per cent. of lime. Also 0.317 gram. of pyro-phosphate of magnesia = 40.55 per cent. of phosphoric acid; finally, 0.0335 gram. of anhydrous sulphate of soda = 2.92 per cent. of caustic soda. A sample of the powdered mineral was heated from 230° to 240° F. without losing any weight. The amount of carbonic acid was calculated to saturate the surplus lime and also the soda.

The surplus lime = 4.77 per cent., requires 3.74 per cent. $\ddot{C}$.
To the soda = 2.92 " " " 2.07 " " $\ddot{C}$.

From these considerations it would seem probable that the composition of the Staffellite from Pike's Peak, like the one described by Stein in Germany, do not differ much from each other.

Putting the analytical results together, it reads:

$3\,\dot{C}a, \dddot{P} = 88.52$ per cent. Mol. $= 0.571$ or 6.
$\dot{C}a, \ddot{C} = 8.51$ " " " $= 0.170$ or 2.
$\dot{N}a, \ddot{C} = 4.99$ " " " $= 0.094$ or 1.

From the ratios, the following formula may be deducted:

$$[6\,(3\dot{C}a, \dddot{P}), 2\,(\dot{C}a\ddot{C}), (\dot{N}a\ddot{C})] = 1083.$$

This requires $3\,\dot{C}a, \dddot{P} = 85.87$ per cent.
$\dot{C}a, \ddot{C} = 9.23$ " "
$\dot{N}a, \ddot{C} = 4.89$ " "

April 16.

The President, Dr. Ruschenberger, in the chair.

Twenty-one persons present.

The death of Michel Charles Durieu de Maisonneuve, a Correspondent, was announced.

On the Relation of Amœba quadrilineata and Amœba verrucosa.—Prof. Leidy stated that the small but characteristic amœboid form originally described by Mr. Carter (An. Mag. Nat. Hist., 1856, 243) as *Amœba quadrilineata*, from specimens found in Bombay, he had repeatedly observed from many positions in our vicinity. In association with it, he had noticed the singularly sluggish *Amœba verrucosa*, and also many intermediate forms, which led him to the belief that the former was the young of the latter. Subsequently, in reviewing the literature of the matter, he had been gratified to learn that Mr. Carter had arrived at the same result from a different point of view. In investigating the history of *Amœba verrucosa*, he found that its germs yielded young of the character he had previously described as *Amœba quadrilineata* (An. Mag. Nat. Hist., 1857, 37).

The forms described by Perty as *Amœba natans* (Kennt. kleinst. Lebensformen, 1852, 188), by Greeff as *Amœba terricola* (Arch. Mik. Anat., 1866, 299), and by Fromentel as *Thecamœba quadripartita* (Etudes Microzoaires, 346), he suspected to be the same as *Amœba verrucosa*.

April 23.

Dr. R. S. Kenderdine in the chair.

Sixteen persons present.

Prehistoric Remains.—Joseph Willcox called attention to portions of the jaws of some Indians, a stone axe, and a copper plate, that were found recently by him and Dr. Geo. H. Ambrose, in an Indian mound in the Gulf Hammock, twenty miles southeast of Cedar Key, in Florida. This mound, made with sand, was about forty feet in diameter at the base, and ten or twelve feet high. They found five Indian skeletons. The teeth in one of the jaws on the table, evidently of an old individual, indicated a remarkable freedom from decay. The stone axe is finished in a very smooth and skilful manner, and is made from a stone that is not found within one hundred and fifty miles of the mound. The copper plate is embossed, and is too highly ornamented to suppose that it was made by an Indian. Mr. J. W. Foster, in his work on the prehistoric races of the United States, writes that "a wide gap exists in connecting the history of the mound-builders with the present race of Indians." There is a large Indian mound among the mountains in Macon County, North Carolina; and the Cherokee Indians, now living in that vicinity, say that they have no tradition in reference to its construction. Perhaps this copper plate might be looked upon as a connecting link between the mound-builders and the early white settlers in this country, as it was found in conjunction with the skeletons and the stone axe.

Note on Corundum.—Mr. WILLCOX said that the corundum crystals presented by him were found at a locality in Laurens County, South Carolina, that had never been described. He lately visited the place. The corundum is found in a matrix of mica slate, which is considered a new rock for bearing corundum. Commencing at a point three-quarters of a mile east of Laurens Court House, the corundum is found at several places in a district about three miles long and one-half mile wide, in a direction nearly northeast. As is the case all through the Southern States, the rocks in Laurens County are so deeply covered with soil that it is difficult to trace them.

APRIL 30.

Mr. THOMAS MEEHAN, Vice-President, in the chair.

Twenty-eight members present.

A paper entitled "Elements of the Sidereal System," by Jacob Ennis, was presented for publication.

The Bridging Convolutions in the Primates.—Dr. A. J. PARKER remarked that the *plis de passage* of Gratiolet, the annectant, bridging or transition convolutions of the English anatomists, are small and in many cases concealed convolutions passing from the occipital to the temporal and parietal lobes. Gratiolet attached great importance to these *plis de passage* as points of diagnosis in different brains. He distinguished altogether six of these transition convolutions, four external and two internal. The two internal connect, according to him, that portion of the occipital lobe known as the cuneus, with the mesial portion of the brain directly in front of the parieto-occipital fissure; the so-called lobulus præcuneus of most authors. He called these, respectively, the superior and inferior internal *pli de passage*. The four external *plis de passage* pass from the lateral portion of the occipital lobe to join the convolutions of the parietal and temporal lobes. He named these the first or superior external *pli de pas-*

sage, deuxième, troisième et quatrième pli de passage externe. The inferior internal *pli de passage* passes from the apex of the cuneus forward, and joins the convolution running forward into the frontal lobe. Attention was called to this convolution in a previous communication on the convolutions of the negro brain; but it might be well to refer to it again in this connection. It is this convolution which in the Simians separates the mesial portion of the parieto-occipital from the calcarine fissure. The presence of this convolution was considered as a characteristic of the Simian brain, but Huxley pointed out its absence in the brain of *Ateles paniscus*. Bischoff states, however, that it is present in *Ateles*, only pushed down and concealed in the depths of the parieto-occipital fissure. In the brain of *Ateles ater* Dr. Parker had found this convolution as well developed as in any of the Simian brains. Formerly it was considered that this convolution was absent in the brain of man; but Bischoff asserts that it is always present, sunk in the depths of the parieto-occipital fissure, and Ecker describes it under the name of the gyrus cunei. He had always been able to distinguish it in the human brain; and especially well-developed, as previously pointed out, in the brain of the negro.

The superior internal *pli de passage* lies just above the inferior internal, and connects also the occipital lobe with the lobulus præcuneus. Bischoff has asserted (Die Grosshirnwindungen des Menschen, etc., Abhand. der k. bair. Akademie der Wissenchaften, 1868) that the superior external and the superior internal *plis de passage* are identical. Ecker, opposing Bischoff's interpretation, remarks (note p. 75, Cerebral Convolutions of Man) as follows: "Bischoff is of the opinion that this convolution (he is speaking of the superior internal *pli de passage*) is homologous with the first outer transition convolution of Gratiolet, our gyrus occipitalis primus, and hence is wanting where the latter is developed, and vice versa. I regret to be obliged to oppose this view; not only do we find, as I will more particularly describe in another place, in the brain of various apes (*Cercopithecus cynocephalus*, etc.) both convolutions most clearly developed together, but we also not infrequently find in man a convolution which arises at the posterior extremity of the præcuneus with the gyrus occipitalis primus, runs backward in an arch convex inward and downward, while the former (gyrus occipitalis primus), as is known, makes an arch outward. In the cuneus the two convolutions again coalesce. This convolution is regularly sunk into the depths of the fissure parieto-occipitalis, and only becomes visible on pulling apart the borders of this fissure; but sometimes it also comes to the surface, and then causes a very unusual appearance at this part of the cerebral surface."

This disagreement between the observations of Bischoff and Ecker in regard to these convolutions is due to the fact that in some Simian brains two convolutions are present as described by Ecker, whilst in other brains only one can be distinguished. Thus, in one specimen of the brain of *Macacus nemestrinus*, but a single convolution was present, passing from the lower part of the lobulus præcuneus backwards to join the occipital lobe. This convolution was in shape like the letter S, the anterior arch being directed downwards and inwards, the posterior arch upwards and outwards. The anterior portion of this convolution evidently corresponds to the superior internal *pli de passage;* whilst the posterior arch corresponds to the convolution which Ecker terms the gyrus occipitalis primus, and which Gratiolet and other writers have also separately designated under the name of the superior external *pli de passage*, the superior annectant, bridging, connecting convolution of the English anatomists, Huxley, Turner, Rolleston, and Marshall. He had found the same condition of things in several other brains, specimens of *Macacus cynomolgos*, *Cercopithecus callitrichus*, and in *Cebus apella.* In most brains, however, two convolutions are to be found, an anterior, inwardly arched, and a posterior outwardly arched, corresponding, as had been already stated, with the anterior and posterior portions of what is in some brains a distinct, single, and separate convolution.

With regard to the development and relations of the superior external *pli de passage* considerable confusion exists. This is the convolution, which, lying concealed in most of the Simians under that portion of the occipital lobe known as the operculum, develops in the higher Apes, in Man, and Ateles upwards and divides the fissura perpendicularis into two parts. Until recently only one of these divisions, the parieto-occipital fissure, has been recognized. Thus Marshall, following Gratiolet, in describing the brain of a Bushwoman calls the lateral portion of the parieto-occipital fissure the external perpendicular fissure, thus identifying this with the external perpendicular of the Simian brain. This identification is incorrect, or at least this lateral portion of the parieto-occipital can be considered as corresponding to only a small portion of the external perpendicular fissure. The fissure which represents the external perpendicular is pushed backwards by the development of this convolution, and is found situated apparently on the occipital lobe and continuous with the interparietal fissure. Pansch appears to be the first who gave a correct description and comparison of this portion of the human brain, and he has since been followed by Ecker. Bischoff identifies the internal perpendicular correctly, but he introduces fresh confusion. In the fœtus he recognizes the presence of the external perpendicular fissure, but states that it disappears in the eighth month. This, however, is by no means the case. In five fœtal brains, at the end of the eighth, Dr. Parker had found this fissure distinct and well-developed, and in all adult brains which he had studied he had found it well marked. In the brain of the fœtus, at the end of the eighth month, this convolution presented almost the same appearance as in the brain of the Orang, according to the figure given by Bischoff. This convolution, the superior external *pli di passage*, varies as to its extent of development in different individuals. In the brain of the negro he had found it much simpler than in the white. Pansch and Ecker are the only writers who recognize in the human brain the fissure corresponding to the external perpendicular of the Simian. Pansch calls it fissura occipitalis externa, and Ecker fissura occipitalis transversus. The remaining bridging convolutions present nothing of importance. The second lies generally concealed under the operculum. The third passes forward from the apex of the occipital lobe into the second temporal convolution. The fourth lies below this, and passes into the third temporal convolution.

In identifying and limiting these convolutions in the human brain, much confusion has arisen, and he agreed entirely with Ecker, that, although they may have some significance in the brain of the Apes, they have no special significance in the brain of Man, and should not, therefore, receive separate and distinct names. In the human brain they appear merely as the posterior portions of convolutions which extend into the temporal and parietal lobes and connect these with the occipital lobe.

Dr. Jos. W. Anderson, Walter Wood, and W. W. Frazier were elected members.

The following paper was ordered to be printed:—

ON A NEW SPECIES OF SPONGE.

BY ALPHEUS HYATT.

Aplysina pedicellata, Hyatt. (Plate 1.)

This species is founded upon three specimens, two in the collection of the Academy, and one in the collection of the Boston Society of Natural History. Locality is unknown, but probably East Indies.

The forms are all fistular, and from a foot to sixteen inches long, though not more than one and one-eighth inch in diameter. The basal portion is almost solid, and is composed of huge vertical fibres connected by very short horizontal branches, the mesh being very small.

The walls of the tubes are built up out of a thin network of fibres of two kinds. The inner part is a sheet of fibre, which surrounds the tube itself; the outer part is composed of palmate extensions of the inner sheet which anastomose with each other in every direction. In this way they give a cellular, or open frill-like aspect to the walls, since the cells or frills open more widely, or flare outwardly.[1] The mesh in most parts has a quadragonal form, but not infrequently has also the usual pentagonal or hexagonal outline common in most species of *Aplysina*. The fibres are hollow, but this is much larger in the vertical or primary fibres than in the secondary or horizontal fibres. The hollows of the primary fibres are universally filled with debris, but the cavities in the secondary fibres are entirely free from foreign matter.

Another very curious peculiarity is observable in the structure of the fibres. The central core of debris in the primary fibres is surrounded by a cement, apparently of keratode. This may be seen where the secondary fibres branch off from the primary as a continuous layer running across the open face of the secondary fibre.

The size of the cavity in the primary appears to be dependent upon the quantity of the debris in the primary fibres, since in one preparation the cavity of the primary fibres became as small as in

[1] This characteristic is not shown in the figures, which give the walls a solid aspect they do not naturally possess.

the secondary fibres whenever the core of debris failed in continuity.

The diameter of this hollow varies normally from one-half to one-eighth of the whole diameter.

These facts lead to the conclusion that, if this species lived where the water contained no sediment, we should find the fibres with an exceeding small central cavity. The concentric coats of keratode comprising the fibre are of two kinds as is usual, those which are primarily formed by the derm and those subsequently deposited by the meso-derm, the former being lighter colored, and occupying the interior, and the latter, in the specimens examined, very dark colored and with an exceedingly fibrous aspect.

This thickening of the walls of the fibre by meso-dermic deposits, and the small size of the central cavity, are similar to the characteristics of *Verongia*, to which also the form of the fibre, rounded rather than flattened, approximates.

This species, therefore, presents a mingling of some of the characteristics of *Verongia* and *Aplysina*, and also possesses a curious resemblance to the true Spongiæ in the habit of taking debris into the core of the fibre.

This mingling of characteristics led me at first to the supposition that it was a new genus.

Upon reflection, however, I do not think that these characteristics justify its separation from the genus *Aplysina.*

The peculiar arrangement of the fibres in sheets, and their resemblance in structure, far outweigh all other characteristics, and give a peculiar aspect to the surface which I believe is confined to the members of the genus *Aplysina.* It is, however, a very remarkable species, and this justifies its publication in spite of the uncertainty about the locality.

May 7.

The President, Dr. Ruschenberger, in the chair.

Thirty-six persons present.

A paper entitled "Descriptions of New Species of American Bees," by E. T. Cresson, was presented for publication.

The death of Robert Frazer, a member, was announced.

On Lepidurus Couesii, Pack.—Dr. A. S. Packard placed on record the occurrence of *Lepidurus Couesii* in northern Utah. The species had not before been found south of northern Montana, near the Milk River. The determination was based upon a specimen of a female with eggs, sent to him by the Academy for examination.

The President read the following:—

NOTICE OF THE LATE DR. PICKERING.

BY W. S. W. RUSCHENBERGER, M.D.

It is a custom of this Society to announce the death of every member or correspondent when it occurs, without accompanying the announcement with a notice of his career. From this custom may be excepted those members who have been conspicuous by their success in the cultivation of natural science, or who have won the general approbation of the Academy by generous contribution towards the advancement of science, or who have largely aided the progress of the Society by their labors.

For such reasons it seems appropriate that the archives of the Society should contain a record to show why his contemporary and fellow-members entertained sentiments of sincere respect and cordial esteem for the late Dr. Charles Pickering.

The records show that Charles Pickering, M.D., of Salem, Mass., was elected a correspondent of this Society Nov. 28, 1826. He had then just entered the twenty-second year of his age. Early in the following year (1827), he became a resident of Philadelphia, and, therefore, a member. From that date until 1838 he was rarely absent from any meeting of the Academy.

At that time the details of the affairs of the Society were conducted chiefly by standing committees. Dr. Pickering served on the Zoological Committee from December 25, 1827, until January, 1838, ten years; on the Botanical Committee from Dec. 28, 1828 (of which he was the chairman from Jan. 1833), until Jan. 1837, eight years; on the Publication Committee from Dec. 1829 until Dec. 1843, four years; and on the Library Committee from Jan. 1837 until Jan. 1838, one year.

He was Librarian from Dec. 1828 until Dec. 1833, five years; and a Curator from Dec. 1833 until Dec. 1837, four years.

The record tells us that he discharged faithfully and efficiently the duties of all the positions to which he was appointed.

To Dr. Pickering was intrusted the transfer to the Academy of the great collection of plants bequeathed by the Rev. Lewis David Von Schweinitz, who died in 1834. He prepared a catalogue of American plants in the collection of the Academy, and presented it at the stated meeting held May 13, 1834. Those plants which were previously in the collection, many of them Mr. Nuttall's types, he intercalated in the Schweinitz herbarium, attaching an appropriate label to each. On the 24th of March, 1835, on motion of Prof. H. D. Rogers it was unanimously resolved, "That the thanks of the Society be awarded to Dr. Charles Pickering for the highly successful manner in which he has executed the very arduous task of collating and arranging the extensive herbarium of the Academy."

The work done by Dr. Pickering has contributed much to facilitate the labors of his successors in the botanical department of the Academy.

On the 26th of Jan. 1836, on motion of Dr. Samuel George Morton it was unanimously resolved, "That the grateful thanks of the Institution be tendered to Dr. Pickering for his voluntary journey to New Harmony, the faithful execution of the trust reposed in him of selecting from the library of Mr. Maclure such works as were designed for the Academy, and for the prompt and successful arrangements made by him for the transportation of said books to this city."

The mission just referred to occupied Dr. Pickering about three months, and brought to the Academy's library an addition of about 2300 volumes of valuable scientific works.

The services of Dr. Pickering to the Academy were important in every sense, and are worthy of grateful remembrance.

While laboring for the Academy, he qualified himself perfectly to discharge efficiently those duties which devolved upon him in 1838, when he became a member of the United States Exploring Expedition. The means and facilities requisite for the instruction and training of students of natural science were at that period nowhere in the country more ample than in the Academy; and it is believed that at this time they are not better in any other institution in the United States.

On the 19th of October, 1827, Dr. Pickering read, at a meeting of the American Philosophical Society, a paper "On the Geographical Distribution of Plants," which was published in the third volume of the Transactions in 1830. He was elected a member of the American Philosophical Society Jan. 15, 1828, and resigned in Nov. 1837.

He was elected Recording Secretary of the Pennsylvania Horticultural Society Feb. 1830, and served till Sept. 1837, when he resigned.

In conjunction with James H. Dana, Dr. Pickering read, Feb. 20, 1838, before the Yale Natural History Society, of which he was a member, a "Description of a Crustaceous Animal belonging to the genus Caligus, C. Americanus," which occupies forty pages of vol. xxxviii. of Silliman's Journal.

Dr. Pickering was appointed a member of the scientific corps attached to the United States Exploring Expedition, under command of Lieutenant Charles Wilkes. He was placed on board of the flag-ship Vincennes. The expedition sailed from Hampton Roads August 19, 1838, and arrived off Sandy Hook, N. Y., June 10, 1842, after an absence of nearly four years. He is recorded among those present at the stated meeting of the Academy, July 5th, and frequently afterwards until he again went abroad. The first record of his presence after his return is May 20, 1845, and from that date he occasionally attended meetings every year. He was last present November 7, 1876.

October 11, 1843, Dr. Pickering left Boston and visited Egypt, Arabia, India, and the eastern part of Africa, for the sake of extending and verifying observations made while attached to the United States Exploring Expedition. Upon his return he settled in Boston, and prepared his "Races of Man and their Geographical Distribution," quarto, pp. 447, published by Charles C. Little and James Brown, Boston, 1848, being vol. ix. of the Exploring Expedition.

In 1850 he contributed a paper, "Enumeration of the Races of Man," to the Edinburgh New Philosophical Journal, vol. xlviii.

His work, entitled "The Geographical Distribution of Animals and Plants," quarto, pp. 212, being vol. xv. of the Exploring Expedition, was published by Little & Brown, Boston, 1854.

In the Proceedings of the American Academy of Arts and Sciences are recorded his observations on the Egyptian computation of Time, Oct. 1849; on the Egyptian Astronomical Cycle, May, 1850; on Sulphur Vapor, Dec. 9, 1856; on the Coptic Alphabet, March 8, 1859; on the Geographical Distribution of Species, March 22, 1859, and Dec. 11, 1860; and on the Jewish Calendar, Oct. 11, 1864. At the request of the Secretary of the Institution he prepared a paper "On the Gliddon Mummy Case in the Museum of the Smithsonian Institution," in June, 1867, which is published in vol. xvi. of the Smithsonian Contributions to Knowledge.

The "Geographical Distribution of Animals and Plants. Part II. Plants in their Wild State," quarto, was published by the Naturalists' Agency, Salem, 1876. It is preceded by a note, "The following 524 pages comprise about one-half of a prepared volume, the printing of which was suspended in 1860.—Charles Pickering."

The great work of Dr. Pickering's life, The Chronological History of Plants, to which he had devoted sixteen years of laborious research, was only recently completed, and is now passing through the press.

This imperfect summary of work completed is sufficient evidence of his unremitting industry, and suggests that he fully utilized his opportunities to qualify himself for research during the ten years he zealously wrought in the offices and on the committees of the Academy. He was certainly a distinguished alumnus of the Institution.

Dr. Pickering was characterized by imperturbable firmness of purpose, and by his loyalty to truth, and integrity in every sense. He was extremely modest, averse to parade, and remarkably free from pretension of every kind. His acquirements were extensive, varied, and minutely accurate. His friends loved him for his unaggressive, always tranquil temper, and his obliging disposition.

To this imperfect outline of Dr. Pickering's scientific career, though a thing apart, may be added a few words on his heredity.

Colonel Timothy Pickering, his grandfather, was native of Salem, Mass., but his active participation in the Revolution brought him to Philadelphia. He served in the army, took part in the battles of Brandywine and Germantown, and was present at the surrender of Yorktown. He was appointed Postmaster-General, August, 1792; Secretary of War, Jan. 1795; and Secretary of State, Dec. 1795, from which office he was removed May 12, 1800, by President John Adams. His son, Timothy Pickering, Jr., the father of Dr. Pickering, was born in this city, Oct. 1, 1779. He graduated at Harvard College; was appointed a midshipman in the navy Jan. 17, 1799, served creditably one cruise under command of the famous Stephen Decatur, and resigned May 2, 1801.

His father, Colonel Pickering, had acquired extensive tracts of "wild lands" in western Pennsylvania. Finding himself in restricted circumstances when removed from office by President John Adams, he determined to transfer his family to those lands with a view to their settlement. Timothy Pickering, Jr., joined his father, and settled at Starucca, now in Susquehanna County, Pa. There he married Lurena Cole, Dec. 29, 1804, and there Dr. Charles Pickering was born Nov. 10, 1805. His father died May 14, 1807, in the twenty-eighth year of his age. A few years prior to this date Colonel Pickering had changed his place of residence to a farm at Wenham, near Salem, and thither he took the widow and her son to remain members of his own household. There Dr. Pickering was raised and educated under the immediate direction of his mother, and the supervision of his distinguished grandfather. He was a member of the class of 1823 at Harvard, and graduated from the medical department of the same school in 1826.

Dr. Pickering married Sarah S., daughter of the late Daniel Hammond, Esq., in 1851. He died in Boston, March 17, 1878, leaving a widow but no child. His memory will be affectionately cherished by those who knew him, and his works will secure him respect from all who may follow the same paths of research.

May 14.

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

Thirty-one persons present.

The death of Prof. Jos. Henry, a correspondent, was announced.

On Parasitic Worms in the Shad.—Prof. Leidy stated that during the last month he had received letters and specimens, from New York, Trenton, Norfolk, and elsewhere, with information that the shad, this season, was much infested with worms. Two of the writers, physicians, had expressed apprehension in regard to the parasites, and supposed that they had traced several cases of illness to the use of shad which they suspected had been infested with the worms.

The worm has long been known in Europe as a parasite of the herring, mackerel, cod, salmon, and other food fishes. It is the *Filaria capsularia* of Rudolphi, or the *Agamonema capsularia* of Diesing. Prof. L. had described it in the Proceedings of this Academy in 1856, from the shad and herring, and had repeatedly observed it in the same fishes every year since. It usually infests the internal organs, and is often observed encapsulated in a close coil, upon the roes, the intestines, and the liver. It is from half an inch to an inch or more long. Most individuals have a few of the parasites, and sometimes they are exceedingly numerous. They appear not to affect the health of the fishes unless they are very numerous, when they impoverish their hosts. Prof. L. believed that they did not affect the wholesomeness of the fish as food, and perhaps when cooked with the fish were equally good and nutritious. Like others, he felt an antipathy to the worms, and he was in the habit of scraping them off from the roes of smoked herring before eating these. He took the opportunity of adding, what was already well known to naturalists, that most animals are infested with parasites, which were transmitted by feeding on one another. The remedy against transmission was heat. He who uses only well-cooked meats need have no apprehension of worms from such food.

Species of Euglypha, Trinema, Pamphagus, and Cyphoderia, with Synonyma and Descriptions of New Forms.—Prof. Joseph Leidy placed on record the following synonyms and descriptions of new species of Rhizopods:—

1. Euglypha alveolata, Dujardin, Carter, Wallich, Hertwig and Lesser, Leidy, Schulze.

Euglypha tuberculata, Dujardin.

Difflugia areolata, *D. acanthophora*, *D. lævigata*, *D. striolata*, *D. Floridæ*, *D. pilosa*, *D. moluccensis*, *D. Amphora*, *D. rectangularis*, *D. Roberti Müller*, *D. seriata*, *D. striata*, *D. Shannoniana*, *D. subacuta*. Ehr.

Euglypha lævis, *E. setigera*, Perty.

Euglypha ampullacea, Hertwig and Lesser.

2. Euglypha ciliata.

Difflugia ciliata, *D. pilosa*, *Setigerella ciliata*, *S. pilosa*, Ehr.

Euglypha compressa, Carter, Leidy, Schulze.

3. Euglypha seminulum.

Difflugia Seminulum, *D. Semen*, *Assulina Seminulum*. Ehr.

Euglypha brunnea, Leidy. *Euglypha tincta*, Archer.

4. Euglypha globosa, Carter, Leidy, Schulze.

5. Euglypha spinosa, Carter, Leidy.

6. Euglypha strigosa.

Difflugia strigosa, Ehrenberg.

Frequent in sphagnous swamps of New Jersey.

7. Euglypha cristata, Leidy.

8. Euglypha mucronata.

Narrow, bottle-shaped, with the fundus terminating in a long spine. Plates oval, overlapping at the borders; the plates of the mouth from 4 to 6, angular and dentate at the free extremity. Length $\frac{1}{8}$th mm., breadth $\frac{1}{25}$th mm., mucro to $\frac{1}{30}$th mm. long. Sphagnous swamps of New Jersey.

9. Euglypha brachiata.

Nearly like the former, but without the mucronate fundus, and with 2, 4, or 6 equidistant, long spines diverging a short distance above the mouth. Size about the same as the former, and found in same localities. Both forms are frequent.

10. Trinema enchelys.

Trinème, Dujardin, 1836. *Trinema*, Dujardin, 1838.

Difflugia Enchelys, and *Arcella hyalina*, Ehrenberg, 1838.

Trinema acinus, Dujardin, 1841, Perty, Fresenius, Claparede and Lachmann, Leidy, Schulze.

Arcella constricta, *A. Nidus Pendulus*, *A. Disphæra*, *A. caudicola*, *A. Enchelys*, *A. Megastoma*, *A. rostrata*, *A. reticulata*, *A. seriata*, *A. Pyrum*, Ehrenberg.

Euglypha Enchelys, Wallich. *Euglypha pleurostoma*, Carter.

11. Pamphagus mutabilis.

Corycie, Dujardin, 1852.

Pamphagus mutabilis, Bailey, 1853.

Corycia (Dujardin) Clap. and Lach. 1858.

Plagiophrys scutiformis, Hertwig and Lesser.

12. Cyphoderia ampulla.

Difflugia Ampulla (Werneck), Ehrenberg, 1840.

Difflugia Lagena, *D. Seelandica*, *D. adunca*, *D. alabamensis*, *D. uncinata*, Ehr.

Cyphoderia margaritacea, Schlumberger, 1845, Fresenius, Carter, Hertwig and Lesser, Leidy, Schulze.

Euglypha curvata, Perty.

Lagynis baltica, Schultze.

Euglypha margaritacea, *Difflugia margaritacea*, *Euglypha baltica*, Wallich.

The following papers were ordered to be printed:—

ELEMENTS OF SIDEREAL SYSTEM.

BY JACOB ENNIS.

Hitherto the work of Astronomy has been mainly on our solar system. Beyond this the labor of astronomers has been given to individual stars; but not to these stars as a body forming our sidereal systen. The time has now come when the sidereal system as a unit must be made in all its vastness a distinct object of investigation. I have demonstrated that our sun acts powerfully through gravity on the so-called fixed stars, and must receive powerful action in return. This mutual interaction between all the stars would bring them with great violence to this common centre of gravity, and therefore they must revolve with high velocities around that centre to gain a corresponding centrifugal force. Now first we learn the uses of such high velocities as those of 61 Cygni and of Arcturus, the one nearly 2000 and the other nearly 3000 miles per minute. In my Memoir on "Our Sidereal System," published in these Proceedings for 1876, I demonstrated that the centre of gravity of our sidereal system, around which all the stars revolve, must lie in the plane of the median line of the galaxy, that its direction is not far from the south galactic pole, and that its distance is not far from that of the stars of the fourth magnitude. Therefore the vast multitude of the stars visible to the naked eye, say five-sixths of them all, must lie on the same side of the centre of gravity with our sun.

This distance of our situation, so far away on one side of the centre of our sidereal system, renders the study of that system the more difficult; the same as our similar position in our solar system, far away from its centre, hindered and rendered difficult the reception of the Copernican theory for two generations. But now, knowing approximately the position of our sidereal centre, and the geometrical data by which that centre was found, we are prepared to enter on the grand work of sidereal astronomy, and to study the revolutions of twenty millions of stars. In building the superstructure of sidereal astronomy on the foundation just laid, it is important to know precisely how to proceed; and the design of this paper is to point out how and where we are to begin; and what are to be the chief parts of the work. In so doing I will merely state what have been my own studies on this subject a few years past.

First. After learning the proper motion of a star, the first thing to be done is to lay down the line of its nodes on the plane of the galaxy. This is in many cases a most difficult task. But the easier ones are to be determined first; and these are situated in the close neighborhood of both galactic poles. After the proper motions within 30 degrees of both poles have been finished, as nearly as possible for the present, then the other proper motions more distant from these poles will be more advantageously studied.

Second. The galaxy must be divided into 360 degrees; because the galactic plane must be the basis of sidereal astronomy; and to this all sidereal motions must be referred. I propose that the initial point for numbering the degrees on the galactic circle be the point where the median line of the galaxy intersects the ecliptic, near the convergence of the three bright constellations, Orion, Gemini, and Taurus. From these the numbers should run southeastwardly until the galactic circle be completed.

Third. The median line of the galaxy should be precisely determined. This is necessary before we can tell where it intersects the ecliptic. This median line must be conspicuously drawn on all star maps and celestial globes, and the galactic degrees must be numbered thereon. Its distance from a parallel great circle must be accurately maintained all around. For on this distance depends the determination of our own distance from the sidereal centre. All this will necessitate a careful study of the galaxy—its breadth, contours, and real position among the stars.

Fourth. After finding as nearly as possible the line of the nodes of any star on the galactic plane, the next thing to be done is to determine the inclination of its orbit to that plane. Here again we find that the stars easiest to begin with, are those nearest the galactic poles. The planes of their orbits are nearly at right angles to the plane of the galaxy.

Fifth. After the median line of the galaxy has been ascertained and accurately drawn, we can then, and not until then, determine the positions of the galactic poles.

Sixth. After establishing the sidereal poles, it will be important that we construct sidereal globes, having parallel circles concentric with the poles, and also meridian lines. These will assist in the very important work of finding the lines of the nodes, and the inclinations of the orbital planes. The numbering of the meridians should begin at the intersection of the median line of the galaxy in or near Orion; and the numbers should be identical with those on the median line of the galaxy. The numbering of the parallels should begin at the north galactic pole, and continue to 180°. They should read S. N. P. D., that is, sidereal north polar distance. As the object of these sidereal globes must be to discover the real nature of sidereal motions, so those stars alone which have known proper motions should be admitted on the globes. All else would only confuse the attention and obstruct discovery.

Seventh. To discover which way around the Milky Way revolves, is a grand object. It must revolve in its own plane like a great wheel. This is absolutely necessary from the fact of the intergravitation of the stars. But with the swiftest stellar velocities yet known, say 3000 miles per minute, about 40 years would be required for the galactic stars to move through one second of arc. Therefore we have no present data to learn anything of the galactic revolutions from its own stars. Hence to attain our purpose, we must study the motions of the larger magnitude stars which are situated in the direction of the galaxy. Because many of these must have the same motion as the galaxy itself, especially those far out toward the galaxy; therefore, the more distant stars in the direction of the galaxy, especially those with very slow proper motions, will give us the most information.

Eighth. One of the fundamental elements in sidereal astronomy is the point in space toward which our sun is tending. The high importance of this element is seen in the fact that our sun's motion obscures and alters the apparent motions of many stars, giving some of them retrograde motions, the same as our Earth's motion in its orbit imparts retrograde motions to the planets.

Some astronomers of the highest repute have entertained the opinion that our sun is moving toward a point in the constellation Hercules. But this opinion is founded on the supposition that all, or nearly all the stars, are relatively stationary in space, and that their observed proper motions are only apparent, and that they are caused by our sun's motion. But this supposition is above all things inadmissible; for there is no conceivable reason why all the other stars should not in general have velocities equal to our sun's. Nevertheless, the discussions on this point may not be altogether barren; for the facts detected in the discussions may be turned to better account with a better theory.

I have clearly shown in my former paper on "Our Sidereal System" that the point in space toward which our sun is moving, must be sensibly the same during two or three centuries, that is, during all the time in which the positions of the stars have been accurately observed and recorded. I submit the following as being a better guide for finding that point. As the circumference of a circle, more strictly speaking a tangent, is always at right angles to a radius, so the direction of our sun's motion, if its orbit be nearly circular, must be nearly at right angles to the direction toward the centre of our sidereal system. Having found that centre approximately, we now know the zone in the heavens, included in a few degrees on each side of a great circle, where to look for the point in space to which our sun is hastening. But if the sun's orbit be strongly elliptical, and if its present position in that orbit be not near the apsides, then this zone in the heavens must be a little widened. Still, even if widened, we may be happy to know where it lies. It must correspond very nearly with the galaxy. This results from the fact that the direction toward our sidereal centre is nearly perpendicular to the galactic plane. Any point in the constellation Hercules cannot be the point we seek, for it is too far from the galaxy.

Ninth. It will be an assistance to workers in sidereal astronomy to make what may be called sideriums. These should stand in the same relation to our sidereal system, that planetariums hold to our solar system; but their structure must be very different from planetariums. We have all seen during our recent centennial celebration many little flags with their staffs stuck in a central ball; and as their staffs were all of the same length, they formed a globe of little flags. A siderium must have a central ball made of soft wood or cork. In this ball must be stuck thin sharp-pointed rods, and their outer ends, instead of flags, should bear paste-board arrows, representing the directions of stellar flights. On the arrow should be written, or printed, the name of the star, as 61 Cygni, and the different lengths of the arrows might aid to show their relative velocities. The lengths of the rods should show the relative distances of the stars from the sidereal centre. In the cases of two stars of the second magnitude, one in the direction of our sidereal centre, and the other in apposition, the lengths of the rods holding the arrows should bear the proportion to each other of about as 1 to 3. The positions and inclinations of the rods should represent the inclinations of the stellar orbits to the galactic plane. The galaxy should be represented by a circular rim held at some distance beyond the arrows, by about 4 supporting radii or spokes.

Tenth. All the star catalogues should be immediately compared to learn the precise amount of their known proper motions and to discover new ones. It is now 28 years since any general work of this kind has been done. Main's catalogue of proper motions was presented to the Royal Astronomical Society in 1850. Since then all the more accurate observations and star catalogues have been made, and therefore, more valuable results might now be obtained. Comparisons of the recorded positions of the southern hemisphere stars are particularly needed; for in that hemisphere but little is known of the stellar motions.

Eleventh. New observations should immediately be made of every star whose proper motion has been announced, or even suspected; this would give accuracy, firmness, and confidence to the data which must be employed in the construction of this new system of sidereal astronomy.

Twelfth. In order to determine which way the galaxy wheels around in its mighty circle, it is of the utmost importance that the positions of many hundreds of its stars should be ascertained with the strictest precision and without any delay. This would be of no benefit to us; but what a rich legacy would such determinations be to the next generation, and how memorable would they stand through all coming time! Hipparchus was the first to make a catalogue of a few hundred stars, and to record their positions, and he receives our sincere gratitude and homage. Who is to be the Hipparchus of the Milky Way, and to send down a blessing through all generations to the end of time? What a worthy object for any young man to propose for the devotion of his life! All the stars of the galaxy cannot be observed, on account of their numbers. But maps of different patches should be made here and there all around the ring. The stars of different magnitudes from the ninth to the twelfth, and even to the very smallest, should be mapped together, so that hereafter the velocities of the different magnitudes, that is, of different distances, might be compared.

Thirteenth. Sidereal mathematics will open new problems of exceeding grandeur. In our solar system there is a controlling central sun, and in the mundane and other planetary systems, there is a controlling central planet. But our sidereal system is ruled by no central sun, and its subordinate clusters, such as the Pleiades, Coma Berenicis, those in Hercules, and many others are equally without a central body. The common centre of gravity in the general system, and the subordinate local centres in the various clusters, are the controlling powers. And they will demand new mathematical processes, and lead to new improvements in mathematical science.

I have demonstrated how a revolving nebulous globe may abandon all its material as rings, which may break up into stars, and how these stars must continue to revolve in the same paths with the rings until they be deflected from these paths by perturbations.

One of the sublime problems of sidereal astronomy will be the amount of centripetal force in the entire sidereal system. This must be told by the centrifugal force, and this latter will have to be determined by the velocities of the stars in their revolutions, and by their distances from the sidereal centre. Judging from the extreme velocities of some stars, velocities of 2000 or 3000 miles per minute, velocities greater than any in our solar system, we must conclude that the common centripetal force toward the centre of our sidereal system is very great.

In our solar system the centripetal force is greater toward the centre of the system; but this is not true in our sidereal system. A particle a hundred or a thousand miles below the earth's surface, is not impelled by gravity toward the earth's centre, as strongly as one on the surface—the same principle rules in our sidereal system.

As the asteroid Pallas has been drawn by perturbation as far as about 35 degrees from its original plane, so it can be shown that perturbations may deflect some stars away from the galactic plane so as to revolve at right angles to it. Other stars may be deflected equally far in the opposite direction. Then these two sets of stars will revolve in opposite directions around the sidereal centre. And when this happens to many stars, the system must become globular in shape, like many nebulæ which are distant sidereal systems. The dynamics of such systems must be new objects of mathematical research, especially in the face of the announcement, that the stability of our solar system depends on the movements of all its members in the same plane, and in the same direction.

When two stars move with high velocities, in contrary directions, around the sidereal centre, and approach near to each other, they will not come in contact, unless their lines of motion meet at the same time in the same point; but they may come indissolubly within each others' gravitating force, and thus form a double star. So triple stars may be formed, and multiple stars, and clusters with hundreds and even thousands of members.

The ultimate revolutions of such clusters, each one around its own centre, and altogether around the general sidereal centre, are absolute necessities. These motions must be the resultants of the prior individual motions, and of the effects of gravity from closer contiguity. To follow them all by calculation will be a new and difficult task. This paper is not designed to pursue these mathematical processes, but only to indicate some of the new and grand problems which sidereal astronomy must open; problems very different from any in our solar system.

DESCRIPTIONS OF NEW SPECIES OF NORTH AMERICAN BEES.[1]

BY E. T. CRESSON.

Trigona nigerrima.

☿.—Piceous-black, the pubescence black; sides of face broadly, and the cheeks, pale sericeous; clypeus broad, the apical middle foveate; tips of mandibles brown; scutellum broadly rounded behind; metathorax smooth and polished; wings fuliginous, apex subhyaline, stigma yellowish; abdomen shining. Length .25 inch.

Hab. Mexico (Sumichrast). One specimen.

Trigona nigra.

☿.—Shining black, the pubescence black; face and clypeus with a pale sericeous pile; flagellum dull testaceous beneath; wings fuscous, whitish at tips; pubescence of legs fuscous; abdomen narrow, polished, more or less brown at base. Length .20 inch.

Hab. Mexico (Sumichrast). Three specimens.

Trigona perilampoides.

☿.—Black, opaque; head and thorax densely punctured, the latter coarsely and confluently so above, clothed with a short pale glittering pubescence; face with a silvery-cinereous pile; labrum, tips of mandibles, and antennæ fulvo-testaceous; narrow lateral margin of mesothorax, apical margin of scutellum, and a round spot on each extreme basal corner, luteous; scutellum subtriangular, flat, projecting over the metathorax, the apex emarginate; tegulæ brown; wings smoky, paler at base; legs brown, paler at base and apex; abdomen short, broad, two basal segments shining, piceous, the remaining segments covered with a pale golden-sericeous pile. Length .18 inch.

Hab. Mexico (Sumichrast). Five specimens.

Trigona thoracica.

☿.—Fulvo-testaceous, opaque; vertex, flagellum above, mesothorax, spot on pleura, and base of second segment of abdomen more or less, fuscous or black; the pubescence on vertex and thorax above fuscous, elsewhere it is pale; wings yellowish sub-

[1] The types of the species described in this paper are to be found in the collection of the American Entomological Society.

hyaline, slightly dusky at tips; abdomen short, golden-sericeous. Length .22 inch.

Hab. Mexico (Sumichrast). Two specimens.

Tetrapedia abdominalis.

♀.—Robust, black, the abdomen ferruginous; sides of face, and cheeks with a whitish pubescence; tip of clypeus, and antennæ beneath brown; thorax broad, smooth and shining, lateral angles of prothorax prominent, subspinose; tegulæ piceous; wings fuscous, subhyaline at tips, stigma and nervures pale, the first recurrent nervure uniting with the second transverse cubital nervure; legs black, with the pubescence black, that on tips of posterior tibiæ exteriorly tinged with ferruginous, tibial spurs black; abdomen short, broad at base, shining, the apex fringed with fulvous, and the ventral segments with long white pubescence. Length .30 inch.

♂.—Narrow line on sides of face, most of clypeus, short transverse line above, labrum, mandibles except tips, line on scape beneath, line on each side of prothorax above, postscutellum, and last joint of tarsi, yellowish-white; scutellum with short dense black pubescence; wings paler than in ♀; legs brown, simple, the pubescence black; abdomen flavo-testaceous, shining, the apical segments fringed with white pubescence. Length .25 inch.

Hab. Mexico (Sumichrast). Two specimens. This species resembles *calcarata* Cress. in color, but has a shorter, broader, and more compact form, the tibial spurs are black, and the wings differently colored.

Bombus Ridingsii.

♀.—Black; vertex, thorax above and laterally, first abdominal segment and basal middle of second more or less, clothed with pale lemon-yellow pubescence; elsewhere the pubescence is black; sometimes the yellow on base of second segment extends nearly to the apex, and generally more or less divided posteriorly, sometimes forming two spots; clypeus smooth and polished, transversely indented near tip; wings stained with fuscous. Length .70 inch.

☿.—Like the female, but smaller. Length .50–.60 inch.

Hab. West Virginia. Numerous specimens collected by Mr. James Ridings. Allied to *separatus* Cress., which, however, has the pubescence of the head entirely black and that on basal middle of second abdominal segment more or less tinged with brown, and never divided.

Bombus Morrisoni.

♀. Black; vertex, thorax above, and first, second, and basal middle of third abdominal segments, clothed with a dense bright lemon-yellow pubescence; elsewhere the pubescence is black; wings fuliginous, violaceous, much darker at base; clypeus smooth, shining, finely and sparsely punctured, depressed. Length .80–.90 inch.

☿.—Like the ♀, but smaller, with the basal half of third segment sometimes yellow. Length .60–.75 inch.

♂.—Face narrow, eyes unusually large; face, vertex, occiput, thorax above, posterior femora, and the first, second, third and basal middle of fourth segments of abdomen, bright lemon-yellow. Length .65 inch.

Hab. Colorado (Mr. H. K. Morrison). Numerous specimens. This is a very handsome species, the yellow being of a bright and beautiful shade.

Bombus appositus.

♀.—Black; face, vertex, occiput, anterior half of mesothorax, continued for a short distance down on each side, clothed with a very pale ochraceous, sometimes nearly white, pubescence; on the scutellum and abdomen above the pubescence is yellow, that on abdomen generally having a browish shade in certain lights; elsewhere the pubescence is black, except on venter, where the segments are fringed at apex with whitish hair; disk of mesothorax smooth and polished, the pubescence on each side black; clypeus smooth and polished, transversely depressed at tip; the space between the eyes and base of mandibles greater than usual; wings stained with fuscous, darker at base. Length .80–.85 inch.

☿.—Like the female, but smaller. Length .65 inch.

♂.—The pubescence on cheeks, sides of thorax and beneath, and on legs, whitish, and that on abdomen above paler than in the female. Length .70 inch.

Hab. Colorado, New Mexico, Utah, Nevada. Eight specimens. This is closely allied to *borealis* Kirby, but is readily distinguished by the pubescence of the head and thorax anteriorly being whitish, and by that on abdomen above being entirely yellow.

Bombus gelidus.

♀.—Black, the pubescence long and loose; that on occiput, a slight admixture on face and vertex, anterior margin of mesothorax, sides of thorax, scutellum, and first and fourth segments of abdomen, pale yellow or ochraceous; that on second and third segments mostly fulvo-ferruginous, mixed with black on middle and sides; elsewhere the pubescence is black; clypeus sparsely punctured, labrum with fulvous hair; wings stained with fuscous, darker at base and at tip of marginal cell; tarsi pale sericeous, fulvous beneath. Length .70 inch.

Hab. Aleutian Islands (Henry Edwards). One specimen. The pubescence of the abdomen is longer than usual, and the colors are not very decided.

Bombus Edwardsii.

♀.—Black; vertex, thorax above except disk, sides of thorax, first segment of abdomen, basal middle of second, apex of fourth, and sides of fifth clothed with a lemon-yellow pubescence; elsewhere it is black except a slight admixture of yellow on the face above antennæ; disk of mesothorax smooth and polished, with black pubescence on each side; wings stained with fuscous, darker at base. Length .70–.75 inch.

☿.—Black; middle of face, vertex more or less, mesothorax anteriorly, scutellum, sides of thorax, femora beneath, first and fourth segments of abdomen and venter, clothed with pale yellow pubescence; elsewhere it is black; wings subhyaline, dusky on apical margin; tarsi more or less fulvous. Length .45 inch.

♂.—Short, robust, black; head, thorax except a black band between the wings, base of legs, first abdominal segment, basal middle of second, and the fourth and fifth and venter, clothed with long lemon-yellow pubescence; elsewhere it is black. Length .40–.45 inch.

Hab. California, Vancouver's Island (H. Edwards); Colorado Morrison). Twelve specimens.

Bombus Crotchii.

♀.—Black; occiput, anterior part of thorax above as far back as the tegulæ, and the second segment of abdomen except basal middle, clothed with a pale lemon-yellow pubescence, that on the two apical segments fulvo-ferruginous; elsewhere it is black; wings fuliginous, violaceous, black at base. Length .90 inch.

Hab. California (Crotch). Three specimens. A handsome species.

Bombus Couperi.

♀.—Short, robust, black; vertex, thorax anteriorly, laterally and beneath, scutellum and two basal segments of abdomen, clothed with an ochreous-yellow pubescence, that on the two apical segments fulvous yellow; elsewhere it is black; wings stained with fuscous. Length .65 inch.

Hab. Canada (Mr. Wm. Couper). Two specimens. The black band between the wings is unusually broad.

Bombus Putnami.

♀.—Black; thorax, except a black band between the wings, two basal segments of abdomen above, lateral apical margin of the third, and the venter, clothed with ochreous-yellow pubescence, that on the fifth segment and apex of fourth fulvous-yellow; elsewhere it is black, except a slight admixture of yellow on the face, vertex and femora beneath; face long, clypeus smooth and polished, the space between eyes and base of mandibles greater than usual; wings stained with fuscous. Length .75 inch.

Hab. Colorado—Alpine. One specimen collected by my friend Mr. J. Duncan Putnam in the month of July.

Bombus oregonensis.

♂.—Black, clothed with a long dense pale lemon-yellow pubescence, that on disk of mesothorax and scutellum, and on segments 3–5 of abdomen above, more or less black, and that on the two apical segments fulvous-yellow; wings hyaline, slightly dusky on apical margin. Length .55 inch.

Hab. Oregon (H. Edwards). One specimen.

Bombus bifarius.

♀.—Black; face, vertex, occiput, a broad band on thorax anteriorly extending a short distance down on each side, scutellum except middle, base of femora beneath, sides of basal segment of abdomen, fourth entirely, apical margin of the fifth, and the venter clothed with pale lemon-yellow pubescence, that on the second segment, except basal middle, and the third entirely, of a beautiful orange-fulvous; elsewhere the pubescence is black, except on posterior tibiæ and tarsi where it is fulvous; wings pale fuliginous on apical margin. Length .60–.70 inch.

☿.—Like the female, but much smaller, and with the yellow pubescence often much paler. Length .40–.45 inch.

Hab. Colorado, Vancouver's, British America. This is closely allied to *ternarius*, Say, but may be distinguished from that species by the broader black band between the wings, by the yellow on scutellum being divided into two spots, by the black pubescence on basal middle of second abdominal segment, by the fifth segment being fringed at apex with yellow hair, and by the pubescence on posterior tibiæ being fulvous.

Bombus improbus.

♂.—Black, clothed with a short dense lemon-yellow pubescence, that on disk of mesothorax more or less black, but not extending laterally to the wings; face very narrow, the eyes being unusually large; wings stained with yellowish fuscous; legs clothed with black pubescence, that on femora more or less yellow, basal joint of posterior tarsi fringed behind with pale hair; abdomen with the fourth and fifth segments black, more or less fringed at apex with yellow, apical segments with fulvous-yellow pubescence. Length .60–.70 inch.

Hab. Colorado (Morrison). Two specimens. This has the same form as the ♂ of *pennsylvanicus* De Geer.

Bombus mixtus.

♀.—Black; head and thorax clothed with pale yellow pubescence, intermixed with black on face, vertex and thorax above; between the wings a broad band of black pubescence slightly intermixed with yellow on the sides; wings subhyaline, dusky on apical margin; legs clothed with black pubescence, that on femora beneath yellowish, and that on posterior tibiæ intermixed with fulvous; abdomen with the first, second, and apical segments clothed with pale yellow pubescence, that on sides of second and base of third black, that on apex of third, the fourth and fifth fulvous, shading into yellow laterally, and that on venter yellowish. Length .55 inch.

☿.—Like the female, but smaller. Length .40 inch.

Hab. Colorado (Morrison). Three specimens. The black band between the wings is not distinctly defined, the yellow pubescence on anterior part of mesothorax being considerably intermixed with black.

Bombus juxtus.

♀.—Black; head, thorax, and two basal segments of abdomen clothed with a dense lemon-yellow pubescence, that on sides of vertex mixed with black; between the wings a distinct well-defined band of black pubescence; wings fuliginous on apical margin; legs with black pubescence, that on femora beneath yellow, and that on tibiæ at tips more or less fulvous, tarsi fulvo-sericeous; third and fourth segments of abdomen clothed with dense orange fulvous pubescence, yellow on extreme sides and on venter; two apical segments black. Length .60 inch.

Hab. Colorado (Morrison). Four specimens. This is allied to *flavifrons* Cress., but readily distinguished by the black band between the wings being well-defined, and by the yellow pubescence on mesothorax anteriorly and on scutellum not being intermixed with black as it is in *flavifrons*.

Bombus vancouverensis.

♂.—Black; head, thorax, and legs clothed with lemon-yellow pubescence, slightly mixed with black on sides of face and vertex; between the wings a tolerably well-defined band of black pubescence; wings hyaline, faintly dusky on apical margin; tarsi pale brown; abdomen with the first, basal middle of second and fourth segments and venter with yellow pubescence, that on sides of second and the third segments fulvous, and that on apical segments black, sometimes intermixed with yellow on apical margin and sides; occasionally there is a patch of black pubescence on sides of second segment. Length .45-.50 inch.

Hab. Vancouver's Island (H. Edwards). Ten specimens.

Bombus mexicanus.

♀.—Black, clothed with jet black pubescence; wings uniformly dark fuscous, with a violaceous reflection; posterior tibiæ and tips of tarsi brown, basal joint of the later fulvo-fuscous within; third segment of abdomen clothed with a yellow pubescence. Length .90 inch.

☿.—Like the female, but smaller. Length .65 inch.

Hab. Mexico (Sumichrast). Twelve specimens. A handsome species.

Anthophora capistrata.

♂.—Black; head, thorax, and basal segment of abdomen clothed with dense ochraceous pubescence, that on sides of face, vertex, and mesothorax slightly mixed with black, that on cheeks and thorax beneath pale ochraceous; clypeus (except a broad transverse black band at base, narrowed laterally, and narrow apical margin), a transverse line above clypeus, sides of face extending narrowly half way up the orbits, labrum except a black spot on each side at base, spot on base of mandibles, and scape beneath, white; wings faintly dusky on apical margin; legs clothed with pale ochraceous pubescence, that on basal joint of posterior tarsi within black, tips of tarsi pale fulvous, intermediate tarsi slender, simple, basal joint of posterior pair robust, simple; abdomen black, with a slight bluish reflection, apical margin of segments 2–6 dull whitish, with a rather narrow even band of appressed whitish pubescence, apical segment bilobate at tip; extreme sides of venter with long whitish pubescence. Length .50 inch.

Hab. Texas (Belfrage). Two specimens. In this and all the following species described under this genus, the second submarginal cell of anterior wings is, unless otherwise mentioned, subtriangular and receives the first recurrent nervure at or about the middle.

Anthophora urbana.

♀.—Black; clothed with a whitish pubescence, that on vertex and thorax above tinged with ochraceous and mixed with black; clypeus confluently punctured and depressed at tip; wings hyaline, faintly dusky on apical margin; legs with white pubescence long on the femora, tip of basal joint of posterior tarsi with a tuft of black hair, the pubescence on the inside fuscous; first segment of abdomen with pale ochraceous pubescence, apical margin of segments 2–4 dull whitish, each with a band of appressed white pubescence, apical segment with black pubescence, fringed on each side with white hair. Length .45–.50 inch.

♂.—Sides of face, clypeus, line above, labrum, base of mandibles, and scape beneath white; tarsi slender and simple, the pubescence on basal joint within yellowish, tips of tarsi pale fulvous; the pubescence on vertex and thorax not mixed with black as in the ♀. Length .40–.45 inch.

Hab. Colorado, Utah, California. Twelve specimens.

Anthophora Krugii.

♀.—Black; head clothed with a whitish pubescence, slightly mixed with black on the vertex; thorax clothed with short black pubescence, that on scutellum and metathorax rufo-ferruginous; wings slightly smoky, subiridescent; legs black, clothed with black pubescence, long on femora and white on coxæ and trochanters, four anterior tibiæ above pale, a small silvery white spot on tip of posterior femora above; abdomen with a slight bluish iridescence, basal segment clothed with a fulvous pubescence, apical margin of segments 1–4 narrowly yellowish-white, extreme sides of the segments with a patch of white pubescence, that on apical segment black; ventral segments fringed with white hair. Length .45 inch.

♂.—Clypeus, line above, sides of face, labrum except two spots at base, scape beneath, and narrow apical margin of abdominal segments 1–5 white; legs rufo-piceous, with short black pubescence, that on coxæ, and tips of four anterior tibiæ white; otherwise as in ♀. Length .45 inch.

Hab. Porto Rico (Mr. Leopold Krug). Two specimens. This is closely allied to *tricolor* Fab.

Anthophora affabilis.

♀.—Black; head, thorax, legs, and basal segment of abdomen clothed with a dense cinereous pubescence, that on vertex tinged with ochraceous and that on thorax above slightly so; wings faintly dusky; tibiæ and basal joint of the tarsi within clothed with black pubescence, that on the latter above black, more or less mixed with white at base; abdomen smooth and shining, with a slight bluish iridescence, apical margin of second and third segments narrowly fringed with white pubescence, fourth and fifth segments with sparse long white hair, more dense on apex of fifth segment which has a patch of black pubescence on apical middle; ventral segments fringed with long white pubescence. Length .60–.65 inch.

♂.—Closely resembles the ♀; sides of face, clypeus, line above, labrum except two black dots at base, and scape beneath, yellowish-white; intermediate tarsi long and slender, terminal joint fringed laterally with black hair; segments 2–6 fringed at apex with white pubescence, broadly so on 5 and 6; otherwise as in ♀. Length .60 inch.

Hab. Texas (Belfrage). Three specimens.

Anthophora simillima.

♂.—Black; head, thorax, legs, and base of abdomen clothed with a long whitish cinereous pubescence, that on vertex and thorax above more or less mixed with black; a sublanceolate mark on each side of the face, clypeus except two spots at base, labrum and scape beneath pale yellow or yellowish-white; wings hyaline, faintly dusky on apical margin; legs clothed above with white pubescence, that beneath except on coxæ, black, middle joints of tarsi fulvous, intermediate pair long and slender, ciliated with long fulvous pubescence, the first and last joints black, the latter ciliated laterally with black hair, posterior legs simple; abdomen with the two basal segments clothed with whitish cinereous pubescence, the two apical segments more or less silvery cinereous, third, fourth, and fifth segments clothed with black pubescence, slightly mixed with pale on apical margin; seventh segment subbidentate at tip. Length .50 inch.

Hab. Colorado (Morrison). Four specimens. This is closely allied to *ursina* Cress., the form of the legs being the same, especially that of the intermediate tarsi.

Anthophora pacifica.

♂.—Black, clothed with a cinereous pubescence, more or less intermixed with black, especially on thorax above; sublanceolate mark on sides of face, clypeus except two spots at base, labrum except two spots at base, and scape beneath pale yellow; wings subhyaline; legs clothed with black pubescence, very long on femora beneath, that on coxæ and trochanters long and white, tips of tibiæ with short white pubescence, the tarsi fringed with long white hair, intermediate tarsi long and very slender, fringed behind with long white hair, intermixed with black on basal joint; abdomen clothed with long cinereous pubescence, not concealing the surface, that on segments 2–5 mostly black, generally intermixed with cinereous on apical margin, but not sufficiently dense to form bands. Length .60 inch.

Hab. California (H. Edwards). One specimen. A very robust species, and easily recognized by the intermediate tarsi being unusually slender and densely ciliated with long white pubescence.

Anthophora Edwardsii.

♀.—Black; head, thorax, legs, and two basal segments of abdomen clothed with cinereous pubescence, intermixed with black on vertex and thorax above; wings hyaline, dusky on apical margin; tibiæ and tarsi within and tip of basal joint of posterior tarsi, with black pubescence; third and fourth segments of abdomen shining, clothed with a very short black pubescence, the apical margin with a more or less interrupted fringe of whitish hair; extreme sides of abdomen, apex of fifth segment except middle and sides of ventral segments clothed with long white pubescence. Length .50 inch.

♂.—Resembles the ♀; lanceolate mark on sides of face, clypeus except lateral suture, labrum except two spots at base, and scape beneath yellow or yellowish-white; intermediate tarsi long, slender, simple, basal joint of posterior pair with a short, stout tooth on inner edge; abdominal segments 1, 2, and 6 with cinereous pubescence, sometimes that on 3–5, which is generally black, is more or less intermixed with cinereous. Length .50 inch.

Hab. California, Nevada (H. Edwards). Seven specimens.

Anthophora mucida.

♀.—Black, clothed with an ochreo-cinereous pubescence, very dense on thorax; wings subhyaline, second submarginal cell subquadrate, the first recurrent nervure uniting with the second transverse cubital nervure; the pubescence on basal joint of the tarsi mostly black; the pubescence on base, sides, and apex of abdomen long, that on third, fourth, and fifth segments more or less black, the fifth segment having a fringe of dense ochraceous pubescence at tip; ventral segment fringed with long pale pubescence. Length .55 inch.

Hab. Colorado (Morrison). One specimen. This species resembles *Edwardsii*, but is easily separated by the form of the second submarginal cell which is normal in that species, being subtriangular in shape and receiving the recurrent nervure at about the middle.

Anthophora miserabilis.

♂.—Black; the entire insect clothed with a cinereous pubescence, intermixed with black on vertex and thorax above, that on the abdomen above shorter and thin, not concealing the surface; narrow line on sides of face, hooked beneath, and a large subtrefoil mark on clypeus, yellowish-white; antennæ entirely black; wings hyaline, second submarginal cell narrow, subquadrate, receiving the first recurrent nervure at the tip and very nearly uniting with the second transverse cubital nervure; legs slender and simple. Length .50 inch.

Hab. California (H. Edwards). One specimen.

Anthophora Morrisoni.

♂.—Black; head, thorax, legs, and basal segment of abdomen clothed with a dense ochraceous pubescence, nearly white on cheeks and thorax beneath, that on thorax above sometimes fulvo-ochraceous; sides of face, clypeus except a dot on each side, a transverse line above, and the scape beneath white; wings hyaline, second submarginal cell subquadrate, being slightly narrowed above, and receiving the first recurrent nervure near the tip; legs slender and simple, the pubescence on posterior legs mostly black; abdomen shining black, the first segment clothed with ochraceous pubescence, and the apical segment has a more or less conspicuous silvery pile. Length .50 inch.

Hab. Colorado (Morrison). Four specimens.

Anthophora Crotchii.

♂.—Black; head, thorax, legs, and base of abdomen clothed with a fulvo-ochraceous pubescence; sides of face, clypeus, labrum, mandibles except tips, and scape beneath, yellow; wings hyaline, slightly dusky at tips; intermediate tarsi very long and slender, pale brown, fringed with long pale hair, the apical or claw joint black, and ciliated laterally with long dense black hair, like a feather; abdomen with short black pubescence, except on the two basal segments where it is ochraceous, and longer on the first, apical segment fringed with white pubescence. Length .50 inch.

Hab. California (Crotch). One specimen. The apical joint of intermediate tarsi is more broadly ciliated than any species known to me.

Melissodes caliginosa.

♀.—Black, opaque; head and thorax clothed with a short dense black pubescence; face, clypeus, sometimes a tuft behind ocelli, sometimes the anterior margin of mesothorax, its lateral and posterior margins narrowly and the metathorax more or less, clothed with dense ochraceous pubescence, sometimes that on the thorax is entirely black; mandibles with a fulvous stripe or spot towards tips; wings fuscous, with a violaceous reflection, nervures black, second submarginal cell nearly as long as first, third broadly truncate at tip and narrowed one-half towards marginal; legs clothed with short black or fuscous pubescence, the posterior tibiæ with long dense fulvous pubescence, that on basal joint of their tarsi fuscous; abdomen with the three basal segments nude, the two apical segments clothed with black or fuscous pubescence, sometimes with a mixture of pale on the sides; in one specimen there is an indistinct oblique line of pale pubescence on each side of third segment and a narrow line on lateral apical margin of fourth segment; venter entirely black. Length .60 inch.

♂.—Pubescence of head, thorax above and basal segment of abdomen bright ochraceous; clypeus, labrum, and spot on mandibles, yellow; antennæ as long as head and thorax, black, rufo-piceous beneath, third joint about one-third the length of fourth; disk of mesothorax and scutellum above, and pleura at sides and beneath, clothed with black pubescence, a slight mixture of pale pubescence beneath tegulæ; tegulæ dull testaceous; wings pale fuscous; legs clothed with short black pubescence, that on anterior tibiæ and tarsi, and all the coxæ, golden ochraceous, and that on tips of four posterior tibiæ ochraceous, tips of tarsi ferruginous, tibial spurs pale, intermediate tarsi long and rather slender; line at extreme base of second segment and a short oblique line on each side of third segment of short dense ochraceous pubescence, extreme sides of sixth segment with a short acute spine, tip of apical segment golden above; venter shining black, piceous at base. Length .55 inch.

Hab. Georgia (Morrison, Ridings). Ten specimens. The pubescence on mesothorax of ♀ is sometimes entirely black.

Melissodes morosa.

♀.—Black; head clothed with ochraceous pubescence which is mixed with black on vertex and occiput; thorax clothed with a short dense black pubescence, that on prothorax above and a slight admixture on metathorax ochraceous; disk of mesothorax nude, sparsely punctured; wings short, subhyaline, nervures fuscous, second submarginal cell shorter than first, second subtruncate at apex and narrowed nearly two-thirds towards marginal; legs clothed with short black pubescence, the posterior tibiæ and tarsi with long dense yellow pubescence, which on the tarsi within is fuscous; abdomen clothed with black pubescence, that on lateral margin of basal segment ochraceous; narrow basal margin of second segment, a narrow suboblique line on each side a little behind the middle, and broad apical margin of third and fourth segments, covered with a dense appressed ochraceous pile; two apical segments fringed with fuscous pubescence; venter with black pubescence, apical margin of the segments dull testaceous. Length .50 inch.

Hab. Mexico (Sumichrast). One specimen.

Melissodes montezuma.

♀.—Black, shining; face, clypeus, and labrum with short pale pubescence slightly mixed with black, that on vertex and occiput long and black, and on cheeks long and white; tips of mandibles fulvous; anterior half of mesothorax and the pleura laterally and beneath clothed with dense black pubescence, that on mesothorax posteriorly, scutellum, and metathorax fulvous; tegulæ fulvo-testaceous; wings subhyaline, dusky at tips, nervures black, second submarginal cell small, narrow, about one-third the length of first, the first recurrent nervure uniting with the second transverse cubital nervure, third submarginal broadly rounded at tip and narrowed one-third towards marginal; pubescence of legs entirely black, tips of tarsi ferruginous; abdomen shining, basal segment with a long thin pale fulvous pubescence, and at sides of two apical segments a tuft of whitish pubescence; venter fringed laterally and at apex of segments with pale pubescence. Length .55 inch.

♂.—Labrum whitish; antennæ rather longer than the body, robust, black, flagellum dull fulvous beneath, third joint very short about equal with the second, the fourth twice as long as the three basal joints taken together; the black pubescence on mesothorax anteriorly narrower than in ♀, femora fringed with long whitish pubescence; apex of abdomen silvery sericeous in certain lights, apex bidentate; venter brown. Length .45 inch.

Hab. Mexico (Sumichrast). Four specimens.

Melissodes dubitata.

♀.—Black; head, thorax, legs, and basal segment of abdomen clothed with ochraceous; clypeus confluently punctured, opaque; disk of mesothorax almost nude, sparsely punctured; tegulæ dull testaceous; wings fusco-hyaline, nervures fuscous, second submarginal cell one-half the length of first, third broadly truncate at tip, narrowed nearly two-thirds towards marginal; tips of tarsi dull ferruginous; abdomen shining black, the pale pubescence on basal segment long and thin, apical segments with short black pubescence, that on apex of fifth and sixth segments sometimes fuscous. Length .55–.60 inch.

♂.—Clypeus, labrum, and spot on base of mandibles, yellowish; antennæ as long as head and thorax, fulvous, brown above, the third joint about one-fourth the length of fourth; legs with mixed fuscous and ochraceous pubescence, tarsi with black hair, apical joints ferruginous; base and sides of two basal segments of abdomen and extreme sides of third segment with whitish pubescence, an indistinct oblique line of pale fuscous pubescence on each side of third and fourth segments; sixth segment with an acute tooth on each extreme side. Length .50 inch.

Hab. Georgia (Ridings, Morrison). Nine specimens. The ♀ of this species closely resembles that of *desponsa* Smith, which, however, has the pubescence of thorax beneath and of four anterior legs entirely black.

Melissodes nigrifrons.

♀.—Small, robust, black, clothed with black pubescence, that on occiput, thorax above, and extreme base of abdomen pale ochraceous; antennæ very short, flagellum subtestaceous beneath; a small patch of pale ochraceous pubescence beneath tegulæ, which is piceous; wings hyaline, nervures black; second submarginal cell small, less than half the length of first, receiving the first recurrent nervure very near the apex, third submarginal about three times longer than second, rounded at tip and narrowed one-half towards marginal; pubescence of legs entirely black; abdomen shining, the pubescence, except on basal segment, short and black. Length .40 inch.

Hab. California (Crotch). Three specimens.

Melissodes Edwardsii.

♂.—Black; head, thorax, legs, and base of abdomen clothed with a dense fulvo-ochraceous pubescence, which is paler on sides and beneath; clypeus and labrum yellowish; antennæ reaching beyond first abdominal segment, entirely black, crenulated toward tips, third joint shorter than first; wings hyaline, nervures fuscous, second submarginal cell more than half the length of first, the third broadly truncate at tip and then suddenly narrowed one-half towards marginal; tarsi long and slender, especially the intermediate pair, simple, the basal joint of posterior pair fringed with long pale hair; abdomen shining, basal segment densely clothed with a long ochraceous pubescence, which extends more or less on base and sides of second segment; remaining segments above clothed with a short black pubescence, longer at sides and at tip; sometimes the fourth and fifth segments have each a narrow, indistinct, subapical fascia of white pubescence; venter clothed with pale pubescence at extreme sides of basal segments. Length .50–.55 inch.

Hab. California (H. Edwards). Six specimens.

Melissodes californica.

♂.—Black; head, thorax, legs, and base of abdomen densely clothed with a pale yellowish-white pubescence; clypeus and labrum yellow; antennæ reaching to tip of first abdominal segment, entirely black, the apical joints subcrenulated, third joint long, attenuated towards base, rather longer than first and second taken together, joints of the flagellum long and flattened and subcarinate laterally; tegulæ dull testaceous; wings hyaline, nervures fuscous, second submarginal cell half the length of first, third shorter than first, subtruncate at tip, and narrowed less than one-half towards marginal; intermediate tibiæ dilated and subdentate beneath, their tarsi long and slender, basal joint long, black, slightly curved, dilated near base beneath and attenuated to tip, and fringed beneath with dense fulvous hair, remaining joints elongate, ferruginous; basal joint of posterior tarsi narrow, flat, black, fringed beneath with short and at tip with long fulvous hair, at the tip within a slender incurved acute tooth, apical joints ferruginous; abdomen shining black, two basal segments clothed with pale yellowish pubescence, long on first segment, remaining segments and venter with short black pubescence, that on apex above more or less fuscous. Length .56 inch.

Hab. California (H. Edwards). One specimen. Closely resembles *Edwardsii*, but easily separated by the longer third joint of antennæ, and differently formed intermediate tibiæ and tarsi.

Melissodes fulvitarsis.

♂.—Black; head, thorax, legs, and base of abdomen clothed with a dense whitish pubescence, more or less tinged with ochraceous above; clypeus and labrum pale yellow, shining; antennæ longer than head and thorax, subcrenulated, third joint longer than first, sometimes pale, subclavate; wings hyaline, nervures fuscous, second submarginal cell quadrate, half the length of first, the third as long as first, broadly truncate at tip, and narrowed nearly one-half towards marginal; legs clothed with white pubescence, tarsi fulvous, the basal joint of posterior pair fringed with long yellowish hair; intermediate tibiæ short, dilated and toothed beneath towards base and with a short acute spine at tip above, almost hidden by the dense white pubescence, their tarsi long and slender, the basal joint subfusiform, more strongly narrowed towards tip, which is slightly dilated and produced behind into a prominent, somewhat curved subacute tooth, remaining joints long and slender; abdomen shining at tip, two basal segments with dense ochraceous pubescence, shorter and paler on second segment, remaining segments with black pubescence, interspersed with long scattering pale hair, sixth segment generally with a narrow fringe of whitish pubescence; sometimes segments 3–6 have each an indistinct subapical fascia of cinereous pubescence, more distinct when viewed in certain lights; venter with mixed pale and black pubescence. Length .50 inch.

Hab. Colorado (Morrison). Six specimens. Allied to *californica*, but smaller, and easily separated by the form of the intermediate tarsi.

Melissodes frater.

♂.—Black; head and thorax clothed with a dense cinereous pubescence, more or less tinged with ochraceous above and pale beneath; clypeus and labrum yellow; antennæ three-fourths the length of the body, entirely black, crenulated towards apex, third joint very short, about twice the length of second; wings hyaline, with fuscous nervures, second submarginal cell large, two-thirds the length of first, the third broadly truncate at tip and narrowed more than one-half towards marginal; legs thickly clothed with white pubescence, tarsi fulvous at tips, clothed at base beneath with dense golden hair, the posterior pair fringed with long pale hair, intermediate legs simple, the basal joint of their tarsi long and narrow; abdomen rather shining, with a changeable pale subpruinose pile, first and second segments with a thin pale pubescence, longer on the first, segments 3–6 each with a more or less distinct fascia of whitish pubescence, more dense 5 and 6, sides of apical segments with long pale hair; venter piceous, almost nude. Length .50 inch.

Hab. Colorado (Morrison). Six specimens. This is closely allied to *honesta* Cress., from Texas, which has the abdomen distinctly banded, the labrum black, and the antennæ shorter, with the third joint longer than in the present species.

Melissodes lepida.

♂.—Black; head, thorax, legs, and base of abdomen clothed with an ochraceous pubescence, that on thorax above more or less tinged with fulvous, and very dense; clypeus and labrum pale yellow; antennæ rather longer than head and thorax, entirely black, subcrenulated towards tip and flattened and subcarinate laterally, third joint three times longer than second and less than half the length of fourth; wings hyaline, with pale fuscous nervures, second submarginal cell half the length of first, receiving the recurrent nervure very near the tip, the third broadly subtruncate at tip and narrowed nearly one-half towards marginal; tarsi except base fulvous, intermediate pair long and very slender, the basal joint narrowed to tip, slightly twisted and curved, basal joint of posterior pair fringed with long yellowish hair; abdomen shining, two basal segments clothed with pale yellow pubescence, short and paler on the second, segments 2–6 each with a narrow, even, apical fringe of pale cinereous pubescence, sides of apical segments with a few long whitish hair; venter piceous, almost nude. Length .45 inch.

Hab. Texas (Belfrage); Colorado (Morrison). Three specimens. Also closely allied to *honesta*, but smaller and with differently formed intermediate tarsi.

Melissodes speciosa.

♀.—Large, black; face with a short griseous pubescence, occiput and thorax with a dense fulvo-ochraceous pubescence; clypeus coarsely and confluently punctured; mandibles fulvous near tips; tegulæ testaceous; wings dusky on apical margins, nervures pale fuscous, second submarginal cell three-fourths the length of first, the third broadly rounded at tip and narrowed one-half towards the marginal; legs clothed with fulvo-ochraceous pubescence, paler and sparse on femora, posterior tibiæ and base of tarsi with long dense fulvous hair; basal segment of abdomen clothed with an erect pale ochraceous pubescence, segments 2–4 each with a broad even fascia of dense appressed white or cinereous pile, apical margin of segments 1–3 smooth and shining, that of 5 fringed with pale pubescence tinged with fuscous medially, apical segment with fuscous pubescence, paler laterally; venter piceous, apical margin of the segments rufo-testaceous and fringed with pale fuscous hair, whitish laterally. Length .60–.70 inch.

Hab. Colorado (Ridings, Morrison). Five specimens. A very handsome species, having the abdominal fasciæ broad and distinct.

Melissodes dilecta.

♂.—Black; head, thorax, and base of abdomen clothed with a dense ochraceous pubescence, strongly tinged with yellow above; clypeus and labrum yellowish-white; tips of mandibles pale; antennæ two-thirds the length of body, entirely black, subcrenulated towards tip, third joint about three times the length of second; wings slightly tinged with yellowish, nervures pale fuscous, second submarginal cell quadrate, more than half the length of first, the third broadly truncate at tip and narrowed about one-half towards marginal; legs clothed with pale ochraceous pubescence, dense and fulvous on base of tarsi beneath; intermediate tarsi slender, simple, the basal joint slightly curved, posterior pair fringed with long pale yellowish hair; first segment of abdomen clothed with a long yellow pubescence, remaining segments with a very short cinereous pile, becoming more dense before apex, and forming a more or less distinct white band, and interspersed with longer mixed pale and black scattering hairs; venter brown, the sides of the segments fringed with pale pubescence. Length .45–.50 inch.

Hab. Texas (Belfrage); Colorado (Ridings). Three specimens. This may be the ♂ of *speciosa.*

Melissodes compta.

♀.—Black; head clothed with a dense cinereous pubescence; clypeus finely and confluently punctured; apical half of mandibles fulvous; thorax and basal segment of abdomen with a short dense fulvous pubescence, very dense on thorax, entirely concealing the surface; tegulæ pale fulvous; wings pale fuliginous, with a violaceous reflection, nervures black, second submarginal cell about half the length of first, the third broadly rounded at tip, and narrowed one half towards marginal; legs clothed with dark fulvous pubescence, black on basal joint of anterior tarsi; abdomen with four narrow fasciæ of dense appressed white pubescence, two on second segment, and one each on third and fourth, that on the latter dilated laterally, two apical segments and venter clothed with black pubescence. Length .70 inch.

♂.—Clypeus, labrum, and spot at base of mandibles yellowish-white; antennæ scarcely as long as head and thorax, black, apical joint long, acuminate and acute at tip, three basal joints brownish, pubescent, the third clavate, about equal in length with the fourth; thorax as in ♀; wings subhyaline, fuliginous and subviolaceous on apical margin; legs clothed with fulvous pubescence, tarsi simple and subrobust; the four white bands on abdomen less distinct, subinterrupted, and sometimes subobsolete; sides of sixth segment with a short acute tooth. Length .55 inch.

Hab. Georgia (Morrison). Three specimens. A very pretty species. The ♂ antennæ are acutely pointed at tip.

Melissodes georgica.

♂.—Black; head, thorax, and base of first segment of abdomen clothed with a short dense ochraceous pubescence; clypeus, labrum, and base of mandibles yellow, the latter fulvous near tips; antennæ as long as head and thorax, third joint twice the length of second, the flagellum dull fulvous beneath; wings tinged with yellowish, the apical margin dusky and subviolaceous, nervures fuscous, second submarginal cell large, three-fourths the length of first, the third rounded at tip and narrowed one-half towards marginal; legs clothed with dull ochraceous pubescence, that on four posterior tibiæ and tarsi fuscous or black, extreme tips of their tibiæ with a tuft of whitish pubescence, tarsi simple, subrobust, tips dull ferruginous; apex of abdomen with rather long black pubescence, the ochraceous pubescence on base of first segment extends narrowly down on the sides of second and third segments; a narrow band at base of second segment and a broader band on third and fourth, slightly oblique laterally and subinterrupted medially of appressed white pubescence; there is a slight indication of an oblique line of pale pubescence on sides of second segment; a short tooth on each side of sixth segment nearly concealed by the pubescence. Length .55 inch.

Hab. Georgia (Morrison). One specimen. This resembles the ♂ of *compar*, but is separated at once by the normal shape of the antennæ and the color of the pubescence on posterior legs.

Melissodes coloradensis.

♀.—Black; head, thorax, and legs clothed with a bright fulvous pubescence, most dense on thorax and long and dense on posterior legs; clypeus finely and confluently punctured; tips of mandibles and flagellum beneath fulvous; disk of mesothorax and scutellum shining, strongly punctured, sparsely clothed with a short black pubescence; tegulæ piceous; wings dusky, fuliginous on apical margin, nervures fuscous or black, second submarginal cell nearly as long as the first, the third rounded at apex and narrowed two-thirds towards marginal; the pubescence on four anterior tarsi and on posterior pair within is fuscous or black; abdomen shining, extreme base thinly clothed with a yellowish pubescence, extreme base of third segment occasionally with a whitish band, two spots or short lines on sides of second segment, a narrow band near apex of third, slightly interrupted medially and a broad band at tip of fourth segment, of short appressed pale fulvous pubescence; sides of apical segments and ventral segments fringed with yellow pubescence. Length .55 inch.

♂.—Closely resembles the ♀; clypeus, labrum, and spot at base of mandibles, yellow; antennæ rather longer than head and thorax, third joint a little longer than second, flagellum pale fulvous or yellow beneath; the black pubescence on disk of mesothorax and scutellum more dense; third submarginal cell narrowed three-fourths towards marginal; pubescence on legs entirely bright fulvous or yellow, tarsi simple, tips ferruginous; base and sides of first segment of abdomen, sides of second and a short lateral subapical line, a band on third, interrupted medially, and a band on fourth and fifth, all of dense ochraceous pubescence; sixth and seventh segments each with a short tooth on extreme sides; ventral segments fringed with ochraceous or yellow hair. Length .55 inch.

Hab. Colorado (Ridings, Morrison). Ten specimens.

Melissodes petulca.

♀.—Black; head clothed with short dense cinereous pubescence, that on occiput fulvous; clypeus finely punctured; mandibles with a pale spot near base; flagellum dull testaceous beneath; thorax clothed with a short dense ochraceous pubescence, more or less tinged with fulvous above, that on disk of mesothorax and scutellum black; tegulæ dull testaceous; wings subhyaline, tinged with yellowish, nervures pale fuscous, second submarginal cell nearly as long as first, the third broadly rounded at tip and narrowed one-half towards marginal; legs clothed with ochraceous or pale fulvous pubescence, long and dense on posterior tibiæ and tarsi, tips of tarsi ferruginous; base and sides of first segment of abdomen and sides of apical segments clothed with ochraceous pubescence, broad apical margin of segments 2-4 and base of second narrowly, densely clothed with a short appressed cinereous pile; apical margin of first segment narrowly testaceous; ventral segments fringed with yellow or ochraceous pubescence. Length .50 inch.

Hab. Georgia (Morrison). Three specimens.

Melissodes montana.

♀.—Black; head densely clothed with pale cinereous pubescence, that on occiput mixed ochraceous and black; mandibles fulvous near tips; thorax densely clothed with a long ochraceous pubescence, tinged above with fulvous, that on disk of mesothorax and scutellum short and black; tegulæ piceous; wings hyaline, dusky on apical margin, nervures fuscous, second submarginal cell three-fourths the length of first, the third long, rounded at tip, and narrowed one-half towards marginal; legs clothed with ochraceous pubescence, that on posterior tibiæ and tarsi long and dense, tips of four posterior tibiæ and basal joint of their tarsi and of the posterior pair within clothed with fuscous or black; abdomen with base and sides of two basal segments, and extreme sides of remaining segments, clothed with ochraceous pubescence, segments 2–4 each with a band of dense appressed golden ochraceous pubescence, broadest on 4, and more or less interrupted on 2; apical segments with black or fuscous pubescence; venter piceous, clothed with black pubescence. Length .50 inch.

♂.—Head, thorax, base, and sides of abdomen clothed with pale ochraceous pubescence, that on disk of mesothorax and scutellum black; clypeus, labrum, and spot on base of mandibles pale yellow; antennæ reaching to tip of second abdominal segment, subcrenulated towards tip, third joint a little longer than second, flagellum fulvous beneath; legs simple, clothed with ochraceous pubescence, fulvous on tarsi beneath, the latter pale ferruginous; apical margin of abdominal segments broadly pale testaceous, the apical half of second and nearly the whole of the three following segments covered with a short subappressed ochraceous or yellow pubescence, that on the two apical segments fuscous or black, these two segments have each a short tooth on extreme sides; venter piceous, the apical margin of the segments narrowly fulvo-testaceous. Length .50 inch.

Hab. Colorado (Ridings); New Mexico (Dr. Lewis). Four specimens.

Melissodes suffusa.

♀.—Black; head clothed with cinereous pubescence, that on labrum and occiput ochraceous; anterior margin of clypeus, most of labrum and base of mandibles pale ferruginous, a yellowish line on mandibles near tips; thorax clothed with a short dense ochraceous pubescence, pale on sides and beneath, and tinged with fulvous above, that on disk of mesothorax and scutellum sparse and black; tegulæ pale testaceous; wings hyaline, slightly dusky on apical margin, nervures fuscous, costal nerve ferruginous, neuration as in *montana*; legs clothed with ochraceous pubescence long and dense on posterior tibiæ and tarsi and fulvous within, tips of tarsi ferruginous; base and sides of first abdominal segment clothed with ochraceous pubescence, a white band at base of second segment and a very broad band of short dense appressed cinereous pile on apex of segments 2–4, two apical segments clothed with fulvous pubescence paler laterally, apical margin of first segment narrowly whitish; venter with fulvous pubescence, apical margin of the segments fulvo-testaceous. Length .60 inch.

♂.—Pubescence paler and more dense on head; clypeus, labrum, and base of mandibles yellowish; antennæ rather longer than head and thorax, third joint three times longer than second and about half the length of fourth, flagellum fulvous beneath; wing nervures fulvous; legs simple, clothed with ochraceous pubescence, that on tarsi beneath fulvous; abdomen much as in ♀ except that the band on fourth segment is narrower, and the fifth has a similar band; apex with fulvous pubescence, the sixth segment having a stout acute tooth at extreme sides. Length .45 inch.

Hab. Texas (Belfrage, Heiligbrodt). Four specimens. The cinereous bands on abdominal segments 2–4 of ♀ are very broad, occupying nearly the entire upper surface.

Melissodes fimbriata.

♀.—Black; head and thorax clothed with pale ochraceous or cinereous pubescence, which on disk of mesothorax and scutellum is sparse and mixed with black; mandibles with a yellowish stripe near tips; flagellum subtestaceous beneath; tegulæ piceous; wings fuscous on apical margin, nervures black, second submarginal cell half the length of first, basal nerve very oblique, third submarginal truncate at tip and narrowed one-half towards marginal; legs clothed with fulvous pubescence, long and dense on posterior pair; abdomen with basal and lateral margins of first segment, extreme basal margin of second, and narrow apical margin of segments 2–4 fringed with whitish pubescence, elsewhere the pubescence is fuscous or black. Length .45 inch.

♂.—Closely resembles the ♀; clypeus and sometimes a spot on labrum yellowish; antennæ two-thirds the length of body, third joint scarcely twice the length of second, flagellum fulvous beneath; pubescence on thorax much longer, disk of mesothorax and scutellum shining and sparsely punctured; pubescence of legs paler, tarsi slender, simple, ferruginous at tips; fifth segment of abdomen fringed at apex with white pubescence similar to that on fourth, two apical segments each with a short acute tooth on extreme sides, sides of venter with long whitish hair. Length .45 inch.

Hab. Texas (Belfrage). Four specimens. This is allied to *rivalis* Cress.

Melissodes agilis.

♂.—Small, black, clothed with a pale ochraceous or cinereous pubescence, dense on thorax; clypeus, labrum, and spot on base of mandibles pale yellow; mandibles dull ferruginous at tips; antennæ nearly as long as the body, fulvous, darker above, three basal joints black, third joint a little larger than second; wings whitish-hyaline, with pale testaceous nervures, second submarginal cell half the length of first, the third rounded at tip and narrowed one-half towards marginal; legs clothed with short cinereous pubescence, tarsi slender, simple, pale ferruginous at tips, tibial spurs white; abdomen thinly clothed with cinereous pubescence, apical margin of the segments rather broadly whitish, and having a narrow band of cinereous pubescence, two apical segments each with a short stout tooth at extreme sides. Length .40 inch.

Hab. Texas (Belfrage). Six specimens. This is much smaller than *menuacha* Cress., which it otherwise closely resembles.

Melissodes communis.

♀.—Black; head and thorax clothed with a short dense cinereous pubescence, very short on clypeus, which is densely punctured; flagellum subtestaceous beneath; disk of mesothorax and scutellum with short sparse black pubescence; disk of metathorax almost nude, the pubescence on sides long; tegulæ piceous; wings dusky, darker on apical margin, nervures fuscous, second submarginal cell more than half the length of first, the third rounded at tip and narrowed one-half towards the marginal; four anterior legs with mixed fuscous and ochraceous pubescence, posterior tibiæ and tarsi with long dense fulvous pubescence, which is darker within; abdomen shining, base and sides of first segment, with cinereous pubescence; narrow band at extreme base of second segment, another, slightly arcuated, across the middle, a broad band near base of third, and another on apex of fourth, sometimes subinterrupted on posterior middle, composed of short dense appressed whitish pile; apex and venter with black pubescence, that on the sides of the latter generally mixed with white. Length .45 inch.

♂.—Resembles the ♀ in color of pubescence and ornamentation of abdomen; clypeus, labrum, and base of mandibles pale yellowish; antennæ two-thirds the length of body, third joint scarcely twice the length of second, flagellum fulvous beneath; legs clothed with ochraceous pubescence, that on tarsi beneath golden, tarsi simple, pale ferruginous at tips; sometimes the fifth abdominal segment has an indistinct band of pale hairs; two apical segments each with a short lateral tooth; sometimes the apical margin of the segments are more or less testaceous. Length .45 inch.

Hab. Georgia, Illinois. Twenty specimens.

Melissodes confusa.

♀.—Black; head and thorax clothed with a dense pale ochraceous pubescence, slightly mixed with black on vertex, occiput, and thorax beneath; on disk of mesothorax and scutellum the pubescence is sparse and black, the former smooth, polished, sparsely punctured; tegulæ piceous; wings hyaline, slightly dusky on apical margin, nervures fuscous, second submarginal cell three-fourths the length of first, the third rounded at tip and narrowed more than one-half towards marginal; legs clothed with black pubescence, mixed with pale ochraceous at base of four anterior tibiæ and apex of posterior femora, posterior tibiæ and outside of their tarsi clothed with a long dense yellow pubescence; abdomen clothed with short black pubescence, longer on apical segments, basal segment with a long sparse pale pubescence at base, segments 2–4 each with a broad band of short dense appressed pubescence, often interrupted on second and third segments, base of second sometimes with a narrow band at base; venter with black or fuscous pubescence. Length .45–.50 inch.

♂.—Black; head, thorax, and base of abdomen clothed with a long dense whitish pubescence, more or less tinged above with ochraceous; clypeus yellowish; antennæ nearly as long as the body, entirely black, third joint a little larger than second; pubescence of legs entirely pale ochraceous, tips of tarsi ferruginous, tibial spurs whitish; apical margin of abdominal segments whitish, and having a band of pale pubescence, sixth and seventh segments each with a short tooth on each extreme side, generally concealed by the pubescence; venter piceous, the pubescence sparse and pale, apical margin of the segments narrowly testaceous. Length .40–.43 inch.

Hab. Colorado (Ridings, Morrison). Twelve specimens.

Melissodes perplexa.

♀.—Black, shining; head and thorax clothed with cinereous pubescence, that on anterior margin of occiput, mesothorax except anterior margin and scutellum, erect and black; disk of mesothorax almost nude and sparsely punctured; mandibles with a yellowish stripe near apex; tegulæ piceous; wings hyaline, slightly dusky on apical margin, nervures black, third submarginal cell rounded at apex and narrowed one-half towards marginal; legs with black or fuscous pubescence, posterior tibiæ and outer side of basal joint of their tarsi pale ochraceous; base of first segment and sides of all the segments beneath with cinereous pubescence, a cinereous band on middle of second and third segments, suboblique on the sides and more or less interrupted on second, and a band of same color at apex of fourth segment, sometimes a narrow cinereous band at extreme base of second segment; apical segments above black. Length .40 inch.

♂.—Pubescence longer and more dense than on ♀; clypeus except base white; antennæ nearly as long as the body, third joint scarcely twice longer than second, flagellum fulvous beneath; third submarginal cell narrowed more than two-thirds to marginal; pubescence of legs entirely pale, tarsi slender and simple, tibial spurs pale; abdominal fasciæ much narrower than in ♀ and more or less interrupted, two apical segments each with a stout tooth on extreme sides. Length .35 inch.

Hab. Georgia (Morrison); Texas (Belfrage). Twenty specimens.

Melissodes condigna.

♀.—Robust, shining black; head clothed with short whitish pubescence, very short on clypeus, the disk of which is nude, a line of long black hair behind ocelli; mandibles near tips and flagellum beneath yellowish; prothorax, lateral and posterior margins of mesothorax, metathorax, and large patch beneath wings clothed with griseous or whitish pubescence, elsewhere it is short and black, a slight admixture of pale hair on mesothorax anteriorly; disk of mesothorax and scutellum shining, sparsely punctured and nude; tegulæ piceous; wings tinged with yellowish and with a golden reflection, pale dusky on apical margin, nervures fuscous, second submarginal cell small, scarcely half the length of first, third submarginal as long as first, rounded at apex and narrowed one-half towards marginal; legs clothed with mixed fuscous and pale pubescence, that on posterior tibiæ and tarsi yellow, fulvous within; abdomen shining, finely punctured, subiridescent; base of first segment with a thin pale pubescence; a narrow band at base of second segment dilated on extreme sides, a broad band at base of third, a broad band at apex of fourth, more or less interrupted medially, and a spot on each side of fifth, of short dense appressed cinereous or pale ochraceous pubescence; apical margin of the segments sometimes narrowly pale testaceous; lateral apical margin of ventral segments fringed with whitish hair. Length .55 inch.

Hab. Illinois, Kansas. Two specimens.

Melissodes Stretchii.

♀.—Black; head and thorax clothed with dense griseous pubescence; clypeus nude, densely punctured; labrum with fulvous pubescence; mesothorax very densely and finely punctured, the pubescence short and not very dense, that on pleura long, dense, and pale; tegulæ piceous; wings subhyaline, nervures black, second submarginal cell less than one-half the length of first, the third truncate at tip and narrowed one-half towards marginal; legs clothed with pale ochraceous pubescence, long and dense on posterior tibiæ and tarsi; abdomen nearly nude, a little griseous pubescence at base of first segment, apical margin of segments 2 and 3 narrowly whitish, the base of 2–5, and apex of 5 with a narrow band of appressed pale ochraceous pile, indistinct on base of 2 and 5; apical segment with fulvous pubescence; venter fringed with long pale pubescence. Length .50 inch.

Hab. California (R. H. Stretch). One specimen. A very distinct species.

Melissodes actuosa.

♀.—Black; head and thorax clothed with griseous pubescence, sparse on face and disk of mesothorax, which latter is opaque and impunctured; tegulæ rufo-piceous; wings hyaline, nervures fuscous, second submarginal cell small, less than half the length of first, the third truncate at tip and narrowed one-half towards marginal; legs with pale ochraceous pubescence, long and dense on posterior tibiæ and tarsi; abdomen with short black pubescence, a few scattered pale hairs on base of first segment, a broad band of appressed cinereous pubescence on apex of segments 2–4, generally interrupted on middle of 2, and a band of pale fulvous pubescence on apex of 5; ventral segments fringed with griseous pubescence. Length .45 inch.

Hab. California (H. Edwards). Three specimens. This has the mesothorax and scutellum opaque and impunctured.

Melissodes donata.

♀.—Small, black; head and thorax clothed with a short, not very dense griseous pubescence, that on vertex, mesothorax, and scutellum more or less black or fuscous; mesothorax opaque, roughly, densely and confluently punctured, the scutellum very densely so; tegulæ piceous; wings subhyaline, nervures black, second submarginal half the length of first, receiving the first recurrent nervure at tip, the third submarginal truncate at tip and narrowed two-thirds towards marginal; legs with pale ochraceous pubescence, long and dense on posterior pair; abdomen shining, closely and minutely punctured, base and sides narrowly of first segment with a little cinereous pubescence, base of second narrowly, and apex of segments 2–4 broadly with a dense, appressed, whitish cinereous pile; two apical segments black, the tip of 5 narrowly fuscous; sides of ventral segments fringed with whitish hair. Length .35 inch.

Hab. Mexico (Sumichrast). One specimen.

Melissodes trifasciata.

♀.—Black; head clothed with griseous pubescence, that on vertex black; mandibles tinged with dull ferruginous; thorax with dense ochraceous pubescence; disk of mesothorax, an arcuate band anteriorly extending beneath, and the scutellum with black pubescence; wings subhyaline, darker on apical margin, nervures fuscous, second submarginal cell obliquely quadrate, half the length of first, third submarginal truncate at tip, narrowed one-half towards marginal; legs with black pubescence, mixed with pale on femora and tibiæ, that on tarsi beneath fulvous, posterior tibiæ and tarsi fulvous clothed with long fulvous pubescence, tip of first joint black; abdomen shining, base of first segment clothed with pale ochraceous pubescence, a narrow band at base of segments 2 and 3, and broad band at apex of 4, of short dense appressed pale ochraceous pile; apex and venter with short black pubescence. Length .40 inch.

Hab. Porto Rico (Krug). One specimen. This may prove to be the ♀ of *mimica* Cress.

Melissodes albilabris.

♂.—Black; head and thorax clothed with a long, dense griseous pubescence, mixed with black on face, vertex and mesothorax anteriorly, and tinged with yellow on sides of scutellum and metathorax; labrum white; antennæ three-fourths the length of the body, third joint a little longer than second, flagellum dull fulvous beneath; tegulæ yellowish; wings tinged with yellow, apical margin dusky, nervures pale fuscous, second submarginal cell less than half the length of first, the third shorter than first and only slightly narrowed towards marginal; legs slender, clothed with pale pubescence, that on outside of posterior tibiæ and tarsi black, tips of tarsi pale ferruginous; apical margin of abdominal segments above broadly pale testaceous, clothed with a very short dense appressed golden pile, base of first segment with a whitish pubescence. Length .40 inch.

Hab. Mexico (Sumichrast). One specimen.

Melissodes otomita.

♂.—Small, black; head and thorax clothed with a dense griseous pubescence, that on occiput, disk of mesothorax and scutellum more or less black; clypeus pale yellow; antennæ as long as head and thorax, third joint about twice the length of second, flagellum beneath except first joint fulvous; tegulæ piceous; wings hyaline, apical margin dusky, nervures pale fuscous, second submarginal large, about equal with first, third rounded at tip and narrowed one-half towards marginal; legs clothed with griseous pubescence; first segment of abdomen clothed with griseous pubescence, segments 2–5 covered more or less with a dense ochraceous pile, becoming more dense on the apical margin and forming golden-ochraceous bands; apical segments black, the sixth with a blunt tooth on each side. Length .35 inch.

Hab. Mexico (Sumichrast). One specimen.

Melissodes tepida.

♀.—Black; head, thorax, legs, and base of abdomen clothed with a dense pale ochraceous pubescence; mandibles yellowish toward tips; flagellum fulvo-testaceous beneath; posterior tibiæ and tarsi clothed with a long dense pale ochraceous pubescence; wings subhyaline, nervures fuscous, second submarginal cell two-thirds the length of first, the third broadly rounded at tip and narrowed more than one-half towards marginal; segments 2–4 of abdomen covered almost entirely with a short dense pale appressed ochraceous pile; two apical segments black, a patch of pale pubescence on each side of the fifth; venter fringed with pale pubescence. Length .40 inch.

Hab. Nevada (H. Edwards). One specimen.

Melissodes suavis.

♀.—Black; head, thorax, and base of abdomen clothed with a dense pale ochraceous pubescence; clypeus nearly nude, shining; mandibles near tips and flagellum beneath rufo-testaceous; tegulæ pale fulvous; wings hyaline, nervures black, second submarginal cell half the length of first, the third truncate at tip and suddenly narrowed one-half towards marginal; legs clothed with pale pubescence, that on tibiæ and tarsi fulvous, long and dense on posterior pair; a spot on each side of first abdominal segment, and the second to fifth, except narrow apical margins, clothed with a short, dense, appressed white pubescence, that on the fifth tinged with ochraceous, the apical margin of the segments nude, smooth, and polished; venter brown, the segments fringed with pale, the apex with fulvous pubescence. Length .45 inch.

Hab. Colorado (Morrison). One specimen. A very pretty little species, the abdomen appearing white with four narrow shining black bands.

Melissodes lupina.

♂.—Black, clothed with a dense griseous pubescence, tinged with ochraceous on thorax above, and white on face and cheeks; clypeus, labrum more or less, and spot on base of mandibles pale yellow; antennæ three-fourths the length of the body, third joint a little longer than the second, flagellum pale fulvous beneath; wings hyaline, nervures pale fuscous, second submarginal cell about half the length of first, the third rounded at tip and narrowed one-half to marginal; legs with griseous pubescence, tarsi pale ferruginous at tips; abdomen clothed with a griseous, sometimes ochraceous pubescence, long on basal segment, and forming a more or less indistinct band near apex of remaining segments; apical margin of the segments dull testaceous; sides of two apical segments with a short acute tooth. Length .35 inch.

Hab. California (H. Edwards). Six specimens.

Melissodes Snowii.

♂.—Black, clothed with a dense white pubescence; clypeus, labrum, and spot at base of mandibles yellowish-white; antennæ two-thirds the length of body, second and third joints subequal, flagellum fulvous, the base of joints above black; wings uniformly whitish-hyaline, nervures pale fulvous, second submarginal less than half the length of first, the third broadly rounded at tip, and narrowed one-half towards marginal; tips of tarsi pale ferruginous; apical margin of abdominal segments whitish and having a fascia of dense white pubescence; two apical segments each with a tooth on extreme sides; venter clothed with white pubescence. Length 40 inch.

Hab. Colorado (Prof. F. H. Snow). One specimen. This is larger than *albata* Cress., and with the abdomen distinctly fasciate.

Melissodes tepaneca.

♀.—Black; head clothed with whitish pubescence, that on labrum long and ochraceous, that on occiput fulvous with a line of long erect black hair behind the ocelli; thorax above clothed with a dense fulvous pubescence, that on the sides and beneath ochraceous; tegulæ pale fulvous; wings subhyaline, dusky at apex, nervures fuscous, second submarginal cell half the length of first, the third rounded at tip and narrowed one-half towards marginal; four anterior legs clothed with fuscous pubescence, that on all the femora whitish, that on posterior tibiæ and tarsi yellow, long, and dense; base of first segment and sides of ventral segments with long ochraceous pubescence; a narrow band at base of second segment, a narrow band across the middle, a broad band at base of third, and another at tip of fourth, all of dense appressed ochraceous pile, that on fifth segment more or less interrupted on posterior middle; apical segment with black pubescence, mixed with ochraceous laterally. Length .45 inch.

♂.—The pubescence longer and more dense, and entirely fulvous or ochraceous except on apical segments of abdomen; clypeus, labrum, and spot on base of mandibles pale yellow; antennæ three-fourths the length of abdomen, third joint a little larger than second, flagellum pale fulvous beneath; legs brownish, clothed with ochraceous pubescence, tarsi pale fulvous; abdomen marked as in ♀, with the pubescence on basal segment fulvous; two apical segments each with a short tooth on extreme sides. Length .40 inch.

Hab. Mexico (Sumichrast). Twelve specimens.

Melissodes aurigenia.

♀.—Black; head, legs, and basal segment of abdomen clothed with ochraceous pubescence, the thorax with dense fulvous pubescence. paler on the sides and beneath; flagellum fulvo-testaceous beneath; wings uniformly hyaline, nervures pale fulvous, second submarginal cell more than half the length of first, the third truncate at tip and narrowed one-half to marginal; posterior tibiæ and tarsi with long fulvous pubescence, that on base of tarsi, at tip and within black; band at base of second abdominal segment, another on the middle, sometimes suffused with that at base, and a broad band at apex of segments 3 and 4, of dense appressed ochraceous pubescence; apical segments black; venter clothed with long fulvo-ochraceous pubescence. Length .45 inch.

♂.—Narrower than ♀ and more densely pubescent; clypeus, labrum, and spot on base of mandibles pale yellow; antennæ two-thirds the length of body, third joint less than twice the length of second, flagellum pale fulvous beneath; legs slender, with ochraceous pubescence, tips of tarsi pale fulvous, tibial spurs white; apical margin of abdominal segments pale testaceous, first segment clothed with a long fulvo-ochraceous pubescence, base of second, and apical margin of segments 2–6 with a broad, more or less indistinct band of ochraceous pubescence; two apical segments each with a stout black tooth on extreme sides. Length .40–.45 inch.

Hab. Can., Me., N. Y., Va., La., Mo., Kan., Col., N. Mex., Utah. Twenty specimens. This may be *pennsylvanica* St. Farg., but it is impossible to accurately determine from his imperfect description.

Melissodes fulvohirta.

♂.—Black, clothed with a bright fulvo-ochraceous pubescence; clypeus and labrum yellow; antennæ a little longer than head and thorax, entirely black, subcrenulate at tip, third joint nearly three times the length of second; wings subhyaline, fuscous on apical margin, second submarginal cell large, two-thirds the length of first, the third truncate at tip and narrowed nearly one-half to marginal; tips of tarsi pale ferruginous; abdomen shining, the apical margin of the segments above and beneath rufo-testaceous, the second and following segments densely clothed with a short dense bright fulvous pubescence; venter piceous, apical margin of the segments fringed laterally with fulvous pubescence. Length .50 inch.

Hab. Georgia (Morrison). Two specimens.

Melissodes exquisita.

♀.—Black; head and thorax clothed with a dense pale ochraceous pubescence, whitish on cheeks and thorax beneath, and mixed with fuscous on occiput, mesothorax, and scutellum; mandibles yellowish before tips and fringed beneath with long pale hair; pubescence of mesothorax short and sparse on disk; wings fuscous, with a violaceous reflection, nervures black, second submarginal cell more than half the length of first, the third truncate at tip and suddenly narrowed one-half towards marginal; legs with fulvo-ochraceous pubescence, long and dense on posterior tibiæ and tarsi, that on femora pale ochraceous; first segment of abdomen clothed with a long ochraceous pubescence, the remaining segments covered with a dense appressed golden-fulvous pubescence; ventral segments fringed at apex with a long dense fulvo-ochraceous pubescence. Length .60 inch.

Hab. Mexico (Sumichrast). One specimen. A very distinct and beautiful species.

Melissodes strenua.

♀.—Black; face and cheeks clothed with griseous pubescence, vertex, occiput, and thorax with dense fulvo-ochraceous pubescence; large, transverse mark on apex of clypeus, labrum, and spot on base of mandibles yellowish; flagellum fulvo-testaceous beneath; tegulæ pale fulvous; wings fusco-hyaline, tinged with yellowish, nervures fuscous, second submarginal cell more than half the length of first, the third subtruncate at tip and narrowed nearly one-half towards marginal; legs with fusco-ferruginous pubescence, paler on anterior pair; abdomen smooth and shining, very finely punctured, base and sides of first segment clothed with ochraceous pubescence, base and sides of second, sides of third and the fourth almost entirely covered with a very short dense appressed cinereous pile; two apical segments and venter clothed with a fulvous pubescence. Length .65 inch.

♂.—Very much like the ♀, but with narrower abdomen, clearer wings, and fulvo-ferruginous legs; clypeus except base, labrum, and spot on base of mandibles pale yellow; flagellum pale fulvous beneath; abdomen more or less incurved at tip, first segment except apex clothed with fulvous pubescence; base of second and a short line on each side near apex, base and apex of third and fourth, and the two following segments entirely, covered with a fine dense appressed ochraceous pile; sixth segment with a short tooth on each side; apical segment narrowed and truncate at tip. Length .60 inch.

Hab. Georgia, Texas, New Mexico. This fine species is allied to *pruinosa* Say, but is much larger, and the abdomen not so distinctly banded.

Melissodes australis.

♀.—Black, shining; head and thorax clothed with a short dense cinereous pubescence, that on thorax above tinged with ochraceous; clypeus, vertex, and disk of mesothorax smooth and nude; tegulæ fulvo-testaceous; wings hyaline, faintly dusky on apical margin, nervures fuscous, marginal cell long and pointed at tip, second submarginal small, oblong quadrate, not narrowed above, less than one-third the length of first, the third as long as first, rounded at tip and narrowed one-half towards marginal; legs clothed with whitish pubescence, that on tarsi ochraceous, posterior tibiæ and base of tarsi with long dense ochraceous pubescence, tips of tarsi pale ferruginous; abdomen covered with an appressed ochraceous pubescence, thin and pale at base, and tinged with fulvous on apical segments, and much more dense, forming narrow bands, on apical margin of the segments; last segment fringed with fulvous pubescence; sides of venter with ochraceous pubescence. Length .45–.50 inch.

♂.—The pubescence paler and more dense than ♀, especially on the abdomen which is narrower and more convex; tip of clypeus and vertex nude, smooth, and shining, labrum densely pubescent; antennæ short as in ♀; four posterior legs robust, the femora and tibiæ incrassate, the tarsi slender and fringed with long pale pubescence, basal joint of posterior tarsi long and curved, and having at apex beneath a prominent curved, subacute tooth, which is flattened and dilated at base; abdomen densely clothed with a short erect pubescence, generally cinereous, sometimes tinged with ochraceous, especially at tip, that on apical margin of the segments narrowly white; apical segment bidentate. Length .45–.50 inch.

Hab. Colorado (Ridings, Morrison); Texas (Belfrage). Eighteen specimens. This is closely allied to *enavata* Cress., which, however, has the pubescence darker, the wings more dusky and subviolaceous at tips, and the second submarginal cell narrowed above. The ♂ closely resembles *ursina* Cress. (which is probably the ♂ of *enavata*), but is easily distinguished by the conspicuous toothed process at tip of basal joint of posterior tarsi, not seen in *ursina*.

This and the remaining species described under *Melissodes*, seem intermediate between that genus and *Anthophora*, the ♂ antennæ, except in *pinguis*, being little or no longer than those of the ♀. The neuration of anterior wings resembles that of *Melissodes*, with the marginal cell long and pointed at tip, and not shortened and broadly rounded as in *Anthophora*.

Melissodes diminuta.

♂.—Small, black, clothed with a short dense ochraceo-cinereous pubescence, vertex and disk of thorax smooth and polished; antennæ about as long as the head is broad, entirely black; tegulæ piceous; wings hyaline, nervures fuscous, second submarginal cell half the length of first, narrowed above, the third as long as first, rounded at tip and narrowed more than one-half towards marginal; four anterior tibiæ and tarsi robust, tarsi long, slender, simple, the basal joint of posterior pair curved; abdomen densely pubescent, that on apical margin of segments paler, apical segment bispinose. Length .32 inch.

Hab. Colorado (Morrison). Two specimens. This is a miniature of *ursina*.

Melissodes olivacea.

♀.—Small, robust, black; head clothed with griseous pubescence, tinged with greenish-ochraceous on occiput; mandibles pale yellowish at base; flagellum fulvo-testaceous beneath; thorax clothed with a short dense pale ochraceous pubescence, tinged with greenish-yellow above, longer and pale beneath; tegulæ fulvo-testaceous; wings subhyaline, tinged with yellowish, nervures fuscous, second submarginal cell more than half the length of first, narrowed above, the third longer than first, rounded at tip and narrowed nearly two-thirds towards marginal; legs brown, clothed with pale ochraceous pubescence, long on posterior pair; abdomen broad ovate, depressed, clothed with a short dense appressed greenish-yellow pubescence, more dense on apical margin of the segments, that on base of first segment longer, pale and suberect, extreme apex of abdomen fuscous. Length .35 inch.

♂.—Form narrower, the pubescence more dense, especially on face and thorax above; clypeus and mandibles dull yellow; antennæ short, but little longer than those of ♀; pubescence of thorax and abdomen brighter in color than in ♀; legs much paler, the two anterior pairs pale testaceous in front, anterior pair short, slender, fringed with long pale pubescence, the two posterior pairs long, subrobust, tarsi long, pale, fringed with long whitish pubescence, the basal joint long, slender, curved, clothed within with yellowish pubescence. Length .30 inch.

Hab. Mexico (Sumichrast). Twelve specimens.

Melissodes pinguis.

♀.—Form short, robust, black; head thinly clothed with a short griseous pubescence, mixed with black on vertex; clypeus deeply punctured; mesothorax and scutellum shining, strongly punctured, clothed with a short black pubescence, that on the metathorax and pleura laterally and beneath griseous; tegulæ piceous; wings subhyaline, dusky on apical margin, second submarginal cell subquadrate, nearly as long as the first, the third as long as first, rounded at tip, and narrowed one-half towards marginal; four anterior legs clothed with fuscous pubescence, that on femora thin and pale, posterior tibiæ and tarsi with long fulvo-ochraceous pubescence; abdomen broad, ovate subdepressed; first segment except sides and middle of second smooth, black, shining; the remainder covered with a short dense appressed golden-yellow pile; ventral segments fringed with fulvous pubescence. Length .35 inch.

♂.—Form narrower, more convex, the pubescence more dense; clypeus, labrum, and spot at base of mandibles yellowish-white; antennæ as long as head and thorax, the flagellum dull testaceous beneath; pubescence of thorax above longer; wings darker, the third submarginal narrowed nearly three-fourths towards marginal; legs slender, simple, clothed with griseous pubescence; base of abdomen with whitish pubescence, the two apical segments each with a short tooth on extreme sides. Length .30 inch.

Hab. Mexico (Sumichrast). Six specimens.

Melissodes afflicta.

♀.—Black, shining, clothed with a short griseous pubescence; clypeus, vertex, most of thorax above and scutellum nude, smooth, and shining; tegulæ pale brown; wings tinged with fuscous, nervures black or fuscous, second submarginal cell about half the length of first, narrowed above, the third subtruncate at tip and narrowed one-half towards marginal; legs with pale ochraceous pubescence, long on posterior pair, that at tip of posterior tibiæ and on tarsi fuscous or black; abdomen depressed, shining, first segment clothed with griseous pubescence, apical margin of segments 2–5 with a narrow band of dense appressed white pubescence, apex tinged with fuscous; ventral segments fringed at apex with fuscous pubescence, pale on the sides. Length .40 inch.

♂.—Much more densely pubescent than ♀, that on thorax above much darker; antennæ short as in ♀; posterior legs incrassate, the tarsi long, first joint curved, with the tip prolonged within; first and second segments of abdomen and venter clothed with a short dense griseous pubescence, that on the remaining segments black or fuscous, apical margin of segments 2–5 and sometimes 6, fringed with whitish pubescence; apical segment bidentate at tip. Length .30–.35 inch.

Hab. Texas (Belfrage, Heiligbrodt). Seven specimens.

Melissodes apacha.

♀.—Black; head and thorax rather densely clothed with a griseous pubescence, more or less ochraceous or fulvo-ochraceous on thorax above; apex of clypeus, vertex, and disk of mesothorax smooth and shining; tegulæ pale piceous; wings hyaline, nervures fuscous, second submarginal cell about half the length of first, nearly quadrate, very slightly narrowed above, the third larger than first, truncate at tip and narrowed one-half towards marginal; legs with ochraceous or pale ochraceous pubescence, long and dense on posterior pair, that on base of posterior tarsi within fuscous or black; abdomen covered with a short appressed whitish or cinereous pubescence, not entirely concealing the surface, that on extreme apical margin of the segments dense and forming narrow bands, apex of fifth segment and the sixth more or less fuscous. Length .30–.35 inch.

Hab. Texas, New Mexico, Arizona. Six specimens.

Melissodes Sumichrasti.

♀.—Black; head clothed with short cinereous pubescence, that on vertex and occiput longer and mixed with fuscous; thorax above with a short dense bright fulvo-ferruginous pubescence, that on the sides and beneath cinereous; tegulæ fulvo-testaceous; wings subhyaline, tinged with yellow, nervures fuscous, second submarginal cell about half the length of first, subtriangular, being narrowed above, the third shorter than first and only slightly narrowed towards marginal; legs with pale pubescence, that on tarsi fuscous; abdomen with very short fuscous pubescence, that on first segment pale, segments 1–4 each with an apical band of dense appressed pale ochraceous pile; ventral segments fringed with pale pubescence. Length .35–.40 inch.

♂.—Pubescence of thorax much paler than on ♀; four posterior legs incrassate, the tarsi long and slender, and ferruginous at tips; pubescence of abdomen pale ochraceous, the bands on all the segments narrow. Length .40 inch.

Hab. Mexico (Sumichrast). Fifteen specimens.

Melissodes bituberculata.

♂.—Black; head, thorax, legs, and base of abdomen thickly clothed with a dense long whitish pubescence, more or less tinged with ochraceous on head and thorax above; tip of clypeus and vertex smooth and shining; tegulæ rufo-piceous; wings pale fusco-hyaline, nervures black, second submarginal cell about half the length of first, slightly narrowed above, the third rather longer than first, truncate at tip and narrowed one-half towards marginal; the pubescence of legs long and silky-white, on outer side of four posterior tibiæ it is short appressed and pale fuscous; posterior legs incrassate, basal joint of their tarsi curved, the tip beneath flattened and prolonged; abdomen shining, clothed with pale pubescence, that on middle of segments 3–6 mixed with fuscous, apical margin of 2–6 each with a narrow fascia of short dense white pubescence, sides of apex and venter with white pubescence, apex prominently bituberculate. Length .45–.50 inch.

Hab. California (Crotch). Three specimens.

Melissodes toluca.

♀.—Black; face and occiput clothed with ochraceous pubescence, sometimes more or less fulvous, that on cheeks whitish; mandibles with a white spot at base; thorax with a whitish pubescence behind, laterally, and beneath; mesothorax densely punctured, opaque, with a very short, sparse fuscous pubescence, longer and more dense on sides of scutellum; tegulæ piceous; wings hyaline, nervures black, second submarginal cell about one-third the length of first, subtriangular, the third nearly as long as first, subtruncate at tip and narrowed one-half towards marginal; legs piceous or black, thinly clothed with pale pubescence, posterior tibiæ and tarsi with a long, loose floccus of blackish-plumose pubescence, more or less mixed with cinereous beneath; abdomen shining, black, basal segment with a little pale pubescence at base, apical margin of segments 1–4 with a narrow fascia of white or yellowish-white pubescence, more or less interrupted on 1 and 2 medially. Length .28–.32 inch.

♂.—Resembles the ♀, but with the pubescence of head and thorax more dense; mandibles with a white spot at base; legs with pale pubescence, posterior femora and tibiæ very robust, inner side of their tibiæ flat with a short tooth on inner margin towards the tip, and basal joint of their tarsi with a small tooth on inside towards the base; abdomen with a narrow line of white pubescence at apex of all the segments except the last, which is pointed and whitish. Length .25 inch.

Hab. Mexico (Sumichrast). Six specimens. This is allied to *fulvifrons* Smith, but is much smaller and otherwise very different.

Melissodes bombiformis.

♀.—Black; head and thorax clothed with short ochraceous or fulvo-ochraceous pubescence, sparse on face; vertex shining; clypeus sparsely punctured, nude on the disk; pubescence of thorax very dense; tegulæ fulvo-testaceous; wings fuscous, paler on apical margin, nervures black, second submarginal cell about two-thirds the length of first, narrowed above, the third shorter than first, rounded at tip and narrowed nearly one-half towards marginal; legs piceous, the pubescence black, mixed with pale on anterior pair, that on posterior legs long; abdomen opaque, with very short black or fuscous pubescence, that on first segment sometimes mixed with ochraceous. Length .55–.70 inch.

♂.—Closely resembles the ♀; clypeus and labrum with short dense ochraceous pubescence; antennæ short as in ♀; legs robust, especially the posterior pair, the pubescence very short, black, ochraceous on coxæ, trochanters and anterior femora beneath, four posterior tarsi long, the basal joint of posterior pair long and curved; basal segment of abdomen clothed with short dense ochraceous pubescence, that on venter with black or fuscous. Length .60 inch.

Hab. Virginia, Georgia, Kansas. Six specimens. This has much the appearance of certain species of *Bombus.*

Tetralonia Gabbii.

♀.—Large, black, clothed with black pubescence, that on labrum fuscous; mandibles with a yellowish line; wings fusco-hyaline, darker at base, nervures black; pubescence of legs entirely black; abdomen above except first segment covered with a short very dense ochraceous pubescence, that on first segment long and black. Length .85 inch.

♂.—Clypeus and base of mandibles yellow; antennæ short as in ♀; apical segment of abdomen flattened and quadrate above, the sides carinate and the apical margin truncate; venter smooth and polished, piceous. Length .85 inch.

Hab. Costa Rica (W. M. Gabb). Five specimens.

Tetralonia apiculata.

♀.—Black; head clothed with ochraceous pubescence, mixed with black on occiput; thorax clothed with black pubescence, that on mesothorax anteriorly and laterally mixed with ochraceous; wings subhyaline, nervures black; pubescence of legs entirely black; two basal segments of abdomen black, shining, the first with a little black pubescence at base, remaining segments covered with a short dense bright fulvous pile; ventral segments fringed with fulvous pubescence. Length .55 inch.

Hab. Costa Rica (Gabb). One specimen.

Megacilissa mexicana.

♀.—Black; head clothed with a griseous pubescence, that on face and vertex intermixed with fuscous; flagellum dull testaceous beneath; thorax above clothed with a short dense fulvous pubescence, that on the sides and beneath pale ochraceous intermixed with fuscous; tegulæ pale fulvous; wings yellowish hyaline, dusky on apical margin, second submarginal cell small, narrow, nearly pointed towards marginal; legs clothed with fuscous pubescence, that on posterior femora and tibiæ beneath dense and ochraceous, basal joint of posterior tarsi short and broad; abdomen with a greenish-blue reflection, strongly pale sericeous, first segment clothed with a short fulvous pubescence, that on extreme sides of remaining segments long and golden-ochraceous, that on the two apical segments long and fuscous, intermixed with ochraceous; venter piceous, fulvo-testaceous at base of the segments, which are fringed at apex with a long pale fulvous pubescence. Length .75 inch.

Hab. Mexico (Sumichrast). One specimen.

Megacilissa electa.

♂.—Black; head and thorax clothed with a short dense fulvous pubescence, paler laterally and beneath; wings pale yellowish hyaline, dusky on apical margin, second submarginal cell about one-third the length of first and narrowed nearly one-half towards the marginal; legs long and slender, clothed with ochraceous pubescence, tibiæ and tarsi pale fulvous; abdomen clothed with a short black pubescence, longer on apical segments, that on first segment above and two basal segments beneath, ochraceous, extreme sides of second dorsal segment fringed with pale ochraceous pubescence. Length .75 inch.

Hab. Georgia (Morrison). One specimen.

May 21.

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

Twenty-seven persons present.

Knee-joint of the Kangaroo.—Dr. A. J. Parker remarked that in studying the anatomy of various animals, but little attention has been given to the comparative structure of the articulations. One reason for this is, that fulfilling as they do mechanical functions almost similar in different animals, their structure varies but little. In examining the knee-joint of the kangaroo, however, an arrangement of ligaments was met with so different from what is ordinarily found in this joint that it deserves some attention. In man the knee-joint is the most complex of all the articulations, and in the kangaroo it is even more complex than in man. This is in accordance with the increased functional use of the joint in this animal. In making its immense leaps, the knee-joint becomes the centre on which the greater part of the strain is exerted and it requires a corresponding strength of structure. This increase in strength and stability is secured by a peculiar arrangement of the ligaments corresponding to the crucial ligaments of man. These ligaments are three in number and are arranged in a very interesting and complex manner. The posterior horn of the external semilunar fibro-cartilage is free and runs continuously into the fibrous tissue of a crucial ligament which proceeds forwards and inwards, and is inserted into the inter-condyloid fossa. The ligament being thus free at its posterior portion would tend to ride upwards, but this is prevented by a stay ligament which runs from about the middle point of this crucial ligament posteriorly, and is inserted at the posterior part of the spine of the tibia internally, thus keeping it firmly in position. A second crucial ligament arises anteriorly in front of the spine of the tibia, proceeds obliquely upwards and backwards, and is inserted into the inter-condyloid fossa crossing the first ligament obliquely as in man. It also has a stay ligament running from its middle point backwards, and is attached at the posterior internal part of the spine of the tibia at about the same point with the stay ligament running from the first crucial ligament. It is this arrangement of stay ligaments that gives the joint its complex character, and so well fits it to resist strain tending to displace the articular surfaces. A third ligament arises posteriorly and proceeds upwards and forwards crossing the course of the other two, and is also inserted into the inter-condyloid fossa internally. Thus there are, counting the two stay ligaments, five distinct ligaments in the knee-joint of the kangaroo as compared with two as found in man, which gives to the joint a very interesting and peculiar mechanical structure. There are no ligamenta alaria or mucosa.

MAY 28.

Mr. THOMAS MEEHAN, Vice-President, in the chair.

Twenty-three persons present.

On Polyxenes fasciculatus.—Mr. J. A. RYDER announced that he had identified the myriapod *Polyxenes fasciculatus*, Say, in the vicinity of the city at several places in the park. It was found that its morphological history agreed with that of *P. lagurus*, of Europe, as detailed by Bode,[1] but there was the same paucity of males as observed by that naturalist. The presence of the hooks terminating the caudal bristles was an independent discovery so far as the American species was concerned, Mr. Ryder not having seen Bode's paper until three days after his own observations had been made. Upon comparing these parts of the two species together we find the ends of the bristles, according to Bode, in the European species bent in the form of a semicircle, with the subterminal processes depending parallel to each other from within the arc; in our species, on the other hand, the bristle terminates in two barbed divaricating points directed forwards, forming a subacute angle with the supporting shaft of the bristle, the subterminal processes depending within the angle on the supporting shaft next the animal. This new locality indicates a wide distribution for the animal, viz., from Georgia, where it was first discovered by Say, to Massachusetts, where it has been found by Packard.

Corundum in North Carolina.—JOSEPH WILLCOX said that he desired to place on record a locality for Corundum recently discovered in Iredell Co., North Carolina. Near Statesville, as the southern limit, it is found associated with Kyanite and Serpentine. It is also found at several localities for a distance of twenty miles nearly northeast of Statesville, and at its northern limit it is associated with Steatite, Actinolite, and Damourite. No large specimens of Corundum have yet been found at this locality.

Prof. Gumesindo Mendoza, of Mexico, and Stephen Bowers of Santa Barbara, Cal., were elected Correspondents.

The following paper was ordered to be printed:—

[1] Zeitsch. f. die gesammten Naturwissenschaften. 3te folge, Berlin, 1877. Bd. II., 8vo. pp. 233–268, Pl. 11–14.

TRANSITION FORMS IN CRINOIDS, AND DESCRIPTION OF FIVE NEW SPECIES.

BY CHARLES WACHSMUTH AND FRANK SPRINGER.

The subcarboniferous rocks of the Mississippi Valley have been divided, by geologists generally, into five divisions or groups, viz., the Kinderhook, Burlington, Keokuk, St. Louis, and Chester, which occur in the order named; the Kinderhook being the lowest and oldest. Full accounts of these formations may be found in the Reports of the Geological Surveys of Iowa and Illinois, to which we refer for detailed information. Of these groups, the Burlington and Keokuk limestones, extending in vertical range from the Oolite bed, which forms the summit of the Kinderhook, into the Geode bed, which apparently forms the boundary between the Keokuk and St. Louis limestones, are characterized in their fossil remains by a great predominance of crinoids. They are thereby somewhat conspicuously distinguished from the other members of the subcarboniferous series. It is to these crinoidal beds that our observations are at present limited. Their fossiliferous character is well known, and we may add that there is probably no region in the world which exhibits, within the same limited geographical extent, so great and uninterrupted a range of crinoidal deposits in geological succession, almost unaltered by disturbing forces, and which at the same time affords such a variety and abundance of well preserved specimens for accurate comparative study, as the vicinity of Burlington, Iowa, and the neighboring exposures of the Keokuk limestone, within a few miles to the south and southwest.

In 1860, in the Boston Journ. of Nat. Hist., vol. VII, No. ii, Dr. C. A. White gave a very interesting account of the geology of the Burlington region, and pointed out the relations, as then understood, of the formations here exposed, with each other. and with those occurring in the series above and below. It was shown that the Burlington limestone consists of two divisions, separated from each other by beds of silicious shales, chert and cherty limestones of varying thickness; that these divisions were characterized by striking differences in their fossil remains; that the upper division was succeeded in turn by an accumulation of silicious beds, above which appeared the Keokuk limestone, differing from the Burlington beds in the specific characters of its fossils, as well as in lithological characters; that the three formations presented in their crinoidal remains three successive grades of development, those of the lower bed being generally of small size and delicacy of construction and ornament, those of the upper bed being of stronger construction and ruder form, while in the Keokuk they reach a culmination of rudeness and extravagance of form and size. He states that few, if any, species of these fossils are *common to both* beds of the Burlington limestone, and that it is hardly probable that any will be found common to the Burlington and Keokuk. The same writer, in the Geology of Iowa, 1870, vol. I, p. 202, says that the separation of the formations of the subcarboniferous group from each other is abrupt and distinctly defined; that the interposition of silicious beds constitutes paleontological boundaries between them; and that the change in the lithological character of each deposit toward the close of each epoch, seems to have had the effect to check, and finally to arrest the progress of those forms of life which previously existed in great profusion; and that with the resumption of calcareous deposits in the succeeding epoch, similar, if not identical forms, were introduced, which flourished and progressed until arrested again by similar deposits of silicious strata. And on page 203, speaking of the two divisions of the Burlington limestone, he says: "It seems that the accession of silicious material to the waters of that epoch resulted in, or at least was followed by, the extermination of all the species of crinoids then existing, and although they flourished in just as great profusion when the calcareous condition of the waters was restored, they were all of new species, these being all in turn exterminated by the accession of the silicious material which we find to mark the close of the full epoch of the Burlington limestone."

Such may be taken as the prevalent opinion among geologists and paleontologists as to the faunal independence of these three formations, although Dr. White does not deem it expedient to recognize *two distinct formations* in the Burlington beds, as proposed by Niles and Wachsmuth in Amer. Journ. Science, July, 1866, and as in practice is done by all the later paleontologists and collectors, it being shown by experience that in their organic remains, particularly crinoidal, the distinction between the two

Burlington beds is much more sharply marked and clearly defined than between the upper bed and the Keokuk limestone. The geologic independence of the two latter beds has been scrupulously regarded by paleontologists, and in no case within our knowledge has a single species of crinoid, out of the many hundreds described, been noted as occurring in both formations. Indeed, it would seem, judging from the descriptions, that the increase in new species would serve to confirm their separation. But an observer who is familiar with the stratigraphy, as well as the fauna of these rocks, throughout their whole vertical range, obtains an entirely different impression. Of the many distinguished paleontologists whose labors have contributed to our knowledge of the fauna of these beds, the majority were not themselves collectors, and they were therefore destitute of that personal familiarity with the mode of occurrence of these fossils, which is so important an aid to an accurate understanding of their relations. The material on which new species have been described has often been comparatively limited, and specific characters were readily distinguished in a single specimen which could not have been defined in a large series. There has also been some confusion, we believe, in regard to the actual horizon of the types of new species collected by various parties along the border land between the Burlington and Keokuk, some localities being referred to the one or the other, when in fact they belonged exclusively to neither. Furthermore, the two beds being thus for a long period considered as independent, it came to be regarded, as we have already seen, as an inflexible rule that their species must be distinct, as was also the case with the Burlington beds. Accordingly, new forms from the one or the other were brought within the rule, and specific distinctions were to some extent assumed to exist because of difference in geological horizon, thus illustrating the tendency to reason in a circle, into which even the most careful investigators, working in a single line, will occasionally fall.

We have been led by our researches to the conclusion that there is a much more intimate connection between these formations than has been generally supposed, and that the assumed extermination of organic forms at the close of each epoch, and the appearance in the next of new and distinct forms, cannot be reconciled with the facts which have been brought to light.

There is no doubt that the introduction of silicious matter in great abundance into the waters was largely destructive of crinoidal life, and had also an important influence in producing the changes observed in the crinoids of the successive deposits. It seems, indeed, when there was too much of it, growth was arrested and life destroyed; but when it existed in the waters in moderate proportion, along with calcareous constituents, its presence was favorable to existence and individual growth. It is on the upper surface of cherty layers in the Burlington and Keokuk beds, that we find most of the "colonies" or local deposits of well-preserved specimens, and from the upper beds to and including the Keokuk, there is more or less of silicious matter in the matrix and in the fossils themselves. The strata which compose the beds of passage between the three beds are mostly impure cherty limestone, in which the proportions of silicious and calcareous constituents vary, and it is a fact that throughout these deposits, wherever a little bed of limestone appears, or the chert becomes rather calcareous in its composition, we find the remains of abundant crinoidal life, although mostly in imperfect preservation.

It thus seems that, notwithstanding the destruction caused by the silicious influx, some of the crinoids survived here and there, and struggled through until more favorable conditions again prevailed. In proof of this, we have the fact that throughout the cherty deposits between the Upper and Lower Burlington beds, we find more or less the remains of crinoids, usually in the form of casts and very imperfect, yet sufficiently distinct to be recognized as *Actinocrinus*, *Platycrinus*, etc. But it is in the beds of passage between the Burlington and Keokuk that we find the most satisfactory evidence of the persistence of crinoidal types, and these with the crinoids found therein form the basis of this paper.

The close of the Upper Burlington limestone (as heretofore considered) was marked by an extraordinary destruction of fishes, whose remains, in the form of teeth and spines, are found in the greatest profusion in a stratum two to ten inches in thickness, which occurs at the very top of the regular limestone beds. It is one of the best stratigraphic landmarks that we know in this formation, as it is found over a wide area in localities over a hundred miles apart, and always in the same position relative to the heavy limestone beds. It is succeeded immediately by cherty layers, sometimes in regular bands and sometimes in irregular masses, with the interstices filled with a fine, brownish-red, silicious clay. These layers average about six to eight feet in total thickness, and above them there appears a stratum of whitish-gray crystalline limestone, from one to two feet thick, on the upper surface of which, and only on the surface, so far as observed, is found another deposit of fish remains. This is succeeded by two or three thinner layers of similar texture, separated by silicious shales and yellowish sand, and above these occur other irregular beds of argillaceous and cherty limestones of varying thickness, which pass gradually and imperceptibly into the bluish-gray limestones of the Keokuk proper. These deposits, from the first fish bed up to the Keokuk limestone, we designate, simply to save repeated explanations, as the "transition beds." They are found well exposed near Burlington, and at Augusta and Pleasant Grove, Iowa, both within twenty miles of Burlington, and at Sagetown and Nauvoo, Illinois, at all of which localities we have carefully studied them. At Nauvoo they are much thickened, and are seen above the town from the water's edge well up into the bluffs, which are capped by the Keokuk limestone, while in the extensive quarries below the town, only the Keokuk limestone has been exposed. A want of attention to these facts has caused some confusion as to the true horizon of the species described from that locality, all being referred to the Keokuk, whereas we have found at the upper locality true Burlington species, such as *Granatocrinus Sayi* and other well-marked species. The transition beds are more or less fossiliferous throughout, though the occurrence of the fossils is irregular and their preservation very variable. They exhibit in an irregular manner the lithologic characters of both formations, while the crinoidal remains which have been obtained from them show such an intermingling and blending of the Burlington and Keokuk species, that it is impossible to say where the one begins and the other ends. The majority of the crinoids found in them can neither be called Burlington nor Keokuk species, and may often be identified as either. They constitute a kind of intermediate type between them, and throw much light upon the growth of the individual and the development of species in course of time.

Our late investigations confirm the opinion, long held by us, that the Keokuk limestone and the Upper and Lower Burlington beds are only subdivisions of one geological formation, which might appropriately be called the "erinoidal limestone." A considerable number of the fossils, under eonsideration herein, were obtained from a single layer of limited extent in the fish bed at the top of the Upper Burlington limestone. They are of comparatively few species, and those are extremely rare in other localities, but at this spot they seem to have flourished in extraordinary abundance. These specimens form so important a part of our material that, to avoid repeated allusions to the locality, we refer to them always as the "fish-bed fossils."

In the following pages we shall endeavor to illustrate in detail, with the excellent material at our command, largely collected with special reference to this subjeet, the transition between the forms of crinoids in the Upper Burlington and Keokuk beds, which we believe will possess geologieal as well as zoölogical interest.

It is to be regretted that greater attention has not been hitherto paid to the individual growth of erinoids. We have made collections expressly for the purpose of illustrating different stages of development, and have found it to be the rule, that in young erinoids, the basals are the most perfeetly developed parts. They attain nearly their full size in young individuals, greater in proportion than the subradials and radials, which are comparatively early developed, and at a time when the interradial and anal plates have scarcely made their appearance. The latter develop the slowest, and in some genera increase continually both in size and number during the growth of the individual. We also find that abnormal growths, or sudden modifications of speeifie characters, almost always take plaee in the interradial and anal areas, the posterior rays, and eonsequently in the dome. Species have been multiplied by attaching too much importance to characters based on such modifications as the comparative size of the base, the number of interradial and anal plates, a more or less elongate form, etc., which we believe are due in many cases to individual growth, and which in species, when found in a later geological epoch, form mere variations of the same species, as will be proved most conelusively by the following genera.

1. BATOCRINUS, Casseday.

This genus is separated by Meek and Worthen into two seetions, Ill. Geol. Rept., vol. V, p. 364, to which we refer for a full discussion of the generie characters and relations. In the first section, *B. Christyi* is included, while *B. pyriformis* falls under the second. The two species form the types of two little groups of crinoids, which exhibit some very interesting features in connection with the succession of the crinoidal beds; both are very common and characteristic species of the Upper Burlington, and were described by Shumard in vol. II, Geol. Surv. Mo., with good figures, and figures of more perfect specimens are given in vol. V, Ills. Geol. Rept. Pl. V. There is a general difference in form and outline between the two species, but their chief distinction, and the one which produces apparently all the other constant differences, is that *B. pyriformis* has 20 arms, *one* from each opening; while *B. Christyi* has *two arms to each arm opening*, or 40 in all. This feature of *B. Christyi* has been for some time known, but hitherto the anatomical construction which produces it has not been understood, and this we are now enabled to explain. *B. Christyi*, in its typical form, has in each ray 3 primary, 2 secondary, and 2 tertiary radials, or radials of the third order, or as they are more commonly designated "brachials." The latter term is used for that series of radial plates within the body walls, which leads to an arm opening. The upper margin of the second or last of these brachial plates, is somewhat excavated, and in the rear of this cavity, the arm opening breaks through. In very well preserved specimens, when the arms have been removed, there may be seen upon the floor of this excavated margin, a narrow indented scar, extending from the arm opening directly outward. We have found resting upon this scar a very small, narrow, triangular or pentagonal plate, often, when the arms are attached, not visible from the outside. This is a rudimentary bifurcating plate, and corresponds to a third tertiary radial or brachial plate. Upon it, the arms divide, and just at the opening, on either side of it, is another small, short plate upon which the arms partly rest, the thin, small plates filling the excavated upper margin of the last brachial plate. Referring now to the dome. we find the double arm feature most beautifully indicated. Directly above each arm opening, there is a prominent interbrachial dome plate,[1] nearly round or elliptic in outline, and from

[1] For an account of these and other dome plates, as well as the construction of the dome of Paleozoic crinoids in general, see Amer. Journ. Scien. vol. XIV, Sept. 1877, p. 186.

low convex to high conical, sharp and projecting over the upper edge of the disk. This row of projecting dome plates is a very characteristic feature of this species, but is entirely wanting in *B. pyriformis*, its absence giving to the dome in that species its pyriform aspect and the upward tendency of the arm openings; while in *B. Christyi*, it gives to the arm openings a lateral direction, and to the disk its wheel-like appearance with its wide periphery standing about parallel to the vertical axis. Its peculiar office is well shown in one specimen, which has abnormally two extra brachial plates, and two arm openings instead of one in part of the ray. Here, a single interbrachial dome plate is situated between the arm openings instead of one over each, and the construction below leaves no doubt, that from these two openings *single* instead of double arms proceeded.

B. Christyi is described as having 7 anals and 4 interradials in 3 ranges each, and radials 3×2×2. Another species described by Meek and Worthen in vol. V, Ill. Geol. Rept. p. 372, under the name of *B. trochiscus*, belongs to this group, but has a more spreading disk, a more concave dome and a comparatively lower body than *B. Christyi;* it is described as having 12 anals and 6 interradials in 4 ranges each; radials 3×2×2 with an extra radial of the third order (or brachial plate) in some parts of the rays, and 1 or 2 interaxillary or intersupraradial pieces. The second radial of the third order is long, bent upward, and about the arm opening constructed exactly as in *B. Christyi*. The same interbrachial dome plate is found over each opening, very sharp and prominent, and although *B. trochiscus* has never been found with any portion of the arms attached, we feel entirely certain that when discovered, they will be found to be double from their origin.

Batocrinus planodiscus, Hall (sp.), (Supplem. to Iowa Rept. p. 45) is of the same type, and has a form similar to *B. trochiscus* with a much greater expansion of the disk, caused by an enormous development of the higher radial and interradial series. It has, according to diagram, 3 radials of the first order, 2 or 3 of the second, 2 or 3 of the third, and 1 or 2 of the fourth, or brachial pieces; 15 interradials in 9 ranges; 9 to 11 intersupraradials, 5 or 6 interaxillary plates between the series of radials of the third order, and it has 40 arm openings. The addition to the structure of *B. trochiscus* of another series of radials within the body walls, and interaxillary plates between them, causes the arms, which, in that species, divided at the opening, to separate in *B. planodiscus* within the body, and to emerge simple from their origin. *B. Christyi* ranges through the Upper Burlington into the division beds. *B. trochiscus* is found only in the transition bed, while *B. planodiscus* is said to be from the Keokuk, although the type specimen came from Nauvoo, and there is the usual uncertainty in regard to its real horizon.

Now we have before us about 50 good specimens of *B. Christyi* from the Upper Burlington of various localities, all of which, by their peculiar aspect, are readily referred to this species. We find in them a wide variation in form, some being tall, with dome much elevated and rising uniformly from the margin of the brachial disk to the subcentral proboscis, others nearly turbinate below, with almost no expansion of the disk, and others having a low, broadly, and rapidly spreading calyx, with concave sides and a nearly flat summit. The proboscis is in small specimens, so far as observed, smooth, while in larger ones, it is rough, nodose, and spiniferous, the latter being generally the case in those found high up in the rock. Between these extremes there is every gradation. In these specimens, we find the following variations in body-structure: Anals, 5, 6, 7, 8, 9, 10, 11, and 21, in 3, 4, 5, and 6 ranges; interradials, 2, 3, 4, 5, and 6, in 2, 3, and 4 ranges, with variations of 2, 3, and 4 in different parts of the same individual. The radial series is 3 × 2 × 2, except in one specimen (the one with 11 anals), which, on the inner branch of one posterior ray, has an additional bifurcation, giving 5 arm openings to that ray, or 21 to the specimen, one double arm being replaced by two simple ones, as in *B. planodiscus.* Three others show simple arms from two openings. Another specimen (with 21 anals) has in one branch of a ray the rudimentary bifurcating plate developed into a nearly full-sized bifurcating third brachial.

In ten specimens of *B. trochiscus* from various localities in the transition bed, we find the following variations in structure: anals, 7, 8, 12, and 13 in 3, 4, 5, and 6 ranges; interradials 4, 6, 7, and 8 in 3 and 5 ranges; interaxillary pieces (intersupraradials), 0 to 1 and 2; radials, 3 × 2 × 2, with occasionally extra brachial bifurcating plates in some of the rays, giving in these parts the formula 3 × 2 × 3. In some mature specimens there is in some places a narrow interbrachial plate inserted between the radials of the third order, producing an expansion of the disk; and in one of them (evidently very mature), the interradial areas are much depressed, and the radial series elevated and rounded, giving to the calyx, as seen from below, a ten-rayed appearance. The proboscis, in specimens from the transition bed, is greatly developed, being very long, and its plates spiniferous.

We have never seen a specimen of *B. planodiscus*, but from the description and diagram, it is evident that this species has the same fundamental construction as the two preceding ones. The only important difference to be found is, in the additional bifurcation of the radial series within the body, and as a consequence of this structure, in the double number of arm openings. *B. Christyi* and *B. trochiscus*, though having 40 arms also, have but 20 arm openings, and the arms really branch after emerging from the body. In them, the small bifurcating plate which we have described, and upon which the arms divide, is evidently a rudimentary free radial, and the two plates beside it, which in *B. Christyi* were only arm plates, become developed in *B. planodiscus* into true radials and form a part of the body. That this is not a mere conjecture on our part is demonstrated by the individual growth of crinoids generally. The *young Strotocrinus* for instance, though having the same number of arms as the adult, has but 4 arm openings to each ray. The radials of the higher orders, which in adult specimens form a part of the body walls, are here still free arms, unsupported by any interradial or interaxillary pieces, which subsequently fill the spaces between them; but the number of arm openings of the nascent crinoid increases to the full number of arms in proportion to the increase of the upward growth of the body. This is exactly the case in *B. planodiscus*, and it will thus be seen that *B. Christyi* and *B. trochiscus* represent earlier stages of development, and that, as we have seen before, the two later forms differ from the older by those characters which appeared irregularly in *B. Christyi*, and became more fixed and general in the succeeding types.

B. pyriformis, whose most important distinction from *B. Christyi* has been mentioned, is described with 7 or 8 anals in 4 ranges; 5 or 6 interradials in 3 or 4 ranges; radials, $3 \times 2 \times 1$ (see vol. V, Ill. Geol. Rept. p. 375, where Meek and Worthen give a revised description). It ranges through the Upper Burlington into the transition beds, where the *B. Nashvillæ* form predominates.

B. Nashvillæ, Troost, from the Keokuk limestone, is of the same type, but is larger, and its body and dome plates are more nodose, the interradial areas constricted, so that the body is divided into lobes. It is described by Hall in vol. I, pt. ii, Iowa Geol. Rept. p. 609, with 8 or 9 anals, 5 to 10 interradials, and an intersupraradial plate between the radials of the second order in every ray; radials, 3 × 2 × 1; arms, 20.

B. Nashvillæ var. subtractus, White, was described (Proceed. Bost. Soc. Nat. Hist. 1862, p. 16) as agreeing with the last species, except that it generally lacked the intersupra-radial plate, this being found in one ray only. It was said to occur in the Upper Burlington.

In upwards of 40 good specimens of *B. pyriformis* examined, we find a great variety in form. In some, the body expands gradually and uniformly from the base to the arm bases, giving a turbinated outline below; while in others, it remains of nearly uniform size to the top of the second radials, when it suddenly and rapidly expands; the radials of the second order and brachials being in a plane nearly at right angles to the vertical axis. In some specimens, two-thirds of the body is below the arm bases, and in others, scarcely one-third. In some, the brachial disk is continuous; in others, the interradial areas are somewhat depressed, and the body shows a tendency to become lobed. Between these extremes there is almost every shade of difference. In the structure of the body we find the following variations: anals, 6, 7, 8, 9, and 11, in 4 and 5 ranges; interradials, 3, 4, 5, 6, and 7, in 2, 3, 4, and 5 ranges, with differences in the same individual. There are no intersupraradials in any of them. In general, the specimens from the upper part of the beds are larger, more developed proportionally in the dome, and exhibit the greatest tendency to become lobed.

The form which Dr. White has described under *B. Nashvillæ var. subtractus*, is found at the very top of the Upper Burlington, and also in the transition bed. It agrees closely with *B. pyriformis*, but is always more or less lobed, and this is the principal distinction between the two forms. In 13 specimens, all from the above horizon, we find the following differences in structure: Anals 9, 10, and 11 in 4, 5, and 6 ranges, interradials, 5, 6, 7, 8, and 9 in 3, 4, and 5 ranges with variations in the same individual. As to the intersupraradials, upon which White founded his variety, we find in some specimens none, and in others one in 1, 3, 4, and even 5 rays respectively, while all our Keokuk species of *B. Nashvillæ proper*, have an intersupraradial in every ray. But the presence and constancy of those plates, is evidently a natural consequence of the greater size of the Keokuk form, and hence of no specific value.

In *B. pyriformis*, the proboscis is long, rather strong, with moderately convex plates. In the *B. Nashvillæ from transition beds*, the dome is prolonged into a proboscis over five times the height of the calyx, the plates of which are convex to slightly spiniferous. In the *B. Nashvillæ of Keokuk*, the proboscis is similarly elongated, but stronger, composed of very nodose plates, and about midway to its summit it is encircled by a row of five very strong spines, nearly an inch long.

We find that the modifications, thus observed in the successive forms of these two types, as they appear in the rocks, have taken place in exactly those parts of the crinoid which are changed by growth; that the prevailing features of the later species are those which in the Burlington types were irregularly developed during the life of the individual; and that the order in which these modifications appeared, corresponds very closely with the succession of changes from youth to maturity.

2. ERETMOCRINUS.

Lyon and Casseday, Am. Journ. Sci. 1859, proposed the above generic name for a type of Crinoids, principally distinguished by the flattening of the arms in their upper parts. Meek and Worthen, Ill. Geol. Rept. vol. V, p. 367, placed it under *Batocrinus* as a subgenus, and made interesting observations on the genus and its associate forms. We have never seen a specimen of Lyon and Casseday's typical species, and are unable to undertake a discussion of these somewhat complicated generic relations. We are inclined to the opinion, however, that at present the characters of *Batocrinus* and *Eretmocrinus*, are not so clearly defined as could be desired. Under existing circumstances, we prefer to leave *Eretmocrinus* where its authors placed it.

Among the fish-bed fossils, some of the most striking examples belong to this type. They exhibit the peculiar arm structure in a remarkable degree, while they possess a special interest in connection with similar forms from other localities. The specimens here occurring belong to a single type. They are characterized by a low, broadly calyculate body, with basal plates in some cases, thickened into a slight rim at the margin, and in others projecting far out around the column in a tripartite disk. Three brachial plates, in succession, rest above the secondary (or supra) radials, with an extra set of radials of the third order, in part of those rays which have five arms. Dome much elevated, pyriform or hemispheric; its plates strongly nodose or subspiniferous. The surface of the body below the arms is ornamented by rugose ridges, which extend along the middle of the radial plates, and follow the branches to the arm bases, the latter being separated from each other by indented sutures. These ridges are in some specimens low and obscure; prominent and angular in others. The arms are strong, rather narrow as if laterally compressed, and nearly angular on the outside for about one-fourth their length. They are there very suddenly flattened, spread out laterally, and become broad and spatulate, remaining thick and heavy in the middle, and growing thin toward the edges. Their breadth at the widest point is about half an inch on an average, they taper very gradually toward the tips, the length being, in mature specimens, about four inches. They are composed of a double series of interlocking joints, which are very short in the lower, and longer in the spatulate portion of the arms. The former are triangular in their transverse section, the short base being on the under or ventral side of the arm, the longer sides being on the outer or dorsal margin and slightly convex, while they join in the middle by their shorter sides. The under faces of the joints make obtuse re-entering angles with each other, in which the ambulacral furrow is situated. In the flattened portion of the arms, the joints have a triangular cross section, but the position of the triangles is so changed that they join in the middle by their bases, the shorter sides are on the flat, dorsal surface of the arm, while the under margins, on the ventral side, which are slightly concave, are the longer sides. The angles opposite the longer sides are a little greater than right angles, so that when closely fitting together by their inner faces, the flattened halves or wings of the arms, are lifted up at their margins, and angularly depressed in the middle. It is a remarkable and interesting fact that the halves of the flattened arms, not only join with each other at the middle by interlocking angles, but have similar angles at their thin, lateral edges, which exactly correspond with the angles in the margins of the adjoining arms. Thus the edges of the arms could be united by closely fitting sutures into a continuous and impenetrable wall, and form an arched dome over the space above the arm bases. Indeed, we always find the arms folded inward at their extremities, no matter in what shape the specimens are crushed.

We have, from other localities in the Upper Burlington limestone, specimens which are perfectly smooth below the arm bases, but which in size, shape, and structure of the arms, agree with the fish-bed specimens very closely. Among a good number of the latter, we find some with 20 arms, some with 21, and some with 22, the difference being always in the posterior rays, as the others have uniformly 4 arms each. The variation in the surface markings bears no relation to that in the number of arms, for we find the smooth specimens with 20 and 21 arms, and the ornamental ones with 20, 21, and 22, and we are therefore led to believe that all the specimens under consideration belong to a single species.

Meek and Worthen, in vol. V, Ill. Geol. Rept. pl. x. Fig. 5, have given, under the name of *Eretmocrinus remibrachiatus*, Hall, a figure of a specimen which was obtained at the same locality, though not in immediate association with our present collection of fish-bed fossils. It gives a good idea of the form under consideration, except that in perfect specimens, the flattened portion of the arms is at least twice as long as seen in the figure. It has three brachial plates in the body, and twenty arms. But that specimen, like those before us, clearly does not belong to *E. remibrachiatus*, described by Hall in his Preliminary Notices, 1861, p. 11, under *Actinocrinus*. His species had, according to the description, no body plates above the secondary (or supra) radials, and had 16 arms which were rounded below and expanded above the middle, which is a totally different thing from our forms. We have not been able to exactly identify Hall's species, but we have several specimens of a form with but two supraradials in some parts of the rays, and a brachial plate in others. It has 14 arms which are very strong, rounded below and flattened above, and we think it belongs to *E. remibrachiatus*, the type of which may have had, abnormally, an additional arm in each posterior ray.

Hall described and figured in the Iowa Rept. pt. ii. p. 615, pl. xv. Fig. 7, under the name *Actinocrinus ramulosus*, a specimen which in most respects shows a very near approach to the fish-bed forms. It is referred to the Keokuk limestone, but as it came from Nauvoo, we are left in doubt as to its actual horizon. It may have come from the transition beds, for we have from corresponding high beds at Augusta, Iowa, where these beds are extensively exposed, a specimen which seems to be almost an exact duplicate of Hall's type as figured. The ridges are composed of series of prominent tubercles in the centre of each plate in the radial and brachial series, and there are also, between the ridges, much smaller tubercles distributed around the margin of the anal and interradial plates. It has, moreover, 5 arms in each posterior ray, or 22 in all, and we have no doubt but that Hall's specimen would have shown the same number, if that portion of the fossil had been preserved. The arms are unknown. A comparison of our specimen of *A. ramulosus*, with the fish-bed forms of *Eretmocrinus* shows that they are most intimately related. The only difference, we can perceive, is the rather greater size and more elaborate ornamentation of the *A. ramulosus*, being difference in degree only, and not in kind.

We are thus brought to the conclusion that the type we have described, is not specifically distinct from *A. ramulosus*, which thus includes forms ranging from the Upper Burlington, through the transition beds, and possibly into the Keokuk. Those who attach great importance to surface markings or minute anatomical differences, such as one or two arms more or less, would perhaps find in these specimens the types of several species. But with the fossils before us, sufficient in number and preservation for thorough study and comparison, and exhibiting the intermingling of characters we have noted, we can but regard them as varieties of one and the same specific form which will be, of course, *Eretmocrinus ramulosus*, Hall (sp.).

In this type we have, again, a most interesting illustration of the gradual shading of Burlington into Keokuk forms, and the intimate relations of the crinoidal remains of the two formations.

3. AGARICOCRINUS, Troost.

On bringing together a large number of good specimens of *Agaricocrinus* from the Upper Burlington, transition and Keokuk beds from various localities, apparently belonging to several species, we found a satisfactory separation into species according to the descriptions impossible. We therefore thought to ascertain their relations by a comparison of the specimens before us, without regard to specific names or geological horizon. The comparative simplicity of construction and absence of ornamentation in this genus renders such an investigation more easy than in many other groups. To this end, we noted for each specimen, separately, the characters which in the descriptions have heretofore been considered of specific importance, viz., the form of the dome, of the basal concavity, and of the anal area; the shape and position of the second and third radial plates; the form and proportions of the interradials, and the character of the interradial area in the dome; the number of arms; and in addition to these, and not heretofore specially noted, the disposition of the apical plates of the dome. Tabulating these data independently of the specimens, we found that they fell naturally into two groups. The first of these is characterized by having the apical plates of the dome separated from each other by small intercalated plates; the central apical plate being tuberculiform and very much larger than its associates or any of the dome plates; the dome pyramidal, anal area flat, and the opening lateral; three arms to each posterior ray; second radial higher than wide; first interradial short, basal concavity small, involving the lower part of the third radial, which is convex. The second group is distinguished by having the apical dome plates connected except at the anal side, the central one not greatly conspicuous above the others; the dome hemispherical; the anal area elevated, rounded, or protuberant, with the opening directed upward; the second radials nearly always quadrangular and wider than high. Within this group are forms with 2 arms to each ray, with 3 in one posterior ray, with 3 in each posterior ray, with 3 in one posterior ray and 4 in the other, with 4 in each posterior ray, the other rays in all cases, save one, having 2, with long and narrow first interradials, and with short and wide ones; with basal concavity very shallow, not involving any part of the third radials, and deep, entirely including them.

The first of these groups is sharply characterized, and is the well-known species *A. Wortheni*, Hall. The second is of the type *A. Americanus*, Roemer, but includes the features of *A. bullatus* and *A. excavatus*, Hall, and *A. nodosus*, M. and W., and a new form not heretofore noticed, having four arms in each posterior ray; but the combination of these characters was so perplexing that the identification of the species was wholly unsatisfactory. Upon arranging the specimens, however, according to the most general modifications, such as the greater or less elevation of the anal area and the number of arms, we found that they arranged themselves into a series, in which, while varying irregularly in the minor characters observed, the forms shaded gradually from one into the others, beginning with those having two arms to the ray and greatly protruding anal area, and ending in those with four arms to each posterior ray and a wide flat anal area. In these respects the succession was nearly regular, but no other characters were coincident with them, and, in other respects, there was no uniformity or constancy whatever. It was now found that the specimens had also *arranged themselves* according to their geological horizons, beginning with two-armed forms in the Upper Burlington, and extending regularly through the transition beds with two and three arms, to the four-armed forms in the highest part of the Keokuk.

In this study which we have described thus in detail, to show that there is nothing arbitrary or theoretical in the result announced, we used about thirty well-preserved specimens, besides the description of the types, and we were forced to the conclusion that, in the second group, it is not possible to draw lines which shall separate it into species, but that these forms are only variations of a single species, of which *A. Americanus* is the type, and under which *A. bullatus*, *A. excavatus*, and *A. nodosus* must fall. *A. Wortheni* occurs, so far as observed, only in the upper part of the Keokuk, and is very characteristic of it. We have from the Upper Burlington a single specimen, evidently very mature, in which the apical dome plates are crowded apart by small plates, and which has short interradials, but which in every other respect agrees with the two-armed form of *A. Americanus*. We also observed in a very large specimen of *A. Wortheni*, which is somewhat injured in the rays, an arrangement of dome plates, which leads us to think it probable that this form will be found with four arms to all the rays.

The Burlington species of *Agaricocrinus* are comparatively small, increasing in size in the upper bed; the transition bed fossils are larger still, and in the Keokuk there are found those ponderous, huge forms which are so characteristic of that horizon, and of which *A. Wortheni* is the extreme. With these extravagant forms the genus becomes extinct, and we meet it no more above the Keokuk beds.

4. ACTINOCRINUS.

The *lobed* Actinocrinus which Meek and Worthen considered to be the true type of the genus, is numerously represented in the crinoidal limestones, and a large number of species have been described from the Upper Burlington and Keokuk beds. The type of the genus is a form subglobose to turbinate below the brachial plane, very slightly convex to pyramidal above the arms, the interradial spaces contracted, the radial areas prolonged and extended outward about at right angles to the vertical axis, and formed into lobes which increase in width as they recede from the body; thus giving to the fossil when seen from above or below, a pentapetalous aspect.

Its leading species in the Upper Burlington beds are *A. multiradiatus*, Shum. and *A. verrucosus*, Hall, both figured on Plate 10 of the Iowa Geol. Rept. The former is characterized by a very low, flat dome, with the interradial areas greatly constricted and excavated; the latter by an elevated dome and a greater development of the interradial dome plates, which extend down between the lobes and form a low rim connecting them. The former has 30 arms, the latter 40, the arms of both remaining simple throughout. In this genus, unless the arms themselves are preserved, it is very difficult to tell their number, for the long projecting lobes are almost always broken away with the arms. In large collections from the Burlington limestone, of specimens otherwise well preserved, it is exceedingly rare to find one in which the brachial plates are preserved to the bases of all the arms. They are generally broken away just above the first bifurcation in the ray, and the number of arms appears less than it really is. This was the case with *A. multiradiatus*, which is represented in the Iowa Report as having two arms to the ray; when in fact it has six as large collections prove. In the Keokuk beds the genus attains its greatest development in size and extravagance in features. It is represented by a large number of described species, of which the leading types are *A. Lowei*, *A. pernodosus*, and *A. jugosus*, Hall, and the species of *A. Humboldti* and *A. Agassizi*, Troost. Most of the Keokuk species were apparently described from specimens more or less imperfect in the brachial part of the lobes, so that very little reliance can be placed in the arm formulæ stated, and no information is given in the descriptions as to the nature of the arms in the different species.

The Burlington specimens exhibit much variation in proportions and ornamentation, and while they are generally of small size and neat sculpturing, we find occasionally a mature individual which, with most of the features of its associates, is much larger in size and is marked with that roughness of habit and rudeness of form, so prevalent in the Keokuk. The Keokuk species named are all very large, uncouth forms, with extreme rugosity of surface, the latter reaches its extreme in *A. Agassizi* and *A. pernodosus*, while in *A. Lowei*, the contraction of the interradial spaces above the arm bases is so great, that almost the entire dome is included in the five lobes. Specimens from this formation, preserving the arms, are exceedingly rare, and our Keokuk material generally is too limited for a detailed comparison of forms. But we have a specimen of the *A. verrucosus* type, apparently *A. pernodosus* or *A. jugosus*, which shows the arms to be very large and strong, and six to the ray; while another, which we suppose to be *A. Agassizi* of Troost's catalogue, has apparently 20 arms, which are the most ponderous that we have seen in any crinoid. Two specimens from the Keokuk of Indiana, received from Dr. H. S. Harrod, of Canton, which we consider to be young and old individuals of *A. Lowei*, have eight primary arms on the posterior rays, and six in the others; they possess the very peculiar feature not hitherto noticed, that the inner arms of each ray, instead of being simple throughout, *bifurcate* about midway, giving 10 and 12 arms to the ray at the extremities.

In the transition beds, there occur certain forms, represented by many specimens, in which the characteristic features of the Burlington and Keokuk species are united. They shade into *A. multiradiatus* on the one hand, and into *A. Lowei* on the other, by such easy gradations that specific distinctions are impossible.

It is probable that *A. brontes* and *A. unicarinatus*, Hall, which were described from Nauvoo, and which we were unable to identify, never seeing an authentic specimen, belong to these same intermediate forms. Among specimens from the transition beds, we have found one in which, as if foreshadowing the peculiar arm features of *A. Lowei*, some of the arms were *simple, while others divide* an inch above their bases into two branches. This type also having reached its culmination in the Keokuk beds, becomes here extinct.

5. PLATYCRINUS, Miller.

Mr. F. B. Meek, in Hayden's Reps. U. S. Geol. Surv. of the Territories, for 1871, p. 373, proposed the name *Eucladocrinus* as a subgenus for the reception of a type of *Platycrinus*, in which the radial series are extended into long, free tubes, bearing the true arms along their sides. Some lately acquired material from the crinoidal beds, and especially the fish bed, enables us to add something to present knowledge of this form. The type under consideration has exactly the body structure of *Platycrinus* up to the third radials. It includes both the low, broad cup-shaped, and the elongate form of calyx. But instead of giving off the arms in clusters from the third radial as usual in *Platycrinus*, it has the radial series of the body, both dorsal and ventral, enormously extended in the form of tubular free rays, from which the arms spring alternately on either side throughout their length. It bears the same relations to the typical *Platycrinus*, that the form, described as *Steganocrinus* by M. and W. in vol. II, Ill. Geol. Rept. p. 195, does to the *typical Actinocrinus*, it being sometimes impossible, with our present knowledge, to determine to which genus the specimen belongs when the arms are removed.[1]

The value of these differences in arm arrangement as to generic relations is as yet an open question; but we have found that the structural difference between the two forms is not by any means so great as first impressions would indicate. The free rays of *Steganocrinus* are actually nothing but extreme developments of the lobes of *Actinocrinus multiradiatus* or *A. Lowei*, and in like

[1] A similar variation in the arms is observed in *Hexacrinus*, those of *H. brevis*, Goldfuss, being similar in type to the earlier forms of *Platycrinus*, while *H. limbatus*, Müller, has arms of different type, somewhat like *Eucladocrinus*, but more like *Barycrinus*.

manner the radial extensions of *Eucladocrinus* are produced by a multiplication of the orders of radials in the body of *Platycrinus*, as proved in the most satisfactory manner by our *Platycrinus prænuntius* herein described, in which the intermediate stage is shown. We doubt whether there is any generic distinction between the two forms, but in the unsettled state of our science upon this question, it is probably best, and may facilitate the search for a natural classification to recognize subgeneric groups however artificial they may be.

This group includes, so far as known, our *Eucladocrinus millebrachiatus*, *Platycrinus pleurovimenus*, White, besides *Pl. Montanaensis*, Meek.[1]

It ranges in our rocks from the Upper Burlington through the transition beds and into the Keokuk limestone.

Another species, somewhat similar to *E. millebrachiatus*, both in ornamentation and form of the calyx, but having the arms of true *Platycrinus*, ranges through the crinoidal beds and is called *Pl. sculptus* when found in the Lower Burlington, *Pl. glyptus* in the Upper, and *Pl. Saffordi* when found at Keokuk localities. We can see no difference between them, and it is an interesting confirmation of our opinion, that we have before us a specimen from the Burlington limestone at Quincy, kindly loaned to us by Prof. Worthen from the Nat. Hist. Museum of Illinois, which is exactly like some of our Lower and Upper bed specimens, and which was identified by Prof. Hall, who described all three species, as *Pl. Saffordi*. It is also worthy of note for our present investigations that this species being a simple and typical form of the genus, survives through all three divisions of the crinoidal limestone, while on the other hand, so far as observed, the extravagant forms soon become extinct.

[1] Hall's species, *Pl. nodobrachiatus*, Iowa Rept. p. 542, seems at a casual glance to have a somewhat similar arrangement of the arms. But his description was undoubtedly made from a young specimen, and a comparison of a large number of very young specimens of *Platycrinus*, in some of which the arms are only sprouting, as it were, shows that the arrangement seen in his diagram, is that of the nascent *Platycrinus* generally, and that the little side appendages are pinnules and not arms. The arm joints, in the young of this genus, are mostly single, the tips only being formed of a double series of interlocking joints, which in the adult prevail down to the bifurcation of the arms.

Eucladocrinus millebrachiatus, n. sp.

Column very large and long, twisted, composed of joints which increase in thickness as they recede from the body. The faces of the joints are eccentric elliptic, the rim beveled to an edge, sometimes sharp and sometimes obtuse, from which project, rather irregularly, small tooth-like spines. Each joint is twisted so that the long axes of the reverse faces make a considerable angle with each other, while the articulation on the long diameters imparts a rapid twist to the whole stem, and permits motion in all directions. The articulating processes run lengthwise of the face of the joint, and consist of a strong ridge along the middle, with another on either side near the periphery, and curving like it. There are deep depressions on either side of the median elevation, probably filled by interarticulary substance. Perforation of the column round and extremely minute, barely large enough for the insertion of a fine needle point.

Body, exclusive of free rays, of medium to large size, cup-shaped to elongate hemispheric. Basal and first radial plates thin; basal disk low, about one-third the height of the body. Facet for attachment of the column slightly indented, and surrounded by a low lamellose ridge, or by a row of small tubercles. Surface of basal plates marked by rows of small nodes and rugose ridges, arranged parallel to the margins and radiating to the angles, the same ornamentation extending upward on the first radials. Edges of basals obtusely bevelled. There is considerable diversity in the surface sculpturing, it being obscure on small specimens, conspicuous on large individuals. First radials higher than wide, their sides about parallel, margins not bevelled, but forming close sutures with adjacent plates; gibbous in the middle and swelling toward the margin of the second radials. Articulating facet large, broad, semicircular, occupying one-third to one-half the height, and one-half to one third the width of the plate, facing outward nearly parallel to the vertical axis. Anal plate about equal in size to the interradials, inflated above, and forming a part of the flattened dome. The anal opening situated at its upper margin.

Beyond the first radials, the rays extend out horizontally, both on the dorsal and ventral side, and are produced into long free tubular, arm-like appendages, which are really extensions of the body in the radial series. They bifurcate on the second radial into two branches, which do not immediately diverge, but remain united by their inner sides as far as the middle of the third radial plate, beyond which they become free, and continue so to their extremities. Hence, there are two free branches to each ray, or ten in all, each of which bears the true arms on either side in alternate succession. The branches are of about uniform size for half their length, after which they taper gradually and apparently terminate in a true arm. A tubular passage, arched over by the extensions of the dome, runs the entire length of the free rays. The tubes of the two branches, after uniting on the inside of the second radial, connect with the central visceral cavity.

Second radials very short, broad and deep, filling the entire surface of the articulating scar, rounded below, curved at the sides to meet the dome plates, their transverse outline about semicircular, dorsal aspect obtusely pentagonal, though actually heptagonal. The lateral extremities of this plate, like those of the succeeding radials, have angular faces interlocking with corresponding faces of small plates, which fill the interbrachial areas on the ventral side of the rays. The upper equal faces of the plate slope at a very obtuse angle, and bear two plates in succession, which are radials of the second order. The first of these is short, hexagonal, its long margins about parallel, its outer lateral margin notched by a small channel, which penetrates through the plate to the tubular cavity within. The inner lateral margins of this and the next interlock with those of corresponding plates in the other branch of the ray, the salient angles of one meeting the sutures of the other. The second radial of this order is almost quadrangular, though actually pentangular, much narrower than the adjoining ones, and sustains on its outer sloping face the base of an arm. It is slightly wedge-form, its greater height being on the inner margin, and this causes the division of the ray, which takes place near the top of this plate.

The plates throughout the entire length of the free rays form an indefinite number of successive orders of radials of two each, the second of which is a cuneiform bifurcating plate, sustaining on its longer upper face the plates of the next order of radials, and on its very short outer sloping face, in connection with the still shorter outer face of the first plate of the next series, the brachial pieces which form the beginning of the arms. The brachial pieces, or first pair of arm-joints, are rather deeply set into the ray, and while they rest chiefly upon the cuneate second radial of each series and the outer face of the succeeding plate, they also abut against the plate above and below. In one very large specimen, in part of the ray near the body, they are imbedded still deeper, so that they touch five plates of the ray, as is the case in *E. pleurovimenus*, but at a greater distance from the body they abut only against four, as is the general rule.

The arms are long, rather strong, gently tapering, directed along the rays toward the extremities; composed of a double series of rather short interlocking plates, every alternate one on either side giving rise to a long, slender, single-jointed pinnule. The arms are given off from each pair of plates in the free rays, alternately on each side, thus giving an arm for every two plates throughout their length. In one of our specimens, of medium size, there are about 30 arms to one branch, but the extremity is not preserved, and we have reason to think they averaged 10 more, which would give 80 to the ray, or 400 in all. In some of the larger specimens, the number was doubtless much greater, and probably in some cases approached 500.

Dome flat, composed of comparatively large plates, the apical and radial dome plates being at their middle part abruptly elevated into papillate nodes with a roughened or wrinkled surface. The plates of the interradial areas, of which there are but few, are smooth. At the place where the rays emerge from the inner body, directly over the second primary radial, there is a large dome plate marking the incipient bifurcation of the ray, with several small ones below, succeeded by two rows of very large, extremely prominent plates like those of the dome, but much more conspicuous and with coarser surface markings. The latter are placed along the ventral side of the ray, and alternately on either side, so that one plate is always situated over the base of an arm, and by counting them the number of arms can be determined as readily as from the radial plates on the dorsal side. The spaces between these brachial dome plates are occupied by smaller, flat, rounded, or subspiniferous plates, irregularly arranged. The arrangement of the vault pieces of the rays is such that they could not have opened, and hence the passage within was always tubular and never an open canal. The radial appendages have a tendency to bend downward, leaving the ventral surface exposed.

We have noted the presence of a small channel at the lateral extremity of the first radial of the second order, and will now add that this forms the passage of a good-sized pore. Similar pores, pierced through at the edge of the plate, and inclosed by the abutting margin of an adjacent plate, are found on each side of the free rays near the base of every arm. They communicate with the tubular passage, and have about the same direction as the arm furrows One pore penetrates every first brachial piece on each side of the arm-base, another enters at the outer lateral edge of the first radial of each order, a third one occurs at the edge of the second radials ; but toward the upper or thinner part of the rays, we found only two pores between each pair of arms in place of three as described.[1]

[1] The presence of the pores in the sides of the radial appendages is such a notable feature in the form under consideration, that interest is naturally awakened as to their probable functions, and this the more since similar pores have been observed by us in several other genera. They are very conspicuous in *Batocrinus*, where they are arranged in ten pairs, five radial and five interradial, each pair is situated between the adjacent arms, and they connect through the body walls with the inner cavity. They are found also in *Actinocrinus* and *Strotocrinus*, in the free arm bearing rays of *Steganocrinus*, within the false arms of *Ollacrinus*, and pores are found in the ventral sac or so-called inflated proboscis of some of the *Cyathocrinidæ*. If now we compare the position of these openings with the so-called ovarian openings of the Blastoids and the pectinated rhombs of the Cystidians, which are considered by some authors to be ovarian, by others respiratory organs, the question is forcibly suggested whether these may not have had the same functions, perhaps serving as a madreporic apparatus for the introduction of water to the body. Such organ has never been noted in Paleocrinoids, and yet, must have existed in them somewhere. In some genera, the pores in the body walls were evidently absent, but we have observed in this connection that in those genera the *column* is not only very large, but the tubular cavity within is of extreme size, and follows with its ramifications the numerous branches and roots into which those columns divide. Their cavity is peculiarly constructed, generally pentapetalous in form, and its inner walls throughout built up of thin laminated plates with innumerable slits, punctures, pores, grooves, ridges, and other processes, through which a communication with the surrounding water was easily effected. Such complicated structure shows that the column must have performed a vastly more important office in the animal economy than that of an attachment to the sea bottom, and may have had here the additional functions of those of the pores, especially as we find that in every genus in which pores have been observed in the body walls, the perforation in the column is very small and shows no signs of a structure as above described. We call attention to these facts at present in the hope that they may lead to observations on the subject elsewhere, and we hope hereafter to give it a more detailed investigation.

In the investigation of this species we have made use of a magnificent series of specimens from the fish bed, found within a few feet of each other. There are nine individuals in good preservation presenting to view almost every aspect of the fossil, they represent different stages of growth, and show the gradations from small to large individuals. We have also before us a specimen from the division bed at Nauvoo and three from the Keokuk limestone. The latter are considerably larger than the fish-bed specimens, but exhibit otherwise, in the parts preserved, no essential difference. Only a portion of the rays is preserved on one of the Keokuk specimens but sufficient to show that it had the same arm structure. Until discovery of more perfect specimens shall prove the existence of more important differences than yet observed, we can only regard the Keokuk form as belonging to the same species, with the tendency to variation generally observed in Keokuk representations of Burlington types.

This species is distinguished from *E. pleurovimenus* by the low discoid calyx, the flat concave base, the massive body plates, the deep sutures, the more robust and rapidly tapering radial appendages of that species. In four specimens, we find that the free rays are always folded inward upon the ventral side instead of hanging down as in our species. It has about the same number of arms as ours, and either of them with their ten long rays fully extended, and the hundreds of arms stretching outward must have presented a very striking appearance.

Locality and Position.—Near Burlington, Iowa; transition bed between the Burlington and Keokuk limestone. Collections of C. Wachsmuth and Frank Springer.

Platycrinus prænuntius, n. sp.

Column large, twisted, and constructed as in *E. millebrachiatus.* Body rather large, low, broadly cup-shaped or discoid. Basal and radial plates heavy; basal disk deeply and abruptly excavated below, so that four or five joints of the column are inside the plane of its outer rim. Basal plates elevated near their margins into a thickened, rugose rim, which is also found near the lower margin of the first radials. All the plates are broadly and deeply bevelled on their margins. First radials one-half wider than high, their lower projecting margins overhanging below the plane of the base, so that the body rests on these margins when placed upon a level surface. Articulating facet prominent, much elevated by the thickening of the plate; broad, semicircular, occupying about one-third the width and height of the first radial, its surface about parallel with the plane of the plate, which makes an angle of about 45° with the vertical axis. Anal plate a little larger than the inter-radials, supporting on its upper face a series of small dome plates, above which is the anal aperture, situated very low and opening laterally.

The radial areas are produced into free appendages, approaching the structure of *Eucladocrinus*. They are large, strong, and broadly rounded below, spreading out about horizontally and folding upward on the ventral side. They bifurcate on the second radial, but remain joined by their inner sides to the top of the second plate above it, where they diverge and become free. The branches diminish in size very rapidly, giving off arms alternately on either side to about the twelfth plate, where each terminates in a bifurcating plate, from whose equal upper faces two true arms diverge. The surface of the plates is irregularly elevated and rounded, and the sutures are slightly sinuous, giving to the rays a wrinkled or corrugated appearance.

Second radial short, broad, filling the articulating faces, pentagonal in outline, bearing upon its upper obtusely-sloping faces the radials of the second order, two in succession, whose inner edges join, but do not interlock, the sutures in the two series coinciding. The first radial of the second order is about quadrangular, its upper and lower margins flexuous. The second is much narrower and is a bifurcating plate, whose longer upper face bears the radials of the next order, while its short, acutely-sloping outer lateral face sustains the lower margin of the first and largest brachial piece. The second radial of the next order gives rise to an arm on the opposite side, and so on alternately to the end of the ray. There are about six pairs of radials of as many orders, each of which represents an arm, and the last pair two arms; thus giving off normally seven arms to each branch, fourteen to the ray, and seventy in all. The first pair of brachial pieces are large, of unequal size, and imbedded in the ray so that they abut against four of the radial plates. Arms comparatively long and heavy, composed of a double series of interlocking plates with a furrow on the ventral side connecting with the tubular cavity of the ray, and apparently bearing pinnules in the usual way.

Dome elevated, hemispheric, composed of large tumid plates, of which the apical and interradial ones are the most prominent, the radial area in the vault being composed of a double series of smaller plates, which extend out along the ventral side of the rays as continuations of the dome.

This species, in its body structure, is most closely related to *E. pleurovimenus*, having a similar low discoid form and heavy plates, but it can be easily distinguished by the extremely deep excavation of the base below, the prominent ridges at the margins of the basal and first radial plates, the extreme depth and width of the bevelings at the sutures, the elevation of the articulating faces, and by the very distinct arm structure. It resembles *P. tuberosus*, Hall, in its discoid dorsal cup, but in that species the calyx is much lower, the arm-bases being in the plane of the base. The deep and acute beveling of the margins of the plates in our species gives it a sharp, angular appearance not visible in any other species.

Position and Locality.—Upper Burlington division of the crinoidal limestone; subcarb., Burlington, Iowa. Collections of Fr. Springer and James Love, Esq.

Platycrinus prænuntius, as stated before, represents the transition form between the *typical Platycrinus* and *Eucladocrinus*, the latter being the extreme wing of the genus. A comparison of the species of *Platycrinus* occurring in the Upper and Lower Burlington beds, gives further interesting results concerning the history of the genus. In all the species from the Lower bed the arms, both of the discoid and of the elongate form, divide upon a triangular or pentangular bifurcating plate having equal sloping faces, and the two halves of the rays are free above the second radial, or become so at the first radial of the second order; while in almost every species from the Upper bed the arms branch off alternately from the smaller sloping face of a more or less cuneate plate (similar to *P. prænuntius*); and while we find on the former not over four arms to each half ray, with abnormally a fifth one, there are species in the Upper bed with seven, eight, and nine arms to each half, or eighteen to the ray. There are before us some most interesting specimens of a form from that horizon, perhaps of *P. Halli*, Shum., but more probably, at least if Meek and Worthen's identification of that species in vol. V, Ill. Geol. Rep. p. 454, is correct, of an undescribed type which, in the form of the body and the general plan of its radial construction, is so intimately related to our *E. millebrachiatus* (as *P. prænuntius* to *E. pleurovimenus*) that one is forcibly struck with the idea that the former may possibly represent a younger stage of the latter. That this, however, is not the fact, is proved beyond doubt by a number of specimens of each species and of different size, which show the greatest constancy in their respective characters; and, as the two forms occur in a distinct horizon, we are compelled to regard it as not individual growth, but as a more mature development of the genus.

6. ICHTHYOCRINUS, Conrad.

In investigating some specimens, apparently of this genus, of a new form and unusual size from the fish bed, we encountered much difficulty in determining their generic relations, and were accordingly led to an examination of the entire literature of this and its allied genera, *Taxocrinus* and *Forbesiocrinus*. Meek and Worthen, in vol. II, Ill. Geol. Rep. p. 269, have discussed the relations of the two last-named genera, and have furnished good reasons for considering *Forbesiocrinus* to be only a subgenus of *Taxocrinus*. The generic formula, which includes both, is shown to be: 3 basals, which are sometimes rudimentary, 5 subradials, and 3 or 4×5 radials. It thus appears that the only difference between the two forms is in the interradial and anal areas, *Taxocrinus* being either without plates in these spaces or having but 1 to 3, and *Forbesiocrinus* having from 7 to 30, or more. *Taxocrinus* ranges from the Upper Silurian up, while *Forbesiocrinus* is mainly confined to the Subcarboniferous. The genus *Ichthyocrinus* was established by Conrad in 1842 without generic diagnosis. According to Bronn, Klassen des Thierreichs, vol. II. p. 231, it has 5 basals, 3×5 radials, and no anals or interradials. Hall, in vol. II, Paleont. N. Y. p. 195, and in the Iowa Rep. vol. I, pt. ii. p. 557, describes the genus as having a round, smooth, and slender column, 5 basal plates, 3×5 radials, the basals being small, and there being sometimes three other rudimentary plates within the 5 basals. Five American species are known of which Hall described *I. lævis*, *I. Burlingtonensis*, *I. subangulatus*, and *I. tiaræformis* (Troost), and Winchell and Marcy *I. corbis*. Of these *I. tiaræformis* is said to have 4 radials in the anterior ray, and *I. corbis* 2×5 radials, but all agree with the generic formula in having no interradials or anals. Specimens of *I. Burlingtonensis* before us distinctly show the presence of 3 rudimentary basals mentioned by Hall as probably of generic importance, and this would make the formula: basals, 3; subradials, 5; radials, 3 × 5; thus agreeing precisely with *Taxocrinus* and *Forbesiocrinus*, except in the absence of anals and interradials.

The discovery of our new species *I. nobilis* brings fresh confusion to the subject, and obliterates at once this apparently satisfactory distinction. In this species, in young and mature individuals, we have 1 to 3 to 5 interradials, 1 to 2 interaxillary plates, and 3 to 4, mostly 4, primary radials with a wide variation in the radials of the second and third orders, sometimes in the same individual. On the other hand, Hall describes, in the Journ Bost. Soc. Nat. Hist. 1861, p. 261, under *Forbesiocrinus Thiemei*, another Burlington form, of which the typical specimen (without doubt adult) had neither anal nor interradial plates. Thus showing in a most satisfactory manner, that the interradials may be present or absent in either type. In Hall's species, the radials are 3 × 5, which increase in size upward, the second order of radials, and sometimes partly the third order, leaning against those of the adjacent rays. This species agrees up to the top of the secondary radials most remarkably with *Ichthyocrinus*, and only differs in the upper series of radials, or free arms, which are rounded on the back in place of being flat as in that genus. That we have since found other specimens with 0 to 1 and 3 interradials in one or more areas, and even 5 or more in its representative from the Upper Burlington bed, cannot diminish the weight of our argument; it rather serves to prove more conclusively, that the presence or absence of these plates is of but little value even as a specific character. Hence there remains no distinction as to the body structure between the three genera. The Burlington forms of *Ichthyocrinus* are readily recognized by the level plates and uniform curvature of the body, the disposition of the arms which rest closely against each other and infold at their tips, the waving sutures, and rapidly increasing width of the primary and secondary radials. In *I. laevis*, Hall, the plates are obtusely angulated, and in *I. subangulatus* the surface of the radials is elevated in the centre, and in *I. corbis* the margins of the radials are straight, while *Forbesiocrinus* and *Taxocrinus* have undulating sutures to a greater or less extent. Thus, the only constant character is the closely joining and infolding arms of *Ichthyocrinus*. Under this state of facts it seems clearly impossible to longer maintain generic distinctions between the three forms. As *Ichthyocrinus* is the oldest name it must take precedence, and *Taxocrinus* and *Forbesiocrinus* be considered, at the most, as subgenera under it. But whether even this separation can be upheld seems to us doubtful. That in *Ichthyocrinus* the arms join and infold, that the basals are rudimentary, only visible from the inside, that in *Taxocrinus* and *Forbesiocrinus* those plates are more developed, appearing externally, are no *bona fide* features upon which to found subgenera, and yet, they seem, with our present knowledge to be the only constant characters for separation; in all others we find such an easy gradation from one species to another, such an intermingling of characters among the three types, that it appears almost impossible to draw a line where the one genus shall begin and the other end.

Ichthyocrinus nobilis, n. sp.

Column round, comparatively small, and with small spiny processes in the periphery of every alternate joint. Central perforation moderately large with pentapetalous section.

Calyx large, forming with the closely folded arms a smooth, subglobose or ovoid body. Basals not visible; the five subradials seen only at the angles. Primary radials, four to the ray, two and a half times as wide as high; widest at the upper margin. In large individuals, they increase rather slowly in width to the fourth plate, the rays being separated by large interradial spaces, but in smaller specimens, with only few interradials, the increase is very rapid. Secondary radials 3 to 4, varying more or less in the same individual, the largest having 4 in 9 branches and 3 in the other branch, one specimen of medium size has 4 in 7 branches, and 3 in 3; a young example has 3 in 5 branches, 4 in 2, and the others not visible. Those plates increase in width very rapidly, the upper ones being 4 to 5 times as wide as high, so that above the interradial spaces, the sides of the rays join again. In the next or third order of radials, there is variation of 3, 5, 8, and 9 plates in the ramifications in the same individual. In all our specimens, there is at least one more bifurcation beyond this, apparently throughout the rays, giving at least 40 arms, but in the largest individual there is still another on the outer tertiary ramifications of each half of the ray, while the inner ones remain simple, thus giving 12 arms to each full ray or 60 in all. All the radial and arm plates have a very irregular outline, the bifurcating plates being pentangular, the others more or less quadrangular, with additional small angular faces. The upper and lower margins of the plates are strongly undulated and deeply depressed in the middle somewhat as in *Forbesiocrinus*, and showing in the second series of radials very obscure patelloid plates. The undulating feature extends even to many of the lateral margins; the tendency throughout the whole body being to curved lines. The surface of all the plates is smooth and level with the others, except the gentle curvature which accommodates them to the general sphericity of the body,—that is to say, the surface of the body is uninterrupted by any elevations or surface angularity of the plates. The arms are flat, comparatively broad, and lie close together, touching at their sides, the lines of junction being straight. The plates both of arms and body are very thick and heavy; those of the arms have on their inner or ventral side a deep furrow with another smaller and shallower groove on either side. Between the rays, there is a set of interradials, extending upward in a wedge-like arrangement from a little above the level of the primary radials, filling a considerable space. There are in full grown specimens from 3 to 5 interradials of rather large size, but we find in one apparently very young individual only a single plate and only one interradial space. Between the first branches of the rays, there are 1 to 2 interaxillary plates which are narrow and elongate. These plates, as a transverse section of one of the rays shows, are cuneate or pyramidal, their apices directed outward and wedged between the radials; and in this case, the interaxillary, though large and massive, had not penetrated through the wall, none being visible from the outside.

This species is readily distinguished from all described forms of the type by its 4 primary radials and its interradial plates. From *Taxocrinus* and *Forbesiocrinus* it differs in its subglobose form, uniform surface, the flatness and close infolding of the arms.

Position and Locality.—From the fish bed at the top of the Upper Burlington division of the crinoidal limestone; subcarb., near Burlington, Iowa. Collection of C. Wachsmuth.

7. **CYATHOCRINUS**, Miller.

This genus is remarkable for the persistence which some of its forms maintain throughout the crinoidal formations. A careful examination of the prevalent Burlington forms (both from description and numerous specimens), which we were induced to make in connection with some unique forms from the fish bed, gave interesting results. The common species described, and most numerously represented in all the collections that have ever been made at Burlington, are *C. Iowensis*, O. and Sh., *C. divaricatus*, and *C. malvaceus*, Hall, always considered lower bed species, and *C. viminalis*, Hall, from the upper bed. The identification of these species in large collections has always been attended with difficulty, except those specimens of this type found in the upper bed, which were promptly referred to *C. viminalis*, it being taken for granted, in pursuance of common understanding which had acquired the force of law, that the same species could not be found in both beds.

If the descriptions of these four species be considered together, it will be found that but one species is represented, with slight variations in the form and proportions of the plates. According to the description, they all have small, subglobose bodies, with basal plates minute to moderately large; subradials proportionally large, equilateral to wider than high, and obtusely angular to tumid, and gibbous; radials about equal to, or smaller than the subradials; articulating scar impressed, small to moderately large; arms divaricating to strongly diverging; surface granulose to granulose-striate. An examination of over a hundred specimens of this type, most of them having the arms preserved, has disclosed such a promiscuous combination of all these characters, as to render specific separations entirely out of the question, and has satisfied us that the differences noticed in describing isolated specimens are individual, and the result of different stages of growth of the one species, *C. Iowensis*. The type of *C. divaricatus* was no doubt the younger stage in which the basal portions were most prominent, and *C. malvaceus*, a mature individual in which the greater development of the subradials left the basals proportionally small. Between supposed typical specimens of *C. Iowensis* from the lower bed, and of *C. viminalis*, no difference can be pointed out in the body, and the only character which we can discover to mark the forms from the two beds is, that in the Upper bed specimens, the arms generally taper slightly more than in those from the Lower bed. The similarity, indeed identity, in all other respects, is so striking, that we see no other course than to consider them all as one and the same species, which would fall under the older name *C. Iowensis*. We have been forced to this conclusion only after the most faithful investigation of the abundant material at our command, and in which the collections from the different horizons are authentic. But our difficulties do not end here. We find this same form occurring not unfrequently in the typical Keokuk localities, and indicating not only a striking persistence of type throughout the whole crinoidal formation, but similarity of specific characters quite remarkable. It is described by Prof. Hall as *C. parvibrachiatus*, and, in the specific characters named by him, it agrees with the Burlington type in every respect except the more rapidly diminishing size of the arms. Numerous specimens from various localities show that this feature is quite variable, and one series of 18 individuals, from near Bonaparte, Iowa, collected there in a thin layer not over two feet square, and preserving the arms, shows the same intermingling of minor characters and variety of size as is found in the Burlington forms. One of these specimens, placed beside a similar individual from the Lower Burlington, presents to the eye scarcely a point of difference. On an average, however, we find the Keokuk specimens to be a little larger, their arms stronger in the lower parts, and more rapidly tapering than in those from Burlington, and hence we do not feel at present authorized (nor do we wish to do so when it can possibly be avoided) to interfere with the specific name. Some other species of *Cyathocrinus* in the Keokuk limestone tend toward more robust forms and heavier arms, and among the fish-bed fossils we have discovered several forms departing from the characteristic types in the same direction, of which we describe two new species.

Cyathocrinus barydactylus, n. sp.

Column very large, larger than in any known species of the genus, its projecting joints more or less serrated, central perforation of moderate size, and obscurely pentapetalous. Body of medium size, bell-shaped, turbinate below, abruptly spreading in the first radials, greatly constricted at the dome. Diameter at arm bases about equal to height, though less in smaller specimens.

Internal cavity egg-shaped, smallest below. Basals large and prominent, more than two-thirds visible beyond the column, the visible part pentangular, directed upward, and forming a cup whose sides make a very small angle with the vertical axis. Subradials large, higher than wide, four hexagonal and one heptagonal, their surfaces slightly convex. First radials about as wide as high, greatly thickened toward the margin of the articulating facet, and their upper margins very strongly incurved, so that the diameter of the dome is about equal to that of the internal cavity at the middle of the subradials. Anal plate about one-fourth the size of the first radials, higher than wide, and supporting the plates of a lateral upright proboscis. Body plates thick and heavy, especially the first radials, marked by a coarse irregular rugose ornamentation, which is least observed in the first radials. The sutures are rather deeply marked. Articulating facet flat to slightly concave, much elevated, facing outward, about parallel with the vertical axis, and occupying about two-thirds the area of the plate. Its outline is elliptic, notched on the ventral side by the arm furrow. Succeeding radials free, broadly and deeply rounded, two-thirds as wide as the first radials, forming very strong rays of nearly uniform diameter, one bifurcating on the fourth free radial and two on the second, the others not being seen, exhibiting in this respect an irregularity common to the genus. The plates below the bifurcation are quadrangular as viewed from the outside, and of about equal size, being a little over half as long as the first radials. The bifurcating plates are pentangular, the upper margins being equal and nearly at right angles, sustaining two equal branches of half the size of the free radials. These bifurcate again on the second or third plate, and there are two or more bifurcations above, apparently all from the second or third plate. The most remarkable feature of the species is the rapid diminution of the size of the arms, which are comparatively shorter than in any other known species of this genus. They are composed of single joints, constricted in the middle, expanding at their upper margins, and are without pinnules. The form and size of the free rays, and the sudden shrinking in the arms, gives to the form an entirely unique appearance not unlike that of *Onychocrinus*, and the height from the base to the top of the primary radials is more than half that of the entire fossil, excluding the column. The arms are provided at their ventral side with a comparatively small, though deep furrow of tripartite form, which extends throughout the arms. The contraction of the body at the summit is very similar to that in *Poteriocrinus* (?) *geometricus*, Goldfuss (*Sphaerocrinus*, Roemer), of the Eifel, as illustrated by Schultze in his monograph Pl. V, Fig. 6. The thickness of the first and the succeeding radial plates in this and the succeeding species might suggest a reference to *Barycrinus*, but the arm structure and column at once proves it to be *Cyathocrinus*.

This species differs so entirely from all other described Burlington forms, that comparison is unnecessary, and the only species occurring elsewhere to our knowledge, which at all approach it, are from the Keokuk limestone; as for instance *C. multibrachiatus* from Crawfordsville, Ind., which has also a turbinate body, but is otherwise quite distinct.

Locality and position same as last. Collections of C. Wachsmuth and Frank Springer.

Cyathocrinus Gilesii, n. sp.

Column comparatively small, projecting joints rounded on the edges, central perforation small, obscurely pentapetalous. Body depressed, cup-shaped, two-thirds as high as wide, though a little more elongate in young specimens; slightly expanded at the middle of first radials, and so deeply and abruptly constricted at the dome, that the diameter at the upper margin of the plates, in mature specimens, is about the same as that at the outer angle of the basal plates, thus making the internal cavity nearly spherical.

Basals comparatively small, about one-half their size exposed beyond the column, forming a nearly flat disk, with the points of the plates inflected upward at a slight angle with the plane of the base. In young specimens, these plates are more prominent and bend upward at a greater angle. Subradials large, about as wide as high, and of the usual form, strongly convex to tumid. First radials very large, more than half the height of the calyx, elevated around the margins of the facet, and their upper margins abruptly and deeply incurved. There is only one anal plate in line with the first radials, and it is of about one-fourth their size; the succeeding plates form a part of the proboscis which is placed laterally with an upward direction. Body plates comparatively thin, excavated in the inside. Surface destitute of ornamentation.

Articulating facet moderately elevated, flat to concave, and about parallel to the vertical axis; its outline circular and notched by the arm furrow. Succeeding radials form free rays, which are cylindrical, thick and strong, the plates having the same transverse outline as the facet. The free radials are irregular in number, and like the arm plates constricted in the middle, as in *C. barydactylus*, with the exception that in our present species the second radial is much shorter. Sometimes, especially when the facet is quite concave, the latter plate is wedge-form with its thin edge directed outward, so that the plate itself is only visible near the ventral side of the ray. The arm furrows converge at the centre of the dome. Five rather prominent so called consolidating plates of deltoid form, placed at the sutures, and resting in the thin incurved margin of two adjoining first radial plates, connect with each other by lateral extensions beneath the furrow, leaving an opening in the centre. Both central opening and furrows were undoubtedly covered with small plates, which have not been preserved in our specimens, but we found one in which a part of the arm furrow is covered by interlocking plates, similar to the arm covering of *C. Iowensis*, described by C. Wachsmuth (Am. Journ. Sci. vol. XIV, Sept. 1877, p. 183).

This species has some features in common with the preceding one, and had we but a single specimen we might well consider it an abnormal variation from that type. But having before us several specimens of each form, of various sizes, we find its leading characters so constant that we are compelled to regard it as distinct. The size of the column, the form and size of the basals, the tumid subradials, the low cup-shaped body, the thinner plates, and the short second radials are features by which it can be readily identified. It bears some resemblance to *C. rotundatus*, Hall, of the Burlington, and *C. parvibrachiatus*, Hall, of the Keokuk bed; but is distinct from both in the size and shape of the first and of the free radials, while it differs, like *C. barydactylus*, from all other known species in its proportions, half the entire height of the fossil above the column being embraced between the base and the first bifurcation.

The specific designation is in memory of J. W. Giles, Esq., of Burlington, Iowa, who first developed the locality of these fossils, and then lost his life while engaged in geological explorations.

Position and locality same as *C. barydactylus*. Collections of C. Wachsmuth and James Love, Esq.

8. OLLACRINUS, Cumberland.

The form which we include under the above generic name, has been described by Phillips as *Gilbertsocrinus*, by Hall as *Trematocrinus*, and by Lyon and Cassidy as *Goniasteroidocrinus*. Meek and Worthen, in vol. II, Ill. Geol. Report, p. 217, have given a very full review of the literature of the subject, together with an able discussion of the characters of this interesting genus, which have been, in some respects, entirely misunderstood by earlier writers. The true nature of the foramina in the upper part of the radial series was shown to be that of arm openings; while the interradial appendages, which were described as arms by Hall and others, were demonstrated to be not arms, but entirely independent organs, supposed to be connected with reproduction or respiration. To their very instructive observations, to which we refer as the basis of our remarks, we are enabled, by the possession of more perfect material, to add some interesting facts. With Meek and Worthen we cannot agree, however, in regard to the nomenclature of the genus. Cumberland, in 1826, proposed the name *Ollacrinus* for this type, and gave very good figures by which it may be recognized with much greater facility, indeed, than by Phillips's generic diagnosis and descriptions. According to the rules of the British Association, Cumberland's name is, without doubt, entitled to priority. Neither can we see any sufficient reason for separating the genus into two sections, as proposed by those authors. Authentic specimens of the three European species, *Gilbertsocrinus calcaratus*, *G. bursa*, *G. mammilaris*, Phill., show that the pseudo-brachial appendages occupy about the same relative position to the arm-openings as in the American species, and that they are not situated over the interbrachial or radial spaces, but over the interradial areas. We are inclined to believe that the misconception of the nature of the pseudo-brachial appendages led to a misunderstanding of the arrangement of the body plates, and that the interradial series has been mistaken for the radial one. There is some variation in American specimens as to the position of the arm openings dependent upon the direction of the arms. In the specimens in which Meek and Worthen found the true arms preserved, they were pendent, and from this fact it was stated that in this genus the arms were always pendent, and not erect as in the allied *Rhodocrinus*. We find this true in the species named, as also in *O. typus*, Hall, of the Upper Burlington; but in *O. tuberculosus* the arms are erect and fold upward over the dome; and, while in the latter species the arm furrows and pinnules are placed like those in other crinoids on the upper or ventral side, they are, in *O. typus*, upon the under or apparently dorsal side. The same is the case in *O. tuberosus*, L. and C., from Crawfordsville. This peculiar structure is easily explained if we consider that the pendent position of the arms in these species is due, not to a forcible bending out of their normal attitude, but to the peculiar construction of the brachial parts, which directs them downward and makes this their natural position; and, while it appears as if the arm structure was entirely reversed in these two types, this is really not the case, the furrow is still on the ventral side, but the arms have rotated on their axes so as to bring it on the inner side when hanging down.

We have before us some twenty-five specimens of this genus, mostly of *O. typus* and *O. tuberculosus*, about half of them having the false arms, and eight the true arms preserved also. The two species are very satisfactorily separated by characters, the most of which were not disclosed to the learned paleontologist who described them, by the material at his command. We therefore give briefly their additional distinctive characters.

Ollacrinus typus, Hall (sp).

Interradials and anals varying from 7 and 11 in young specimens to 14 and 17 in mature individuals. Pseudo-brachial appendages very large, long, and pendent, spreading to nearly twice the diameter of the dome, tapering gradually, each joint having on the upper side a row of bead-like tubercles, which vary in number and size in different individuals. True arms (as observed in five specimens) pendent, long, and recumbent, directed downward from the openings, which originate in rather large, deep cavities under the overhanging margins of the bases of the false arms. The arms bifurcate on the second short, free, brachial plate, and again, on the third or fifth plate above, after which they are simple and composed of a double series of small thin interlocking plates.[1]

[1] *O. tuberosus*, from Crawfordsville, Indiana, also has a double series of plates in the arms, instead of a single, as described by Meek and Worthen.

The ambulacral furrow is on the under side of the arms, and bears pinnules which point downward. *Trematocrinus papillatus*, Hall, seems to be identical with *O. typus*, for we find both the papillate nodes and long spines on specimens which undoubtedly belong to the latter.

Ollacrinus tuberculosus, Hall (sp).

Anals and interradials about thirteen in adult specimens. Pseudo-brachial appendages without ornamentation, short, small, rapidly tapering to a point. The true arms, as observed in three specimens, are directed upward and folded over the dome, with the ambulacral furrow and pinnules on the inner side, as usual in crinoids. Arm openings in small cavities on either side the base of the false arms. Arms composed of a double series of plates and arranged as in *O. typus*. There are apparently four arms to the ray, although in one instance a fifth one was observed. Body plates large, tuberculiform, and not spiniferous. This, as well as all other Burlington species, has two secondary radials (supra-radials), and not three as stated.

In the fish-bed locality the *O. typus* existed in vast numbers, but, although the fragmentary remains of upwards of a hundred individuals were traced there, only a few were found in fair preservation. They were mostly of larger size and more robust form than specimens from other localities; the tubercles on the joints of the false arms were fewer in number and larger, while the lower body plates were less prominently spiniferous.

Ollacrinus robustus, Hall (sp.), from Keokuk, seems to be larger and more robust than the Burlington species, but the structure of the false arms is not described, and we have never seen an authentic specimen of that species.

In *Ollacrinus tuberosus*, L. & C. (sp.), the only species of the genus described from the Keokuk limestone of Crawfordsville, Indiana, there is a marked distinction from the prevalent Burlington types in the false arms which are composed at their bases of four ranges of plates above and two below. It is therefore an extremely interesting fact to find that in *O. obovatus*, M. and W. (sp.), which occurs only at the very uppermost part of the Upper Burlington beds, there are also four ranges of plates in the upper side of the false arms, which is the case in no other Burlington species. This is one of the rarest fossils of our rocks, only three specimens having ever been found, to our knowledge; and in this isolated crinoid we have another instructive illustration of the structural transitions by which types are modified in the successive epochs.

9. DORYCRINUS, etc.

The history of this genus in the Crinoidal limestone is of great interest. The species of the Lower Burlington are small, and all have a single spine which is on the apex of the dome. *D. unicornis*, O. and Sh., is occasionally found with three, in which case the nodes of the radial dome plates in the posterior rays are prolonged into small spines—an abnormity upon which Hall founded his *Actinocrinus tricornis*. This latter species cannot be upheld, as we find those plates in every stage of development from nodose to spiniferous; sometimes only one plate is prolonged, the other one being normal. Yet, this variation is exceedingly interesting as showing the first step toward a modification which, in the Upper Burlington and Keokuk beds becomes a constant character; in the species of those two beds the first radial dome plates, not only of the posterior ray but of every ray, are prolonged into long spines. The *lower bed Dorycrini* have heavy arms, flattened toward the tips, and closely resembling those of some species which Meek and Worthen refer to *Eretmocrinus*, but differing from them in being double from their origin instead of single, as in *Eretmocrinus*.

In the *upper bed* species, with the exception of *D. parvus*, O. and Sh, which has altogether the character of those from the lower bed, the body is larger, but the arms comparatively more slender, shorter, and less flattened, while the central apical plate and the five first radial dome-plates are produced into long spines, as already stated. In the *transition beds*, the specimens attain a still larger size in *D. intermedius*, Meek and Worthen. The dorsal side of the calyx, which in all Burlington species is higher, or at least as high, as the ventral, here becomes proportionally lower, while the opposite part (above the arms) predominates; and in the Keokuk species the latter is by far the larger portion of the body.

In the *Keokuk beds* the extreme is reached. The body and body-plates are massive, the spines which, in the Burlington species, increase with the progress in geological time, here attain the immense length of 4 or 5 inches, and in one species bear secondary spines. This species, *D. Gouldi*, with its extraordinary feature of spines on spines, was exceedingly short-lived, and disappears already in the lower part of the Keokuk, where it first occurs.

A very similar case is that of *Strotocrinus*, Meek and Worthen (Ill. Geol. Rep. vol. II, p. 181), which, in its typical form, began in the Upper Burlington, though its ancestry is very readily traced in certain Lower Burlington forms. It apparently found favorable conditions in the upper beds, for several species at once developed extreme proportions, the rim at the brachial disk extending in some specimens nearly an inch and a half from the body all around. These large forms are a very common and characteristic fossil in the middle part of the upper bed, but above that they are scarcely ever seen. The smaller types are found somewhat higher, but the genus is extinguished in this formation, not a single specimen having ever been found in the Keokuk.

Barycrinus has a similar history. Commencing in the Lower Burlington in species of moderate size, it becomes in the Keokuk, through transition forms, which are with great difficulty separated into varieties, one of the leading genera, and attains in *B. magister*, Hall (sp.) and *B. magnificus*, M. and W., a gigantic size. These large forms disappear with the Keokuk, and the isolated species found in later formations are small in size and of rare occurrence.

Amphoracrinus appears in the Lower Burlington, where it at once develops extraordinary features in the dome, which is extended into a large, but short proboscis, surrounded by very strong spines, which sometimes give off four or five branches as large as the primary spine. It reaches in America its climax in the Lower Burlington, and no trace of it is found in any succeeding formation.

Megistocrinus, Owen and Shumard, after attaining an immense size, perishes in the Upper Burlington. *Zeacrinus*, on the other hand, like *Cyathocrinus*, in its more prevalent small forms, ranges almost unchanged through all the crinoidal beds, it being very difficult to distinguish those from a different horizon by definite characters. It even continues to flourish in somewhat similar forms in the later formations.

It seems, from the foregoing observations, to be a general rule in the crinoids of these formations, that extravagant forms and rank developments in structure are not perpetuated, and that types mostly cease to exist when they reach a culmination in anatomical features.

We have also seen that, although crinoidal life existed abundantly throughout the formations under consideration, a large proportion of the genera did not survive them; that where extinctions of generic types occurred, it was generally upon their attaining a climax in growth; that the extinguishment of specific forms was not coincident with the close of the respective epochs of limestone deposits, but that most of the changes were made by a series of slow and gradual modifications of specific characters, which correspond in a striking manner with the changes in individual life by growth; that the silicious deposits, while accompanied by great changes in the crinoidal forms, instead of marking sharp distinctions between the limestone formations, exhibit the gradations by which they are connected; that the smaller and less conspicuous forms were generally persistent, and ranged through the whole crinoidal formations with comparatively little change.

We have by no means given all the data at our command bearing on the subject, and our knowledge is necessarily limited. Much further research is required before a thorough understanding of the questions herein discussed can be expected. We are satisfied that a comparative study of the other organic remains, so abundant in these rocks, especially the Fishes, Brachiopods, and Bryozoa, would yield facts similar to those observed in the crinoids. But, however imperfect our investigations, we believe the evidence tends strongly to prove that the distinctions said to exist between these three limestone beds are, to a great extent, arbitrary; that the relations between their crinoidal fauna are most intimate; and that there is good reason for believing that they all belong to one great crinoidal epoch, and should be classed accordingly by geologists.

June 4.

The President, Dr. Ruschenberger, in the chair.

Twenty-four persons present.

The death of Wm. M. Gabb was announced.

The Law Governing Sex.—Mr. Thomas Meehan referred to his observations originally reported to the Academy, developing an entirely new view of the laws of sex from that formerly prevailing, and which proved that what we called the female sex or final reproductive element in flowers, required a higher grade of nutritive power to perfect than the male. Though numberless facts have proved this point, there have always been some which, though they have offered no obstacle, have at least not been capable of explanation by the light of this theory, and among these have been some connected with diœcious plants. Among hermaphrodite and especially among monœcious plants there has been no difficulty in tracing the operation of this principle. In such coniferous trees as pines, firs, and larches, there is no difficulty in perceiving that branches once bearing female flowers, and maturing cones and seeds, produce nothing but male flowers when the branches come in time to be weakened by the shade of younger branches, or in some other way are imperfectly nourished. But when we come to the red cedar, *Juniperus Virginiana*, where some trees are always wholly male, and others always seed bearing, no difference could be found in the vigor of the trees. As in the monœcious cases we found the female element in exact proportion to nutritious advantages, we looked for the seed-bearing trees of the red cedar to be more vigorous than the males, but found instead all equally vigorous and healthy.

The enormous crops of seed borne by the silver maple this year, together with the confirmation of their truly diœcious character, have not only furnished an explanation of the apparent anomaly, but at the same time affords one of the best possible illustrations of the new theory.

As already noted in communications to the Academy, the flowers in *Acer rubrum* and *Acer dasycarpum* are alike in all trees when the petals first open. The anthers seem perfectly formed when another stage of growth commences. The pistils elongate in the female flowers while the filaments remain stationary, and the anthers never open; while in the male flowers the pistils do not grow, but the filaments elongate, and the anthers are carried on to perfection. Each tree is in fact strictly a male or a female tree.

It is a matter within common knowledge that after the maturity of the immense crop of seeds last month, the bearing trees were comparatively leafless; while the completely barren male trees abounded with foliage. There is a well-known morphological law, that the parts of flowers and the resulting seed vessels are metamorphosed leaves. In the case of these maples, the female trees, engaged in developing primordial leaves to perfect fruit, make few leaves in addition to those they started with in the spring, until, after several weeks, their fruitage has been completed. But the male flowers, dying immediately on perfecting their pollen, the male trees push at once into a heavy leaf growth, clothing the tree at a very early period with a dense foliage.

But another consideration intrudes itself here. The woody parts of a tree are made up mainly from the atmosphere through the medium of the leaves, and we may suppose that the greater the proportionate amount of leaves, the greater would be the woody product. Applying now these acknowledged principles to these maple trees, we find some remarkable results. Notwithstanding the male trees are relieved from the enormous strain on the powers of nutrition which the annual and often wonderfully heavy crops must entail, and notwithstanding they have, as in many cases this season especially, the advantage of a hundredfold more foliage at so early a period in the season, male trees are no larger, vigorous, or in any way more healthy than the female ones. In a crowded group of five trees where a female tree is the central one, and a male on the outside, the male with every advantage of food for the roots, and light and air for its large crop of leaves, and which happens to be an unusually large mass of foliage even for a male maple, the girth of the trunk is four feet three inches, while the crowded female tree is five feet five inches, or two inches larger, with all its disadvantages!

We have been looking for weaker individuals in the male than in the female trees. But since he had first made his discoveries we have learned to distinguish much more clearly between vegetative and reproductive force. A large man is not necessarily a strong man in what we should call vital power; but we measure it by endurance under severe trials, and we see now that we need not have looked for weaker trees among the cedars or other diœcious trees, so much as for powers of endurance under reproductive or other essentially vital strains. Here we have this power thrown heavily in favor of the female tree; and he submitted that diœcism in trees instead of being an objection, is a powerful argument in favor of his views.

The President, Dr. Ruschenberger, inquired if Mr. Meehan had ever noticed any difference in the longevity of the male and female trees.

Mr. Meehan replied that he had so far seen no difference.

On a Singular Tartar on the Teeth of a Sheep.—Mr. E. Goldsmith called attention to a deposit upon the teeth in the lower jaw of a sheep. The specimen had been exhibited at a previous meeting of the Academy by Dr. Harrison Allen. He had received it from a gentleman who informed him that he had picked it up in the neighborhood of a silver mine in Mexico. The grass near the mine was contaminated with silver amalgam, and the sheep were said to have been poisoned by the herbage. The peculiar tartar on the teeth was supposed to consist of silver amalgam.

Upon examination it was found that the tartar formed a thin scale covering the teeth so far as they were exposed. The thickness was about 0.2 millimeter. When viewed under a lens of moderate power the deposit seemed to have been built up gradually from within, for, on breaking, a series of very thin layers were noticed of which the outer one appeared darker than those underneath. The scales were very fragile. Its lustre was truly metallic, as no light could pass through it even on the thin edges, but the lustre of the reflected rays of light were decidedly metallic, and this property was alike throughout the scales. These scales did not allow an impression to be made with the nail of the finger, hence they were harder than silver amalgam. If heated on platinum foil it blackened, showing the presence of organic matter; the form of the fragment did not change during the heating, but the silvery lustre entirely disappeared. Heated in the tube closed on one end, at first a gray cloud arose, then water and an oily matter deposited themselves on the upper or cooler end of the tube; lower down near the now carbonized test a metallic layer was recognized with the aid of the lens. The powdered substance being mixed with carbonate of soda, and treated in the same way the result did not differ. If melted on coal with the addition of carbonate of soda there was obtained a white enamel but no metal whatever. In nitric acid the tartar was soluble as long as the solution was concentrated; if diluted with water a turbidity, caused by the separation of an organic matter, was formed. This organic matter was soluble in caustic ammonia and from this ammoniacal solution it was again precipitable by nitric acid; the precipitate was flocculent, not at all cheesy; it carbonized when heated, and left no residue if the heating was prolonged for a sufficent time.

The remaining solution from which this organic substance had been separated gave no reaction with hydrochloric acid, the absence of silver being thereby proven.

A stream of sulphuretted hydrogen gave a precipitation in which a very little quantity of sulphuret of mercury was discerned. Very strong reactions of phosphoric acid and lime were observed in the nitric acid solution with the ordinary reagents.

This singular tartar is consequently not silver amalgam but the same material of which teeth are generally made, modified, however, by the influence of a small quantity of mercury. That metallic mercury is easily absorbed by the animal economy is well known, it seems, however, not to have been noticed on the outside of the teeth before.

June 11.

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

Twenty-one persons present.

The following papers were presented for publication:—

"Description of a New Fossil from the Cretaceous of Charleston, S. C." By Wm. G. Mazyck and A. W. Vogdes.

"On Unio subrostrata." By James Lewis, M.D.

June 18.

The President, Dr. Ruschenberger, in the chair.

Thirty-one persons present.

June 25.

The President, Dr. Ruschenberger, in the chair.

Twenty-seven members present.

The following papers were presented for publication:—

"Descriptions of New Species of Fossils from the Pliocene Clay Beds between Limon and Moen, Costa Rica, together with Notes on previously known species from there and elsewhere in the Caribbean Area." By Wm. M. Gabb.

"Descriptions of Caribbean Miocene Fossils." By Wm. M. Gabb.

Geo. B. Cresson was elected a member.

July 2.

The President, Dr. Ruschenberger, in the chair.

Nineteen persons present.

A paper entitled "Pelagic Amphipoda." By Thos. H. Streets, M.D., U. S. N., was presented for publication.

The deaths of Jos. W. Miller and Thomas Stewardson, M.D., were announced.

JULY 9.

The President, Dr. RUSCHENBERGER, in the chair.

Thirteen persons present.

The death of Mr. Bloomfield H. Moore was announced.

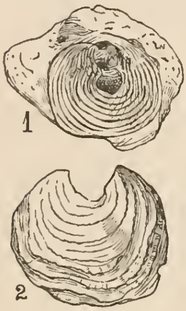
The following papers were ordered to be printed:—

DESCRIPTION OF A NEW FOSSIL FROM THE CRETACEOUS BEDS OF CHARLESTON, S. C.

BY WM. G. MAZYCK AND A. W. VOGDES.

Anomia Andersonii, M. & V. n. s.

Description.—Shell thin, suborbicular in outline, but somewhat irregular; beak subcentral, marginal; hinge line almost straight; upper valve moderately convex. Lower valve unknown. The surface of the upper valve is regularly marked with obscure lines of growth and concentric wrinkles, the latter become prominent laminæ towards the ventral margin.



1

2

This shell will be readily distinguished from all other species of the genus by its marked regular prominent concentric wrinkles. It preserves the peculiar pearly lustre, characteristic of the genus remarkably well.

The greatest diameter of our Fig. 1 is 18 mm., and its smallest diameter is 15 mm. The convexity of this specimen is about 4 mm.

Position and locality.—Cretaceous period: artesian well on the Citadel Green, Charleston, S. C. The shell ranges between the depth of 1880 feet to 1930 feet below the surface. We have also the following cretaceous species from the strata between the depths mentioned.

Ostrea prudentia, White; *Ostrea subspatu'a*, L. & S. with others which we are unable to identify on account of their broken condition. The collection has been deposited in the Charleston College Museum.

A dorsal view of the upper valve showing the hinge line and prominent wrinkles near the ventral margin is given in Fig. 1. This specimen is from the depth of 1920 feet, and was found in a layer of limestone. Fig. 2 shows the wrinkles near the ventral margin much more perfectly developed than in Fig. 1. This shell ranges higher up and comes from the depth of 1880 feet from an arenaceous stratum.

ON UNIO SUBROSTRATUS, Say.

BY JAMES LEWIS, M.D., MOHAWK, N. J.

The records which relate to *Unio subrostratus* afford a curious instance of the obscurity in which the identity of a species may be involved through the influence of trifling errors. Practically up to the present time *U. subrostratus* has had scarcely more value in scientific records than if it had never been described.

To dispel the obscurity which invests this subject, the records which most essentially bear upon the identification of the species will now be offered for consideration, commencing with Say's description of the species transcribed from page 134 of W. G. Binney's edition of Say's conchological writings.

"Unio subrostratus, transversely elongated, subrostrated, radiated.

Inhabits Wabash.

Transversely elongate subovate, brownish or pale ochreous, with numerous dark-green radii; beaks but little elevated with a few small, angular, concentric lines; ligament margin a little compressed; anterior margin[1] somewhat elongated, hardly subrostrated; separated by an obtuse angle from the ligament margin; base arquated; posterior margin rounded; within white, often slightly tinted with flesh color; somewhat iridescent on the margins, particularly the anterior margin; substance of the shell not thick; teeth very oblique, crested.

Length one inch and two-fifths; breadth three inches and one-fifth. Convexity hardly over one inch.

This may be said to be the analogue of the *U. nasutus*, nob. of the western waters. The rostrum, however, is not so definite, and it is a more convex shell. The aged shell is dark-brown, but near the beaks reddish-brown."—January 15, 1830, New Harmony Disseminator.

Subsequently Mr. Say put *Unio iris*, Lea, in the synonymy of *subrostratus*,[2] and this mistake on the part of Mr. Say may be presumed to be the source of the obscurity that *subrostratus* has

[1] Say reversed our present understanding of the anterior and posterior of Uniones.

[2] See page 225, Binney's ed. of Say.

since been involved in. There is no evidence to show that Mr. Say had any other knowledge of *U. iris* than a reading of Mr. Lea's description of that species.

Mr. Lea in his treatment of synonymy, follows Say's idea of the identity of *iris* and *subrostratus*, but places *iris* first. See Synopsis (1870), page 60. This serves to make the obscurity still more complete, and were it not for Mr. Lea's foot-note to *iris* on the page just cited, *subrostratus* might for all time have remained in the synonymy of *iris*, or what amounts to the same thing, the two might continue to be regarded as identical. As Mr. Lea's foot-note affords an important hint by which the identification of *subrostratus* is approached, it is here transcribed.

"Mr. Say in his *Synonymy*, gives *iris* as a synonym of *subrostratus*. *If they were the same* I would be entitled to precedence, as my description bears date March, 1829, while his is January, 1831. *His description*, however, of *subrostratus does not apply to my iris*, and *certainly this shell could not have been under his eye when his description was made.* He says that the *subrostratus* 'may be said to be the analogue of the *Unio nasutus* (nobis) of the western waters.' As the *U. nasutus* inhabits the western waters, a variety of that species may have been described by him for *subrostratus*."—Lea's Synopsis, 1870, page 60, foot-note 4.

The most significant parts of the above note are underlined

In endeavoring to ascertain the facts which bear upon Mr. Lea's closing sentence in the above note, I have obtained specimens of *U. nasutus* from the northern counties of Ohio, the streams of which flow into Lake Erie. In Indiana, Illinois, and Iowa my correspondents find shells which they call *nasutus*, but which are plainly referable to Lea's description and figure of *U. Nashvillianus.* The males of this species satisfy the demands of Say's description of *subrostratus* even to local reference, a part of my specimens being from the ponds of the "Wabash."

Extending the inquiry I find that this species merges by slight variations into the form known as *U. Mississippiensis*, Conrad.

The geographical distribution of *U. subrostratus* reaches Indiana, Illinois, Iowa, Nebraska, Tennessee, Mississippi, and Alabama. Further investigations may reveal its presence in all the States along the Lower Mississippi.

I am indebted for specimens and information in aid of this investigation to the following named gentlemen: C. M. Wheatley, Phœnixville, Chester Co., Penna.; Dr. R. M. Byrnes, Cincinnati, Ohio; Dr. J. Schneck, Mt. Carmel, Illinois; J. M. McCreery, Akron, Ohio; Philip Marsh, Esq., Aledo, Illinois; Prof. F. M. Witter, Muscatine, Iowa; Dr. E. R. Showalter, Alabama. I am also indebted to the records of the Hayden Exploring Expedition for facts in geographical distribution.

PELAGIC AMPHIPODA.

BY THOMAS H. STREETS, M.D., U.S.N.

The crustaceans to be discussed in this and subsequent papers "are oceanic species, and are mostly found remote from the land." They belong to Dana's subtribe *Hyperidea*, and to Bate's division *Hyperina.*

There is a remarkable contrast between the two great divisions of Amphipoda—the *Gammaridea* and the *Hyperidea.* The former are generally found along shore, in deeper water near the bottom, or on floating material, and there is a great resemblance running through all the species; while the latter swim free in the mid-ocean, and there is the greatest diversity of characters among them.

The collection, which has been placed in my hands for identification, is probably the largest which has ever been gathered together by a single individual. It was collected by Surgeon William H. Jones, U. S. Navy, and his work embraces a period of about four years. It comes from nearly the entire Pacific Ocean, north and south of the equator, except the extreme high latitudes. A portion of it now enriches the Academy's collection, and the remainder has been retained by the collector.

The specimens were mostly taken with a towing-net at night, which is "about the only time when surface dredging can be carried on with any prospect of success." (I quote from the notes furnished by Dr. Jones.) "Those captured in daytime were taken under special circumstances, such as discoloration of the water, the presence on the surface of objects visible to the naked eye, or when passing through schools of fish, *Velella*, *Porpita*, or *Physalia*, when some rare forms would be occasionally met with in the dredge or net.

"The dredge was frequently tried in daytime when the speed of the vessel would permit, and towed for several hours at various depths, ranging from the surface to forty fathoms, without securing a specimen beyond a few that have an almost universal distribution, while, if the dredge was put over an hour or two afterwards, when it had become dark, they would be taken in great numbers. The state of the weather and sea, and the character of the night have great influence in effecting their approach to the surface or within reach of the dredge. A smooth sea, a dark night, especially if cloudy or squally, or warm and sultry, seems to be their favorite time for approaching the surface in the greatest numbers; while, on the other hand, a moonlight night, or high winds, and a rough and heavy sea, keep them from coming so near the surface.

"Usually they approach the surface about twilight, or within half an hour after dark, and remain on or near the surface for two or three hours, although occasionally they remain much later, being apparently influenced by the darkness of the night and state of the weather."

I attach much importance to these notes, as they give the first information we have had of the habits of these little animals. I have noticed myself that a great many of them, when alive, have the property of phosphorescence, and it has occurred to me may it not be this which causes them to shun the light? They carry their own light about with them.

OXYCEPHALIDÆ.

Body elongate, narrow. Head lengthened in the direction of the axis of the body, and produced anteriorly beyond the superior antennæ in the form of a pointed rostrum. Eyes occupying the greater portion of the head, posterior to the superior antennæ. Antennæ on the inferior surface of the head; the superior (anterior) pair short; the inferior (posterior) long, and folded upon itself four times, and concealed in a groove on the under surface of the head. Mandibular appendage long. The inferior antennæ and mandibular appendage are absent in the female.[1] First and second pairs of the thoracic legs small, and chelately developed. The basal joint of the three posterior pairs of thoracic legs broadly dilated, except in some species of *Rhabdosoma*. The last pair of legs smaller than the preceding; either rudimentary developed or obsolete. Caudal appendages lanceolate, or linear; biramous. Telson broadly triangular, or linear.

[1] Claus classifies the *Oxycephalidæ* along with the *Phronimidæ* in his family *Phronimides*, and states that the mandibular palpus is absent, which is an error. Though absent in both sexes of the *Phronimidæ*, it is present in the male of the *Oxycephalidæ*.

OXYCEPHALUS, Edwards.

Body moderately long, robust. Head narrow, produced anteriorly in a broad, triangular rostrum, short, grooved below; a constriction of the head may, or may not, exist behind the eyes and in front of the first thoracic segment. The superior antennæ three-jointed, the middle joint short; inferior antennæ five-jointed, joints subequal, except the last, which is short. Mandibular appendage three-jointed. The first and second pairs of thoracic legs short, clawed; the third and fourth simple; the last three pairs with the basal joint broadly dilated; the last pair diminutive or rudimentary; the extremity of the sixth pair—articulating with the broad basal joint—finely serrated along the anterior margin. The sixth abdominal segment broad, not elongated. The caudal appendages short, broadly lanceolate. Telson broadly triangular.

Oxycephalus tuberculatus, Sp Bate. Fig. 1, 1*a*, 1*b*.

Oxycephalus tuberculatus, Sp. Bate, Catalogue Amphi. Crust., 1864, p. 343, pl. 54, fig. 5.—Streets, Bulletin of the National Museum, Washington, 1871, p. 136.

Head long, almost equal to the first five segments of the thorax, broad, deeper posteriorly than anteriorly, superior surface straight, on a level with the dorsum of the thorax. inferior margin convex, sloping upward anteriorly; rostrum short, somewhat more than half the length of the head, broad, triangular, acute, lateral edges serrated, a high longitudinal ridge along the middle above, extending backward on the head. Superior antennæ with peduncle broad, three-jointed, the second joint the shortest, the third longer than the first and second combined; a few auditory hairs at the apex; flagellum bi- or tri-articulate, short, slender, bent forward. Inferior antennæ with the first joint enlarged at its distal extremity, the second the longest, the fourth and fifth together slightly shorter than the third, the fifth short; the whole antenna folded upon itself four times, and concealed in a groove on the under surface of the head. The mandibular palpus long, about the same length as the first joint of the inferior antenna, the second and third joints short, subequal.

Three longitudinal ridges along the dorsum of the thorax, one in the median line of the body, and one on either side of the median row, with an anterior and posterior tubercle on each segment of the thorax; the ridges are interrupted at the articulations of the segments, commencing and terminating in the tubercles on each segment; similar ridges descend from the tubercules along the front and after margins of the segments; along the side of the thorax are a number of short ridges, irregularly placed. On the side of each of the three anterior abdominal segments is an oblique ridge, forked posteriorly; the median dorsal ridge of the thorax gradually disappears on the abdominal segments. The first and second pairs of thoracic legs short, perfectly chelate; the first shorter than the second, the fourth joint short, produced antero-inferiorly, but not to the apex of the fifth joint, acute, spinous on the lower and anterior edges, serrated on the latter, antero-superior angle acute, projecting forward; the fifth joint articulating with the fourth below the superior angle, convex above, lower edge straight and serrated, spinous; dactylus short, slightly longer than the anterior edge of the fifth joint. The hand of the second pair more elongate, the fourth joint produced antero-inferiorly to the apex of the fifth joint, and the tip slightly curved upward; the fifth joint oblong; in other respects resembles the first pair. Third and fourth pairs of legs subequal, simple, with a few hairs, or spines, along the posterior edge; the fifth pair the longest, with the hairs arranged along the anterior edge; the anterior edge of the sixth pair pectinated, fine teeth in the intervals between the coarser ones; basal joint of the last three pairs of legs broadly dilated, the sixth shorter than the fifth, but broader, margins finely serrated; the seventh pair of thoracic legs diminutive, the broad basal joint narrowing distally, the remaining portion of the leg shorter than the first joint. In the smaller specimens the length of the seventh pair about equals the length of the basal joint of the preceding pair, but in the larger specimens it is somewhat longer.

The inferior margin of the first three abdominal segments furnished with two sharp, prominent spines directed downward and backward, and separated by a deep notch; one is situated on the middle of the inferior margin, and the other projects from the posterior angle. The first and third pairs of caudal appendages extending backward about the same distance, and reaching to the extremity of the telson; the second pair terminating opposite the commencement of the rami of the last pair; rami serrated, long. Sixth abdominal segment longer than broad. Telson broad, triangular, serrated.

No. examined.	Localities.	Temp. water	Temp. air.	Lengths.	Sex.
1	Lat. 32°23′ S. Long. 98°30′ W.	64°F.	68°F.	28 mm.	♀
2	" 28 47 N. " 124 29 "	63 "	62 "	28 "	♀
3	" " " " " " " "	" "	" "	20 "	♀
4	" 35 25 " " 142 53 "	61 "	59 "	25 "	♂
5	" " " " " " " "	" "	" "	15 "	♀
6	" 5 00 " " 128 00 "	....	....	10 "	♀
7	" 25 22 " " 133 12 "	67 "	67 "	12 "	♂ (young)
8	" 25 13 " " 143 15 "	....	....	14 "	♀

The males of this species are smaller than the females, and there is a slight difference in the shape of the superior antennæ. The peduncle is more robust, and the apex of the last joint is produced; the anterior aspect of the produced portion slopes backward forming an obtuse angle with the main portion of the joint, and is sparsely covered with hairs.

Oxycephalus bulbosus, n. sp. Fig. 2, 2*a*, 2*b*.

Female.—Body compressed; head one-fourth of the total length, the portion containing the eyes rounded in profile, equally convex above and below, compressed, the neck portion constricted, but not narrower that the first segment of the thorax; the rostrum one-third the length of the head (its own length included), depressed, narrower than the head when looked at from above, slightly constricted in the situation of the superior antennæ, duck-bill shape, acute, ridged along the median line above. Superior antennæ slender; peduncle with the first and last joints subequal, the second short, the third joint with hairs along the anterior margin; flagellum two-jointed. Three slightly elevated ridges running the length of the thorax—one in the median line, and one on either side of it—ridges not continuous, but interrupted at the articulations of the segments. The first and second pairs of thoracic legs short, perfectly chelate; the first smaller than the second, stouter, the fourth joint produced antero-inferiorly to the apex of the fifth joint, spinous; dactylus short. The third and fourth pairs of legs subequal; the fifth the longest, its basal joint oval; the sixth shorter than the one preceding, but its basal joint broader, remaining joints pectinated as in *O. tuberculatus;* the last pair shorter than the sixth, all its joints well developed, together longer than the basal joint of the sixth pair. The postero-inferior angle of the anterior abdominal segments acutely produced; in front of the posterior angle on the inferior margin a broad notch, no spine on the inferior border. The first and last pairs of caudal appendages and telson extending about the same distance backward; the second pair terminating opposite the commencement of the last pair and the commencement of the rami of the first pair. The sixth segment of the abdomen longer than broad. Telson broad, triangular at apex.

No. exam.	Localities.	Temp. water.	Temp. air.	Length.	Sex.
1	Lat. 28° 00′ N. Long. 140° 00′ W.	70° F.	69° F.	17 mm.	♀
2	" 27 00 N. " 140 00 W.	70 "	69 "	13 "	♀
3	" 35 45 N. " 144 25 W.	62 "	58 "	14 "	♀

The affinities of this species are with *Oxycephalus tuberculatus*, but is very readily distinguished by the bulbous shape of the head and by the absence of the spine on the inferior margin of the three anterior abdominal segments. There are no males in the collection.

Oxycephalus scleroticus, n. sp. Fig. 3, *3a*, *3b*, *3c*.

Male.—Animal with the tegumentary covering hard and resisting. Head as long as the first six segments of the thorax; the portion containing the eyes rounded and shorter than the part anterior to it, compressed, wedge-shaped, with the broad end of the wedge posterior, constricted in front, and notched behind and above at its articulation with the thorax, inferior surface convex, superior surface rounded and sloping downward; rostrum broad, triangular, depressed towards the end, acute, elevated in the median line; in the smaller specimens the point of the rostrum was deflexed; a broad deep concavity beneath the rostrum for the reception of the superior antennæ; the groove for the inferior antennæ and mandibular palpi long and narrow. Superior antennæ bowed in the form of a half-circle, and springing from the posterior extremity of a lengthened elevation on the under surface of the rostrum, the convex margin densely hairy, the apex of the concave border produced at nearly a right angle with the rest of the joint; peduncle with the middle joint short; flagellum three-jointed and articulating with the base of the produced apex of the last joint of the peduncle. Inferior antennæ when folded reaching nearly to the extremity of the rostrum, first four joints long and subequal, the fifth short. Mandibular palpus long, first joint long, the last two short and subequal. The thorax elevated along the median line into a broad, rounded ridge, with the sides sloping down from the summit; the ridge appearing somewhat nodulated; a row of nodules along the side above the epimerals; on the fifth epimeral a prominent spine, directed backward; the segments of the thorax decreasing posteriorly, each segment bulging, not overriding its fellow; the whole surface of the body finely granulated. First and second pairs of thoracic legs short, chelate; the first smaller than the second, with the fourth joint broad, produced, apex acute, spinous; the second pair with fourth joint more produced than in the first, the anterior margin of the joint nearly straight; the fifth joint as long as the anterior margin of the fourth, spinous below; claw long, acute. The last three pairs of thoracic legs with the basal joint broadly dilated, and with a series of four pits along the median line of the outer surface of each joint, their posterior edge broadly produced backward near the middle; the basal joint of the sixth pair the broadest; that of the last pair small, its distal margin broad, the entire leg shorter than the first joint of the preceding pair. The three anterior abdominal segments with the postero-inferior angle produced, acute, inferior edge straight; the fourth segment small; the fifth and sixth consolidated, and together as long as the telson. Telson triangular, broad, projecting but slightly beyond the extremities of the caudal appendages. The first and third pairs of caudal appendages reaching backward nearly the same distance; the last pair very short, the rami equalling the length of the base; the second pair slender, and terminating opposite the commencement of the rami of the last pair; rami lanceolate.

No. exam.	Localities.	Temp. water.	Temp. air.	Length.	Sex
1	Lat. 26° 13′ N. Long. 143° 15′ W.	71° F.	67° F.	15 mm.	♂
2	" 25 13 N. " 143 15 W.	......	......	10 "	♂
3	" " " N. " " " W.	......	......	10 "	♂
4	" 25 50 N. " 132 45 W.	68° F.	68° F.	10 "	♀

The female of this species is more robust than the male. The head is deeper and broader, more rounded above and below, the notch posterior shallower; the rostrum shorter and narrower. Superior antennæ straight, or slightly curved, slender, not produced at the apex of the third joint of the peduncle. In the one specimen of this sex in the collection the spine on the fifth epimeral was absent.

The figure was taken from the largest specimen in the collection. The head is longer, and the constricted portion behind is broader than in the two other male specimens. In the latter the tip of the rostrum is somewhat deflexed.

LEPTOCOTIS, Streets.

Body long and slender. Head produced anteriorly to the superior antennæ in a long, slender rostrum, constricted posteriorly at its articulation with the thorax, the constricted portion short. Superior antennæ short, three-jointed, curved in the male, and straight in the female; inferior antennæ five-jointed, joints subequal, excepting the last which is short. Mandibular appendage three-jointed. First and second pairs of thoracic legs short, chelate; the third and fourth simple; the last three pairs with the basal joint dilated; the last pair diminutive. The sixth abdominal segment (the fifth and sixth fused) elongated. The caudal appendages long, linear. Telson long, triangular at apex.

This genus occupies an intermediate position, showing the transition from the short *Oxycephalus* into the excessively elongated form of the *Rhabdosoma*. Its affiliations are with both.

Leptocotis spinifera, Streets. Fig. 4, 4*a*, 4*b*.

Leptocotis spinifera, Streets, Bulletin of the U. S. National Museum. Washington, 1877, p. 137.

Male.—Head long, excluding the rostrum, as long as the thorax. deeper posteriorly than anteriorly, gradually narrowing above and below to the rostrum, superior surface abruptly constricted behind, the neck on a level with the dorsum of the thorax, the rest of the superior surface elevated above the dorsum of the thorax, straight, slightly arched over the superior antennæ, inferior margin convex, the front hollowed out below on either side into fossæ for the superior antennæ; rostrum slightly more than one-third the length of the head (including its own length), slender, acute, slightly arched. Superior antennæ sickle-shaped, the first and second joints short, forming the handle of the sickle, the second joint shorter than the first, both together shorter than the broad, curved, terminal joint of the peduncle, margins of the last joint densely hairy, apex produced into a long, stout process, at right angle with the rest of the joint; a short, bi-articulate flagellum articulating with the anterior surface of the base of the process, two or three auditory hairs on each articulus. Inferior antennæ when folded reaching as far forward as the base of the superior pair, the distal extremity of the first joint clubbed, the first three joints equal in length, the fourth somewhat shorter, fifth very short, with one or two hairs at the apex. Mandibular appendage as long as the first joint of the inferior antennæ, the second and third joints short.

First and second pairs of thoracic legs short, chelate; the first smaller than the second, with the fourth joint broad, and produced anteriorly, the produced portion triangular, spinous, the apex long. slender, acute; the fifth joint broad, spinous below and anteriorly; dactylus nearly one-half the length of the fifth joint, curved, with a spine on the inferior edge behind the middle. The second pair of legs similar to the first; the third and fourth pairs simple, slender, shorter than the fifth; the fifth, sixth, and seventh with the first joint dilated; the basal joint of the sixth broader than the fifth, but with the remaining joints shorter, and closely pectinated along their anterior margin; the pectinations on the third joint coarse, on the fourth very fine, while those on the fifth joint are intermediate between the two preceding; the last pair of legs diminutive, not half as long as the basal joint of the preceding. The first three segments of the abdomen subequal. inferior margins finely serrated, the third segment with the postero-inferior angle produced into a long, spinous process, the angle of the first and second segments square behind, not produced; the peduncles of swimming feet broadly oval. Sixth abdominal segment and telson elongated. The first pair of caudal appendages longer and broader than the second, and reaching nearly as far backward as the last pair; the latter short; all of them biramous. and serrated along their inner margins. Telson extending beyond the extremity of the last pair of caudal appendages.

No. exam.	Localities.	Temp. water.	Temp. air.	Length.	Sex.
1	Lat. 21°37′ N. Long. 152°28′ W.	74° F.	71° F.	11 mm.	♂
2	" 29 00 N. " 157 00 W.	......	......	13 "	♂
3	" 25 13 N. " 143 15 W.	......	......	11 "	♂
4	" 15 38 N. " 118 00 W.	76° F.	......	9 "	♀
5	" 16 25 N. " 118 00 W.	75 "	......	8 "	♀
6	" 2 57 S. " 81 40 W.	68 "	73° F.	9 "	♀

Female.—Animal smaller and slenderer than the male. Head oblong, convex above and below, tapering in front and behind, not abruptly constricted at the neck, as is the case in the male; rostrum relatively longer, being equal to the length of the head behind it. Superior antennæ slender, straight, not produced at the apex. The thorax increases in thickness towards the middle. The peduncles of the swimming feet oblong.

CALAMORHYNCHUS. n. gen.

Body elongated, slender, almost rod-like. Head large, depressed, produced anteriorly to the eyes in a broadly-expanded, triangular rostrum; constricted behind the eyes into a short, narrow neck. Superior antennæ with the peduncle three-jointed; in the female straight. First and second pairs of thoracic legs small, chelate; the fourth joint broad and long, the fifth short and narrow. The last three pairs of legs with the basal joint narrowly dilated; the seventh pair diminutive. The sixth segment of the abdomen long and narrow. Caudal appendages long and linear. Telson short, triangular.

Calamorhynchus pellucidus, n. sp. Fig. 5, 5*a*.

Female.—Head long, nearly one-third of the total length, its breadth twice that of the thorax; neck short, and slightly narrower than the thorax; the portion containing the eyes oblong, convex above and below when viewed in profile, elevated above, in the median line, into a sharp ridge, which terminates at the apex of the rostrum, below the eyes from two long and rounded lobes separated by a broad, shallow groove; rostrum flattened, posteriorly broader than the eyes, commencing on either side of the eyes in a broad, rounded wing-like expansion, and tapering forward to a long and acute apex. Superior antennæ situated about the centre of the under surface of the rostrum, small and slender, with the first and last joints of the peduncle subequal, the middle joint short, auditory hairs at the apex; flagellum bi-articulate, bent forward at its articulation with the peduncle. Segments of the thorax subequal. First pair of thoracic legs shorter than the second; the fourth joint broad, produced, and rounded anteriorly, so that the apex points upward slightly, spinous and serrated, apex acute, short; fifth joint slender, spinous, serrated on inferior edge; dactylus long, slender, acute; the hand of the second pair oblong in shape, fourth joint more elongate than that of the first pair, convex below, apex prolonged, slender, spinous, sharply serrated on anterior edge, fifth joint slender, as long as the anterior margin of the fourth joint, spinous, sharply serrated below. Third and fourth pairs of legs simple; the last three pairs with the basal joint narrowly dilated, lanceolate; the fifth pair the longest; the sixth shorter than the fifth, with the third, fourth, and fifth joints minutely serrated along their anterior margin; the seventh pair diminutive, barely exceeding the basal joint of the preceding pair. The anterior three abdominal segments subequal, the postero-inferior angle acute, projecting. The sixth segment long and narrow, slightly longer than the peduncle of the first pair of caudal appendages. First and second pairs of caudal appendages long and linear, the first stouter than the second, equal in length, falling short of the apex of the telson and the extremity of the last pair, inner margin and rami serrated; the last pair short, about one-third the length of the first pair, slightly shorter than the telson. Telson narrow, acute at apex.

Length, 12 mm. Locality, lat. 28° 06′ N.; long. 140° 12′ W. Temp. water, 70°; temp. air, 69°. Sex, female.

RHABDOSOMA, White.

Animal exceedingly elongated and attenuated, rod-like. Head produced anteriorly to the superior antennæ in a very long and thread-like rostrum; neck long and slender. Superior antennæ situated in front of the eyes, three-jointed, curved in the male, and straight and slender in the female; inferior antennæ long and five-jointed. First and second pairs of thoracic legs small and chelately developed; the fifth and sixth pairs either similar to the preceding, or with the basal joint very slightly enlarged; the seventh pair obsolete. The posterior abdominal segments, and caudal appendages very long and slender.

Rhabdosoma whitei, Bate. Fig. 6, 6*a*, 6*b*.

Rhabdosoma whitei, C. Spence Bate. Catalog. Amphi. Crustacea, 1862, p. 345, pl. 54, fig. 7.

Male.—Length of the head nearly one-half of the total length ($\frac{5}{11}$); rostrum, from the situation of the superior antennæ, three times as long as the rest of the head; the portion containing the eyes shorter than the neck, the superior surface, posteriorly, sloping backward with a gentle incline to the neck; inferior surface straight, anteriorly ascending obliquely to the insertion of the superior antennæ; the neck narrowest about the middle, enlarged at its articulation with the thorax, superiorly very slightly concave, inferior surface straight, on a level with the under surface of the eyes, a narrow and shallow groove running the whole length of the under surface. Superior antennæ with the peduncle stout, sickle-shaped, first and second joints short, third long, broad, curved, with the concavity forward, anterior apex produced into a stout process, hairy; flagellum short. Inferior antennæ long, joints subequal, except the last, in adult individuals when folded longer than the neck, reaching nearly to the middle of the eye-portion. Mandibular palpus as long as the first joint of inferior antennæ, first joint long, last two short. The third, fourth, fifth, and sixth thoracic segments subequal and lengthened, the first, second, and seventh short, the latter about one-half the length of the sixth. First pair of thoracic legs with the fourth joint short, dilated, produced anteriorly to near the apex of the fifth joint; fifth joint stout, inferior edge anteriorly dilated and slightly produced; dactylus long, slender, curved; the second pair of legs longer than the first, fourth joint slender, but slightly enlarged, produced anteriorly in a long, slender, curved process, acute at the apex, and extending slightly beyond the apex of the fifth joint; the latter produced anteriorly at its inferior angle into a short process, toothed, distal extremity of the joint enlarged; dactylus long, curved. The remaining thoracic legs simple, first joint not dilated, as slender as the preceding, increasing in length to the sixth, the third and fourth joints of the sixth pair finely toothed on the anterior margin, the fifth joint coarsely toothed; the seventh pair obsolete. The anterior three abdominal segments subequal, the postero-inferior angle produced into a prominent, acute spine, with a broad, shallow notch in front of each spine, last spine longest; the fourth segment as long as the third, and about three-fourths the length of the sixth, slender. Caudal appendages long, linear, serrated, biramous, rami short; the first pair reaching backward to about middle of the length of the last pair; the second pair slightly longer than the sixth abdominal segment; the last pair falling short of the extremity of the telson, and shorter than the first pair. Telson cylindrical, tapering to the extremity, which is acute, and slightly defined.

No. exam.	Localities.	Temp. water.	Temp. air.	Length.	Sex.
1	Lat. 27° 17′ N. Long. 111° 19′ W.	70° F.	72° F.	*45 mm.	♂
2	" " " " " "	" "	" "	*39 "	♂
3	" " " " " "	" "	" "	55 "	♀
4	" " " " " "	" "	" "	*42 "	♀
5	" " " " " "	" "	" "	*32 "	♀
6	" " " " " "	" "	" "	*48 "	♀
7	Lat. 16° 25′ N. Long. 118° 00′ W.	......	......	*25 "	♂

Those marked with asterisks had more or less of the point of the rostrum broken off.

In the female the thorax is larger, the superior antennæ are small, slender, and straight. The last joint of the peduncle is broad and flattened at the apex, and crowned by a number of hairs. In other respects similar to the male.

The drawing was taken from a female, for the reason that it was the only one of the collection that possessed the rostrum entire.

Rhabdosoma armatum (Edw.), Adams and White. Fig. 7, 7*a*, 7*b*.

Oxycephalus armatum, M. Edwards, Hist. des Crust., iii, 1840, p. 101.

Rhabdosoma armatum, Adams and White, Voyage of the Samarang, 1850, Zoology, Crust., p. 63, pl 13, fig. 7 (non *R. armatum*, Bate, Catalog. Amphi. Crust., 1862, p. 344, pl. 54, fig. 6.).

Young Male.—Animal robust. Rostrum broken off 4 mm. from the superior antennæ, spinulose; the portion containing the eyes oblong, deeper posteriorly than anteriorly, shorter than the portion posterior to it; the latter spinulose. Antennæ immature.[1] The superior pair stout, slightly curved, first and second joints short, subequal, the third joint long and broad, with the extremity

[1] The antennæ and mandibular palpi are in the same condition as in the immature males of *R. whitei*, where the superior pair becomes curved, and the inferior pair elongates with age, or at maturity.

crowned with hairs. Inferior antennæ and mandibular palpi short. Thoracic segments gradually increasing in length to the seventh, which is about two-thirds the length of the sixth; epimerals long, with the inferior margins finely serrated; the last epimeral contracted in the middle, somewhat dumb-bell shaped. First pair of thoracic legs short, the fourth joint produced anteriorly beyond the extremity of the fifth joint, the process slender, apex acute, inferior margin straight; fifth joint produced antero-inferiorly into a short, broad, triangular process, dactylus long; second pair slender, longer than the first pair, fourth joint produced anteriorly into a very long, slender, curved process extending beyond the extremity of the fifth joint; the latter joint longer, but produced as in the first pair, dactylus long, slender. The third and fourth pairs of thoracic legs shorter than the fifth and sixth pairs, subequal, the fourth somewhat the longer; the fifth longer than the sixth, the first joint of both somewhat enlarged, the anterior margin of the third, fourth, and fifth joints of the sixth pair finely serrated. The anterior three abdominal segments subequal, the posterior and inferior margins of the first meeting at an obtuse angle, not produced; the margins of the second segment meeting at nearly a right angle, slightly projecting; the angle of the third segment still more projecting, the margins meeting at an acute angle; finely serrulated. The sixth segment (fifth and sixth fused) nearly twice as long as the fourth, and the latter about two-thirds the length of the third; the slender posterior abdominal segments and telson spinulose. The first pair of caudal appendages reaching not quite to the middle of the last pair; the latter longer than the former, and extending quite or nearly to the extremity of the telson; the second pair slender, and of the same length as the sixth segment of the abdomen; rami long, lanceolate, margins of peduncles and rami serrated. Telson cylindrical, gradually tapering posteriorly, apex acute.

Length, from end of broken rostrum, 45 mm. Locality, lat. 27° 17′ N., long. 111° 19′ W. Temp. water, 70° F. Temp. air, 72° F.

White named his species on the authority of Milne Edwards, that it was the same as his *Oxycephalus armatum*. I have identified the present specimen with White's figure; they agree in every essential particular. What *R. armatum*, Bate (=*Macrocephalus longirostris*, Bate, Ann. and Mag. Nat. Hist., 3d ser, i, 1856, p. 362) is, I do not know, although both the description and figure are supposed to have been taken from the same specimen that furnished White's figure; namely, the Sir E. Belcher specimen, which was captured during the cruise of the Samarang, and which is the only specimen Mr. Bate claims to have had access to. For some unexplained reason he omits all reference to White's figure, although he refers to the latter's text. Concerning the Belcher specimen, Adams and White say, "We regret that the state of the only specimen in the British Museum is such that we cannot give the generic character with that detail which we should wish." They also state that the drawing was made at the time of capture. The following characters will denote the difference between *R. armatum*, Bate, and the present species: The presence in the former of a tooth on the inferior margin of the fourth joint of the first pair of thoracic feet; of a postero-dorsal spine on the second and third abdominal segments; the non-enlargement of the first joint of the fifth and sixth pairs of thoracic legs (White's figure shows these to be enlarged); and in the relative lengths of the first and last pairs of caudal appendages, the first being longer than the last, and reaching as far backward. I give it provisionally the name *Rhabdosoma longirostris* (Bate). There are other points of difference, but the above are sufficient for the present.

EXPLANATION OF PLATES.

Fig. 1. *Oxycephalus tuberculatus*, Bate; 1*a*, 1*b*. First and second thoracic feet.

Fig. 2. *Oxycephalus bulbosus*, Streets; 2*a*, 2*b*. First and second thoracic feet.

Fig. 3. *Oxycephalus scleroticus*, Streets; 3*a*, 3*b*. First and second thoracic feet; 3*c*. Head of female.

Fig. 4. *Leptocotis spinifera*, Streets; 4*a*. Second thoracic foot; 4*b*. Head of female.

Fig 5. Head of *Calamorhynchus pellucidus*, Streets; 5*a*. Second thoracic foot.

Fig. 6. *Rhabdosoma whitei*, Bate; 6*a*, 6*b*. First and second thoracic feet.

Fig. 7. *Rhabdosoma armatum*, (Edw.) White; 7*a*, 7*b*. First and second thoracic feet.

JULY 16.

Mr. THOMAS MEEHAN, Vice-President, in the chair.

Sixteen persons present.

JULY 23.

The President, Dr. RUSCHENBERGER, in the chair.

Fifteen persons present.

JULY 30.

The President, Dr. RUSCHENBERGER, in the chair.

Sixteen persons present.

The death of Carl Stal, a correspondent, was announced.

Herman C. Evarts, M.D., and Mrs. Emily T. Eckert were elected members.

J. B. Ellis, of Newfield, N. J., was elected a correspondent.

AUGUST 6.

The President, Dr. RUSCHENBERGER, in the chair.

Ten persons present.

AUGUST 13.

The President, Dr. RUSCHENBERGER, in the chair.

Twenty-one persons present.

AUGUST 20.

The President, Dr. RUSCHENBERGER, in the chair.

Sixteen persons present.

A paper entitled "Notes on the Natural History of Fort Macon, N. C., and Vicinity, No. 5," by Drs. Elliott Coues and H. C. Yarrow, was presented for publication.

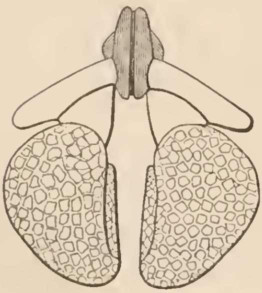
August 27.

The President, Dr. Ruschenberger, in the chair.

Twenty-eight persons present.

Foraminifera of the Coast of New Jersey.—Prof. Leidy remarked that in recent visits to Cape May and Atlantic City he had incidentally examined the shore sands for foraminifera. In both localities, between tides, along the slight ridges left by the receding waves, he had found an abundance of specimens, but they appeared all to belong to a single species, which he supposed to be the *Nonionina millepora.* On the sandy beaches of the rocky New England shores, as at Newport, R. I., and Noank, Conn., he had observed a far greater quantity, of several genera and species.

Sensitive Organs in Stapelia.—Dr. J. Gibbons Hunt remarked that his attention had been called to the flower of *Stapelia asterias* by Mr. Isaac Burk, who had expressed the opinion that it was probably a fly-catcher. The flower of this plant is well known to botanists because of its extremely disagreeable and animal odor, which appears to attract many flies when the flower is matured. Continuous observation for several hours, under a lens which took in a large field of view, revealed many flies eagerly applying their tongues all over the petals and essential organs, apparently eating with almost intoxicated relish the attractive excretion covering those parts. This banquet was indulged in in safety until their tongues came in contact with one or more of five black spots situated near and alternate with the stamens, when, with amazing quickness, the fly was seized and firmly held by the tongue, a hopeless prisoner. Now a struggle commenced, and, if the fly was small and not vigorous, he remained in the trap, but, if large and strong, his efforts to escape were successful, and he flew away, dragging from its position the black sensitive spot and also the pollen masses, two of which are attached to each trap. This adhesion of the fly's tongue to these black spots is not caused by any cementing liquid, but it is fairly caught by an organic structure, the action resembling that of a common steel-trap used for catching rats.



The figure shows the arrangement and connection of these parts. The organ at the junction of the pollen masses is the sensitive trap, and when touched, however lightly, by the fly or other object (as a hair, for example), the opposing, separated, parallel, and hard edges instantaneously close like pincers, and the prey is secured.

Stapelia belongs to the Asclepiadacea, and analogous sensitive organs attached to the pollen masses exist in other genera, and perhaps in all that natural order. We have probably no other vegetable fly-catcher so instantaneous in its action as the organ he had described, and he could therefore confirm Mr. Burk's observation.

Sensitive Organs in Asclepias.—Mr. Edward Potts stated that, at the suggestion of Dr. Hunt, he had examined such species of the genus *Asclepias* as were within his reach, with the view to determine whether a sensitiveness and contractile power existed in the dark gland-like bodies associated with their pollen masses, similar to those which Dr. Hunt had discovered in *Stapelia*. On account of the lateness of the season, his observations were limited to the *A. incarnata*, native, and a cultivated species, the *A. curassavicum*, and, as these were identical as to the points under examination, his description would be understood to apply to both. The accompanying wood-cut (Fig. 1) clearly shows the position and form of the so-called glands (which may be easily seen on the flower by the aid of a pocket magnifying glass), near the extremity of the pistil, just peeping out from beneath the mantles of adjacent anthers. These latter are closely adherent to the pistil, or more properly to its stigma, and when separated therefrom present, on the under side, the appearance he had endeavored to show in fig. 2, of a pair of sacks or cases in which the pollen masses are suspended, left open at the top apparently with a view to facilitate their withdrawal. The sensitive glands are placed in shallow depressions upon the perpendicular columnar ridges of the stigma, and seem to be attached to it by a very delicate, easily ruptured membrane. Fig. 3 represents one of these as connected by somewhat broad and twisted filaments, with the two adjacent pollen masses of neighboring anthers, not those belonging to the same. In this sketch he had endeavored to represent it as open and expectant, and in fig. 4, as firmly grasping a slender hair. The fact of the removal of these groups by insect agency has been frequently mentioned; his ex

Fig. 1.

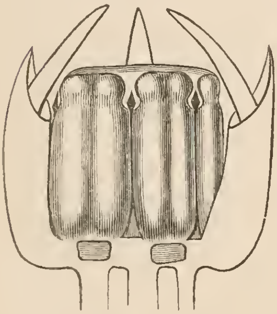
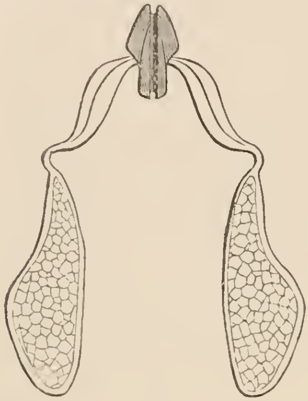


Fig. 2.

periments have been made to determine whether the glands themselves took an active part in the matter.

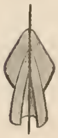
As these species seemed to present few attractions to the insect world, and received but few such visitors, he was compelled to use both force and strategy to accomplish his ends.

Fig. 3.



He at first tried to insert a human hair while observing the gland under the microscope, but failed, on account of the relatively large size of the hair and the difficulty of manipulating it where all directions were reversed. His next plan was more successful; he caught house flies and held them by the wings above the flowers, allowing their feet to scramble over them. Almost immediately one or more of these would become ornamented by groups of the glands and pollen masses which clung so closely that their later struggles and rubbings failed in any case to detach them. The experiment of course was less conclusive as to the active agency of the gland than that mentioned by Dr. Hunt, where in the *Stapelia*, it closed on the hairs clothing the proboscis of its prey. To avoid the objection that the hooks and spines upon the insect's legs caught and drew out the glands by friction, he tried a modification of his first experiment. Taking a fine camel's hair pencil, he brought its end gently, perpendicularly upon the summit of the flower, sometimes without special guidance and sometimes directing some of its hairs towards a particular gland. In a few moments one of the many hairs would touch the sensitive inner surface of a gland, causing it instantly to contract and cling to the hair, which tore it loose from the stigma. The pollen masses uniformly remaining attached to it by their filaments were withdrawn with it; and the whole have, in nearly every case, remained together during all the manipulation required in the preparation and mounting of them as microscopic objects. It is noticeable that the glands remain open and susceptible long after plucking the flowers; in fact until they are nearly withered. In a recent case he carefully examined each gland upon one flower of a group which had been gathered twenty-four or forty-eight hours, under a power of fifty diameters, and found them in this condition; then, with a camel's hair pencil, but without violence, he removed the whole five, and again viewing them, the change in position of the jaws in every case was very observable.

Fig. 4.



If it should be conceded from the result of these experiments that there is at least a probability that motion can thus be excited in these glands, it will appear further that the withdrawal of the pollen masses is so far within the plan of creation, that it has not been left to the accident of occasional entanglement in the legs of insects. But to what end is this rude withdrawal? The fertilization of the plant by their rupture upon the edges of the stigma is a very natural suggestion.

But doubt is thrown upon the necessity for this exceptional method of fertilization when we notice the existence of a still more extraordinary one mentioned by Dr. Gray. If we dissect and carefully examine a thoroughly matured flower just before its stigma and surrounding anthers have fallen, we will probably find some of the pollen masses materially modified in appearance from their earlier condition, and sending forth, always from their inner, more convex edge, a great bunch of pollen tubes which penetrate the stigma at its lower extremity where it joins the apex of the styles. In this view, its fertilization, instead of being, as it would appear at first glance, practically impossible without external help, seems almost absolutely certain, failing where our insect friends or some other form of violence may have extracted all the pollen masses before their tubes were protruded, or where the latter may have failed to appear on account of the prior drying of the stigmatic surface.

In this connection he would refer to a recent observation in which the facts, though far too few to establish a rule upon the question, yet, so far as they go, tend to confirm the opinion of Robert Brown, as drawn from his own experience, viz., that fertilization in this family of plants *does* depend largely upon insect agency. In three instances Mr. Potts had noticed upon flowers of *A. curassavicum*, beside their own normal features, another sensitive gland and its attached pollen masses, which must have been brought there by some external agency. In each case one mass of the pair had been inserted under the edge of an anther in the immediate vicinity of another pollen mass occupying its natural position; that is, while the latter was *in*, the former was *under* the antheridial sack, and of course close against the sloping lower surface of the stigma. The first found of these three instances was not examined more particularly, but the other two forming parts of separate groups of flowers upon the same stem, were marked, the twig kept alive in water for several days to allow time for the formation of pollen tubes, and then carefully dissected. It is worthy of remark that by this time every other flower of each group had withered and fallen, leaving these alone. On dissection it was found that each of these inserted pollen masses had thrown forward a profusion of pollen tubes towards the point of junction of the stigma with the extremities of the styles; and though he could not detect their entrance into the latter, fertilization had probably been effected as the ovaries had noticeably increased in size.

None of the masses which occupied their natural position had formed tubes, though in several a strongly marked granulation and tendency to rupture appeared in those cells adjoining the convex inner edge.

If it be allowable to deduce a theory from the observation of so few facts, when these are confirmed by so high an authority as Robert Brown, he would suggest that while there is no imperative physical obstacle to self-fertilization in these plants, the inner membrane of the anther being cut away apparently for the purpose of promoting or allowing it (as seen in fig. 2), yet the maturity of the pollen masses is reached so late that the stigma of the same flower has frequently lost its susceptible condition as to moisture, etc., before that period arrives. When, however, the pollen masses pertaining to one of the earlier flowers are removed by insects and lodged in the position above described upon another just opened, they find and respond to the more favorable circumstances, and cross-fertilize that flower.

A *motif* is thus suggested for the sensitive character noticed in the above described glands, and the care taken, by this means, to insure the frequent transplantation of the pollen masses into other flowers.

Dowling Benjamin, M.D., was elected a member.

The following paper was ordered to be published:—

NOTES ON THE NATURAL HISTORY OF FORT MACON, N. C., AND VICINITY. (No. 5.)

BY DRS. ELLIOTT COUES AND H. C. YARROW.

The present paper continues a series of articles which have appeared in these Proceedings, as follows:—

No. 1. By Dr. Coues, Vertebrates (except Fishes). 1871, pp. 12–49.

No. 2. By Dr. Coues, Invertebrates. 1871, pp. 120–148.

No. 3. By Dr. Yarrow, Fishes. 1877, pp. 203–218.

No. 4. By Drs. Coues and Yarrow, supplementary to No. 1, Vertebrates. 1878, pp. 21-28.

No. 5, herewith presented, may similarly be considered as supplementary to No. 2, Invertebrates, as it gives species either identified after No. 2 had been printed, or added by Dr. Yarrow after Dr. Coues had left Fort Macon.

Numerous specimens, notably sponges and ascidians, still remain undetermined, but there seems to be no immediate prospect of identifying them.

Our best thanks are due to Prof. A. E. Verrill, who has been kind enough to revise the present paper, making many additions. We are also indebted for the identification of various specimens to Prof. A. Agassiz, Prof. A. Hyatt, Mr. G. W. Tryon, Jr., and Prof. S. I. Smith.

The classification and nomenclature of this paper are substantially according to Verrill's "Report on the Invertebrates," etc., in the Ann. Rep. U. S. Comm. of Fish and Fisheries, 1873, pp. 293 *et seq.*

The Appendix, with which we are favored by Mr. J. S. Kingsley, will be found a valuable article, complete in itself, on the Decapod Crustacea of the Atlantic Coast, with special reference to those of Fort Macon.

CRUSTACEA.

BRACHYURA.

Heterocrypta granulata, Stimpson.

Was occasionally found in the small mesh gill-nets fished on outside or sea-beach.

MACROURA.

Eupagurus longicarpus, Stimp. (= *E. longipes*, in Dr. Coues's List, p. 124.)

Very abundant.

Alpheus heterochælis, Say.

Collected by Dr. Yarrow.

Alpheus minus, Say.

Not uncommon. Found in the cavities of sponges, etc.

Tozeuma carolinensis, Kingsley.

Obtained by Dr. Yarrow and Dr. A. S. Packard.

Crangon vulgaris, Fabricius.

Very numerous on outside beach, and individuals of large size were frequently found in pools left by the receding tide. Smaller ones abundant in the marshy creeks of the sounds.

Palæmonetes vulgaris, Stimpson.

Is abundant on the outer beach; found with preceding species.

NOTE.—In Dr. Stimpson's list of the Decapod Crustacea of Beaufort, N. C. (Amer. Journ. Sciences, Ser. II., vol. xxix. p. 444, 1860), the following species are enumerated, which are not included in this ner in Dr. Coues's previous list: *Pelia mutica*, *Leptopodia calcarata*, *Pinnotheres maculatus*, *Pinnixa cylindrica*, *P. Sayana*, *P. chætopterana*, *Lithadia cariosa*, *Calappa marmorata*, *Porcellana ocellata*, *P. sociata*, *Euceramus prælongus*, *Lepidops scutellata*, *Eupagurus annulipes*, *Calianassa major*, *Alpheus intermedius*, *Virbius pleuracanthus*, *Peneus constrictus*.

SQUILLOIDEA.

Squilla empusa, Say.

Abundant on sea-beach after storms, but is frequently taken in drag-nets. Incautiously handled it can give quite a severe wound with the spines of the large claw. It is possessed of considerable muscular power, and uses its spined caudal extremity quite forcibly to escape. Largest specimen seen was 10 inches long.

AMPHIPODA.

Talorchestia longicornis, Smith.

A few seen on sea-beach after extremely high tides; are readily distinguishable by the extreme length of the antennæ.

Gammarus mucronatus, Say.

This species, having, according to Verrill, *loc. cit.*, "the posterior margin of each of the anterior segments of the abdomen produced into a slender spiniform dorsal tooth," is very common near the mouths of fresh water streams emptying into the sounds. Is particularly numerous in eel-grass.

ISOPODA.

Sphæroma quadridentata, Say.

Called "Pill bug" by residents; and is common on the rocky artificial breakwaters of the sea-beach.

Idotea cæca, Say.

Common on sand flats.

Of the Siphonostoma two species have been observed, one a parasite of the drum fish (*Pogonias chromis*), filiform, with a stellate head, the other oval in shape, and attached to the sting-ray (*Trygon centrura*).

CIRRIPEDIA.

Balanus galeatus, Darwin.

Common on *Leptogorgia virgulata*.

Balanus eburneus, Gould.

Common.

Balanus balanoides, Stimpson.

Abundant on stakes and piles of wharves.

Lepas anatifera, Linné.

The only specimens secured were found attached to pieces of wreck and drift wood, which had probably floated from far to the southward. These were living when found.

ANNELIDA.

POLYCHÆTA.

Nereis limbata, Ehlers

Is tolerably common under rocks and stones at extreme low water-mark. Is considered excellent bait for small fishes.

Diopatra cuprea, Claparède.

This beautiful and characteristic species is tolerably abundant on the muddy sand flats. A number were taken on Bird Shoal opposite Fort Macon.

Arabella opalina, Verrill (= *Lumbriconereis opalina*, Verrill, in Report).

In sand at low water.

Rhynchobolus americanus, Verrill.

Collected on the flats by Dr. Yarrow.

Anthostoma robustum, Verrill.

Collected on the sand flats by Dr. Yarrow.

Sabellaria vulgaris, Verrill.

Common on shells, etc.

Cistenides Gouldii, Verrill.

A few specimens obtained by Dr. Yarrow.

Sabella microphthalma, Verrill.

Common on piles in the interstices of ascidians, etc.

Hydroides dianthus, Verrill (= *Serpula dianthus*, Verrill, in Report).

Common on dead shells.

But little attention was devoted to the smaller crustacea and annelids, and numerous other species undoubtedly occur.

SCOLECIDA.

PHARYNGOPNEUSTA.

Balanoglossus aurantiacus, Verrill.

The original *aurantiacus* of Girard was from South Carolina (Verrill).

This species is extremely common in the vicinity of Fort Macon, and its resorts may readily be discovered, owing to peculiar coils of sand which it expels from the orifice of the holes in which it lives. These holes are lined with a coating, apparently of mucus, excreted by the animal. Largest specimens seen were six inches long.

NEMERTINA.

Cerebratulus ingens, Verrill (= *Meckelia ingens*, Leidy).

This curious species is quite abundant in the shallow waters of the salt marshes; it is also found on the sea-beach. Its appearance is so peculiar when quiescent that the closest observation only could determine, it a living organism. Some specimens seen at least eight feet in length.

MOLLUSCA.

CEPHALOPODA.

Dibranchiata.

Ommastrephes Bartramii, Lesueur.

Two or three specimens of this comparatively rare species were found in Bogue Sound, not far from Harkers Island, having been taken in nets.

Loligo brevis, Blainville (= *L. brevipinna*, in Dr. Coues's List.)

Mr. G. W. Tryon, Jr., of Philadelphia, has identified this species from Bogue Sound, Fort Macon. A few specimens only taken.

GASTROPODA.

Pectinibranchiata.

Acus concavus (Say, sp.).

One specimen was obtained by Dr. Yarrow.

Anachis similis, Verrill.

Common on sea-beach; a few dredged on Bird Shoal at high water.

Columbella mercatoria, Linn.

Is tolerably abundant on Bird Shoal, from which locality it was dredged.

Cerithiopsis terebralis, Adams.

This species is the one alluded to by Dr. Coues in Proc. Acad. Nat. Sci., 1871, p. 141, as *Cerithium*, sp. It is not abundant.

Eulima conoidea, Kurtz and Stimpson

Not observed by the authors, but is given upon the authority of Kurtz and Stimpson, Proc. Bost. Soc. Nat. Hist., vol. iv., p. 115, 1851.

Strombus alatus, Gmelin.

Tolerably common on the sea-beach near Fort Macon, numerous near Cape Lookout.

Mitra granulosa, Lamarck.

A single specimen was found on the beach near Cape Lookout. Is appparently uncommon.

Marginella guttata, Dillwyn.

Marginella roscida, Redfield.

Both species dredged on Bird Shoal. Uncommon.

Porcellana exanthema (*Cypræa exanthema*, Linn.).

A single specimen secured.

Scalaria turbinata, Conrad.

Less abundant than *S. lineata*.

Crepidula aculeata, Gmelin.

Collected by Dr. Yarrow.

Littorina dilatata, d'Orbigny.

A few dead shells dredged on Bird Shoal. Uncommon.

Volva uniplicata, Sowerby.

A few individuals of this species were found as parasites of *Leptogorgia virgulata*, near the wharves of Beaufort, N. C.

TECTIBRANCHIATA.

Utriculus canaliculatus, Stimpson.

Abundant on Bird Shoal, numbers having been dredged there.

PTEROPODA.

Thecosomata.

Styliola acicula, Lesueur.

We are informed by Prof. Verrill that he has discovered this species in the cells of some sponges sent to him from Fort Macon

LAMELLIBRANCHIATA.

Dimyaria.

Teredo dilatata, Stimpson.

Tolerably common in floating drift wood near Fort Macon. Is hardly to be distinguished from *T. megotara*, Hanley, an allied form which is more northern. Prof. Verrill states, *loc. cit.*, "I have not met with this species south of Cape Cod."

Zirphæa crispata, Mörch

Uncommon. A few found near the rocky breakwaters on the sea-beach.

Donax idoneus, Conrad (fossil).

This species, described by Mr. T. A. Conrad, Proc. Acad. Nat. Sci., 1872, p. 216, was discovered by Dr. Yarrow in 1871, on the sea beach near Fort Macon, a single specimen only being secured. Mr. Conrad says "is probably from a miocene bed under the sea."

Glycimeris (Panopæa) bitruncata, Conrad.

A single valve only of this species was discovered by Dr. Yarrow, which Mr. Conrad deems recent, from the presence of the unaltered ligament and polish. Mr. G. W. Tryon, Jr., however, judges it to be from a submarine fossil deposit. It was found on the sea-beach six miles above Fort Macon.

Mya arenaria, Linn.

Common in the marshy creeks near Fort Macon.

Saxicava distorta, Say.

Among ascidians, etc.

Tottenia manhattensis, Verrill.

A few specimens found on the sea-beach. Prof. Verrill is not certain that this species is distinct from *T. gemma*, Perkins.

Chione grata (Say).

One fresh valve.

Lucina crenulata, Conrad.

Abundant in Dr. Yarrow's collection; but perhaps not recent.

Argina pexata, Gray.

Common in the muddy, sandy portion of Bird Shoal, where it was dredged.

Heteromyaria.

Modiolaria lateralis (Say).

Found in the interstices of ascidians from piles.

Modiola hamatus, Verrill

Common in marshy creeks.

Pinna muricata, Linn.

Abundant on sea-beach, less so, however, than *P. seminuda*.

Crassatella uadulata, Emmons (fossil).

Very abundant in the post-pliocene deposits on the main land near Fort Macon.

TUNICATA.

Saccobranchia.

Molgula pellucida, Verrill.

A few specimens of this beautiful species were dredged on Bird Shoal by Dr. Yarrow. This species has been figured by Mr. Binney, who called it *M. producta*, Stimpson, which is quite a distinct sand-covered species, and not smooth like *M. pellucida*.

Cynthia partita, Stimpson.

Very common in the sounds in the vicinity of Fort Macon.

Amarœcium stellatum, Verrill.

Very abundant on rocks and stones near Beaufort, and on the piles of the wharf at Fort Macon. The species attains a large size, and the rapidity of its growth is surprising; new clean piles used to repair a wharf were, in less than four months, well covered with large clusters of this ascidian.

POLYZOA.

The following species have been identified by Professor Verrill. Many other species doubtless occur.

Crisia eburnea, Lamx.

Small colonies were found attached to *Aglaophenia.*

Amathia alternata, Lamx.

One fine specimen about two inches high was obtained.

Amathia, sp. undetermined.

Grows in branching tuffs three inches high, with the branches appearing as if twisted in a spiral, owing to the cells being arranged in a continuous spiral along one side of the branches. The spiral is more rapidly ascending than in *A. spiralis*, Lamx. (Verrill.)

Vesicularia armata, Verrill.

Creeping over the preceding species.

Ætea anguina, Lamx. (?)

Found creeping over ascidians (*Cynthia partita*), taken from the breakwater.

Bugula turrita, Verrill.

Attached to shells and hydroids.

Acamarchis neritina, Lamx.

Common, growing in large brownish clusters attached to gorgoniæ, ascidians, etc.

Membranipora lineata, Busk.

Two characteristic specimens were found on dead shells.

M. catenularia, Smitt.

One specimen of the unarmed variety on a dead shell.

? Cupularia umbellata (Manz.), Smitt.

One specimen. Too much worn for accurate identification.

Biflustra denticulata, Smitt, Florida Bryozoa, p. 18, pl. iv. figs. 89–91.

Common on shells.

Hippothoa hyalina, Smitt.

Common on algæ, etc.

H. biaperta, Smitt, Florida Bryozoa.

Several specimens on dead shells, one with the oœciæ.

H. variabilis, Verrill (*Escharella variabilis*, V , in Report).

Is tolerably common as calcareous incrustations on shells, etc. In thickened masses much resembles true coral.

Cellepora avicularis, Hincks.

One cylindrical colony attached to the stem of *Aglaophenia*, others on algæ, etc.

Lepralia Americana, Verrill.

On dead shells; not uncommon.

Discopora nitida, Verrill.

Common on dead shells.

RADIATA.

The following list contains all the species that have been identified up to this time:—

ECHINODERMATA.

Holothurioidea.

Thyone briareus, Selenka.

An extremely abundant and characteristic species, great numbers being found among masses of sea-weed on the beach near Fort Macon. Many hundreds have been noticed during a walk of less than a mile, particularly after an easterly storm. This species is noticeable and remarkable for a peculiar habit it possesses of ejecting the entire viscera if exposed long to the rays of the sun, or kept for a length of time in the collector's basket.

Pentamera pulcherrima, Ayres.

Lighter in color than the preceding species, and has the ambulatory suckers arranged in five bands. Numerous on sea-beach after storms.

Thyonella gemmata, Verrill.

Tolerably abundant.

A walk of a few miles up the sea-beach at Fort Macon, after an easterly blow, will reveal to the observer a number of pinkish translucent formless lumps of semi-cartilaginous appearance; these masses, varying in coloration from light pink to vivid red, are occasionally met with of a light blue or green tint. This undetermined organism is, perhaps, the one named above. Placed in a salt-water vivarium after a short time the tentacles begin to be extended, resembling clusters of the most beautiful algæ. The entire surface of the animal is covered at intervals with indented specks, darker than the surrounding tissue, these are probably analogous to the warts of *Synapta tenuis*, Ayers (*Leptosynapta Girardii*, Verrill).

?**Leptosynapta Girardii**, Verrill.

We find in our notes taken in June, 1871, this species as having been identified, with the following remarks: "This curious holothurian is particularly noticeable on account of its transparency. They are found at low-water in the sandy marshes abundantly." As Prof. Verrill considers it a northern form, we prefer to mark it as doubtful.

Echinoidea.

Arbacia punctulata, Gray (*Echinocidaris punctulatus*, in Coues's List).

Tolerably abundant on sea beach and inlet beach after storms. It has long stout purple spines, and the anal region is composed of four large plates.

Toxopneustes variegatus, A. Agassiz (*Lytechinus variegatus,?* in Coues's List).

Common.

Mellita pentapora, Lütken (*Melita quinquefora*, in Coues's List).

Very common on sandy bottoms.

Moira atropos,[1] A. Agassiz (*Schizaster lachesis*, in Coues's List).

Very common.

Asterioidea.

Asterias Forbesii (Desor.), Verrill (*A. arenicola*, in Coues's List).

Common.

[1] A. Agassiz has changed this genus to "*Moira*."—V.

Astropecten articulatus (Say), Lütken.

Common.

Luidia clathrata (Say), Lütken.

Not uncommon on sandy bottoms.

Ophiuroidea.

Ophiura olivacea, Lyman.

Very numerous on shoals in Beaufort Harbor.

Ophiophragmus Wurdemanii, Lyman Verrill, Amer. Journ. Sci. and Arts, vol. ii. p. 133, 1871.

Common in sand at low water. Dr. Coues.

Ophiothrix angulata, Ayres.

"Common in the cavities of sponges." (Verrill.)

ACALEPHÆ.

Discophoræ.

Pelagia cyanella, Peron and Lesueur.

Occasionally found in the inlet creeks.

HYDROIDÆ.

Thecaphora.

Campanularia carolinensis, Verrill, sp. nov.

A small species, creeping over the stems of *Aglaophenia*, remarkable for the unusually large goblet-shaped hydrotheeæ, which are supported on short and slender pedicles. Root-stalks slender, translucent, wrinkled, but not regularly annulated, giving off at short intervals the slender pedicles which are shorter than the cups, mostly having only four or five somewhat irregular and imperfect oblique annulations. Hydrothecæ deep cup-shaped or goblet-shaped, with a smooth, thin, slightly everted rim. These cups are nearly twice as deep as wide, and about twice as long as the pedicles. They taper toward the narrow base with a gradual curvature; the basal portion is considerably thickened internally, with a small septum very near the bottom. Gonothecæ unknown.

Height of hydrotheeæ, 1 mm.; diameter, .60 mm.; length of pedicles, .45 mm.

Collected by Dr. Yarrow.

Owing to the absence of gonothecæ the reference of this species to *Campanularia* is only provisional. (A. E. V.)

Lafoea calcarata, A Agassiz.

Found creeping over *Sertularia cornicina.*

Sertularia (Desmoscyphus) Achilleæ, Verrill, sp. nov.

Stem alternately pinnate, articulated, each segment bearing first a branch, and then about three hydrothecæ arranged alternately; branches somewhat elongated, simple on our specimen, distinctly articulated near the base, below the first hydrotheca; beyond this the articulations are rather indistinct and irregular; the internodes usually appearing to bear two, three, or more pairs of opposite secund hydrothecæ, which are adnate to the branch and to each other, and so placed on the upper side of the branch as to have both their apertures turned upward and outward; the hydrothecæ are stout, swollen in the middle, with the upper free portion bent abruptly outward, nearly at a right angle, and tapering rapidly to the aperture, which is distinctly bilobed, the lobes rounded. The intervals between the hydrothecæ about equal them in length. On the main stem the hydrothecæ have nearly the same form, but are alternate and distant from each other, though still somewhat secund.

Height of the specimen (probably young), 33 mm.; length of longest branches, 5 mm. Gonothecæ unknown.

This peculiar species would belong to the genus *Desmoscyphus*, of Allman, but it unites that group still more closely to the true *Sertulariæ*. Collected by Dr. Yarrow. (A. E. V.)

Sertularia carolinensis, Verrill. Am. Journ. Sci. iii 1872–4, p. 37.

A new species, discovered near Beaufort, N. C., by Dr. Yarrow. Uncommon.

Sertularia cornicina, Verrill.

Tolerably common.

Diphasia, sp.

A single specimen was secured, which may, perhaps, have been *D. rosacea*, Agassiz.

Aglaophenia trifida, Agassiz.

Very common.

Aglaophenia rigida, Allman.?

Several fine specimens, six to eight inches high, with a few long, slender branches arising singly. In other respects it agrees closely with the above species recently described by Allman from off Cape Fear. (A. E. V.)

Athecata.

Margelis carolinensis, Agassiz.

This beautiful and delicate jelly-fish is tolerably abundant.

Eudendrium tenue, A. Agassiz. ?

A single female colony was found on *Cynthia partita*. This species has rather slender, much branched, simple, light yellowish brown stems, rather irregularly annulated throughout. The branches diverge widely at first, and then bend upward and are more or less crooked. The female gonopheres are pedicelled, and form thick clusters around the blastostyles. (A. E. V.)

Parypha crocea, Agassiz.

This species is considered by Prof. Verrill to be probably not distinct from *P. cristata*, Agassiz. It is quite common near Fort Macon.

Hydractinia polyclina, Agassiz.

Common at Fort Macon in clusters on stones and shells.

Porpitæ.

Physalia pelagica, Lamarck.

Dr. Coues in a former paper (Proc. Acad. Nat. Sci. 1871, p. 148) mentions the occurrence of a *Physalia* in the locality under discussion, which has been since recognized as *P. pelagica*. In March, 1871, large numbers were noticed in and beyond the surf and on the sea-beach after a severe storm from the southward. A number of specimens were secured, among them one which had a small dead fish entangled in its long tentacular hydroid appendages. Most of those upon the beach were dead, and could be handled with impunity, but when living the stinging produced by touching the hydroid tentacles is very apparent and painful. Dr. Yarrow on one occasion was consulted by a fisherman, who, seeing the animal floating on the water, reached out and grasped it, but paid dearly for his temerity, as when seen the entire arm to the shoulder was very red, much swollen, and exquisitely painful. The irritation lasted several days, and was allayed by a saturated solution of bi-carbonate of soda. The *Physalia* may be handled without danger if seized by the corrugated crest of the bladder-like portion. It is supposed by many that this animal is a virulent poison, and that fish eating it also become poisonous. Mons.

P. Labat in his *Book of Voyages* mentions that several persons eating of a fish that devours the *Physalia* became dangerously ill, but this sickness may have been produced by other causes. However this may be, Dr. Yarrow saw a case in which a small terrier dog died in a very short time after eating a piece of the hydroids of this species. Upon making a post-mortem the stomach was found entirely empty) with the exception of the piece of the animal eaten) and greatly congested. Mons. Ricord Madiana made a series of experiments to test the poisonous qualities of *Physalia*, and arrived at the conclusion that it is not poisonous apart from the stinging property. Specimens secured at Fort Macon were about six inches wide on the bladder portion, with hydroids five or six feet long. They were of a beautifully iridescent purplish color.

Porpita, sp.

A single specimen of this genus was found stranded on the sea-beach, which Prof. A. Agassiz informs us was possibly *P. pacifica*, or *P. Linnæana*, of Lesson, but, unlike the latter, the hydroid appendages were bright yellow in color.

Vellela mutica, Lamarck.

Occasionally noticed.

POLYPI or ANTHOZOA.

Alcyonaria.

Renilla reniformis, Cuvier.

Common on the sand flats at low water.

Leptogorgia carolinensis, Verrill.

This new species, described by Prof. Verrill, *Am. Journ. Sci.*, iii. 1872, p. 432, was discovered near Beaufort, N. C., by Lt. C. S. Smith, U. S. A., and was subsequently taken in same locality by Dr. A. S. Packard and the authors. It is of a bright brick-red color, and is found attached to oyster shells near Beaufort wharf. Quite common. Largest specimen seen was twelve inches in height.

Leptogorgia setacea, Verrill. Am. Journ. Sci. iii. 1872, p. 433.

A very interesting and beautiful species, of peculiar form. Color purple-yellow, axis black. One specimen was fifty-six inches long (fid. Verrill). Is quite abundant; attached to shells within sounds and inlets, but more were seen on or near the sea-beach.

Leptogorgia virgulata, Milne Edwards.

Quite common in same localities, with preceding species. Varies exceedingly in color.

Anthopodium rubens, Verrill. Am. Journ. Sci., iii, 1872, p. 435.

This interesting new species was discovered by Prof. Edw. S. Morse at Fort Macon, encrusting the dead axis of *Leptogorgia*. Color light red. Is not common.

Titanideum suberosum, Verrill.

Was first discovered in North Carolina by the lamented Stimpson. Is abundant.

Telesto fructiculosa, Dana.

Common near Beaufort, N. C.

Actinaria.

Sagartia leucolena, Verrill.

Abundant; found attached to the under sides of rocks and stones.

Paractis rapiformis, Milne Edwards.

This curious species, called *Actinia rapiformis* by Lesueur, who took it in New Jersey, in 1817, after which time it was long lost sight of, was discovered by Dr. Yarrow on the sea-beach at Fort Macon, where it occurred in great numbers after a hard north-east gale. It then resembles a water-soaked peeled pear or onion, with whitish striæ. Very abundant.

Halocampa producta (Stimpson MSS.), Verrill.

Tolerably common in sandy and muddy places inside of Beaufort inlet, living beneath the surface with the tentacles extruded, when undisturbed. Is capable of great expansion and contraction. Some specimens seen were twelve inches in length.

Calliactis sol, Verrill.

Very numerous at Fort Macon; found adhering to eel-grass, stones, and to shells occupied by the hermit crab (*Eupagurus pollicaris*). Is one of the most beautiful of the anemones of the locality.

Aulactinia capitata, Verrill.

A very common species.

Cladactis cavernata, Verrill.

Common on rocky breakwaters of sea-beach. It is so firmly attached that considerable force is required to dislodge it.

Cerianthus americanus, Verrill.

Abundant in muddy marshes.

Ilyanthus chloropsis (Agassiz MSS.), Verrill.

Although Prof. Verrill states in his paper (*Rev. Polyps. East Coast, U. S.*, 1864) that this species is thought to be very rare, it is believed to have been discovered by the authors at Fort Macon, as at least two dozen individuals answering the description in the paper quoted were taken on the sea-beach after severe storms from the northward.

Paranthea pallida, Verrill.

It is believed this species has been recognized, a few specimens having been collected on the sea-beach in the summer of 1871.

Some few specimens of an undetermined species were taken on the beach after a severe gale. May be readily recognized by the six white radiating lines across the disc from the mouth.

Madreporaria.

Astrangia Danæ, Agassiz.

Common on sea-beach after storms.

Oculina arbuscula, Verrill.

Oculina implicata, Verrill.

Both species are common.

PORIFERA OR SPONGES.

SILICEA.

Microciona prolifera, Verrill.

Abundant; found on stones and dead shells, forming an incrustation.

Chalina arbuscula, Verrill.

Occurs on the coast of North Carolina, but was not recognized by the authors.

Cliona sulphurea, Verrill.

A common and well marked species.

KERATOSA.

Hircina campana, Nardo.

One specimen, collected by Dr. Yarrow.

Spongia vermiculata, *var. vermiculatiformis*, Hyatt.

This interesting form is not uncommon; several large specimens, both dry and in alcohol, having been collected by Dr. Yarrow.

Spongelia dubia, *var. foraminosa*, Hyatt.

Collected by Dr. Yarrow.

Spongelia spinosa, Hyatt.

One or two specimens obtained by Dr. Yarrow.

Dysidea fragilis, Johnston (?)

Specimens, referred doubtfully to this species by Prof. Hyatt, are in the collection.

It is greatly to be regretted that the identifications of many of the sponges forwarded from Fort Macon have not been made.

INSECTS.

It might be supposed from the paucity of vegetation near Fort Macon that this class would be but poorly represented, such is not the case, as during the sojourn of the authors of this paper at that place hundreds of different specimens were collected and forwarded to competent specialists for examination. Unfortunately, names only for the Coleoptera and Orthoptera have been received, for the former from Dr. G. W. Horn, of Philadelphia, for the latter from Dr. P. R. Uhler, of Baltimore, to whom our hearty thanks are due for their favors. We regret particularly being unable to furnish the names of more of the Lepidoptera, as the collection was large, being particularly rich in moths.

COLEOPTERA.

Of the following species, all are more or less common in the vicinity of Fort Macon:—

Tetracha virginica, Linn.

Cicindela punctulata, Fab.

Discætus purpuratus, Bon.

Harpalus compar, Lec.

Harpalus pennsylvanicus, Lec.

Harpalus stigmosis, H'bs't.
Harpalus caliginosus, Say.
Anisodactylus mysticus, De Geer.
Staphylinus maculosus, Gran.
Trox punctatus, Fab.
Canthon lævis, Fab.
Canthon chalcitæs, Hald.
Euryomia sepulchratus, Lac.
Allorhina nitida, Lac.
Cyclocephala immaculata, Burm.
Sigynus gibbosa, De Geer.
Passalus cornutus, Fab.
Corynetis rufipes, Fab.
Chalcophora virginica, Linn.
Alaus myope, Esch.
Alaus oculatus, Esch.
Chauliognathus marginatus, Hy.
Collops eximius, Er.
Macendes melanura, Fab.
Oxacis dorsalis, Say.
Mallodon dasytemus, Hald.
Prionus laurgatus, Harris.
Clytus capræa, Say.
Leptura nidens, Forst.
Monohammus dentator, Fab.
Hylotrupes sagalus, Fab.
Elaptendion atomarium, De Geer.
Charynopha cribraria, Fab.
Hippodamia convergens, Guer.
Coccinella novem-notata, Hust.
Coccinella munda, Say.
Epilactura borealis, Fab.

ORTHOPTERA.

All the species noted are abundant.

Mantis carolina, Burm.
Acheta abbreviata, Serv.
Xiphidium fasciatum, De Geer.
Orchelimum agile, De Geer.
Conocephalus crepitans, Scudd.
Phaneroptera curvicauda, Harris.
Oedipoda sincerata, Harris.

Acridium americanum, Drury.

Acridium obtusum, Burm.

Oxya claviger, Sew.

Caloptenus femur-rubrum, De Geer.

Stenobothrus maculipennis, Scudd.

Opsomala bivitata, Lew.

HYMENOPTERA.

Vespa crabio, Linn.

Polistes pallipes, Lacip.

LEPIDOPTERA.

Papilio asterias, Drury.

Colias philodice, Godart.

Sphynx carolina?

The last named species is very rare, but two individuals having been seen.

Utetheisa bella, Drury.

Very numerous in July and August.

Spilosoma acrœa, Drury.

Tertrix, sp.

DIPTERA.

Tabanus lineola, Fab.

Tabanus atratus, Fab.

Musca domestica, Linn.

Musca cæsar, Linn.

Musca vomitoria, Linn.

All the preceding species of Diptera are much too common for comfort at Fort Macon.

In addition to the list of Insects, others of the following genera have been found:—

Blatta, sp.

Membracis, sp.

Correus, sp.

Cimex, sp.

Forficula, sp.

Ixodes, sp.

Lithobius, sp.

Unless, within a reasonable period, further determination of specimens are received, this paper may be considered as the concluding one of the series.

APPENDIX.

List of Decapod Crustacea of the Atlantic Coast, whose range embraces Fort Macon.

BY J. S. KINGSLEY.

CRUSTACEA DECAPODA.

MAIOIDEA.

Maiidæ.

Pelia mutica, Stm.

Pisa mutica, Gibbes, Proceedings American Association for the Advancement of Science, 1851, vol. iii. p. 171.

Pelia mutica, Stimpson, Annals of the Lyceum of Natural History in New York, 1860, vii. p. 177. Smith, in Report U. S. Commissioner of Fish and Fisheries for 1871–72, Washington, 1875, p. 548.

Massachusetts to Florida; Fort Macon (Stimpson).

Libinia canaliculata, Say.

Libinia canaliculata, Say, Journal of the Academy of Natural Sciences in Philadelphia, 1817, vol. i. p. 77, pl. iv. f. 1. Henri Milne Edwards, Histoire Naturelle des Crustacés, Paris, 1834, vol. i. p. 300. *Ibid.*, in Regne Animal de Cuvier, pl. xxxiii. f. 1. Gould, Invertebrata of Massachusetts, 1841, p. 327. Dekay, New York Fauna, Crustacea, 1843, p. 2, pl. iv. f. 4. Gibbes, l. c., p. 169. Streets, Proceedings of the Academy of Natural Sciences, Philadelphia, 1870, p. 105. Smith, Fish Comm. for 1871–2, p. 548. Coues, Proc. Phila. Acad. 1872, p. 120.

Maine to the West Indies; Fort Macon (Coues).

Libinia dubia, M. Edw.

Libinia dubia, H. Milne Edwards, Hist. Nat. des Crust., 1834, i. p. 300, pl. xiv. bis. f. 2. Gibbes, l. c., p. 169. Streets, l. c., f. 104. Smith, Rep. Fish Comm., p. 548.

Long Island to Florida; West Coast of Africa (Streets).

Leptopodidæ.

Metoporhapis calcarata, Stimpson.

Leptopodia calcarata, Say, l. c. i., p. 445. Edw., H. N. Crust., i. p. 276. Dekay, op. cit. p. 3. Gibbes, l. c., p. 169.

Metoporhapis calcarata, Stimpson, Ann. Lyc. vii. p. 198.

Beaufort, N. C. (Stimpson), to Charleston, S. C.

Parthenopidæ.

Heterocrypta granulata, Stimpson.

Cryptopodia granulata, Gibbes,, l. c., p. 173 ; ibid., Proceedings of the Elliot Society of Charleston, S. C., June, 1856, i. p. 35 (wood-cut). Stimpson, Ann. Lyc., vii. p. 202.

Heterocrypta granulata, Stimpson, Annals Lyc., 1870, x. p. 102.

Beaufort, N. C. (Stimpson), to the West Indies.

CANCROIDEA.

Cancridæ.

Cancer irroratus, Say.

Cancer irroratus, Say, l. c., i. p. 59, pl. iv. f. 2. Stimp. Ann. Lyc. vii. p. 50. Smith, Fish Comm. p. 546. Coues, l. c., p. 120.

Platycarcinus irroratus, M. Edw., op. cit., i., p. 414.

Cancer sayi, Gould, op. cit., p. 323.

Platycarcinus sayi, Dekay, op. cit., p. 7, pl. ii. f. 2. Gibbes, Proc. American Asso. iii. p. 177.

Cancer borealis, Packard, Memoirs Boston Society of Natural History, 1867, i. p. 303.

Labrador to South Carolina ; Fort Macon (Coues).

Cancer borealis, Stimpson.

Cancer irroratus, ♀ Say, Journal of the Academy of Natural Sciences, Philadelphia, 1818, vol. i. p. 59.

Cancer irroratus, Gould, Invertebrata of Massachusetts, 1841, p. 322.

Platycarcinus irroratus, Dekay, N. Y. Fauna, Crustacea, 1842, pl. 6.

Cancer borealis, Stimpson, Annals Lyceum Nat. Hist. N. Y., 1860, vii. p. 50. Smith, Report U. S. Fish Commission for 1871–2, p. 546.

A young specimen of this well-marked and valid species occurs in the collection made at Fort Macon, N. C., by Dr. A. S. Packard, Jr., and I am informed by Mr. Faxon that there are specimens in the Museum of Comparative Zoology, at Cambridge, from the Bermudas.

It is readily separated from the common *Cancer irroratus*, Say, by the granulated carapax and the crenulated antero-lateral teeth. This species was described by Say (*l. c.*) as the female of his *C. irroratus*. But it was first pointed out by Dr. Gould that it was a distinct species. He, however, thought proper to retain the name for this species, rather than the more common form, which Say regarded as the male.

It ranges from Nova Scotia to the West Indies.

Menippe mercenaria, Stimpson.

Cancer mercenaria, Say, l. c., 1818, i. p. 448.

Cancer (*Xantho*) *mercenaria*, H. Milne Edwards, Histoire Naturelle des Crustaces, 1834, vol. i. p. 399.

?*Pseudocarcinus ocellatus*, Edw., op. cit., 1834, i p. 409.

Pseudocarcinus mercenaria, Gibbes, Proceedings American Association for the Advancement of Science, 1851, iii. p 176.

Menippe mercenaria, Stimpson, Annals N. Y. Lyceum, 1859, vii. p. 53 (in text). Streets, Proceedings of the Academy of Natural Sciences, Philadelphia, 1871, p. 239. Coues, l. c., p. 120.

North Carolina to Florida. Dr. Streets (*l. c.*) reports it from the Isthmus of Panama. Fort Macon (Packard).

It is readily separated from the only other species of *Menippe* (*M. rumphii*, De Haan, Stimpson, Annals N. Y. Lyceum, 1871, x. p. 107) found on this coast, by the sharp edges of the teeth on the antero-lateral margin.

Dr. Coues sent the dactylus of the cheliped of an enormous example to the Peabody Academy. It measured three inches in length.

Panopeus herbstii, Edwards.

Cancer panope, Herbst, Naturgeschichte der Krabben und Krebse, pl. 54, f. 5. Say, l. c., 1818, i. p. 58, pl. iv. f. 6.

Panopeus herbstii, Edw., op. cit., i. p. 403. Dekay, op. cit., p. 5, pl. ix. f. 26. Gibbes, l. c., iii. p. 175. Heller, Reise der Novara, p. 16. Smith, Proceedings of the Boston Society of Natural History, 1869, xii. p. 276 ; ibid., Transactions of the Connecticut Academy of Arts and Sciences, 1869, ii. p. 34 ; ibid., Report U. S. Fish Commission, 1871–2, p. 547. Coues, l. c. p. 120.

Long Island Sound to Brazil. Dr. Packard collected a quantity at Fort Macon.

Panopeus herbstii var. obesus, Smith, Proc. Bost. Soc. xii. p. 278. Coues, l. c., 1871, p. 120.

A single specimen, which I refer with a doubt to this species and variety, was found among the collections made by Dr. Packard at Fort Macon. The front is prominent, arcuate, but has only two lobes. The lateral lobes resemble somewhat those of *obesus*, the last being obtuse and not at all curved forward. The single specimen, a female, gives the following measurements :—

Length of carapax 9 mm., breadth, 12.2 mm., ratio 1 : 1.36.

Smith's specimens came from Egmont Key, Florida, and Aspinwall.

Panopeus depressus, Smith.

Panopeus depressus, Smith, Proc. Bost. Soc. xii. p. 283; *ibid.*, Fish Comm., p. 547, pl. i. f. 3.

Massachusetts Bay to Florida.

Panopeus sayi, Smith.

Panopeus sayi, Smith, Proc. Bost. Soc., xii. p. 284; ibid., Rep. U. S. Fish Comm., p. 547.

Massachusetts to Florida.

Panopeus harrisii, Stm.

Pilumnus harrisii, Gould, op. cit., p. 326. Dekay, op. cit., p. 7, pl. vii. f. 15.

Panopeus harrisii, Stimpson, Ann. Lyc., vii. p. 55. Smith, Fish Comm., p. 547.

Massachusetts Bay to Florida.

The various species of North American *Panopei* are well separated by Prof. Smith in the paper referred to in the Proceedings of the Boston Society.

Eurytium limosum, Stm.

Cancer limosus, Say, l. c., p. 446.

Panopeus limosus, Edwards, op. cit., i. p. 404. Dekay, op. cit., p. 5. Gibbes, l. c., p. 176.

Eurytium limosum, Stm., Ann. Lyc., vii. p. 56.

New York to Florida.

Eriphidæ.

Pilumnus aculeatus, M. Edw.

Cancer aculeatus, Say, l. c., i. p. 449.

Pilumnus aculeatus, M. Edw., op. cit., i. p. 420. Dekay, op. cit., p. 8. Gibbes, l. c., p. 177. Stimpson, Bulletin of the Museum of Comparative Zoology, 1871, ii. p. 141. Coues, l. c., p. 120.

Fort Macon (Coues) to Florida.

Portunidæ.

Neptunus sayi, Stimp.

Lupa pelagica, Say, l. c., p. 97. Dekay, op. cit., p. 11, pl. vi. f. 8 (non Leach).

Lupa sayi, Gibbes, l. c., p. 178. Dana, Crustacea U. S. Exploring Expedition, 1852, p. 273, pl. xvi. f. 8. Stimpson, Proceedings Acad. Nat. Sci., Philadelphia, 1858, p. 38.

Neptunus sayi, Stimpson Ann. Lyc., vii. p. 220; ibid., Bulletin M. C. Z., ii. p. 147. A. Milne Edwards, Archives du Museum d'Histoire Naturelle, 1861, t. x. p. 317, pl. xxix. f. 2.

New York to Florida.

Callinectes hastatus, Ordway.

Lupa hastata, Say, l. c , 1818, i. p. 65.

Lupa diacantha, Dekay, op. cit., 1842, p. 10, pl. iii. f. 3.

Callinectes hastatus, Ordway, Journal Boston Society, vii. p. 568. Smith, Rep. U. S. Fish Comm. 1871, 2, p. 548. Coues, l. c., p. 120.

This species which, at the time of moulting, furnishes the well-known soft shell crab, is found from Salem, Mass., to Florida and Alabama. It is, however, rare north of Cape Cod. Several specimens brought by Dr. Packard from Fort Macon.

Araneus cribrarius, Dana.

Portunus cribrarius, Lamarck, Animaux sans Vertebres, v. p. 259 (teste M. Edwards).

Lupa maculata, Say, l. c., p. 445. Dekay, op. cit., p. 11.

Lupa cribraria, Edw. Crustacés, i. p. 452, pl. xviii. f. 1. Gibbes, l. c., p. 178.

Araneus cribrarius, Dana, U. S. Exploring Exped. Crustacea, p. 290, pl. xviii., f. 2. Smith, Transactions Connecticut Acad., ii. p. 35 ; 3d Report Peabody Academy of Science, 1871, p. 91. Coues, l. c., p. 121.

Neptunus cribrarius, A. M. Edw., Arch. Mus. d'Hist. Nat. 1861, t. x. p. 324.

New Jersey to Aspinwall and Brazil ; Fort Macon (Coues and Packard).

Achelous spinimana, De Haan.

Portunus spinimanus, Latreille, Encyclopedie Methodique, x. p. 188 (teste Edwards).

Lupa spinimana, Leach. Desmarest Considerations sur les Crustacés, 1825, p. 98. Edw., op. cit., i. p. 452. Dana, U. S. Ex. Ex., Crust. i. p. 273. Stimpson, Ann. Lyc., vii. p. 57.

Achelous spinimana, De Haan, Fauna Japonica, p. 8. Stimpson, Ann. Lyc., vii. p. 221 ; ibid., Bulletin Mus. Comp. Zool. ii. p. 150. Alphonse Milne Edwards, Archiv. du Museum d' Histoire Naturelle, tome x. p. 341, pl. xxxii. f. 1. Heller, Reise der Osterreichen Friggate Novara, p. 27. Smith, Trans. Conn. Acad., ii. pp. 9 and 34. Coues, l. c., p. 120.

Fort Macon (Coues) to Brazil.

Achelous gibbesii, Stimpson.

Lupa gibbesii, Stimpson, Ann. Lyc., vii. p. 57.

Achelous gibbesii, Stimpson, Ann. Lyc., vii. p. 222. Coues, l. c., p. 121.

Neptunus gibbesii, A. M. Edw., l. c., p. 326, pl. xxxi. f. 1.

Fort Macon (Coues) to Florida.

Achelous depressifrons, Stimpson.

Amphitrite depressifrons, Stimpson, Ann. Lyc., vii. p. 58.

Achelous depressifrons, Stimpson, l. c., vii. p. 223. Alph. M. Edw., l. c. x. p. 342. Coues, l. c., p. 121.

Fort Macon (Coues) to Florida.

Platyonichidæ.

Carcinus mœnas, Leach.

Cancer mœnas, Pennant, British Zoology, iv. p. 3. pl. iii. f. 5 (teste Bell).

Portunus mœnas, Leach, Edinburg Encyclopedia, vii. p. 390 (teste Bell).

Carcinus mœnas, Leach, l. c., p. 429; ibid., Trans. Linnean Society of London, xi. p. 314; ibid., Malacostraca Podophthalmia Brittaniæ, pl. v. f's. 1–4. M. Edw., op. cit. i. p. 434. Gould, op. cit., p. 321. Dekay, op. cit., p. 8, pl. v. f's. 5–6. Bell, British Stalk-eyed Crustacea, 1853, p. 76. Streets, Bulletin U. S. National Museum No. 7, 1877, p. 109. Kingsley, Bulletin Hayden's Survey, 1878, iv. p. 191.

Cancer granulatus, Say, l. c., 1817, i. p. 61.

Carcinus granulatus, Smith, Fish Comm. p. 547.

This speeies is almost cosmopolitan in its range. It is found on the Eastern Coast of the U. S., from Cape Cod to New Jersey, at Panama, in the Hawaiian Islands, France and England, in the Baltic and Mediterranean, the Red Sea, Brazil, and, doubtfully, in Australia.

Platyonichus ocellatus, Latreille.

Cancer ocellatus, Herbst, Naturgeschichte der Krabben und Krebse, p. 61, pl. xlix. f. 4.

Portunus pictus, Say, l. c., i. p. 62, pl. iv. f. 4.

Platyonichus ocellatus, Latreille, Encyc. Method., xvi. p. 152. Edw , op. cit., i. p. 437. DeKay, op. cit., p. 9, pl. i. f. 1, pl. v. f. 7. Gibbes, l. c., p. 177. A. Milne Edwards, l. c., x. p. 415, pl. xxxvi. f. 4 (1861). Smith, Fish Comm., p. 547, pl. i. f. 1. Coues, l. c., p. 120.

Provincetown, Mass., to Florida; Fort Macon (Coues).

OCYPODOIDEA.

Ocypodidæ.

Gelasimus minax, Le Conte.

Gelasimus minax, Le Conte, Proceedings Acad. Nat. Sci., Philadelphia, 1855, p. 403. Smith, Trans. Conn. Acad , ii. p. 128, pl. ii. f. 4, pl. iv. f. 1–1 *b*. Ibid., Fish Commission, p. 545. Coues, l. c., 121.

Gelasimus palustris (pars), Stimpson, Ann. Lyc , vii. p. 62.

New Haven to Florida; Fort Macon (Coues).

Gelasimus pugnax, Smith.

Gelasimus vocans (pars), Gould, op. cit., p. 325.
Gelasimus vocans, *var. A.*, DeKay, op. cit., p. 14, pl. vi. f. 10 (non *Cancer vocans*, L.)
Gelasimus pugillator, Le Conte, l. c., p. 403 (non Bosc.).
Gelasimus palustris, (*pars*), Stimpson, l. c., vii. p. 62 (non Milne Edwards).
Gelasimus pugnax, Smith, Trans. Conn. Acad., ii. p. 131, pl. ii. f. 1, pl. iv. f. 2. Ibid., Fish Commission, p. 545. Coues, l. c. p. 121.

Cape Cod to Florida, the West Indies, and the Gulf of Mexico; Fort Macon (Coues).

Gelasimus pugillator, Latreille.

Ocypoda pugillator, Bosc, Histoire Naturelle des Crustacés, i. p. 197.
Ocypoda pugillator (pars), Say, l. c. i. pp. 71 and 443.
Gelasimus pugillator, Latreille, Nouv. Dictionaire d'Histoire Naturelle, 2me Edition, t. xii. p. 250. Desmarest, Considerationes sur les Crustacés, p. 123. H. Milne Edwards, Annales des Sciences Naturelles, Zoologie, t. xviii. p. 14, pl. iv. f. 149. Stimpson, Ann. Lyc., vii. p. 62. Smith, Trans. Conn. Acad., ii. p. 136, pl. iv. f. 7. Ibid., Fish Comm., p. 545. Coues, l. c., p. 121.
Gelasimus vocans (pars), Gould, op. cit., p. 325.
Gelasimus vocans, DeKay, op. cit., p. 14, pl. vi. f. 9.

Cape Cod to the West Coast of Florida; Fort Macon (Coues).

Ocypoda arenaria, Say.

Cancer arenarius, Catesby's Carolina, ii. pl. 35 (teste Say, Edwards).
Ocypoda arenaria, Say, Journal Academy of Natural Sciences, Philadelphia, 1817, i. p. 69. H. Milne Edwards, Hist. Nat. des Crust., ii. p. 44, pl. xix. f. 13–14. Dekay, op. cit., p. 13. Gibbes, l. c., p. 180. Smith, Rep. U. S. Fish Commission, p. 545. Coues, l. c., p. 122.

Long Island, southward; Fort Macon (Coues).

Professor S. I. Smith (l. c.) says that our form seems to be identical with the Brazilian one, which is known as *O. rhombea*, Fabricius, in which case the name *rhombea* will hold. In case they be different, the names *O. quadratum*, Bosc, and *O. albicans* seems to have priority over Say's name. Professor Smith has also shown (l. c. p. 534), and in the "American Journal of Science and Arts," 3d Series, vol. vi. p. 67 (1873), that the *Monolepis inermis* of Say (l. c., p. 157), is the "megalops stage" of the present species. The habits are well described by Dr. Coues.

Grapsidæ.

Sesarma reticulata, Say.

Sesarma reticulata, Say, l. c. i. pp. 73, 76, and 442, pl. iv. f. 6. Gibbes, l. c. p. 180. Edw., Ann. Sci. Nat., III. xx. p. 182. Stimpson, Annals N. Y. Lyc., vii. p. 66. Smith. Trans. Conn. Acad., ii. p. 156. Ibid., U. S. Fish Commission, p. 546. Coues, l. c., p. 121.
Sesarma reticulata, Dekay, op. cit., p. 15.

Long Island Sound to Florida; Fort Macon (Coues, Packard).

Sesarma cinerea, Say.

Grapsus cinereus, Bosc, Histoire Naturelle des Crustaces, i. p. 204, pl. v. f. 1.
Sesarma cinerea, Say, l. c., i. p. 442. Edwards, op. cit., ii. p. 75. Ibid., Annales des Sciences Naturelles, IIIme Serie, Zoologie, t. xx. p. 182. Gibbes, l. c., p. 180. Stimpson, Annals N. Y. Lyceum, vii. p. 65. Smith, Transactions Connecticut Academy, ii. p. 157. Coues, l. c., p. 121.

Virginia to Florida; Fort Macon (Coues).

Pinnotheridæ.

Pinnotheres ostreum, Say.

Pinnotheres ostreum, Say, l. c., i. p. 67, pl. iv. f. 5. Gould, Invert. Mass., p. 328. Dekay, op. cit., p. 12, pl. vii. f. 16. Gibbes, l. c., p. 179. Stimpson, Annals N. Y. Lyceum, vii. p. 67. Coues l. c., p. 123. Smith, Fish Comm., p. 546.

Salem, Mass. (in transplanted oysters), to South Carolina; Fort Macon (Coues).

Pinnotheres maculatus, Say.

Pinnotheres maculatus, Say, l. c., i. p. 450. Dekay, op. cit., p. 13. Gibbes, l. c., p. 179. Stimpson, Ann. N. Y. Lyceum, vii. p. 67. Smith, Fish Comm., p. 546.
Pinnotheres ostreum, ♂ Smith, Fish Comm., pl. i. f. 2.

Cape Cod to South Carolina; Fort Macon, Stimpson.

(The following species of *Pinnotheres* may possibly be found at Fort Macon. They were described by Say, but so far as I am aware they have not been observed by other carcinologists :—

P. depressum, from New Jersey.

P. byssomyæ, "Southern coast."

P. monodactylum, no locality.

Pinnixa sayana, Stimpson.

Pinnixa sayana, Stimpson, Annals N. Y. Lyceum, vii. p. 236.

Fort Macon (Stimpson).

Pinnixa cylindrica, White.

Pinnotheres cylindricum, Say, l. c., p. 452. Dekay, op. cit., p. 13.

Pinnixa cylindrica, White, List Crustacea in the British Museum, 1846, p. 33. Ibid., Annals and Magazine of Natural History, 1846, First Series, xviii. p. 177. Stimpson, Annals N. Y. Lyceum, vii. p. 235. Smith, U. S. Fish Commission, p. 546, pl. i. f. 1.

Pinnixa lævigata, Stimpson, Annals N. Y. Lyc., vii. p. 68.

Long Island Sound to South Carolina.

Pinnixa chætopterana, Stimpson.

Pinnixa cylindrica, Stimpson, Annals N. Y. Lyceum, vii. p. 68 (non White).

Pinnixa chætopterana, Stimpson, l. c., vii. p. 235.

Charleston, S. C. (Stimpson). A single male occurred in the collections made by Dr. Packard at Fort Macon.

LEUCOSOIDEA.

Calappidæ.

Calappa marmorata, Fabr.

Cancer marmoratus, Fabr.; Ent. Syst., ii. p. 450.

Cancer flammeus, Herbst, op. cit., ii. p. 161, pl. xi. f. 2.

Calappa marmorata, Fabr., Sup. Ent. Syst., p. 346. Edw., Hist. Nat. Crust., ii. p. 104. Gibbes, l. c., p. 183. Stm., Ann. Lyc., vii. p. 71. Ibid., Am. Journ. Sci. and Arts, II. xxix. p. 444. Ibid., Bulletin Mus. Comp. Zool., ii. p. 153.

Fort Macon (Stimpson) to the West Indies.

Matutidæ.

Hepatus decorus, Gibbes.

Cancer decorus, Herbst., Naturgeschichte der Kraben und Krebse, ii. p. 154, pl. xxxvii. f. 6.

Hepatus decorus, Gibbes, Proc. Am. Assoc Adv. Sci., iii. p. 183. Stimpson, Annals N. Y. Lyceum, vii. p. 70. Coues, l. c. p. 124.

Hepatus vanbenedeni, Herklots' Notice Carcinologique, 1852, p. i. pl. i. f. 1.

There are two dry specimens of this species in the museum of the Peabody Academy of Science, from Fort Macon, presented by Dr. Coues. The range of the species is from North Carolina to Texas.

Leucosidæ.

Persephone punctata, Stimpson.

Cancer punctatus, Browne, Natural History of Jamaica, pl. xlii. f. 3.

Persephona Latreillii, Leach, Zoological Miscellany, iii. p. 22 (teste Bell).

Persephona Lamarckii, Leach, Zool. Misc., iii. p. 23 (teste Bell).

Guaia punctata, Edw., Hist. Nat. des Crust., ii. p. 127. Gibbes, Proc. Am. Assoc. iii. p. 185.

Persephone guaia, Bell, Transactions Linnean Society, London, xxi. p. 292. Ibid., Catalogue Crustacea in British Museum, pt. i. Leucosiadæ, 1855, p. 10.

Persephone punctata, Stimpson, Annals N. Y. Lyceum, vii., p. 70. Coues, l. c., p. 123.

Fort Macon, N. C. (Coues), to Florida and the West Indies.

Lithadia cariosa, Stim.

Lithadia cariosa, Stimpson, Ann. N. Y. Lyc. vii. p. 238.

Fort Macon (Stimpson).

RANINOIDEA.

Raninidæ.

Ranilia muricata, Edw.

Ranilia muricata, H. Milne Edwards, Hist. Nat. des Crustaces, ii. p. 195. Gibbes, Proc. Am. Assoc. Adv. Sci., iii. p. 187. Ibid., Proceedings of the Elliot Society of Charlestown, S. C., i. p. 225, pl. xiii. (1857).

North Carolina to Florida.

PORCELLANOIDEA.

Porcellanidæ.

Porcellana ocellata, Gibbes.

Porcellana ocellata, Gibbes, Proc. Am. Assoc., iii. p. 190. Ibid., Proc. Elliot Soc., i. p. 12, pl. i. f. 2. Stm., Proc. Phila. Acad., 1858, p. 229. Ibid., Ann. Lyc., vii. p. 77. Ibid., Am. Journ., II. xxix. p. 444.

Fort Macon (Stimpson) to the West Indies.

Porcellana sociata, Say.

Porcellana sociata, Say, l. c., i. p. 456. Edw., Hist. Nat. Crust., ii. p. 258. Gibbes, Proc. Am. Assoc., iii. p. 190. Ibid., Proc. Elliot Soc., i. p. 12, pl. i. f. 6. Stimpson, Proc. Phila. Acad., 1858, p. 229. Ibid., Am. Journ. II. xxix. p. 444.

Pisidia sociata, Leach, Desmarest.

Fort Macon (Stimpson) to Florida.

In Say's description the specific name of this species was spelled *soriata*, probably a typographical error.

Euceramus prælongus, Stm.

Euceramus prælongus, Stm., Am. Journ. Sci. and Arts, II. xxix. p. 445.

Fort Macon (Stimpson).

HIPPOIDEA.

Hippidæ.

Hippa talpoida, Say.

Hippa talpoida, Say, l. c., i. p. 160. Stimpson, Proc. Acad. Nat. Sciences, Philadelphia, 1858, p. 230. Coues, l. c., p. 124. Smith, U. S. Fish Commission, p. 548, pl. ii. f. 5. Ibid., Trans. Conn. Acad., iii. pp. 311–342, pls. xlv.–xlviii. (Development).

Cape Cod to Florida; Fort Macon (Coues, Packard).

Albunidæ.

Lepidops scutellata, Stm.

Albunea scutellata, Desmarest, Consid. Crust., p. 173. Edw., Hist. Nat. Crust., ii. p. 204, pl. xxi. f. 9–13. Gibbes, Proc. Am. Assoc., iii. p. 187.

Lepidops scutellata, Stm., Proc. Phila. Acad., 1858, p. 230. Ibid., Am. Journ., II. xxix. p. 444. Ibid., Ann. Lyc., vii. p. 79.

Fort Macon (Stimpson) to the West Indies.

PAGUROIDEA.

Paguridæ.

Clibanarius vittatus, Stimpson.

Pagurus vittatus, Bosc, Histoire Naturelle des Crustaces, ii. p. 8, pl. xii. Edwards, Hist. Nat. des Crust., ii. p. 237. Gibbes, Proc. Am. Assoc., iii. p. 189.

Clibanarius vittatus, Stimpson, Proc. Acad. Nat. Sci., Philadelphia, 1858, p. 235. Smith, Trans. Conn. Acad., ii. p. 18.

Fort Macon (Packard) to Florida, the West Indies, and Brazil.

Eupagurus longicarpus, Stimpson.

Pagurus longicarpus, Say, l. c., i. p. 163. Gould, op. cit., p. 330. Dekay, op. cit., p. 20, pl. viii. f. 22.

Eupagurus longicarpus, Stimpson, Proc. Acad. Nat. Sci., Philadelphia, 1858, p. 237. Smith, Rep. U. S. Fish Comm., p. 549.

Eupagurus longipes, Coues, l. c., p. 124.

Salem, Mass. (Kingsley), to South Carolina; Fort Macon (Packard).

Eupagurus annulipes, Stimpson.

Eupagurus annulipes, Stimpson, Annals N. Y. Lyc., vii. p. 243.

Fort Macon (Stimpson).

Eupagurus pollicaris, Stimpson.

Pagurus pollicaris, Say, l. c., i. p. 162. Edwards, Hist. Nat. des Crust., ii. p. 237. Gould, op. cit., p. 329. Dekay, op. cit., p. 19, pl. viii. f. 21.

Eupagurus pollicaris, Stimpson, Proc. Acad. Nat. Sci., Philadelphia, 1858, p. 237. Ibid., Annals N. Y. Lyceum, vii. p. 92. Coues, l. c., p. 124. Smith, Fish Commission, p. 548.

Massachusetts to Florida; Fort Macon (Coues, Packard).

THALASSINOIDEA.

Gebidæ.

Gebia affinis, Say.

Gebia affinis, Say, l. c., i. p. 241. Dekay, op. cit., p. 22. Gibbes, l. c., iii. p. 195. Smith, Fish Comm., p. 549, pl. ii. f. 7.

Long Island Sound to Florida.

Callianassidæ.

Callianassa stimpsoni, Smith.

Callianassa stimpsoni, Smith, Report U. S. Fish Commission for 1871–72, p. 549, pl. ii. f. 8.

Long Island Sound, southward.

Callichirus major, Stm.

Callianassa major, Say, l. c., i. p. 238. Edw., Hist. Nat. Crust., ii. p. 310. Dekay, op. cit., p. 22. Gibbes, Proc. Am. Assoc., iii. p. 194. Stimpson, Am. Journ., ii. xxix. p. 444.

Callichirus major, Stm., Ann. Lyc., x. p. 122.

Fort Macon (Stimpson) to Florida.

ASTACOIDEA.

Astacidæ.

Homarus americanus, Edw.

Astacus marinus, Say, l. c., i. p. 165 (non Fabr.).

Homarus americanus, M. Edw., Hist. Nat. des Crust., ii. p. 234. Gould, op. cit., p. 330. Dekay, op. cit., p. 23, pl. xii. Gibbes, l. c., p. 195. Coues, l. c., p. 124. Smith, Trans. Conn. Acad., ii. pp. 251–381, 5 plates (Development). Ibid., Fish Comm., p. 549, pl. ix. f. 38–39. Wheildon, Proceedings American Association, xxiii. p. 133, 1874. Kingsley, American Naturalist, 1876, x. p. 396, pls. v., vi.

New Jersey to Labrador (Smith). Dr. Coues reports a single specimen from Fort Macon.

CARIDEA.

Crangonidæ.

Crangon vulgaris, Fabricius.

Cancer crangon, Linne, Syst. Nat., 12th Edit., p. 1052.

Astacus crangon, Herbst., Naturgeschichte der Krabben und Krebse, ii. p. 57, pl. xxix. f. 3 and 4. Olivier, Encyclopedie Methodique, t. vi. p. 348, pl. ccxciv. f. 4–7.

Crangon vulgaris, Fabricius, Suppl. Ent Syst., p. 410. Latreille, Hist. Nat. des Crustacés, vi. p. 267, pl. iv. f. 1–2. Lamarck, Anim. sans Vertebres, v. p. 202. Leach, Malacostraca Podophth. Brittaniæ, pl. xxxvi. f. B. Desmarest, Consid. sur les Crustaces, p. 218, pl. xxxviii. f. 1. Edwards, Hist. Nat. des Crustaces, ii. p. 341. Gould, Invert. Mass., p. 331. Kroyer, Naturhistorisk Tidsckrift, 1842–3, p. 239, pl. iv. f. 29–33. Brandt in Middendorff, Bd. ii. th. i. p. 113. Gibbes, l. c., iii. p. 195. Bell, British Stalk-eyed Crustacea, 1853, p. 256. Stimpson, Invertebrata of Grand Menan, p. 58. Sars, Videnskabs Selskabet, i Christiania, 1861, p. 179. Kinahan, Proc. Royal Irish Academy, 1862, vii. p. 68 and 71, pl. iv. (poor figures). Heller, Crustaceen des Sudlichen Europa, 1863, p. 226, pl. vii. f. 8–9. Smith, Fish Comm., p. 551, pl. iii. f. 10. Meinert, Naturhistorisk Tidsskrift, 1877, III. xi. p. 198. Kingsley, Proc. Acad. Nat. Sci., Philadelphia, 1878, p. 89. Ibid., Bulletin Essex Inst., 1878, x. p. 53.

Crangon septemspinosus, Say, l. c., p. 246. Dekay, op. cit., p. 25, pl. viii. f. 24.

Mediterranean, France, England, Norway, Labrador, south to Fort Macon (Packard).

Tozeuma carolinensis, Kingsley.

Tozeuma carolinensis, Kingsley, Proc. Acad Nat. Sci., Philadelphia, 1878, p. 90; ibid., Bulletin Essex Inst., x. p. 56.

This species was found to be quite common in the eel grass near Fort Macon, by Dr. Packard. It is readily recognized by its slender elongate form and its long straight rostrum.

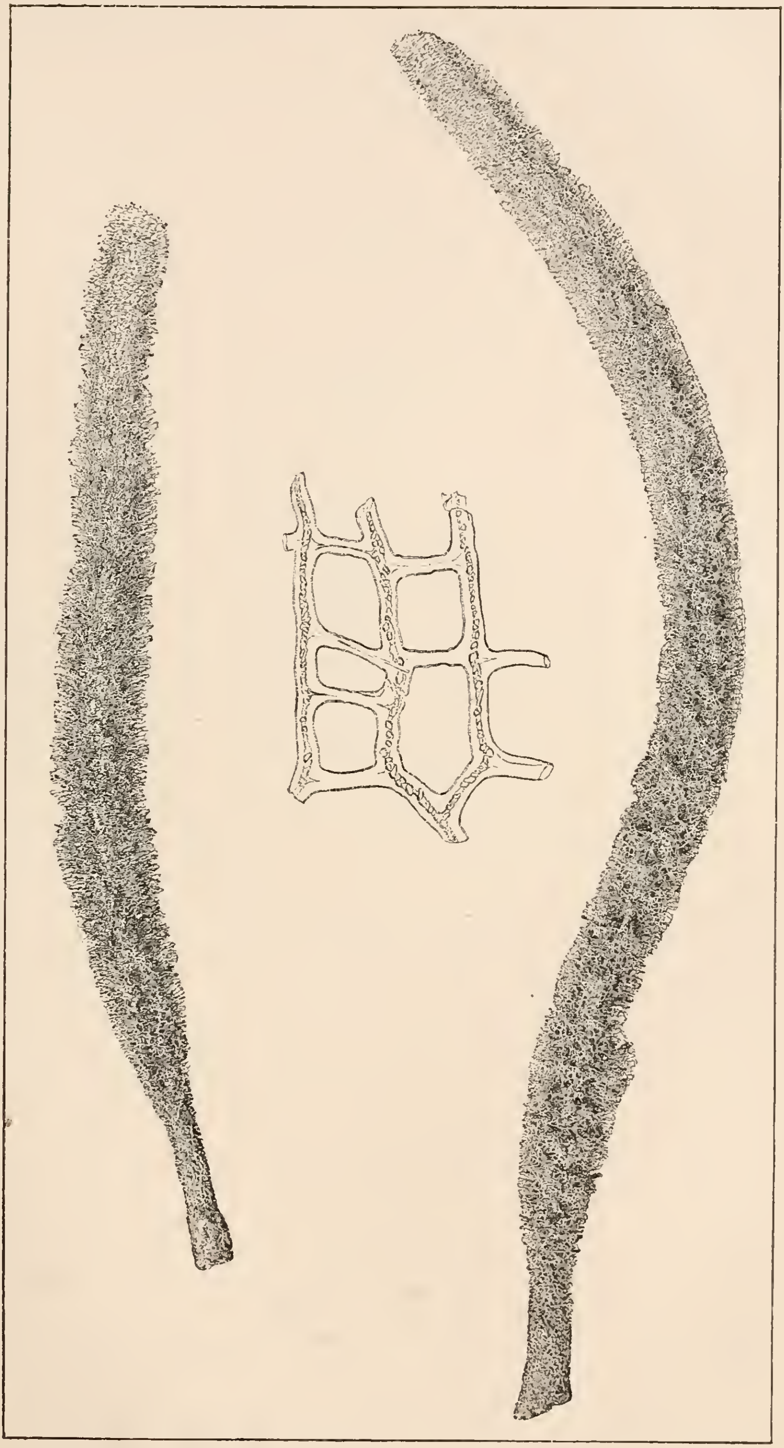
Palaemonidæ.

Alpheus minus, Say.

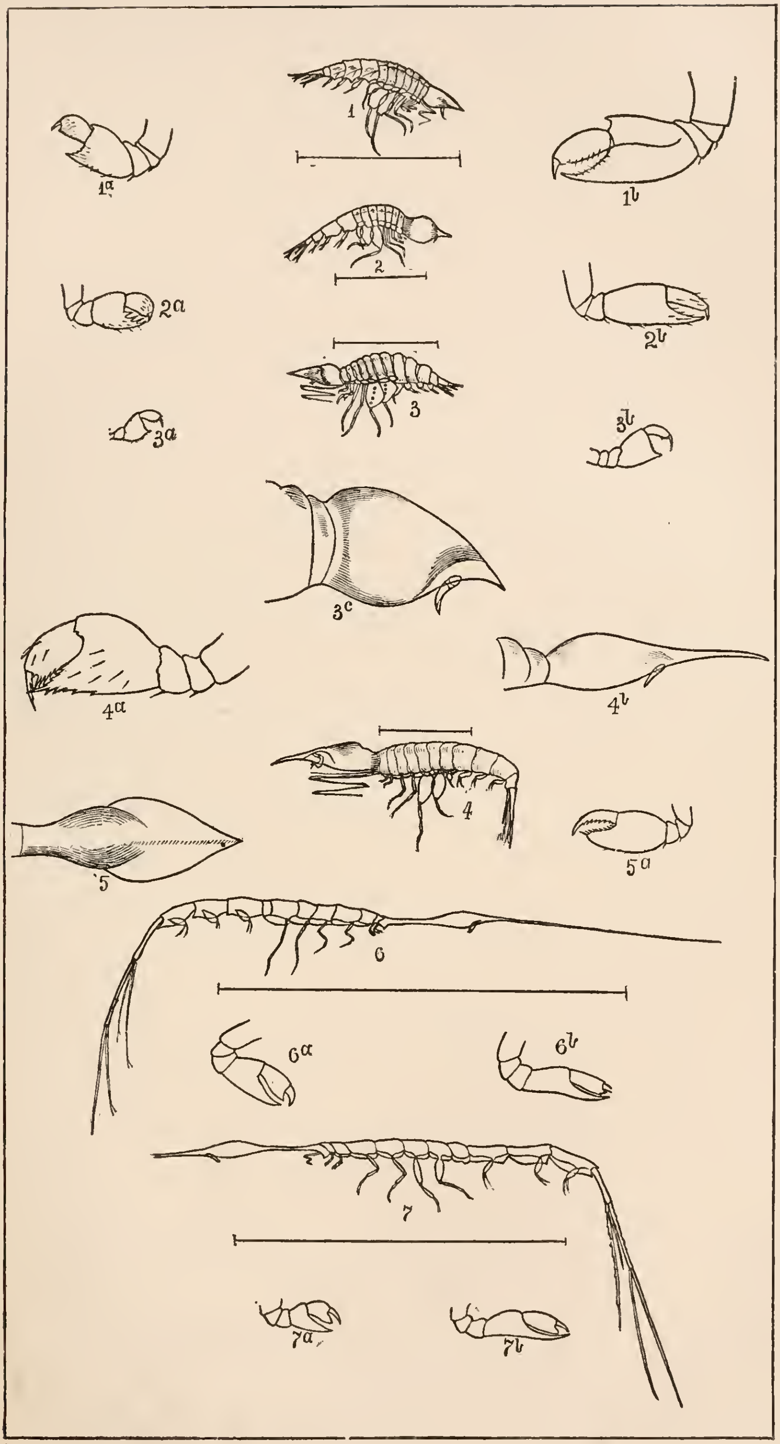
Alpheus minus, Say, l. c., i. p. 245. Edwards, Hist. Nat. des Crust., ii. p. 356. Kingsley, Bulletin U. S. Geological and Geographical Survey of the Territories, 1878, iv. p. 190; ibid., Bulletin Essex Inst. x. p. 57. Lockington, Annals and Magazine of Natural History, 1878.

Alpheus formosus, Gibbes, l. c., p. 196.

When working at my Synopsis of the North American Alphei I found specimens in the Museum of Yale College, collected by Dr. H. C. Yarrow, at Fort Macon. This is its farthest north. I have also examined specimens from Florida, Bermudas, West Indies, and the Bay of Panama. This species can readily be separated from any other Caridean likely to be found at Fort Macon, by the three spined front and the great disproportion in the anterior pairs of chelipeds.



APLYSINA PEDICELLATA, HYATT. (3/7)



J. H. STREETS, DEL.

STREETS ON PELAGIC AMPHIPODA.

In the Annual Report of the U. S. Geological and Geographical Surveys of the Territories for 1874, p. 388, Mr. Ernest Ingersoll says, "From the pond mentioned, between camps E. & F. [in southwestern Colorado], a small crab was brought home, which Prof. S. I. Smith pronounced to be a true marine form, belonging to the *Astacidoæ* (sic)." Prof. Smith informs me that the specimen shown to him was undoubtedly *Alpheus minus*, and thought it more than probable that some confusion of localities or mixture of specimens had occurred, but, on the other hand, Mr. Ingersoll is as positive as it is possible to be that the specimen was found in the pond mentioned.

Alpheus heterochelis, Say.

Alpheus heterochelis, Say, l. c , i. p. 243. Edwards, op. cit., ii. p. 356. Dekay, op. cit., p. 26. Gibbes, l. c., p. 196. Smith, Trans. Comm. Acad., ii. p. 23 and 39. Kingsley, Bulletin U. S. G. and G. Survey, iv. p. 194; ibid., Bulletin Essex Inst., x. p. 58. Lockington, Annals and Mag. Nat. Hist., 1878.

Alpheus armillatus, Edw., op. cit., ii. p. 354.

Halopsyche lutaria, Saussure, Revue Zoologique, 1857, p. 100 (teste Saussure).

Alpheus lutarius, Saussure, Crustacés nouv. Antilles, Mexique et Etats Unis, p. 45, pl. iii. p. 24. E. von Marten, Archiv für Naturgeschichte, 1872, p. 139.

Alpheus equidactylus, Lockington, Proc. California Academy, vii. p. 35, 1877. (Extras published in 1876.)

I have examined specimens from Fort Macon (Dr. H. C. Yarrow), Florida, Bahamas, Bermudas, Brazil, Aspinwall, Panama, and the West Coast of Nicaragua. Mr. Lockington informs me that his *A. equidactylus*, from Monterey, Cal., presents no appreciable differences from specimens of *A. heterochelis*, from Florida, that I sent him. This species is readily recognized by its front with a single spine, its enormous hand, and is larger than the preceding species.

Stimpson in his "Trip to Beaufort, N. C.," American Journal Sciences and Arts, 2d series, vol. xxix. p. 444, mentions a species of *Alpheus* under the name *A. intermedius*. What he refers to is unknown.

Virbius pleuracanthus, Stimpson.

Virbius pleuracanthus, Stimpson, Annals N. Y. Lyceum, 1871, x. f. 127. Smith, Fish Comm. p. 550. Kingsley, Bulletin Essex Inst. x. p. 63.

New Jersey to Fort Macon (Dr. Packard).

Urocaris longicaudata, Stimpson.

Urocaris longicaudata, Stimpson, Proc. Acad. Nat. Sci., Philadelphia, 1860, p. 39. Kingsley Bulletin Essex Inst., x. p. 65.

"In littoribus Carolinensibus habitans" (Stimpson).

Palæmonetes vulgaris, Stimpson.

Palæmon vulgaris, Say, l. c., i. p. 248. Edw., Hist. Nat. des Crust., ii. p. 394. Gould, op. cit., p. 332; Dekay, op. cit., p. 29, pl. ix. f. 30. Gibbes, l. c., p. 198. Coues, l. c., p. 124.

Palæmonetes vulgaris, Stimpson, Annals N. Y. Lyceum, x. p. 129. Smith, Fish Comm. p. 550, pl. ii. f. 9. Kingsley, Bulletin Essex Inst., x. p. 65.

Salem, Mass. (C. Cooke), to Florida. Fort Macon (Dr. Packard).

Palæmonetes carolinus, Stimpson.

Palæmonetes carolinus, Stimpson, Annals N. Y. Lyceum, x. p. 129. Kingsley, Bull. Essex Inst. x. p. 65.

New Jersey to South Carolina; Fort Macon (Dr. Packard).

Peneidae.

Peneus setiferus, Edw.

Cancer setiferus, Linne (teste Edw.).

Peneus fluvialis, Say, l. c., i. p. 236.

Peneus setiferus, Edw., op. cit., ii. p. 414. Dekay op. cit., i. p. 230. Gibbes, l. c., iii. p. 199. Smith, Trans. Conn. Acad., ii. p. 40. Stimpson, Annals Lyceum, x. p. 133. Kingsley, Bull. Essex Inst., x. p. 69.

Virginia to Texas and Brazil.

Peneus braziliensis, Latreille.

Peneus braziliensis, Latreille Nouvelle Dictionaire d'Histoire Naturelle, tome, xxv. p. 154. Edwards, op. cit., ii. p. 414. White, List Crust. in Brit. Museum, p. 80. Gibbes, l. c., p. 198. Smith, Trans. Conn. Acad., ii. p. 27; ibid., Fish Comm., p. 551. Stimpson, Annals N. Y. Lyceum, x. p. 132. Coues, l. c., p. 124. Von Martens, l. c., 1872, vol. xxxviii. p. 140. Kingsley, Bull. Essex Inst. x. p. 69.

New York to Brazil; Fort Macon (Coues).

Peneus constrictus, Stimpson.

Peneus constrictus, Stimpson, Ann. N. Y. Lyc., x. p. 135. Kingsley, Bulletin Essex Institute, x. p. 70.

Fort Macon, N. C. (Stimpson), to Charleston, S. C.

September 3.

The President, Dr. Ruschenberger, in the chair.

Twenty-one persons present.

On the Black Mildew of Walls.—Prof. Leidy remarked that in the number of "Hardwicke's Science Gossip" for August, presented this evening, there is an article by Prof. Paley entitled "Is the Blackness on St. Paul's merely the effect of Smoke." According to the author, the blackness is mainly due to the growth of a hitherto undescribed lichen, which appears to flourish only on limestone and in situations unaffected by the direct rays of the sun. Prof. Leidy continued, that his attention had been called a number of years ago to a similar black appearance on the brick walls and granite work of houses in narrow shaded streets, especially in the vicinity of the Delaware River. Noticing a similar blackness on the bricks above the windows of a brewery, from which there was a constant escape of watery vapor, in a more central portion of the city, he was led to suspect that it was of a vegetable nature. On examination, the black mildew proved to be an alga, closely allied to what he supposed to be the *Protococcus viridis*, which gives the bright green color to the trunks of trees, fences, and walls, mostly on the more shaded and northern side, everywhere in our vicinity. It probably may be the same plant in a different state, but, until proved to be so, may be distinguished by the name of *Protococcus lugubris.* It consists of minute round or oval cells, from 0.006 to 0.009 mm. in diameter, isolated or in pairs or in groups of four, the result of division; or it occurs in short irregular chains of four or more cells up to a dozen, occasionally with a lateral offset of two or more cells. The cells by transmitted light appear of a brownish or olive-brownish hue. In mass to the naked eye the alga appears as an intensely black powder.

September 10.

The President, Dr. Ruschenberger, in the chair.

Nineteen persons present.

The death of Geo. Dawson Coleman, a member, was announced.

SEPTEMBER 17.

The President, Dr. RUSCHENBERGER, in the chair.

Twenty-eight persons present.

A paper entitled "Description of a supposed New Species of Smynthurus," by John A. Ryder, was presented for publication.

Remarks on Mactra.—Prof. LEIDY remarked that the most frequent and conspicuous shell met with on the sandy coast of New Jersey was the Beach-clam, *Mactra solidissima*. The living mollusk was thrown up in great numbers during severe storms; and high above the position reached by ordinary tides, its dead shells are thickly strewn over the sands. Shells are often met with having a smooth circular hole bored near the umbo, which appeared to be due to *Natica heros*, for several years ago, at Atlantic City, on the beach, near low-tide mark, Prof. L. had dug out of the sands many specimens of *Natica*, each of which embraced a beach-clam. The tongue of the *Natica*, covered with strong teeth, and over an inch long, formed a rasp, well adapted for boring the shell of its prey. Why the *Natica* always made choice of the position near the umbo for boring through the shell did not appear clear, though perhaps it might have something to do with reaching the adductor muscles of the shell of the *Mactra*. These are equidistant from the perforation, and, if torn through by the tongue of the *Natica*, would cause the shell of the *Mactra* to open, and thus render all the soft parts more accessible.

The *Mactra* lives in the sands of the coast, and appears to feed chiefly on diatoms and perhaps infusorians. Prof. L. had been surprised at the number of different genera and species of diatoms found in the contents of the intestines of the *Mactra*, though from an observation recently made, these delicately constructed plants would appear to thrive even on shore exposed to the disturbance of the ocean waves. Near the inlet, at Atlantic City, the beach between tides was noticed in many places to be covered with streaks and patches of a yellowish-green hue, and of extreme thinness. Some of this colored matter with sand was scraped up and put into a bottle and taken home for examination. After a few hours' rest, the green matter, diffused through the sand and water in the bottle, formed a thin layer on the sand. Under the microscope the green matter proved to be composed of a single diatom, the *Amphiprora constricta*. It was in a remarkable state of activity, and Prof. L. added, he thought he had never beheld any other diatom so much so as this one. Its power of movement and its broad keels were conditions which wonderfully favored its ability to extricate itself from the sand to occupy a position on the surface.

Diatoms, from their constitution, are admirably adapted as food for the beach-clam, oyster, and other lamellibranch mollusks. They are crystal cases containing besides the endochrome, a quantity of colorless protoplasm, and considerable drops of oil. They might be likened to boat loads of corn, meat, and oil. In the materials of the commencement of the intestine of clams and oysters, Prof. L. had observed the diatoms with the contents in various conditions of change due to digestion; and in the materials of the rectum, the diatoms were empty or had been deprived of their contents.

In several beach-clams examined, among the matter of the intestine, Prof. L. had observed what he at first supposed to be the shell of a difflugian, but which he since suspected to be that of a ciliated infusorian, *Tintinnus*. In form and construction the shell resembles that of *T. annulatus* (Fig. 2, pl. 9, vol. i., Etudes sur les Infusoires, etc., Claparede and Lachmann). Its length was 0.78 to 0.12 mm., the breadth 0.024 to 0.036 mm.

The *Amphiprora constricta* above referred to was from 0.078 to 0.09 mm. long, 0.024 broad, and 0.012 mm. thick.

Irritable or Sensitive Stamens.—Mr. Thomas Meehan remarked on the large list of plants now known that exhibited an irritative motion in some of their parts. A few years ago there were few in the list besides the Sensitive plant and the Venus fly-trap; now there were many scores of similar cases known, though chiefly as regards the stamens or portions of the pistils. He had already placed on record a large number of instances in plants of the orders *Bignoniaceæ*, *Scrophulariaceæ*, and *Acanthaceæ*, and he had found so many cases that he thought wherever there were bilobed flattened stigmas in these orders, we might expect to find this sensitiveness to touch exhibited in a greater or less degree. In regard to stamens, it was well known that in *Opuntia*, a family of *Cactaceæ*, the stamens moved in various directions when touched, and it was very remarkable that no such motion had been observed in *Cereus*, *Mammillaria*, and other allied genera of the order. Having noted a similar motion in the stamens of the common garden *Portulaca grandiflora*, he was led to look for and to find a similar motion in the Purslane, *Portulaca oleracea*. Examining another Portulacaceous plant, *Talinum teretifolium*, last year, he could find no trace of motion, but when on his recent journey south, he found growing in the Botanic Garden of Mr. Henry Shaw, of St. Louis, a West Indian species, *Talinum patens*, in which the expanded stamens fell down on the petals when touched. It was remarkable that this power should exist in *T. patens* and not in *T. teretifolium*, though some approach to this exceptional character was already noted in the genera, though not among the species of *Cactaceæ*.

The objects of these movements may yet form an interesting study. In *Dionæa*, *Drosera*, and some others, the motion had been found to result in some immediate benefit to the plant; in *Mimosa*, *Hedysarum*, and others, no such immediate benefit had been suggested. In the case of sensitive stigmas it had been supposed to have some reference to arrangements for cross-fertilization. But this was doubtful for the following reasons: In the case of *Mimulus ringens* the stigmas expanded, and the anthers dispersed their pollen before the corolla was quite open, and pollen might be generally found on the stigmatic surfaces when the mouth exposed these parts to view. In *Tecoma radicans*, on the other hand, the lobes of the pistil did not expand till some time after the mouth of the corolla was open. In many cases pollen-hunting bees had carried away all the pollen before these lobes expanded. In cases where the expanded lobes and dispersing pollen were simultaneous, it was theoretically supposed that a bee or insect touched the lobes with its pollen-covered head or back, and that the lobes then closed against the admission of pollen on the withdrawal of the insect from the flower. But he had found that the bees in the cases observed by him occupied but from three to five seconds in visiting a flower, while it took from thirty to sixty seconds for the lobes to close, and then they were seldom so completely closed as to render the reception of fresh pollen difficult. He thought from these and other facts that the hypothesis in relation to cross fertilization was untenable, and that the real use of this motion in the economy of nature was an open and yet promising field to the future investigator.

September 24.

The President, Dr. Ruschenberger, in the chair.

Twenty-seven persons present.

Henry C. Wood, M.D., Francis X. Dercum, M.D., Henry A. Green, and E. Gybbon Spilsbury were elected members.

The following was ordered to be published:—

DESCRIPTION OF A NEW SPECIES OF SMYNTHURUS.

BY JNO. A. RYDER.

Smynthurus quadrimaculata, Nob.

Dark brown, nearly black on the sides; median dorsal and ventral surfaces lighter; spring and middle of legs still more pale.

Its distinguishing character consists in the two pure white spots, low down on each side of the abdomen, the posterior ones larger than the anterior by one-third to one-half, are arranged, when the back of the animal is viewed from above, in an equilateral quadrangle. The surrounding dark color immediately bordering the white spots is intense, but becomes paler more remote from them in all directions, and especially on the middle of the back. Antennæ four-jointed, smynthuriform, resembling those of *S. Bourletii*, Gerv.

Length from front of head to tip of abdomen .5 mm.; vertical diameter of abdomen .3 mm.; width of abdomen .23 mm.

This remarkably beautiful little Collembolan was found in company with a large species of *Papirius*, apparently near *P. ornatus*, Nicolet, feeding on a polyporous fungus which grew on a stump in a damp, shady ravine in East Fairmount Park. It is one of the smallest of our American species of *Smynthuridæ*, and is totally distinct from any described by Say, Harris, or Fitch, some of which are no doubt *Papiriidæ*. It may be one of the species which the latter entomologist mentions as being known to him, but to which he did not give names. The descriptions of both Harris and Fitch, in the absence of good figures, are vague and unsatisfactory.

The species I have no doubt will prove to be one new to science. In form it greatly resembles the *S. Bourletii*, but in marking and color it is so totally distinct that it would be immediately recognized as different.

OCTOBER 1.

The President, Dr. RUSCHENBERGER, in the chair.

Thirty-nine persons present.

The death of Thomas Potter, Sr., a member, was announced.

Foraminiferous Shells of our Coast.—Prof. LEIDY remarked that the vast numbers of Foraminiferous shells, which formed a constituent of the sea-side sands, had been a subject of frequent notice. Feeling interested to know their proportionate quantity on the comparatively barren shore of New Jersey, he had examined the sand at Atlantic City, and at Cape May. The sand in these localities mainly consists of quartz, with black grains, often in considerable quantity, and formerly largely collected for "writing sand," which he supposed to consist of ilmenite and magnetite. Among these were also brilliant red particles, which he supposed to be garnet. All these materials are the comparatively insoluble residue of our inland gneissic, and other rocks.

In sand scraped up from the surface between the tides at Atlantic City, he had found the Foraminiferous shells, all of one species of *Nonionina*, resembling that figured by Ehrenberg as *N. polypora*. They were found in the proportion of about 19,000 to the ounce avoirdupois of sand. In sand, obtained in the same manner at Cape May, there were about 38,000 shells, of the single species just named, to the ounce avoirdupois of sand.

The sands on the rocky New England coast are much richer in Foraminiferous shells, both in numbers and kinds, but they are generally smaller. In sand from the bathing beach at Newport, R. I., collected from the white lines left by the edge of the waves, there were 280,000 shells to the ounce of sand.

OCTOBER 8.

The President, Dr. RUSCHENBERGER, in the chair.

Fifty persons present.

On Crustaceans at Cape May, N. J.—Prof. LEIDY remarked that, in a recent visit to Cape May, N. J., he had been struck with the immense numbers of the Mole Crab, *Hippa talpoidea*, which inhabited the beach between tides. They were especially abundant above the village of Ocean Grove, but were also numerous below this point, down as far as the light-house. They were generally young, and not larger than the little finger nail. A few only were of mature size. In many positions they were so numerous, that they appeared like rolling pebbles, as they were exposed by the breaking of the surf on the shore, and as they rapidly followed the receding waves, and buried themselves in the sand. The sand, on being dug up, was found to be as full of them as an ordinary plum-pudding is of currants.

Below Ocean Grove, near low-tide mark, the Lady Crab, *Platyonichus occellatus*, was frequent. Above Ocean Grove, and above the high-tide line, in the dry sand, and in the bank covered with Sea-sand Grass, *Calamagrostis arenaria*, the burrows of the Sand Crab, *Ocypoda arenaria*, were numerous. and the animals frequent. One of these crabs, brought home after eight days, was still in good condition without once having been in water. It appeared to be fond of meat of any kind, and had been fed on beef and oysters.

Supplementary Note on the Aeronautic Flight of Spiders.—Rev. H. C. McCook remarked that, in the Proceedings of the Academy for 1877, pp. 308–312, would be found the result of some observations made by him upon the ballooning habits of spiders, which he was now able to supplement by several important items. The facts which he had to detail were observed Oct. 1, 1878, upon the farm of Mr. Geo. B. Lownes, about ten miles from Philadelphia, in Delaware County; and they would best be presented by giving the record made in his note-book of the flight of several spiders. The day was warm and bright, and a gentle breeze was blowing throughout the day. but not steadily from any quarter.

No. 1. A young Lycosid, apparently *Lycosa scutulata*, Hentz. On the side of a fence-post opposite to the wind, face downward, abdomen elevated, the body raised by the legs. Followed it after flight for 200 feet; it rose as high as 30 feet before it was lost sight of. Its flight was across a wide meadow, and promised to be a long one. Several threads were streaming out and up behind and before the spider.

No. 2. A saltigrade, probably the young of Hentz's *Attus vittatus*, on the side of a fence-board opposite the wind. Its legs elevated, raising up the body, abdomen turned well nigh straight upward, long thread floating out and up from the spinnerets; it walked several inches upward along the rail, keeping its body in the same stilted position, the thread meanwhile flying, and then was off, rather slowly, and about on a line with the face. There was one small thread in front and one (or more) behind. It moved straight forward for about 50 feet, and then rose suddenly upward.

No. 3. *Lycosa*, observed at 2 P. M. Actions as No. 1. Distinctly saw one thread before and apparently two behind; the head was toward the wind. After 15 feet it rose up and out of sight, a long stretch of meadow before it. Once before it mounted it lifted up one hind foot as though holding on to the stay thread.

No. 4. *Lycosa.* Followed for 40 to 50 feet; one thread apparently; in front a ray of several fine diverging threads floating behind from the spinnerets. Its back was toward the ground. Its abdomen seemed, but could not be certainly determined, to be riding in front. The body of the spider was thus at the apex of the angle formed by the fore and hind threads, the free points of which were quite far apart. The balloon struck a tree, and part of it went on, the spider apparently staying on the tree.

No. 5. *Lycosa.* The abdomen behind, *i. e.*, toward the point of departure. Several threads floating from it, one in front; feet gathered together, but, apparently, the back upward. It crossed the highway, and a carriage just then passing interfered with the observation.

No. 6. The head riding in front, back down—this is absolutely certain. A four-shaped steamer of threads thrown out before mounting. At first it moved off slowly. soon climbed up the fore thread, the "bow," so to speak; further on it climbed up the pencil of rays for several inches. The balloon, when lost sight of, had at least three separate pencil rays visible. It was followed 100 feet before it rose out of sight.

No. 7. *Lycosa.* Back down; sailed sidewise part of the time; head forward apparently afterward.

Many of the aeronauts noticed first turned the elevated abdomen to various points, as though testing the direction of the wind.

Most of the points noted in the previous communication were confirmed, and those, together with these now presented, seem to make quite complete the mode of ballooning, at least among the Citigrade, and perhaps also the Saltigrade Spiders. The whole process may be briefly given as follows: 1. The spider seeks a high position, as the top of a fence post, as the point of ascent; 2. The abdomen is elevated to as nearly a right angle with the cephalothorax as may be; 3. A *pencil of threads* is issued from the spinnerets, the face being meanwhile turned to various points until it looks in the direction of the wind; 4. The legs are stretched upward, thus raising the body aloft; 5. They gradually incline in the direction of the breeze, the joints straighten out, the legs sink forward and down till the first pair are almost on the level with the post, the whole attitude of the animal being that of one resisting some force exerted from above; 6. Suddenly and simultaneously the eight claws are unloosed, and the spider mounts with a sharp bound, apparently; 7. and floats off with the back downward generally, but sometimes with this position reversed; 8. At first the abdomen seems to be in advance, but generally the body is turned so that the head rides in front; 9. The pencil of threads is caught apparently by the feet, and floats out in front, upon which, 10, sometimes the spider will climb upward, as though to adjust the centre of gravity; 11. Meanwhile a thread or pencil of rays issues from the spinnerets which floats out behind, leaving the spider to ride in the angle of the two pencils, or 12, as it sometimes happens, of three, which diverge widely at the upper free ends; 13. The feet seem to be united by delicate filaments, which would serve to increase the buoyancy of the balloon; 14. The spider now is carried forward by the wind, riding for long distances in an open space, and often borne high upward upon ascending currents; 15. Its anchorage appears at times to be in its own volition, by drawing in with the claws the forward pencil and gathering it in a white roll within the mandibles; but, 16, most frequently the balloonist is stopped by striking against some elevated object or by the subsidence of the breeze; 17. A bright, warm day in October is commonly chosen for the ascent; and, 18, judging from the presence of a number of dry moults upon many posts, apparently of the same species of spider observed in flight, the animals had recently cast their skins. Of the above points, Nos. 3, 7, 9, 10, 11 in part, 12, 14 in part, 15 in part, and 18 are those which were determined by the last observation.

The object of this interesting habit seems to be the distribution of species.

Simian Characters in Negro Brains.—Dr. A. J. PARKER remarked that in a previous communication on the convolutions of the negro brain he had pointed out in one negro brain out of thirteen (then examined) the existence of an internal inferior pli de passage, which was as well developed as in any of the Simiadæ. In that brain the convolution measured a quarter of an inch in width, and completely separated the parieto-occipital or internal perpendicular fissure from the calcarine, so that this region presented the same appearance as it does in the Simians. This convolution is uniformly present in the brain of all the Simiadæ thus far described, except in *Ateles paniscus*, Huxley, and *Hylobates*, Bischoff. It had not been found in a fully developed condition in man before, and the absence of this small bridging convolution had been regarded by some anatomists as a distinguishing peculiarity of the human as compared with the anthropoid brain. Since then he had found this convolution present in another adult female negro brain. It was fully developed up to the surface, presented a superficial width of an eighth of an inch, and completely separated the parieto-occipital from the calcarine fissure. This convolution was, therefore, present in two cases out of thirty-three negro brains examined.

Turner describes (Edinburgh Medical Journal, 1866) a brain in which the fissure of Rolando joined the fissure of Sylvius completely, the small bridging convolution which usually separates them being completely absent. Pansch states that sometimes there is a superficial connection between these two fissures. Ecker says he has never met with such an instance. Dr. Parker had observed in one instance in the brain of an adult male negro the complete connection of these two fissures, no trace of a bridging or separating convolution being present.

OCTOBER 15.

The President, Dr. RUSCHENBERGER, in the chair.

Fifty-four persons present.

The following papers were presented for publication:—

"Descriptions of Ichneumonidæ chiefly from the Pacific Slope of the United States and British North America." By E. T. Cresson.

"The Solar Corona." By Jacob Ennis.

Notice of a Tetrarhynchus.—Prof. LEIDY stated that in the *Remora*, or Sucker, from our coast, presented this evening by Mr. Holbrook, he had found a curious parasite. This was inclosed in a compressed oval cyst, pearly white, thick-walled, and about half an inch long, tightly adherent to the intestine of the fish. The cyst contained a flask-shaped, translucent whitish sac, which was feebly contractile, and furnished at the narrow end with two minute papillæ, which were slowly protruded and retracted. Within this sac-worm, coiled up about the centre, was an opaque white worm or scolex, which proved to be a *Tetrarhynchus*. Removed and extended it measured 7 lines long, and was divisible about equally into a broad anterior body portion, and a posterior narrow tail-like portion. The head was formed of a pair of obcordate bothria inclined from each other. Four long tortuous proboscides extended through the body and projected from the head. The projecting portions were successively elongated and shortened by eversion and inversion, and were armed with recurved hooks. The hooks extended within half the length of the proboscides, and as they were everted and inverted appeared like the streaming of liquid through narrow tubes. The tortuous proboscides at the bottom were continuous with as many elliptical pedestals placed at the back part of the body. The tail, about half the width of the body, was not segmented, but exhibited a disposition to assume this condition. The end was slightly tapering, and occupied by a bell-shaped sinus opening externally and alternately contracting and expanding. The interior of the sinus was lined, and its mouth thickly furnished with non-vibratile cilia. The species appeared to be undescribed, and was named *Tetrarhynchus tenuicaudatus*.

OCTOBER 22.

The President, Dr. RUSCHENBERGER, in the chair.

Fifty-five persons present.

OCTOBER 29.

The President, Dr. RUSCHENBERGER, in the chair.

One hundred and seven persons present.

A paper entitled "On the Structure of the Gorilla," by H. C. Chapman, M.D., was presented for publication.

The death of Jonathan S. Helfenstein, a member, was announced.

Dr. J. B. Brinton and Messrs. Wm. T. Haines, Edmund Lewis, and Wm. Ayres were elected members.

The following paper was ordered to be printed:—

RECOVERY OF ALL THE FACULTIES IN A PIGEON FROM WHICH FOUR-FIFTHS OF THE UPPER PORTION OF THE CEREBRUM HAD BEEN REMOVED.

By J. H. McQuillen, M.D.

Monday, February 4th, 1878, in illustration of my regular course of lectures on Physiology in the Philadelphia Dental College, I exposed the cerebrum of a pigeon, as I have regularly done each session for the past twenty years, and cut out four-fifths of the upper portion in slices, to illustrate the fact that the sensorium thus exposed could be cut, pinched, or burned without any manifestation of suffering on the part of the animal. The usual phenomena attendant upon the operation followed, *i. e.*, profound stupor, the bird standing motionless on the table, with eyes closed, the head sunk between the shoulders, and the feathers ruffled. When pushed it opened its eyes and moved the body, when thrown into the air it flew a few feet, and then on lighting relapsed into somnolency with an evident obliviousness to surrounding objects until again aroused by handling. In this condition, along with another pigeon from which the cerebellum had been removed, it was shown to the members of the Biological and Microscopical Section of the Academy of Natural Sciences, on the evening of that day at the regular monthly meeting of the Section. Prof. Emily White, M.D., Professor of Physiology in the Woman's Medical College, who was present, having manifested much interest in the pigeons, I offered to send them to the Woman's College so that she could show them to the students, with the request that an effort should be made to keep them alive, and ascertain whether the functions of the cerebrum and cerebellum would be restored. Other duties of an absorbing character so occupied my time and attention that I had quite forgotten the request made by me until March, when a note was received from Prof. White stating that "the pigeon from which the cerebrum was partially removed seems to have recovered all his faculties. He is, perhaps, less excitable than normal, seems perfectly tame, but bright. . . . The other pigeon died on the third day after the removal of the cerebellum."

I at once sent for the pigeon, and was surprised at the complete recovery of the voluntary movements of walking and flying, the power of feeding itself and drinking as usual, and the general manifestation of intelligence. There could be no question about the identity of the pigeon. It was of a peculiar breed, and the cicatrix on the neck, where the incision had been made so as to throw the scalp back and expose the cranium, along with a soft place on the latter from which a portion of bone had been removed, left no doubt on that point. I again exhibited it at the monthly meeting of the Biological and Microscopical Section, March 4th, and the members were surprised to find it fly about from one end of a long room and back again, feed itself, etc.

I asked then, and I repeat now the same question, How are we to account for the restoration of these functions? Is it due to the fact that the small portion of the cerebrum left after the operation assumed the functions of the entire organ, or has there been a regeneration of the part removed? Vulpian, one of the most accurate and reliable of the recent experimentalists and observers of these phenomena, positively asserts that an animal from which the cerebral hemispheres have been removed, is incapable of a spontaneous voluntary movement. In this he is apparently supported by every observer, with only one exception, Voit.

The latest author, in writing on this subject, M. Foster[1] (whose views may be regarded as summing those generally entertained), says: When the cerebral hemispheres are removed from a bird the animal is able to maintain a completely normal posture, and that too when the corpus striata and optic thalami are taken away at the same time. It will balance itself on one leg, after the fashion of a bird which in a natural way has gone to sleep. In fact the appearance and behavior of a bird which has been deprived of its cerebral hemispheres are strikingly similar to those of a bird sleepy and stupid. Left alone in perfect quiet, it will remain impassive and motionless for a long time, it may be for an almost indefinite time. When stirred it moves, and then on being left alone returns to a natural easy position. Placed on its side or on its back it will regain its feet; thrown into the air it flies with considerable precision for some distance before it returns to rest. It frequently tucks its head under its wings, and if by judicious feeding it has been kept alive for some time after the operation, it may be seen to clean its feathers, and to pick up corn

[1] A Text Book of Physiology, by M. Foster, M.A., M.D., F.R.S. London, MacMillan & Co., 1878.

or drink water presented to its beak.[1] It may be induced to move not only by ordinary stimuli applied to the skin, but also by sudden sharp sounds, or flashes of light; and it is evident that its movements are, to a certain extent, guided by visual sensations, for in its flight it will, though imperfectly, avoid obstacles. Save that all signs of volition are absent, that the movements are on the whole clumsy, resembling rather those of a stupid, drowsy bird than those of one quite wide awake, there is very little to distinguish such a bird from one in full possession of its cerebral hemispheres.

There is but one other case on record that I have met with, where there has been a recovery of voluntary action on the part of a pigeon from which the cerebral hemispheres had been removed, and I was not aware of that fact until the experience with my pigeon induced me to make a careful examination of the literature of the subject. I refer to the pigeon kept alive by Voit for five months after the cerebral lobes had been completely removed. "At first the pigeon presented the phenomena usually observed after this operation; but it gradually recovered, until it seemed entirely normal, with the single exception that it never would eat, all food being introduced forcibly. Five months after the operation the pigeon was killed, and the encephalic cavity was found filled with a white substance containing dark-bordered nerve-fibres and nerve-cells. Voit never before observed anything like regeneration of the nervous substance or so complete a restoration of the cerebral functions, and he regarded this as an instance of anatomical and physiological regeneration of the hemispheres." Flint,[2] from whom this extract has been taken, goes on to say that "the objections to accepting this observation, with the physiological conclusions presented by Voit, are that it is not only possible, but probable, that the hemispheres were not entirely removed, and that the posterior portion of the encephalon had advanced to occupy in part the space originally filled by the extirpated mass. While we do not assume that anatomical and functional regeneration of the cerebrum in a pigeon is impossible, it must be admitted that such an extraordinary state-

[1] Bischoff and Voit, Sitzungsberichte Acad. Wiss. München, 1863, pp. 479, 469, 1868, p. 105.

[2] Human Physiology, by Austin Flint, Jr., M. D. N. Y., D. Appleton & Co., 1876, p. 699.

ment as that made by Voit cannot be accepted without reserve, merely upon the basis of a single observation."

In contrast to this case it must be remembered that I only removed the upper four-fifths of the cerebrum. In doing this, however, the superficial gray matter of the hemispheres, recognized as the structure physiologically concerned in the exercise of the faculties of attention, perception, memory, and will, was removed.

The subject of the present communication continued in the full possession of its faculties for six months, when, in the presence of several scientific friends it was put to death under chloroform, and a *post-mortem* examination made. On removing the scalp a fibrous structure, analogous to pericranium, was found, occupying the place from which the bone had been removed, in making the vivisection. Cutting this away, a small amount of fluid escaped, and the cranial cavity thus exposed was found occupied by a white substance resembling the cerebral structure that had been removed six months before. Placing a section of the upper portion of this, which had been stained with hematoxyline, under the microscope, a number of bipolar cells characteristic of the gray structure were observed.

That the bird should have survived such an operation and lived for six months after in the full possession of its faculties, is a remarkable illustration of the recuperative powers of the system. And the regeneration of the parts removed is additional evidence in substantiation of the case reported by Voit.

Unwilling that such an important question should merely rest upon my own observation, I requested the appointment of a committee by the Biological and Microscopical Section to examine the regenerated structure.

The following report on the microscopic characters of the regenerated tissue was prepared by Dr. Carl Seiler, Chairman of the Committee:—

"The specimen handed to me by Dr. J. H. McQuillen appeared to be the medulla, cerebellum, and part of the cerebrum of a bird. Intimately connected with the parts were two tumor-like growths, the one spherical, and of the size of a pea; the other of irregular outline, and smaller than the first.

"A microscopical examination of these growths revealed them to be composed of nerve-tissue, showing longitudinal and transverse sections of nerve-fibres, and, in some places, multipolar ganglionic cells. The bloodvessels which in the round growth appeared to radiate from a common centre at the base of the growth were filled with oval blood-disks."

This report was accompanied by a section of the brain placed under the microscope, and a micro-photograph, showing the multipolar nerve-cells, prepared by Dr. Seiler.

NOVEMBER 5.

The President, Dr. RUSCHENBERGER, in the chair.

Sixty-six persons present.

The following papers were presented for publication :—

"On a Belt of Serpentine and Steatite in Radnor Township, Del. Co." By Theodore D. Rand.

"Description of three new Species of Calceolæ, from the Upper Silurian Rocks of Kentucky." By Victor W. Lyon.

Calluna Vulgaris.—Mr. THOMAS MEEHAN referred to a statement in a botanical periodical about the Heath being found apparently indigenous in New Jersey. He had visited the given location in company with Mr. Chas. F. Parker, one of the curators of the Academy, and gave his reasons in detail for concluding that it had been introduced probably about twelve years ago. It showed no disposition to get beyond the original place of planting. He referred to the facts given in *Silliman's Journal* of 1861 and 1862, in regard to the discovery of the same plant at Tewkesbury, Mass , pointing out their inconclusive character, and expressing his opinion that, as in the New Jersey case, it was introduced there.

The following paper was ordered to be printed :—

DESCRIPTIONS OF ICHNEUMONIDÆ, CHIEFLY FROM THE PACIFIC SLOPE OF THE UNITED STATES AND BRITISH NORTH AMERICA.[1]

BY E. T. CRESSON.

Ichneumon solitus, Cresson (Trans. Am. Ent. Soc., vi. 144).

♀.—Black, immaculate; mesothorax, scutellum and abdomen shining, the latter rather strongly tinged with blue or purple; antennæ rather stout, strongly involute, with a pale annulus beyond middle; third joint more than twice longer than broad, and conspicuously longer than the fourth; scutellum flat, polished, and nearly destitute of punctures; metathorax broadly and deeply excavated behind, central area large pentangular, rounded laterally and emarginate posteriorly; wings uniformly pale fuliginous; femora robust, anterior tibiæ pale in front; posterior coxæ nude; abdomen oblong ovate, finely, closely, and evenly punctured, apex polished; apex of first segment broadly dilated and punctured; gastrocæli small and deep. Length .30–.42 inch.

Hab. Lake Lahache, B. Col. (Crotch); Colorado (Smith).

Ichneumon odiosus, Cresson (Trans. Am. Ent. Soc., vi. 145).

♂.—Black; anterior orbits, dilated on sides of face, short line in front of tegulæ, dot beneath, and tips of anterior femora and the four anterior tibiæ in front, white; scutellum convex, punctured; metathorax with strongly defined elevated lines, central area rather large, subreniform; wings faintly dusky, nervures and stigma black; legs slender; abdomen slightly tinged with blue, closely and strongly punctured, strongly constricted at base of segments three and four; apex of first segment moderately broad, raised medially and punctured; gastrocæli small and deep. Length .56 inch.

Hab. California (Behrens).

[1] In the early part of the year 1877 this paper was presented to the California Academy of Natural Sciences for publication in its Proceedings, and accepted with the assurance that it would be published in the volume for that year; with this understanding, the species of *Ichneumon*, *Hoplismenus*, *Amblyteles*, *Trogus*, and *Platylabus* herein described, were referred to in my paper on the Subfamily Ichneumonides (Trans. Am. Ent. Soc., vi. p. 129), as published in the Proc. Cal. Acad. Nat. Sci., 1877; but after a delay of over a year, the Academy finding it impossible to publish the paper in any reasonable time, the same was withdrawn.

Ichneumon neutralis, Cresson (Trans. Am. Ent. Soc., vi. 149).

♂.—Black; anterior orbits, broad on face, lower posterior orbits, dot on each side of clypeus, spot at base of mandibles, palpi, line before tegulæ, short one beneath, dot on tegulæ anteriorly, scutellum, anterior femora in front, four anterior tibiæ in front and intermediate knees, all white; scutellum subconvex, sparsely punctured; metathorax transversely rugose, posterior face oblique, bounded above by a sharp carina, central area of moderate size, rounded anteriorly, and truncate posteriorly; wings smoky hyaline, nervures and stigma black; legs moderately slender; abdomen faintly tinged with blue, closely punctured, somewhat shining; apex of first segment not broadly dilated; gastrocœli deep. Length .56 inch.

Hab. California (H. Edwards). Closely allied to *subcyaneus*, but is distinguished from that species by the posterior legs being entirely black.

Ichneumon salvus, Cresson (Trans. Am. Ent. Soc., vi. 166).

♂.—Black; face, clypeus, mandibles, palpi, scape beneath, upper margins of prothorax, tegulæ, short line beneath, scutellum and post scutellum, yellow; mesothorax with two longitudinal, dull, ferruginous lines dilated anteriorly; scutellum convex, polished, very abrupt at sides; metathorax entirely black, obliquely truncate behind, with large transversely quadrate central area; wings pale yellowish hyaline, stigma fulvous; legs yellowish, femora ferruginous, with coxæ more or less black above, tips of posterior tibiæ dusky; abdomen opaque, densely punctured, apex of first segment, and the second and third entirely, except narrow black posterior margin, yellow; fourth segment ferruginous, black at tip, remainder black; apex of first segment broad, coarsely longitudinally rugose and pyramidal in profile; gastrocœli very large and deep; apical segments almost smooth, and shining; venter black, segments 2–4 yellowish ferruginous. Length .66 inch.

Hab. Vancouver's Island (H. Edwards).

Ichneumon indemnis, Cresson (Trans. Am. Ent. Soc., vi. 172).

♀.—Long, cylindrical, ferruginous; suture at base of antennæ, middle of vertex, spot inclosing ocelli, apex of antennæ, sutures of thorax more or less, tips of posterior femora and of the tibiæ, apex of second, third, and fourth abdominal segments and the fifth and following segments entirely, black; head rather narrow, buccate; antennæ slender, third joint long and cylindrical, as long as first and second together, and nearly twice as long as the fourth; scutellum convex, yellow; metathorax truncate behind, central area large and oblong subquadrate; wings smoky hyaline; legs slender; abdomen long, narrow, linear, subcompressed at tip; first segment subquadrate at tip, slightly narrowed to base of second segment, so that the sides are somewhat rounded, lateral margins depressed, the raised middle being indistinctly aciculated; base of second segment narrowed, depressed, faintly longitudinally sculptured; gastrocæli subobsolete; last ventral segment long, narrow, not retracted. Length .42 inch.

Hab. British Columbia (Crotch).

Ichneumon purpuripennis, Cresson (Trans. Am. Ent. Soc., vi. 175).

♀.—Ferruginous; head buccate; antennæ robust, with short, stout joints, black, the basal joints generally ferruginous, sometimes entirely black, apex more or less involute; scutellum flat, shining, sparsely punctured; metathorax opaque, finely rugosely punctured, rather deeply excavated behind, central area subquadrate; wings fuscous, with a more or less strong violaceous reflection, stigma varies from black to fulvous; legs subrobust, posterior tarsi sometimes fuscous; abdomen broadly fusiform, finely and closely punctured, becoming gradually less distinct beyond third segment; apex of first segment broadly dilated and longitudinally aciculated; gastrocæli small and rather deep; basal margin of third or fourth segment, or both, sometimes narrowly black. Length .50 inch.

Hab. California (Behrens, H. Edwards, Stretch).

Ichneumon cupitus, Cresson (Trans. Am. Ent. Soc., vi. 175).

♂.—Ferruginous; antennæ except scape, sometimes occiput and middle of vertex, and sutures of thorax more or less black; face, scutellum and anterior legs in front pale ferruginous or yellowish; scutellum subconvex, shining, and sparsely punctured; central area of metathorax quadrate; wings fuliginous, violaceous; abdomen opaque, closely and finely punctured; apex of first segment rather narrow, shining, minutely aciculated; gastrocæli large and deep. Length .60 inch.

Hab. California (Behrens). May be the ♂ of *purpuripennis.*

Ichneumon crudosus, Cresson (Trans. Am. Ent. Soc., vi. 175).

♂.—Head, antennæ, and thorax black; face yellow; mandibles, palpi, upper anterior orbits, scape, mesothorax except central black stripe, scutellum, metathorax above each side of central area and tegulæ ferruginous; scutellum convex, polished; central area of metathorax small, subrotund; wings violaceous black; legs and abdomen entirely ferruginous, the latter narrow, opaque, densely and finely punctured; apex of first segment narrow, aciculated; gastrocæli large and deep. Length .70 inch.

Hab. California (H. Edwards).

Ichneumon compar, Cresson (Trans. Am. Ent. Soc., vi. 175).

♀.—Ferruginous; head strongly buccate, anterior orbits and palpi yellowish; antennæ with short stout joints, apex black; collar yellow above; scutellum flat, shining, sparsely punctured; metathorax strongly punctured, posterior face deeply excavated, bounded above by a sharp carina, central area quadrate; sutures of thorax sometimes more or less broadly margined with black, in one specimen the pleura beneath is almost entirely black; wings yellowish fuscous, stigma honey-yellow; femora robust, sometimes the posterior tibiæ is more or less yellowish at base, and the anterior legs tinged with yellow in front; abdomen fusiform, very closely and finely punctured, smooth at apex; apex of first segment broadly dilated and longitudinally aciculated; gastrocæli rather large and deep. Length .55 inch.

Hab. Vancouver's Island (H. Edwards). Closely allied to *purpuripennis*, which has stouter antennæ, with shorter basal joints, etc.

Ichneumon difficilis, Cresson (Trans. Am. Ent. Soc., vi. 176).

♂.—Head black, upper anterior orbits, face, clypeus, mandibles, except tips, palpi, and scape beneath yellow; thorax black, upper margin of prothorax, large furcate mark on mesothorax, scutellum, and metathorax above more or less ferruginous; tegulæ, short line beneath and sometimes the scutellum, yellow; scutellum subconvex, polished; wings fuscous, stigma fulvous; legs ferruginous, coxæ and tips of posterior tibiæ black; abdomen ferruginous, densely punctured, opaque, base of segments three, four, and five, more or less black: apex of first segment coarsely aciculated; gastrocæli large and very deep. Length .56 inch.

Hab. California (Behrens).

Var.? Pale ferruginous; thorax same as the above, with the scutellum yellow; *four anterior coxæ yellow;* apex of first abdominal segment nearly smooth, scarcely aciculated; black bands at base of segments 3—5 narrow.

Hab. Vancouver's Island (H. Edwards).

Ichneumon nuncius, Cresson (Trans. Am. Ent. Soc., vi. 176).

♂.—Black; face, anterior orbits, lower posterior orbits, clypeus, mandibles except tips, scape beneath, upper margin of prothorax, tegulæ, short line beneath, scutellum, post-scutellum, and posterior face of metathorax more or less pale yellow; mesothorax with two pale lines or a spot on the disk; scutellum convex, polished; elevated lines of metathorax sharply defined, posterior face obliquely truncate, central area quadrate; wings hyaline, dusky at tips, stigma fulvous; legs ferruginous. four anterior coxæ and trochanters yellow, their femora, tibiæ, and tarsi yellowish in front; posterior coxæ, trochanters and tips of their tibiæ black; apex of their coxæ beneath, and tips of their tarsi yellowish; abdomen ferruginous, first segment black, with the apex ferruginous, aciculated; gastrocæli rather large and moderately deep. Length .55 inch.

Hab. California (H. Edwards).

Ichneumon sequax, Cresson (Trans. Am. Ent. Soc., vi. 181).

♀.—Ferruginous, shining, finely, rather feebly punctured; anterior orbits pale; antennæ long, slender, black, scape ferruginous, third joint long, cylindrical, longer than fourth, apex of flagellum attenuated; scutellum broad, flattened, broadly truncate at tip, the lateral region, basal excavation and carinæ, pleura except lateral spot, sides of prothorax more or less, and base and flanks of metathorax black; metathorax truncate behind, lateral angles prominent. central area large, quadrate; wings hyaline, faintly dusky, stigma black; legs slender, entirely ferruginous; abdomen broadly fusiform, depressed, polished at tip; apex of first segment broad, and finely aciculated; gastrocæli oblique and deep. Length .50 inch.

Hab. Vancouver's Island (H. Edwards).

Ichneumon hiemalis, Cresson (Trans. Am. Ent. Soc., vi. 181).

♀.—Small, densely sculptured, ferruginous, space behind antennæ, apex of flagellum, pleura and metathorax black; antennæ yellowish-ferruginous, rather long, slightly thickened towards tip, joints short, third about twice longer than broad and subequal with fourth; scutellum flattened; metathorax obliquely truncate behind, central area quadrate; wings dusky, stigma yellow; legs slender, four posterior coxæ black, ferruginous at tips; abdomen fusiform, depressed, densely coarsely sculptured, smooth and shining at apex; first segment rather broadly dilated at tip, and coarsely longitudinally sculptured, gastrocæli obliquely linear. Length .30 inch.

Hab. Aleutian Islands (H. Edwards).

Ichneumon cestus, Cresson (Trans. Am. Ent. Soc., vi. 182).

♀.—Pale ferruginous, opaque, densely and finely punctured; antennæ slender, third joint long, cylindrical, much longer than fourth, apical joints blackish; anterior angle of prothorax, basal excavation of scutellum, basal suture of metathorax, irregular patch on disk of second abdominal segment and broad band at base of third segment, black; scutellum depressed, polished, punctured, sides abrupt, apex rounded; metathorax coarsely punctured, excavated behind, with spiniform lateral angles, central area quadrate, not well defined; wings yellowish hyaline, a fuscous cloud along base of first submarginal cell, stigma fulvous; tips of posterior tibiæ slightly dusky, their coxæ beneath with a small pubescent patch near tip; abdomen fusiform, apex of first segment broad and finely scabrous; gastrocæli transversely linear, rather deep. Length 40 inch.

Hab. Vancouver's Island (H. Edwards). Easily recognized by the broad black band at base of third abdominal segment, and by the subfasciate wings.

Ichneumon russatus, Cresson (Trans. Am. Ent. Soc , vi. 183).

♀.—Ferruginous; head and mesothorax sparsely punctured; head buccate, middle of face prominent; antennæ short. robust, strongly involute, scape subglobose, third joint nearly subquadrate, and equal with fourth, the joints towards apex thickened, obfuscated; scutellum flat, polished, with a few scattered punctures; metathorax deeply excavated behind, with rather prominent subspiniform lateral angles, central area subquadrate; sutures of prothorax beneath, suture at base of scutellum, as well as its lateral region, and lower margin of metathorax, black; wings fusco-hyaline; abdomen fusiform, very densely and minutely sculptured on second and third segments, apical segments smooth and shining; apex of first segment gradually dilated, rather coarsely aciculated, depressed, not at all raised medially; gastrocæli subobsolete; a fuscous stain on second segment (which may be accidental). Length .40 inch.

Hab. Vancouver's Island (H. Edwards).

Ichneumon semissis, Cresson (Trans. Am. Ent. Soc., vi. 183).

♀.—Ferruginous, opaque; head broad, sub-buccate; antennæ moderately slender, dusky at tips, third joint more than twice longer than broad, and a little longer than fourth; anterior angle of mesothorax and basal and lateral regions of scutellum black; scutellum subconvex, shining, rounded at tip; metathorax roughly punctured, rather deeply excavated behind, with prominent obtuse lateral angles, central area quadrate; wings pale yellowish-fuscous; abdomen fusiform, rather strongly punctured on second segment, apical segments gradually smoother and shining; apex of first segment gradually, rather broadly dilated and feebly aciculated; gastrocæli shallow, not well marked. Length .40 inch.

Hab. Mohave Desert, California (Crotch).

Ichneumon petulcus, Cresson (Trans. Am. Ent. Soc., vi. 185).

♀.—Small, robust, ferruginous, shining; head strongly buccate, face short and prominent on middle, polished; antennæ short, robust, with short close-set joints, scape globose; third joint nearly quadrate, equal with third, flagellum obfuscated; front behind antennæ deeply excavated, occiput deeply emarginate; mesothorax subtrilobate; scutellum flat, polished; metathorax deeply excavated behind, lateral angles rather prominent, central area subquadrate; lateral region of scutellum, spot on sides of prothorax, anterior margin of pleura and lower margin of metathorax, black; wings hyaline, faintly tinged with yellowish; legs robust; abdomen fusiform, finely punctured, shining at apex; first segment gradually dilated at tip and depressed, indistinctly sculptured; gastrocæli obsolete. Length .26 inch.

Hab. San Barbara, California (Crotch).

Hoplismenus pacificus, Cresson (Trans. Am. Ent. Soc., vi. 186).

♀.—Black, opaque; mandibles and palpi brownish; clypeus sometimes more or less ferruginous; antennæ slender, with a yellowish-white annulus, scape ferruginous beneath; scutellum strongly gibbous, convex, or subpyramidal, shining; metathorax coarsely, transversely rugose, smoother on each side at base, truncate behind, lateral angles very prominent, obtuse, central area quadrate, sometimes longitudinally rugose; wings uniformly fuliginous, with a strong violaceous reflection, nervures and stigma black; legs, with coxæ, ferruginous, sometimes brownish-ferruginous, posterior tibiæ fuscous, the base often more or less ferruginous, their tarsi whitish with basal joint almost entirely fuscous; abdomen broad, ovate, depressed, shining at tip, second and third segments closely and strongly punctured, the punctures confluent at base of second, gastrocæli large and deep; apex of first segment broad, scabrous; venter shining. Length .70 inch.

♂.—More slender; sides of face yellow; clypeus, labrum, and scape beneath ferruginous, flagellum entirely black; legs pale ferruginous. Length .55 inch.

Hab. Vancouver's Island (H. Edwards).

Amblyteles mormonus, Cresson (Trans. Am. Ent. Soc., vi. 190).

♀.—Deep black; four anterior legs, except coxæ and trochanters, and posterior femora ferruginous; antennæ long, slender, basal joints of flagellum long and cylindrical; head small, cheeks flat; thorax robust, strongly punctured; scutellum depressed; metathorax obliquely truncate behind, central area transverse; tegulæ fuscous; wings fuscous, rather paler at tips; legs subrobust, posterior tibiæ and tarsi unusually robust, the latter short; abdomen broadly fusiform, opaque at base, shining at tip, apex of first segment broad, aciculated; second and third segments closely and strongly punctured, longitudinally rugose at base of second, gastrocæli small and deep; last ventral segment scarcely retracted. Length .45 inch.

Hab. Great Salt Lake, Utah.

Amblyteles hiulcus, Cresson (Trans. Am. Ent. Soc., vi. 194).

♀.—Long, narrow, cylindrical, shining ferruginous; sutures of thorax, apex of posterior tibiæ and sometimes of their femora, and basal margins of abdominal segments 3–5, black; head narrow, buccate; antennæ long, slender, curled, and fuscous at tip, third joint at least three times longer than broad, cylindrical, much longer than fourth; mesothorax strongly punctured, convex; scutellum subconvex, polished; metathorax obliquely truncate behind; wings dusky-hyaline, stigma yellow; legs slender; abdomen smooth and polished, long, narrow, subcompressed at tip; apex of first segment narrow, with almost parallel sides, depressed above and indistinctly sculptured; base of second slightly narrowed, depressed, very finely and sparsely punctured, gastrocæli longitudinal, subobsolete; last ventral segment long, narrow, not retracted. Length .48 inch.

Hab. Lake Lahache, British Columbia (Crotch).

Trogus Edwardsii, Cresson (Trans. Am. Ent. Soc., vi. 195).

♂.—Black; head transversely subtriangular, not at all buccate; face, clypeus, labrum, mandibles, palpi, narrow upper anterior orbits, line on posterior orbits, scape beneath, and most of flagellum beneath, two spots in front of mesothorax, scutellums, elevated disk of metathorax and tegulæ, ferruginous; scutellum acutely pyramidal; metathorax with two sharp longitudinal ridges behind, between which the surface is coarsely and transversely rugose; wings blackish-fuliginous, violaceous; legs slender, yellowish-ferruginous, four anterior coxæ at base and posterior pair entirely black; abdomen depressed, longitudinally aciculated, the segments strongly constricted at base, especially at sides, ferruginous, a black spot on disk of second and following segments, becoming gradually larger, until the one on the fifth covers nearly the entire upper surface of the segment; apex of first segment quadrate, narrowing suddenly before tubercles; gastrocæli large and deep. Length .73 inch.

Hab. Vancouver's Island (H. Edwards). A very pretty species.

Trogus buccatus, Cresson (Trans. Am. Ent. Soc., vi. 199).

♀.—Robust, ferruginous; head large, strongly buccate, cheeks much swollen; tips of mandibles and antennæ, except base, black; scutellum gibbous, convex, sides very abrupt; metathorax scabrose, with two sharp, divergent carinæ behind, between which the surface is transversely striated, central area small, raised and not well defined; wings violaceous black in one specimen, and yellowish-fuscous in another; stigma fulvous, areolet shaped as usual in the genus; abdomen robust, subconvex, densely and finely punctured; gastrocæli large, but not deep. Length .60 inch.

Hab. Vancouver's Island (H. Edwards).

Platylabus consors, Cresson (Trans. Am. Ent. Soc., vi. 200).

♂.—Black; anterior orbits, broad on face, line on posterior orbits, sides of clypeus, spot on mandibles, palpi, scape beneath, upper margin of the prothorax narrowly, sometimes interrupted, dot on tegulæ and a line beneath, white; antennæ as long as the body, slender; scutellum distinctly margined, with a pale spot towards tip; metathorax obliquely truncate behind, lateral angles small, subspiniform; wings hyaline; legs blackish, tips of posterior coxæ, their trochanters and all the femora ferruginous, spot on anterior coxæ beneath, spot on four anterior trochanters and their femora and tibiæ in front whitish; abdomen shining, feebly punctured; gastrocæli deep, transverse. Length .35 inch.

Var. Abdomen black, with segments 2–5 narrowly margined with red at apex; metathorax entirely black, legs mostly black, posterior femora only tinged with red.

Hab. California (Behrens). This may be the ♂ of *californicus.*

Platylabus californicus, Cresson (Trans. Am. Ent. Soc., vi. 201).

♀.—Ferruginous, shining; anterior, and sometimes posterior, orbits more or less white; occiput sometimes blackish; antennæ long, slender, more or less black; upper margin of prothorax sometimes narrowly white; mesothorax often varied with black; scutellum strongly margined; metathorax obliquely truncate behind, bounded above and laterally by a sharp carina, lateral angles prominent, spiniform; wings hyaline; abdomen polished, a few small punctures at base of second segment; gastrocæli transverse, deep, nearly meeting on disk, apex of first segment rather broad, depressed, smooth, sparsely punctured. Length .35 inch.

Hab. San Zalito, California (Behrens.).

Phygadeuon Crotchii, n. sp.

♀.—Robust, black, shining; mandibles, palpi and upper anterior orbits more or less ferruginous; antennæ long, stout, a broad white annulus on middle, third joint rather more than twice longer than broad, and equal with fourth; mesothorax finely punctured; scutellum triangular, flat, sparsely punctured; metathorax opaque, densely sculptured, not areolated, broadly excavated behind, lateral angles prominent, tuberculiform; tegulæ ferruginous; wings yellowish-hyaline; legs subrobust, ferruginous, coxæ, trochanters, posterior femora except base, and tips of their tibiæ black, anterior tibiæ yellowish; abdomen depressed, smooth and polished, apex of first, and second segment entirely, ferruginous; first segment robust, broad at apex; ovipositor short. Length .38 inch.

Hab. Lake Lahache, British Columbia (G. D. Crotch). A very distinct species.

Phygadeuon albirictus, n. sp.

♂.—Black; head buccate, cheeks swollen; mandibles, palpi, scape beneath and tegulæ, white; wings hyaline, iridescent; metathorax areolated; anterior legs, and four posterior tibiæ ferruginous, four anterior trochanters pale, tips of posterior tibiæ blackish; abdomen shining, impunctured, first and base of second segment finely aciculate, narrow apical margin of second, and most of third segment pale ferruginous; first segment narrow, slightly wider towards apex. Length .20 inch.

Hab. California (H. Edwards).

Phygadeuon limatus, n. sp.

♀.—Black, shining; head scarcely buccate; mandibles, antennæ at base, tegulæ, legs and abdomen, except first segment, ferruginous; palpi pale; antennæ slender, basal joints of flagellum slender, cylindrical; metathorax strongly areolated, excavated behind, with prominent lateral angles; wings hyaline, areolet quite small, 5-angular; legs slender, posterior tarsi blackish; abdomen ovate, convex, smooth, polished, impunctured, first segment gradually dilated to apex, with prominent lateral tubercles behind the middle, apex narrower than base of second segment; ovipositor about half the length of abdomen. Length .25 inch.

Hab. California (H. Edwards).

Phygadeuon crassipes, Provancher (Nat. Can. ix., p. 11).

♀.—Robust, black; clypeus, mandibles, palpi, antennæ except tips, tegulæ, legs and abdomen ferruginous; antennæ robust, with short, thick-set joints; disk of mesothorax flat, depressed and rugose; excavation at base of scutellum bifoveolate, deep; metathorax distinctly areolated, the carinæ sharp and well defined, posterior face deeply excavated. lateral angles prominent, central area transversely ovate; wings fuscous; legs robust, femora swollen, tibiæ dilated at apex, and strongly setose; abdomen smooth, shining, impunctured, apex of first segment broadly dilated, flattened. Length .20-.30 inch.

Hab. California; Vancouver's Island (H. Edwards).

Phygadeuon californicus, n. sp.

♂.—Black, shining; head large, face pubescent; clypeus, mouth, antennæ at base beneath, tegulæ, legs and abdomen, ferruginous;

antennæ long; metathorax strongly areolated, truncate behind; wings smoky; legs subrobust; abdomen elongate, shining, impunctured, first segment blackish at base, strongly bicarinate before apex, which is a little narrower than base of second segment; apical segment black. Length .25 inch.

Hab. California (H. Edwards). This may be the ♂ of *crassipes.*

Phygadeuon fulvescens, n. sp.

♀.—Shining, fulvo-ferruginous; apical half of antennæ black, third joint rather more than twice longer than wide, and longer than fourth; cheeks, mesothorax, and scutellum polished, impunctured; metathorax subopaque, not areolated, deeply excavated behind, lateral angles prominent, the carina being sharp, a triangular rugose space on summit; sutures of thorax beneath more or less black; wings smoky, stigma fulvous; legs subrobust, tibiæ smooth; abdomen polished, impunctured, apex of first segment gradually dilated to tip, which is moderately broad; ovipositor short. Length .35 inch.

Hab. California (H. Edwards).

Cryptus proximus, Cresson (Proc. Ent. Soc., Phila., iii. p. 290).

♀.—Black, legs except coxæ ferruginous; wings violaceous, black; abdomen with a bluish tinge; all the coxæ slender, simple; antennæ setaceous, very slender. Length .65 inch.

Hab. Vancouver's Island (H. Edwards). Differs from Colorado specimens only by the darker wings.

♀ var.? *perplexus.*—Scape beneath, spot on mandibles and the legs, including coxæ and trochanters, brown-ferruginous.

Hab. California (H. Edwards).

Cryptus dirus, n. sp.

♀.—Black; abdomen except first segment ferruginous; anterior legs tinged with ferruginous; antennæ slender, fourth joint about two-thirds the length of third; a short narrow pale line on posterior orbits; prothorax, pleura, and metathorax rugose; mesothorax finely punctured; wings fuliginous, areolet moderate, side nervures slightly oblique; tarsi simple; abdomen shining, impunctured; ovipositor nearly as long as abdomen. Length .43 inch.

Hab.—California (H. Edwards).

Cryptus relativus, n. sp.

♀.—Black; legs except coxæ, trochanters, posterior tibiæ, and tarsi, and abdomen except first segment more or less, ferruginous; line or spot on anterior orbits and posterior orbits narrowly whitish; antennæ setaceous, very slender, the fourth joint about three-fourths the length of third, which is long and cylindrical; mesothorax with deeply impressed longitudinal lines, shining, confusedly punctured; prothorax, pleura, and metathorax opaque, rugose, obliquely so on sides of metathorax, which is truncate behind, with prominent subacute lateral angles, disk with a subtriangular, ill-defined inclosure; wings fuscous or fuliginous, areolet moderate. with side nervures slightly oblique; legs slender, the joints of the four anterior tarsi dilated and spinose. posterior tarsi fuscous; abdomen impunctate, with first segment slender at base, gradually and slightly dilated to apex, bicarinate on disk, black, the apex sometimes ferruginous; ovipositor two-thirds the length of abdomen. Length .55 inch.

Hab. British Columbia (Crotch). Closely related to *robustus* Cres., from Colorado, which also has the four anterior tarsi dilated, but has all the tibiæ ferruginous, the abdomen black, with the apex only sometimes ferruginous.

Cryptus pictifrons, n. sp.

♂.—Black; four anterior legs except coxæ and trochanters, posterior femora and the abdomen except first segment fusco-ferruginous; anterior orbits, broad on face, line on posterior orbits, spot on clypeus and spot on mandibles, white; mesothorax and scutellum shining, rest of thorax rugose, opaque; a well-defined arcuated carina across metathorax on verge of truncation, and an irregular transverse one across the middle, the space between the two longitudinally rugose; wings hyaline, areolet moderate, almost quadrate; posterior tibiæ and basal joints of tarsi black, remainder of their tarsi whitish; abdomen slender, shining, impunctate. first segment slightly broader posteriorly, with prominent lateral tubercles. Length .52 inch.

Hab. Green River, Wyoming Territory (Putnam).

Cryptus tejonensis, n. sp.

♀.—Black; orbits, sometimes spots on face, on clypeus, and on mandibles, scape beneath, legs including coxæ, and abdomen entirely, ferruginous or sanguineous; antennæ setaceous, very slender; metathorax with spiniform lateral angles; wings fuliginous, more or less violaceous; tarsi slender, simple; apex of first abdominal segment broad, nearly quadrate, the sides being straight, ovipositor long. Length .45–.70 inch.

Hab. Fort Tejon, California (H. Edwards, Crotch).

Cryptus pacificus, n. sp.

♂.—Black; legs including coxæ and abdomen entirely, ferruginous; orbits, interrupted behind summit of eyes, spot on middle of face, clypeus, spot of mandibles and palpi, whitish; antennæ long, scape beneath sometimes tinged with red; tegulæ reddish in front; mesothorax and scutellum shining, the former with two deeply impressed lines; metathorax rugose, with two irregular, wavy, transverse carinæ, somewhat confused on the disk, lateral angles subacute; wings hyaline, apical margins narrowly dusky, areolet moderate, broad, nearly quadrate; legs long, slender, posterior tibiæ dusky, their tarsi whitish beyond first joint, sometimes the anterior coxæ and the four anterior trochanters beneath are pale; abdomen long, slender, especially at base, shining, impunctate, the first segment slightly widened towards tip, lateral tubercles prominent, behind which the upper surface is somewhat sulcate. Length .45–.65 inch.

Hab. California (H. Edwards).

Cryptus latus, Provancher (Nat. Can. vi. p. 204).

♀.—Small, black; antennæ with a white annulus; four anterior legs except coxæ and trochanters, posterior femora except tips, and the three basal segments of abdomen ferruginous; wings fusco-hyaline; base of posterior tibiæ and of the first, and more or less of the second, joint of their tarsi, also of the tibial spurs, white; a white spot at apex of abdomen; ovipositor as long as abdomen. Length .25 inch.

Hab. British Columbia (Crotch).

Cryptus atriceps, n. sp.

♀.—Fulvo-ferruginous; head entirely black; palpi pale; antennæ black beyond the fifth joint, joints 8–10 white above, third joint very long, about one-fifth longer than fourth; sutures of thorax more or less black; impressed lines of mesothorax black anteriorly; a line or spot on upper margin of prothorax, tegulæ, apex of scutellum and spot on postscutellum, white; metathorax finely sculptured, a well-defined transverse carina before the middle, lateral angles small, spiniform; wings fusco-hyaline, areolet pentagonal; tips of posterior tibiæ and of their tarsi dusky, second and third joints of the latter white; abdomen robust, minutely punctured on second segment, apex of first segment dilated; apex of abdomen dusky, ovipositor long. Length .25 inch.

Hab. Great Salt Lake, Utah.

Cryptus calipterus, Say (Bost. Journ. Nat. Hist., i p. 234).

♀.—Ferruginous; antennæ except base, tips of posterior tibiæ and band at base of third abdominal segment, black; head narrow, cheeks flat; third joint of antennæ about four times longer than broad, and equal with fourth; wings yellow with three broad fuliginous bands, the apical one broadest and confluent beneath with the middle band, leaving a triangular yellow spot beyond areolet, which is small and nearly quadrate; ovipositor longer than abdomen. Length .50 inch.

Hab. California (Stretch), Utah. The specimen from the last locality is paler ferruginous, with tip only of antennæ black, and the fuscous bands on wings quite narrow.

Cryptus Crotchii, n. sp.

♀.—Robust, fulvo-ferruginous; head subbuccate; antennæ black at tips, third joint rather more than three times longer than broad, and equal with fourth; mesothorax and scutellum shining, minutely punctured; pleura confluently punctured, opaque; metathorax rugose, opaque, an arched transverse carina above posterior truncation; wings yellow, marked as in *calipterus*, areolet small, nearly quadrate; tips of posterior tibiæ black, tarsi strongly setose beneath; abdomen opaque, impunctate, a black band at base of third segment, apex of first segment squarely dilated, somewhat sulcate medially; ovipositor as long as the abdomen. Length .60 inch.

♂.—Yellowish-ferruginous; face, clypeus, and cheeks yellow; antennæ stout, slender at tips, which are black as well as joints two and three above; prothorax beneath, pleura, sides of metathorax, and lateral region of scutellum, more or less black; wings yellow-hyaline, with the fuscous bands nearly or quite obliterated; abdomen slender, base of third and fourth segments more or less black; sometimes the whole abdomen is obfuscated. Length .50 inch.

Hab. San Diego, California (Crotch). Closely allied to *calipterus*, but more robust, with broader head, and shorter basal joints of flagellum.

Cryptus turbatus, n. sp.

♀.—Size and sculpture of *Crotchii*, but of a darker ferruginous color; apex of antennæ, sutures of thorax, tip of posterior tibiæ, and band at base of third abdominal segment, black; metathorax scabrous, rounded, subtruncate behind, with a short oblique carina on each side; wings fuliginous, a paler patch immediately before and behind stigma, areolet small, quadrate; otherwise as in *Crotchii*. Length .60 inch.

Hab. California (Stretch). This may prove to be only a dark-winged variety of *Crotchii*.

Cryptus resolutus, n. sp.

♂.—Fulvo-ferruginous; head black, sides of face, spot on middle, clypeus and labrum yellow; orbits very broad behind eyes, but narrowed beneath, palpi and scape beneath fulvous; remainder of antennæ black; prothorax except upper margin, whole of pleura, broad stripe on anterior middle of mesothorax, lateral region of scutellum, basal margin of metathorax and the flanks, black; mesothorax shining, sparsely punctured; scutellum elongate, flattened, polished; metathorax rounded, depressed above, pubescent, without transverse carinæ; wings fusco-hyaline, darker at tips; the coxæ, except posterior pair above, stripe on posterior femora beneath and tips of their tibiæ black; abdomen slender, especially at base, smooth and polished, basal margin of second and following segments more or less black, first segment slightly broader at tip. Length .55 inch.

Hab. California (H. Edwards).

Cryptus Edwardii, n. sp.

♀. Ferruginous, shining; head buccate, cheeks swollen; antennæ unusually short, third, fourth, and fifth joints each rather more than twice longer than broad, sixth joint quadrate, remainder transverse, apical joints black; sides of thorax and legs with sparse glittering hairs; mesothorax with a few scattering large punctures; pleura sparsely punctured; metathorax obsoletely sculptured, destitute of carinæ, the flanks smooth and shining, posterior face with a broad shallow excavation, sides rounded; wings fuliginous or generally fusco-hyaline, darker on apical margins, sometimes yellowish-hyaline, subfasciate with fuscous, areolet moderate, subquadrate; legs robust, the femora somewhat swollen, four anterior tarsi with dilated, spinose joints, the intermediate tibiæ densely spinose; abdomen robust, impunctured, apex of first segment rather broadly dilated, base of third segment narrowly black; ovipositor about as long as abdomen. Length .40–.60 inch.

Hab. California (H. Edwards); Wilmington, Cal. (Crotch). Very distinct by the form of antennæ and legs. The color of the wings varies greatly.

Cryptus punicus, n. sp.

♀.—Dark rufo-ferruginous, shining; head long, narrow, subtriangular in front, cheeks flat, polished; antennæ long, setaceous, very slender, black, scape ferruginous; mesothorax and scutellum smooth and polished, with a few scattering punctures, the two longitudinal impressed lines on mesothorax very deep; prothorax and pleura opaque, finely rugose, obliquely so on pleura; metathorax rugose, opaque, truncate behind, the verge with a sharp carina, ending on each side in a short stout spine, disk with a subtriangular inclosed space; wings dark fuliginous, violaceous, areolet moderate, subquadrate; legs slender, tarsi slender and simple, posterior tibiæ more or less fuscous, middle of their tarsi pale; abdomen shining, impunctured, first segment with moderately dilated apex, before which the disk is strongly bicarinate; ovipositor two-thirds the length of abdomen. Length .55 inch.

♂.—Very slender; dark ferruginous; shining; a broad band extending from base of antennæ to posterior margin of occiput, tips of mandibles, antennæ except scape and sutures of thorax nearly black; anterior orbits sometimes yellowish; pleura finely punctured; metathorax oblique, subconvex, gradually descending to tip, finely punctured, thickly clothed with short black pubescence, flanks strongly punctured; legs slender, posterior tibiæ more or less obfuscated, tarsi beyond first joint yellowish-white; abdomen slender, polished, first segment very slightly wider posteriorly, the lateral tubercles prominent. Length .50–.55 inch.

Hab. California; Washington Territory; Vancouver's Island (H. Edwards).

Cryptus purpuripennis, n. sp.

♀.—Ferruginous, shining; head subbuccate, deeply excavated behind antennæ; antennæ long, rather slender, apical half black, joints 3–5 equal in length, each being about three times longer than broad; mesothorax convex, sparsely and finely punctured, with a few scattering larger punctures; pleura and flanks of metathorax finely punctured, shining; upper portion of metathorax finely shagreened, subopaque, rounded, without carinæ, except on verge of the posterior truncation; wings blackish-fuliginous, strongly violaceous, areolet small, nearly quadrate; legs rather slender, tarsi simple; abdomen swollen beyond first segment, polished, impunctured, apex of first segment dilated, disk of first and second segments with a shallow depression; ovipositor as long as abdomen. Length .55 inch.

Hab. California (H. Edwards). Resembles *punicus* very much in color, but the head is more buccate, the antennæ more robust, with shorter joints and differently colored; the sculpture of the thorax and shape of the abdomen are entirely different.

Linoceras Edwardsii, n. sp.

♂.—Black; face, clypeus, labrum, mandibles, palpi, upper anterior orbits, line on posterior orbits, scape beneath, tegulæ, spot beneath, and the scutellums, pale lemon-yellow; antennæ orange-yellow, black at extreme tips; wings hyaline, tinged with yellow, extreme apical margins fuscous; legs yellow, very slender, posterior pair very long, posterior coxæ, base of their trochanters above and their femora except base, and tips of their tibiæ beneath, black; abdomen very slender, lemon-yellow, base of second and following segments broadly black, also a black spot on apex of first segment between tubercles and tip. Length .55 inch.

Hab. California (H. Edwards). A very handsome species.

Mesostenus gracilipes, n. sp.

♀.—Elongate, narrow, shining, uniformly fulvous; tips of mandibles, antennæ, except scape and third joint beneath, and extreme base of posterior tibiæ black; antennæ long and slender; mesothorax prominently trilobed, sparsely punctured; metathorax obliquely depressed behind, rugulose, with an angulate carina at base, anterior to which the surface is smooth and shining; wings fuscous, areolet long and very narrow; legs long and very slender, especially the posterior pair, the trochanters of which are half the length of the femora, the posterior trochanter about double the length of the anterior one; abdomen polished, first segment long, slightly swollen at tip, base of second segment considerably contracted; ovipositor very long, nearly twice the length of body. Length .46 inch, of ovipositor .90 inch.

Hab. California (H. Edwards).

Ophion costale, n. sp.

♀.—Fulvo-ferruginous, shining; face broad, the middle closely punctured, subtuberculate immediately beneath base of antennæ; clypeus strongly punctured, tips truncate, lateral sutures and tips of mandibles black; cheeks swollen; antennæ shorter than usual, reaching about to tip of second abdominal segment; mesothorax convex, polished; scutellum very convex; metathorax confluently punctured, without transverse carina, sutures of thorax narrowly black; wings subhyaline, stained with yellowish at base and with fuscous along apical costal margin, darkest at tip of marginal cell; basal margin of third and fourth abdominal segments and an oblique mark on sides of second segment, black. Length .53 inch.

Hab. Klamath Co., California (H. Edwards). Readily distinguished from all the other species known to me by the ornamentation of the wings.

Nototrachys californicus, n. sp.

♀.—Black; orbits entirely, broad beneath antennæ, sides of clypeus, mandibles, palpi, short stripe on each side of mesothorax, tegulæ, spot before, another beneath, and spot on scutellum, yellow, sometimes shading into sanguineous; antennæ brown, scape beneath paler; mesothorax transversely rugose; metathorax reticulated, densely silvery-sericeous at the sides and at apex; wings hyaline, iridescent; legs honey-yellow, four anterior coxæ and their tibiæ and tarsi more or less yellow; posterior legs brown-ferruginous, coxæ black, tips of femora and of tibiæ blackish, tarsi fuscous, pale at base of joints 1 and 2; abdomen black, shining, second, third, and fourth segments more or less brown-ferruginous. Length .32 inch.

Hab. San Diego, California (Crotch).

Exochilum occidentale, n. sp.

♀.—Black, head and thorax clothed with short black pubescence, coarsely punctured; orbits, broad on each side of antennæ, and interrupted behind summit of eyes, stripe down middle of face, clypeus, labrum, upper margin of mandibles, and palpi, yellow; antennæ fulvous, scape black; tegulæ and scutellum yellowish; spot on each side of pleura posteriorly, and on flanks of metathorax ferruginous; metathorax coarsely reticulated, subconcave; wings fusco-hyaline, stained with yellowish, stigma and costal nerve honey-yellow; legs yellow, all the coxæ, apical half of posterior femora and apical third of their tibiæ, black; abdomen honey-yellow, polished, basal two-thirds of upper edge of second segment, stripe on each side of fourth segment, and the following segments entirely black. Length .70 inch.

Hab. Oregon (H. Edwards). This also occurs in Colorado.

Anomalon Edwardsii, n. sp.

♀.—Ferruginous, head and thorax clothed with a short pale sericeous pubescence; head short, broad, yellow, vertex, occiput, and posterior margin of cheeks black, upper part of cheeks tinged with ferruginous; a transverse prominence immediately beneath insertion of antennæ; antennæ two-thirds the length of body, fulvous, darker above, first, second, and base of third joints black above and yellow beneath; three broad stripes on mesothorax, the lateral ones confluent behind, prothorax anteriorly, pleura, except anterior margin, and base of metathorax, black; metathorax very coarsely reticulated; wings fusco-hyaline, darker beyond stigma which is fulvous, discoidal cell very slightly narrowed at base; four anterior legs honey-yellow, tibiæ and tarsi paler; posterior legs black, second trochanter and extreme base of femora ferruginous, basal half of tibiæ and the tarsi, except terminal joint, yellow, tarsi thickened, the first joint nearly three times longer than second; abdomen shining, ferruginous, apex of first broad, upper margin of second, and the fifth and sixth segments entirely black, sides of third and fourth varied with fuscous. Length .85 inch.

Hab. Vancouver's Island (Henry Edwards).

Anomalon californicum, n. sp.

♀.—Ferruginous, head and thorax clothed with short brownish pubescence; face, orbits, and clypeus yellow, spot inclosing ocelli black; antennæ short, stout, about half the length of body, scape yellow beneath; sutures of thorax narrowly black; mesothorax shining, sparsely punctured; scutellum gibbous, slightly furrowed down the middle; metathorax coarsely reticulated, depressed and subconcave above; wings tinged with yellowish-fuscous, darker at tips, discoidal cell not narrowed at base; four anterior legs honey-yellow, posterior pair fulvous, with tips of femora and of tibiæ black, tarsi yellow, thickened, first joint twice the length of second; abdomen shining, basal half of upper edge of second segment and upper edge of fifth and sixth segments black, lower margin of apical segments tinged with blackish. Length .65 inch.

Hab. California (H. Edwards).

Anomalon verbosum, n. sp.

♂ ♀.—Black; head large, face narrowed beneath; narrow orbital line on each side of face, dot at summit of eyes, spot beneath eyes and mandibles except tips, yellowish; antennæ short, about as long as head and thorax together, entirely black; thorax immaculate; metathorax reticulated, grooved down the middle; wings fusco-hyaline, discoidal cell very much contracted at base; legs rufo-ferruginous, coxæ and trochanters black, posterior tibiæ fuscous in ♀, their tarsi blackish in ♀ with basal joint slightly thickened, and in ♂ with second and third joints ferruginous and basal joint dilated; abdomen yellowish-ferruginous, upper edge of second segment and the fifth and following segments black, sometimes only the apex of fifth segment is black. Length .40 inch.

Hab. California (H. Edwards).

Anomalon maceratum, n sp.

♂.—Black; head and thorax clothed with short pale pubescence; head not wider than thorax, cheeks prominent; orbits, face, clypeus, labrum, mandibles except tips, palpi and scape beneath, yellow; antennæ about half the length of body; posterior middle of mesothorax depressed and transversely rugose; prothorax and pleura more or less, longitudinally striated; scutellum rugose, with two reddish spots at tip; metathorax coarsely reticulated, sulcate down the middle; tegulæ fulvous; wings fusco-hyaline, discoidal cell slightly narrowed at base; four anterior legs yellow, their femora honey-yellow, posterior legs ferruginous, base of coxæ and apex of tibiæ black, tarsi yellow, slightly thickened, first joint about twice as long as second; abdomen long, slender, fulvo-ferruginous, upper edge of second and the two apical segments black. Length .60 inch.

Hab. California (H. Edwards).

Anomalon vivum, n. sp.

♀.—Ferruginous; vertex, covering ocelli and occiput, black; face, orbits, clypeus and mandibles yellow; antennæ about half the length of body, black, brown beneath, scape yellow beneath; prothorax in front and pleura beneath black; metathorax reticulated, deeply sulcate down the middle, with a short arcuated carina on each side near base; wings yellowish-hyaline, discoidal cell slightly narrowed at base; tips of posterior tibiæ dusky, their tarsi slender, yellowish; abdomen shining, with upper edge of second and following segments narrowly black. Length .50 inch.

Hab. Oregon (H. Edwards).

Campoplex major, n. sp.

♀.—Black, opaque, clothed with short whitish pubescence, more dense on face and metathorax; mandibles, palpi and tegulæ lemon-yellow; a tuft of long pale pubescence on each side of scutellum; middle of metathorax longitudinally concave and transversely aciculated; wings hyaline, tinged with yellowish, a little smoky at tips, areolet large, rhomboidal; anterior legs except base of coxæ and trochanters and femora beneath, intermediate trochanters and femora above, their tibiæ and tarsi entirely, and a stripe on outer side of posterior tibiæ, lemon-yellow; four anterior ungues black; abdomen shining, ferruginous, base of first segment, its apex above, upper surface of second segment and base of third, black. Length .75 inch.

Hab. Vancouver's Island (H. Edwards). A fine large species.

Limneria californica, n. sp.

♂.—Black, shining; mandibles, palpi, scape beneath, and tegulæ yellow; flagellum testaceous beneath towards the tip; metathorax transversely rugulose behind; wings hyaline, iridescent, areolet small, petiolated; legs fulvo-ferruginous, four anterior coxæ, and all the trochanters yellow, base of posterior tibiæ and of their tarsi yellowish, posterior coxæ and base of their trochanters black; narrow apical margin of second abdominal segment and apical half of third ferruginous. Length .30 inch.

Hab. San Diego, California (Crotch).

Mesochorus iridescens, n. sp.

♀.—Luteo-testaceous, polished; tips of mandibles, spot behind antennæ, back of head, three broad stripes on mesothorax, broad band at base of metathorax, pleura beneath, and first abdominal segment except tip, black; antennæ long and slender, fuscous, paler at base, scape beneath luteous; tegulæ white; wings hyaline, beautifully iridescent; legs pale, tips of posterior tibiæ and of their tarsi blackish; sides of second abdominal segment and the apical segments more or less stained with fuscous. Length .25 inch.

Hab. California (Behrens).

Pristomerus pacificus, n. sp.

♀.—Black; orbits and clypeus ferruginous, mandibles yellow, antennæ entirely black; tegulæ yellow; wings hyaline, iridescent; legs, including coxæ, ferruginous, anterior pair paler, posterior trochanters, tips of their tibiæ and their tarsi more or less dusky, femoral tooth robust; abdomen polished, ferruginous, first segment except apical margin, basal two-thirds of second, and base of remaining segments more or less black; ovipositor three-fourths the length of abdomen. Length .30 inch.

Hab. California (H. Edwards).

Exetastes maurus, n. sp.

♀.—Entirely black, shining, robust; head and thorax clothed with short black pubescence; antennæ tinged with brown; mesothorax strongly and rather closely punctured; scutellum gibbous, coarsely punctured; metathorax coarsely rugose, opaque; wings dark fuscous, paler towards tips, violaceous; abdomen short, robust, polished, impunctured. Length .45 inch.

Hab. California (H. Edwards).

Exetastes zelotypus, n. sp.

♂ ♀.—Black, shining; thorax closely and finely punctured, metathorax finely rugose; wings fuliginous, strongly violaceous; tips of anterior femora and tibiæ and posterior femora ♀, four anterior femora except base, their tibiæ and tarsi entirely, posterior femora and base of their tibiæ ♂, ferruginous; abdomen entirely ferruginous, polished, elongate, and rather slender at base. Length .50 inch.

Hab. San Diego, California (Crotch).

Grotea californica, n. sp.

♀.—Head and thorax yellow, polished, impunctured; occiput, middle of vertex, three stripes on mesothorax, stripe on pleura and base of metathorax fulvo-ferruginous; two fuscous spots behind scape; antennæ fulvous, scape dusky above (joints 10 and following wanting); sutures of thorax and a wedge-shaped mark on sides of pleura black; wings pale fuliginous, a small dark cloud in apical margin; legs yellow, the femora and posterior legs more or less varied with fulvous; abdomen fulvo-ferruginous, the first segment, except a stripe above and spot at tip above, and also spot on each side of all the segments becoming larger on apical segments, yellow. Length .70 inch.

Hab. California (H. Edwards).

Mesoleptus innoxius, n. sp.

♂.—Honey-yellow; face, clypeus, mandibles, except tips and palpi, tegulæ, spot before and spot beneath, pale yellow; antennæ long and slender, dusky at extreme tips; large spot on pleura beneath, and sides and tips of metathorax more or less black; wings hyaline, iridescent, stigma luteous, areolet small, petiolated; legs long and slender, four anterior coxæ and trochanters pale yellow; abdomen dark honey-yellow or fulvous, base of first segment black, apical segments more or less varied with dusky; first segment straight, not slender at base and slightly dilated to apex, lateral tubercles large and prominent. Length .30 inch.

Hab. Lake Quesnel, British Columbia (Crotch).

Mesoleius Stretchii, n. sp.

♀.—Opaque black; head rather swollen behind the eyes; clypeus, mandibles except tips and scape beneath luteous; sides of mesothorax tinged with dull ferruginous; metathorax with an inclosed elongate central area; tegulæ yellowish white; wings hyaline, iridescent, stigma luteous, areolet small, triangular, subpetiolated; legs slender, and with coxæ, pale ferruginous, four anterior coxæ beneath and their trochanters yellow; tips of four anterior tarsi and posterior pair more or less fuscous; abdomen subpetiolated, finely and densely sculptured, depressed at base, first segment very slightly curved, gradually dilated to tip which is broad, upper surface flat and even, the lateral margin finely carinate, sides of apex yellow; lateral margin, broad at tip and very narrow apical margin of all the segments—sometimes indistinct on second and third, pale yellow; second and third segments sometimes tinged with brown. Length .27 inch.

Hab. California (Stretch).

Mesoleius? aleutianus, n. sp.

♂.—Slender, black, head and thorax with short pale pubescence; head short, subbuccate; antennæ long, curved at tip, metathorax flat and declivous behind, with carinate sides; scutellum longitudinally compressed, convex above; metathorax roughened, subsulcate on each side of middle, spiracles small, circular; tegulæ whitish; wings hyaline, beautifully iridescent, stigma rather large, fuscous, areolet 5-angular, with thickened nervures; legs long and very slender, ferruginous, coxæ and trochanters black. tips of posterior femora, their tibiæ and tarsi more or less dusky; abdomen subsessile, slightly widened to tip, spiracles placed a little before the middle. Length .30 inch.

Hab. Aleutian Islands (H. Edwards).

Mesoleius? lætus, n. sp.

♂.—Black; face, clypeus, mandibles except tips, palpi, scape beneath, spot on each side of mesothorax in front divided by impressed line, spot behind anterior coxæ, tegulæ, short line beneath, four anterior coxæ, trochanters, femora and tibiæ, posterior trochanters, extreme base of their femora, basal two-thirds of their tibiæ, and abdomen except two apical segments, all pale yellow; apex of flagellum fulvous beneath; wings yellowish hyaline, no areolet; legs slender, all the tibiæ honey-yellow, claws simple; abdomen subpetiolated, subclavate, being gradually broader to tip, the first and fourth and fifth segments often stained with fulvous. Length .35 inch.

Hab. Vancouver's Island (H. Edwards).

Mesoleius? rubiginosus, n. sp.

♂.—Fulvous; face, clypeus, mandibles except tips (which are black), palpi, spot on scape beneath, tegulæ, short line beneath. scutellum, pleura beneath, four anterior coxæ and trochanters, and middle of tarsi pale yellow; tips of antennæ and sutures of thorax black; wings dusky, no areolet; base of posterior tibiæ sometimes pale, claws simple; abdomen subpetiolate, subclavate. Length .40 inch.

Hab. California (H. Edwards).

Tryphon tejonicus, n. sp.

♂.—Black, shining, clothed with a short, pale sericeous pubescence; head broad, clypeus, anterior margin of tegulæ and legs except coxæ, ferruginous; mesothorax broad, gibbous, finely punctured; scutellum very abrupt posteriorly, depressed above and carinate laterally; metathorax short, with strongly elevated carinæ; wings hyaline, nervures and stigma black, areolet obliquely triangular, subpetiolated; legs short and robust, especially the femora, claws simple; abdomen short, broad towards apex, sessile, densely sculptured, opaque; first segment broad, with two strongly elevated longitudinal carinæ on middle extending to the tip. Length .25 inch.

Hab. Fort Tejon, California (Crotch).

Tryphon lusorius, n. sp.

♂.—Black, rather shining, clothed with a short pale sericeous pubescence; apex of clypeus, mandibles and tegulæ yellow; antennæ pale beneath at tip; wings hyaline, iridescent, stigma fuscous, pale at base, areolet small, rhomboidal, petiolated; four anterior legs yellow, coxæ, trochanters and femora beneath black; posterior femora robust, ferruginous, black at base beneath and at extreme tip, coxæ, trochanters, tibiæ and tarsi black or fuscous, the tibiæ above with a yellow stripe extending from base nearly to tip, claws simple; abdomen subclavate, ferruginous, the first segment entirely, second except apex, and base more or less of remaining segments black; first segment slightly narrowed at base, not carinate above. Length .25 inch.

Hab. California (H. Edwards).

Tryphon californicus, n. sp.

♂ ♀.—Black, shining, clypeus, mandibles, palpi and tegulæ yellow; head rather broad; face with an elevated, flattened, strongly punctured space on the middle; metathorax with two approximate longitudinal carinæ on disk, two on each side and a circular one at tip; scutellum convex, deeply excavated at base; wings hyaline, areolet small, oblique, petiolated; legs robust, fulvo-ferruginous, coxæ and trochanters black, four anterior tibiæ and tarsi yellow, tips of posterior femora, their tibiæ and tarsi more or less fuscous or black; abdomen ferruginous or fulvous, sometimes fusco-ferruginous, in ♀ the first segment only is black with apical margin ferruginous, in ♂ the first and often more or less of the base of second and third segments black; first segment at base above sub-bicarinate. Length .20 inch.

Hab. San Diego, California (Crotch).

Erromenus obscurellus, n. sp.

♀.—Black, shining; head broad; face broad and flattened, densely sculptured; spot on mandibles and palpi dull testaceous; mesothorax minutely punctured; scutellum convex; metathorax with strongly elevated lines; wings hyaline, areolet oblique, subpetiolated; legs subrobust, black, tips of femora, a line on posterior pair above, and all the tibiæ and tarsi ferruginous, tips of posterior tibiæ and tarsi dusky; claws pectinated; abdomen subsessile, subcompressed at tip, first segment broad at tip, and strongly narrowed behind the tubercles, apex of second and the third and following segments more or less ferruginous. Length .30 inch.

Hab. California (H. Edwards).

Ctenistes californicus, n. sp.

♂.—Black, clothed with a short fine pale pubescence; face, clypeus, mandibles, palpi, lower part of cheeks, scape beneath, sides of collar, tegulæ, spot before, another beneath, spot on anterior margin of pleura, tip of scutellum, lateral apical margin, post-scutellum, four anterior coxæ and the trochanters, and apical margin of second and following segments of abdomen, all white; flagellum luteous beneath; broad stripe on each side of mesothorax, scutellum, and pleura ferruginous; wings hyaline, iridescent, areolet present; legs fulvous, tips of posterior femora, their tibiæ and tarsi black; claws pectinate; abdomen subclavate, sessile, the white bands broader on apical segments. Length .22 inch.

Hab. California (H. Edwards). A handsomely marked species.

Exochus brunnipes, n. sp.

♀.—Small, black, smooth, and polished, impunctured; antennæ brown; metathorax with conical central area; tegulæ pale brownish; wings hyaline, areolet present; legs short, robust, brownish-fulvous, femora very much swollen, coxæ, trochanters and femora beneath black, posterior tibiæ and tarsi fuscous, paler at base; abdomen above perfectly smooth, first segment with plain upper surface. Length .22 inch.

Hab. Nevada (Putnam).

Bassus maculifrons, Cresson (Proc. Ent. Soc., Phila., iv. p. 272).

♀.—Black; sides of face, spot on middle, clypeus, mandibles hooked-marked on each side of mesothorax, broad stripe on scutellum, post-scutellum, tegulæ, spot before, another beneath, and transverse spot on each side at tip of second and following segments white; wings hyaline, iridescent, areolet wanting; legs fulvous, posterior tarsi black; abdomen shining, the first and base of second segments roughly sculptured and opaque, no transversely impressed lines. Length .34 inch.

♂.—All of head beneath antennæ, anterior orbits, lower part of cheeks, scape beneath, anterior margin of pleura, transverse line on each side, and four anterior coxæ and trochanters, white or yellowish-white; otherwise marked as in ♀, except that the mark before tegulæ is large and cuneiform, and the lateral spots on abdomen are sometimes connected by a narrow line on apical margin of the segments. Length .27 inch.

Hab. California (Behrens, ♀; H. Edwards, ♂). This pretty species occurs also in Colorado.

Bassus cinctulus, n. sp.

♂ ♀.—Black; face, anterior orbits, lower part of cheeks, clypeus, mandibles except tips, scape beneath, two longitudinal stripes on mesothorax, the lateral margin before tegulæ, broad stripe on scutellum, postscutellum, tegulæ, spot before, short line beneath, anterior margin of pleura, trifurcate mark beneath, sutural line between pleura and metathorax, narrow line on tip of first segment of abdomen not reaching the side, rather broad band at tip of second, third, and fourth segments, and spot on each side at base of fourth segment, all white; wings hyaline, areolet wanting; legs fulvous, four anterior coxæ, tips of posterior pair, all the trochanters, four anterior legs in front, and broad annulus on posterior tibiæ white; extreme base and apical third of posterior tibiæ black, their tarsi ———; base of abdomen opaque, punctured, apex shining, a transverse impressed line on second and third segments. Length .22 inch.

Hab. California (H. Edwards). Easily recognized by the two distant white stripes on mesothorax and white bands on abdomen.

Bassus decoratus, n. sp.

♂.—Black; face, anterior orbits, lower parts of cheeks, clypeus, mandibles, palpi, scape beneath, two stripes on mesothorax abbreviated behind and confluent anteriorly with broad lateral margin, sides of scutellum, postscutellum with line on each side extending to base of wings, narrow anterior margin of pleura, transverse line on each side, sutural line between pleura and metathorax, tegulæ, spot before and another beneath, all pale yellow; wings hyaline, areolet present; legs pale fulvous, all the coxæ and trochanters white, posterior coxæ black at base beneath, posterior tarsi black; abdomen shining, with first and base of second segments rough and dull, no transverse impressed lines; apical third of second segment, the third and apical half of fourth fulvous; a yellowish band at base of third segment interrupted medially, basal margin of fourth segment narrowly pale yellow, broadly margined behind with black. Length .23 inch.

Hab. California (H. Edwards).

Bassus pacificus, n. sp.

♂ ♀.—Black; spot on middle of face, clypeus, mandibles, palpi, broad lateral margin of mesothorax hooked in front, tegulæ, spot before and one beneath, pale yellowish; wings hyaline, iridescent, areolet wanting; four anterior coxæ except base, their trochanters and tips of posterior coxæ white, remainder of coxæ black, femora, tibiæ, and four anterior tarsi fulvous, posterior tarsi blackish; abdomen ♀ subcompressed at tip and shining, no transverse impressed lines, first and second segments roughly sculptured, apex of second, the third, and more or less of fourth segments ferruginous. Length .23–.25 inch.

Hab. California, ♀; Vancouver's Island, ♂ (H. Edwards).

Metopius Edwardsii, n. sp.

♂.—Short, robust, black, opaque, roughly sculptured; face, anterior orbits, labrum, palpi, scape beneath, upper margin of prothorax, narrow apical margin of scutellum, spot on each side of metathorax, spot at tip of four anterior coxæ, all the trochanters, four anterior femora in front, base and apex of posterior pair, all the tibiæ, four anterior tarsi, and base of posterior pair, first abdominal segment except base, spot on each side of second segment at tip and apical margin of remaining segments broader on third and fourth, all yellowish-white; thorax closely and strongly punctured; wings subhyaline, tinged with fuscous especially along costa; posterior femora swollen; first segment pyramidal in profile and bituberculate on disk, second and following segments coarsely longitudinally rugose, much more rough on second and third. Length .50 inch.

Hab. Washington Territory (Henry Edwards).

Coleocentrus occidentalis, n. sp.

♀.—Black; scape beneath and palpi pale; tegulæ fulvous; wings yellow-hyaline, with a violaceous reflection, stigma pale brown with yellow spot at base, nervures blackish; legs brownish fulvous, anterior pair in front and intermediate tibiæ in front and tarsi yellow, coxæ dark, black at base; abdomen dark brownish-fulvous, first segment except tip and the two or three apical segments above, black; ovipositor as long as body. Length .85 inch.

Hab. Vancouver's Island (H. Edwards).

Ephialtes thoracicus, n. sp.

♀.—Black; tip of clypeus, mandibles, and scape beneath, brown; face with short pale pubescence, clypeus with long pale hairs; palpi whitish; mesothorax, scutellum, pleura, and flanks of metathorax ferruginous; middle lobe of mesothorax gibbous, very prominent, smooth; metathorax finely rugulose, clothed with short pale pubescence; lower margin of prothorax and tegulæ white; wings hyaline, iridescent, areolet small, triangular, subpetiolated; legs very slender, the anterior pair entirely, middle trochanters, femora, and tibiæ, pale yellow, middle coxæ, honey-yellow, pale beneath, their tarsi blackish, posterior coxæ, trochanters beneath and femora bright ferruginous, their trochanters above, tibiæ and tarsi black; abdomen long, narrow, black, immaculate, finely sculptured; ovipositor as long as the body. Length .50 inch.

Hab. Vancouver's Island (H. Edwards).

Pimpla Behrensii, n. sp.

♂ ♀.—Black; palpi, tegulæ and spot in front white; mesothorax, scutellum, and pleura shining, the former finely and sparsely punctured; wings hyaline, iridescent; legs fulvous, anterior pair pale in front, coxæ black, middle tibiæ with whitish annulus; posterior tibiæ black, with broad white annulus towards base, their tarsi black more or less white at base of all the joints; abdomen strongly punctured and finely pubescent, apical margin of the segments narrowly pale or ferruginous, sides of the segments with ferruginous spot, or more or less broadly margined with ferriginous; ovipositor of ♀ short. Length .35–.40 inch.

Hab. California (Behrens). A very common species.

Lampronota gelida, n. sp.

♂.—Black, clothed with short pale pubescence; face yellow, with three longitudinal black stripes, sometimes broken into spots; clypeus yellow, with basal margin or spot on each side black; mandibles except tips, and palpi, yellow; tegulæ and spot before and sometimes a spot on each side of mesothorax in front, yellow; metathorax densely punctured; wings hyaline, more or less tinged with yellowish, tegulæ and basal nervures pale, areolet small, subrhomboidal, petiolated; legs fulvous, four anterior coxæ more or less beneath, their trochanters and line on their femora beneath, yellow; four anterior coxæ at base, posterior pair, and the basal trochanters black, posterior tarsi blackish; abdomen slender, ferruginous, first segment, except tip and sometimes the two or three apical segments, black. Length .45 inch.

Hab. Lake Lahache, British Columbia (Crotch).

Lampronota vivida, n. sp.

♂.—Black, clothed with a short pale pubescence; face, anterior orbits not reaching summit of eyes, clypeus, mandibles except tips, palpi, scape beneath, line on anterior lateral margin of mesothorax dilated and hooked in front, tegulæ, spot before and one beneath, pale yellow; tip of scutellum pale; wings pale yellowish hyaline, areolet subrhomboidal, petiolated; legs fulvous, four anterior coxæ and trochanters and their femora and tibiæ in front pale yellow: base of posterior coxæ more or less black, their tarsi fuscous; abdomen yellowish fulvous, first segment except apical margin, black. Length .45 inch.

Hab. Vancouver's Island (H. Edwards).

Lampronota segnis, n. sp.

♂.—Small, black; face, anterior orbits, lower part of cheeks, clypeus, mandibles, palpi, scape beneath, two slender stripes on mesothorax, confluent in front with broad lateral margin, collar, scutellum, large mark on each side of pleura, tegulæ, spot before and one beneath, and four anterior coxæ and trochanters, all yellowish-white; spot on flanks of metathorax, remainder of legs, except tips of tarsi which are dusky, and apical margin of abdominal segments fulvous; wings hyaline, beautifully iridescent, areolet subtriangular, not petiolated. Length .25 inch.

Hab. Vancouver's Island (H. Edwards). A very prettily marked species.

Lampronota hilaris, n. sp.

♀.—Small, black; face and scape beneath fulvous, the orbits slightly interrupted behind summit of eyes and broad beneath, clypeus and spot on mandibles white; mesothorax, scutellum, prothorax, sides of pleura, and flanks of metathorax fulvous; two slender stripes on mesothorax, confluent in front with broad lateral margins, spot on scutellum, collar, margins of prothorax, lower margin of pleura, and tegulæ white; wings hyaline, areolet small, subpetiolated; legs fulvous, four anterior coxæ white, posterior tibiæ more or less, and tarsi dusky; abdomen subclavate, apical margins of segments pale fulvous, broader on terminal segments; ovipositor as long as the body. Length .25 inch.

Hab. Wilmington, California (Crotch).

Lampronota Edwardsii, n. sp

♀.—Entirely fulvo-ferruginous; antennæ except scape, spot beneath wings, and lower margin of metathorax black; mesothorax finely punctured; metathorax confluently punctured, with a sinuate carina near apex; wings dark yellow-hyaline, stigma and basal nervures fulvous, areolet subrhomboidal, petiolated; abdomen shining, first segment sparsely punctured; ovipositor as long as the body. Length .50 inch.

Hab. Vancouver's Island (Henry Edwards).

Lampronota? lugubris, n. sp.

♀.—Deep black, shining; head small, with flattened cheeks; antennæ long and very slender, third joint very long, and one-third longer than fourth; mesothorax prominently trilobate; metathorax opaque, with four ill-defined longitudinal elevated lines, the two middle ones approximate; wings smoky, nervures and stigma black, no areolet; legs rather slender, ferruginous, coxæ and trochanters black, claws simple; abdomen sessile, depressed, opaque at base, shining at tip, apical margins of third and following segments narrowly dull ferruginous; ovipositor as long as the body. Length .42 inch.

Hab. Lake Quesnel, British Columbia (Crotch).

Phytodietus obscurellus, n. sp.

♀.—Dull black, clothed with a very short, pale, sericeous pubescence; spot beneath eyes, dot on each side of ocelli, short line on each side of base of antennæ, clypeus, mandibles, palpi, lateral anterior margin of mesothorax, tegulæ, dot before and spot beneath white; middle of metathorax longitudinally rugose; wings hyaline, iridescent, stigma black; legs, including coxæ, fulvo-ferruginous, posterior tibiæ towards tip and their tarsi dusky; abdomen shining, apical margin of second and third segments narrowly pale; ovipositor short. Length .30 inch.

Hab. California (H. Edwards).

Phytodietus californicus, n. sp.

♀.—Small, shining black; dot on each side of ocelli, clypeus, mandibles except tips, palpi, tegulæ and line in front, white; pleura beneath and flanks of metathorax fulvous; metathorax smooth, with a medial longitudinal groove; wings hyaline, beautifully iridescent. stigma pale; legs, with coxæ, pale fulvous. anterior coxæ, four anterior trochanters, knees, and apical posterior trochanter white, tips of their tibiæ and the tarsi dusky; abdomen shining, apical margin of segments five and six more or less white; ovipositor about half the length of abdomen. Length .21 inch.

Hab. California (Behrens).

Xorides occidentalis, n. sp.

♀.—Black; anterior orbits not reaching summit of eyes, dot on mandibles, palpi, line on each side of collar before anterior coxæ, tegulæ and spot beneath posterior wings white; scape beneath reddish; middle of mesothorax depressed and transversely wrinkled; metathorax finely transversely sculptured above; wings hyaline, nervures and stigma black; legs, with coxæ, fulvo-ferruginous, line on middle tibiæ, their tarsi, tips of posterior femora, and their tibiæ and tarsi entirely black; abdomen black, immaculate; ovipositor about as long as the body. Length .50-.70 inch.

Hab. Vancouver's Island (H. Edwards).

Poemeria insularis, n. sp.

♀.—Black; anterior orbits, broad upper margin of prothorax, tegulæ and spot beneath. white; cheeks brown; mesothorax strongly trilobate, the anterior lobe prominent, convex and sparsely punctured, two short pale lines on disk between the wings; apex of scutellum and apex of metathorax dull fulvous; metathorax strongly areolated; wings hyaline; legs, with coxæ, fulvous, line on outer side of four anterior coxæ white, posterior femora, tibiæ and tarsi black; abdomen opaque, middle of third and following segments narrowly white at tip, first and base of second segments finely scabrous; ovipositor as long as the body. Length .55 inch.

Hab. Vancouver's Island (H. Edwards).

Xylonomus californicus, n. sp.

♀.—Uniformly ferruginous; flagellum, except narrow white annulus beyond middle, and sutures of thorax black; sometimes there is a narrow stripe on anterior lobe of mesothorax, and the sutures between side lobes are black ; wings hyaline, stigma black with whitish spot at base ; ovipositor longer than body. Length .75–.85 inch.

Hab. California (H. Edwards). Easily distinguished from all the other known species of this genus by the uniform ferruginous color of the body.

Echthrus ? maurus, n. sp.

♀.—Robust, black, immaculate; head large, broad, buccate, shining; antennæ with short robust joints, the third much longer than fourth; mesothorax and scutellum shining; metathorax opaque ; wings smoky, areolet 5-angular, stigma black ; legs subrobust, tips of four anterior femora and all the tibiæ pale, anterior tibiæ not twisted nor inflated, claws simple; abdomen subfusiform, subsessile, first segment rapidly narrowed to base, a deep elongate puncture on apical middle, base of second segment densely and finely sculptured, opaque, remainder of abdomen shining; ovipositor longer than abdomen. Length .50 inch.

Hab. Victoria, Vancouver's Island (Crotch).

November 12.

The President, Dr. Ruschenberger, in the chair.

Forty-eight persons present.

A paper entitled "Description of a New Species of Dolabella, from the Gulf of California, with remarks on other rare or little known species from the same locality," by R. E. C. Stearns, was presented for publication.

On Donax fossor.—Prof. Leidy remarked that last July, while on a visit to Cape May, N. J., he had observed on the beach, near low tide, east of the town, in many positions, vast numbers of the little lamellibranch mollusk, *Donax fossor*, of Say. It is well named the "Digger" from the ease and rapidity with which it digs its way into the sand by means of its powerful foot. It lives in the surface sand, and is uncovered by the surf breaking on shore, but instantly buries itself again as the waves retire. In some places the little Digger was so abundant, that large patches reminded him "of barley grains lying on a malting floor," and they lay so thick as actually to interfere with one another in the attempt to bury themselves. As indicated by Mr. Say they present two varieties; one in which the shell is white, the other in which it is straw-colored. The shells generally exhibit an interior livid tint in three rays, successively widening from before backward. The rays are sometimes feeble or nearly obsolete; the anterior one is the most persistent, and the posterior one least so. The siphons are long and actively protruded and retracted, looking in their movements like wriggling worms. The Digger affords a bountiful supply of food to shore birds and fishes.

As is so frequently the case with crowded communities, the Digger is much infested with parasites. From half a dozen to several dozen Flukes are found in the liver, and a ciliated infusorian in the branchial cavity.

The Fluke is a minute larval *Distomum*, with the following characters: oval, obovate, clavate, or nine-pin like; head rounded with a conspicuous nipple-like papilla on each side (which, when seen in the lateral view of the animal, gives the appearance of a beak to the head); tail obtuse, with a minute terminal pore. Integument finely granulate, the granules arranged in alternating transverse series. Oral acetabulum twice the size of the ventral, which is central or nearly so. Mouth large, unarmed; pharynx minute, with a short, narrow gullet, ending in two pouch-like stomachs, which extend to the ventral acetabulum. A distinct body cavity, with no other contained organs than those just mentioned. A small orifice occupies the median line nearly midway between the acetabula; but no appearance of generative apparatus. Length of animal in the contracted state .24 mm.; width .15mm.; length in the elongated state to .36 and .42 mm.; width .09 mm. Oral acetabulum .072 mm.; ventral acetabulum .042 mm. The species may be named *Distomum cornifrons.*

It is probable that this little Fluke undergoes its further development in some of the shore birds or fishes which use the *Donax fossor* as food.

The infusorian infesting the Digger is a *Trichodina*, resembling that which is found on the *Hydra* or fresh water polyp, and which is also stated by Stein to live on the gills of the Pike and the fins of the Stickleback. The Trichodine is bell-shaped, with a wreath of cils near the top, and a circle of cils at the margin beneath. It is .048 mm. broad and from .035 to .036 mm. high. Though living on a marine mollusk, it too nearly resembles the *Trichodina pediculus* of fresh-water animals for him to think of giving it another name.

Dimorphism in Mitchella repens.—Mr. THOMAS MEEHAN referred to note published in the Proceedings many years ago, in regard to dimorphic flowers in *Mitchella repens*, and suggesting that the plant was practically diœcious. Three years ago he found a variety on the Wissahickon with snow-white berries; the plant, judging by the size of the patch, having been growing and bearing there many years. Some of this was removed to his garden, where, though it blossoms freely, it bears no berries, thus indicating that it was fertilized when in its wild state by the pollen from the normal scarlet berried forms in the vicinity, and that it is incapable of making use of its own pollen.

NOVEMBER 19.

The President, Dr. RUSCHENBERGER, in the chair.

Forty-two persons present.

Notices of Gordius in the Cockroach and Leech.—Prof. LEIDY exhibited a Gordius, which had been submitted to him by Dr. Robert Meade Smith, of this city, with the note that "a servant killed a large cockroach (*Blatta orientalis?*) in the kitchen, and threw it into a tumbler of water, and had then noticed, as she described it, one of its legs growing and swimming off." The Gordius is nine inches long, chocolate brown, with darker spots of the same, attenuated anteriorly with the head rounded, and the tail spiral and at the end slightly compressed and roundly truncated. Thickness of the worm anteriorly $\frac{1}{5}$th of a line; posteriorly $\frac{2}{5}$ths of a line. The species is probably *Gordius aquaticus.*

Prof. L. further remarked that twenty years ago he had collected from Lily Pond, Newport, R. I., a number of little leeches, of two species of *Clepsine*, which were much infested with delicate hair-worms, coiled up in the interior of the body. The Clepsines were the fourth to the third of an inch in length. The most frequent of the species had two eyes, the other had three pairs of eyes. The leeches contained from one to five of the hair-worms ranging from 10 lines to 2 inches in length. The worms appear to pertain to a species of Gordius, which, from its slender character, may be named *Gordius tenuis*. The worm is white or cream-colored, but has become brown as preserved in alcohol. It is attenuated anteriorly, with the head end tapering and conical; the posterior end is curved, thickened, and obtusely rounded. A short œsophagus is succeeded by a simple, straight, capacious intestine imperforate at the posterior extremity. A worm of two inches in length, measured 0.06 mm. near the head end, 0.14 mm. at the middle, and 0.12 mm. at the tail end. A specimen 10 lines long measured at the middle 0.1 mm. thick.

November 26.

The President, Dr. Ruschenberger, in the chair.

Forty-six persons present.

A paper entitled "Note on Hyraceum," by Wm. H. Green, M.D., and A. J. Parker, M.D., was presented for publication.

The deaths of Thomas H. Powers, a member, and Dr. Bennet Dowler, a correspondent, were announced.

Wm. S. Baker, J. Ward Atwood, and L. Ashley Faught were elected members.

R. Neilson Clark was elected a correspondent.

The following papers were ordered to be printed:—

ON THE STRUCTURE OF THE GORILLA.

BY HENRY C. CHAPMAN, M.D.

As the opportunity does not often present itself of anatomizing a Gorilla, and as the literature on the structure of that anthropoid is not extensive, it appears to me proper to communicate to the Academy the results of my recent dissection of that animal, and to notice more especially in what the Gorilla agrees with, and how it differs from other monkeys and man. I take great pleasure in prefacing my observations by stating that I am indebted to Dr. Thomas Morton, of this city, for the very rare chance of dissecting a specimen of *Troglodytes gorilla*, it having been seldom done abroad, and never before in this country, so far as I know. For a number of years past Dr. Morton has made numerous efforts to obtain a Gorilla, and finally, through the kind offices of Rev. R. H. Nassau, M.D., of the Presbyterian Missionary station at Gaboon 100 miles below the equator in Africa, succeeded, in the early part of the summer, in getting to Philadelphia the subject of the present communication. The specimen was sent from the Gaboon preserved in rum, and, through the excellent precaution of Dr. Nassau, considering all the circumstances, was received here in a tolerably good condition. Owing to his numerous professional engagements Dr. Morton was unable to dissect the animal himself, which at his request I did, with the exception however of the right leg, which Dr. Morton dissected entirely. My remarks will be confined to my own dissections. The specimen placed in my hands by Dr. Morton was a young male, said to be about fifteen or eighteen months old, and which had lived under Mr. Nassau's hospitable roof for some months in quite a domestic manner, being very docile and affectionate in its ways. I noticed its right arm had been broken, and that the lungs were quite decomposed, and so considered its death was probably caused by phthisis. Notwithstanding that the animal had undergone decomposition in some parts, Mr. Nash, the preparateur at the University of Pennsylvania, with his usual skill succeeded in making an injection, which sufficiently filled the principal vessels for all practical purposes, and which materially assisted the dissection. The specimen measured 21 inches from heel to the crown of head, the upper extremity 17, in the lower $13\frac{1}{2}$. The upper extremity was measured from head of humerus to tip of middle finger; the lower from head of femur to tip of middle toe.

What struck me at once as regards the extremities was the great length of the upper extremities, the tips of the fingers reaching $3\frac{1}{2}$ inches below the knee when the animal stood erect. The length of the upper extremities is conditioned by the peculiar gait of the Gorilla, which shuffles along semi-erect on all fours, using the extended hand as a fulcrum, and not flexing the fingers like the Chimpanzee. I make use of the term hand intentionally in contradistinction to that of foot, as, in my opinion, Prof. Huxley[1] has satisfactorily proved that the upper extremity is terminated by a hand and the lower by a foot. The hand, Plate V., fig. 1, measures 5 inches, and is slightly longer than the foot, Plate V., fig. 2, which is $4\frac{1}{2}$ inches long.

A very noticeable difference in this young male, as compared with an old one, is the absence from the head of the crest or ridge of bone running along the sagittal suture of the skull, which is so characteristic a feature of the skull of the adult male Gorilla. As the animal advances in life the temporal muscles develop, and their great size necessitates a firm basis of origin, and hence the absence of this bony ridge at the early age of two years. The young Gorilla, however, exhibits that width and elongation of the face and massiveness of the jaws, Plates III. and IV., which give the animal such a bestial aspect, so remarkable also in the Papuans, Hottentots, Caffres, and some others of the lower races of mankind. The part of the head containing the brain, however, is far from being misshapen; on the contrary, it presents a very fair contour, and this is as might be expected, as the brain of the adult Gorilla, whose skull is very animal-like, amounts to $34\frac{1}{2}$ cubic inches, while in some of the lower races of mankind, according to the high authority of the late Dr. Morton, there is as little as 63 cubic inches, the higher races, however, attaining as much as 114. These facts illustrate the importance, if one really wishes to get at the truth, of comparing the highest kinds of monkeys with the lowest types of mankind, and not with the highest, as is usually done, the latter comparison immeasurably increasing the gap between man and monkey.

[1] Man's Place in Nature. 1864.

On removing the calvarium the brain was found almost entirely decomposed. The base of the skull was remarkably human in its appearance, and the following measurements were noted: Antero-posterior diameter, from the foramen cæcum to the torcular herophili $4\frac{3}{8}$ inches; lateral diameter through sella turcica $3\frac{1}{4}$ inches; lateral diameter from bases of petrous portions of temporal bones $3\frac{1}{8}$ inches. The distance between the foramen cæcum and olivary process measured $1\frac{1}{2}$ inches, from olivary process to posterior clinoid process $\frac{1}{2}$ inch; sella turcica to torcular herophili $2\frac{3}{8}$ inches; outer border of lesser wing of sphenoid to ridge of temporal $1\frac{3}{8}$ inches. These measurements indicate a well-formed and relatively large brain.

The number of teeth in the Gorilla, like all the catarrhine monkeys, is the same as in man. The ferocious aspect of an old male is due to a great extent to the large size of the canine teeth, which in the young male are comparatively small. The neck in our specimen is short and thick; the chest and shoulders broad, body long.

As the skeleton of the Gorilla has been admirably described by Prof. Richard Owen,[1] it would be superfluous for me to consider it here, and I take the opportunity also of testifying to the general accuracy of the description of its myology by the late Prof. Duvernoy,[2] so far as my specimen enables me to make a comparison. In some parts the muscles were too much decomposed to determine positively their origin and insertion, and in some instances muscles described by Duvernoy were certainly wanting in the specimen dissected by me, or had a different disposition. As the muscles of the extremities are the most interesting, being regarded by Prof. Huxley as among the tests for the bimanous or quadrumanous nature of the Gorilla and other monkeys, I will confine myself more particularly to the description of the muscles that I found in the extremities of this specimen.

In reference to the muscles of the arm in my specimen the biceps, coraco brachialis, brachialis anticus, and triceps did not differ in any way from the corresponding muscles in man. But there was present the latissimus condyloideus, its name indicating its origin and insertion—a muscle which I have found in various

[1] Zoological Trans., vols. 4, 5.

[2] Archives du Musée, 1855–56.

other monkeys, viz., *Cynocephalus*, *Cercopithicus*, *Macacus*, *Cebus*, *Hapale*. This muscle has been described as occurring also in the Chimpanzee, Orang, and Gibbon. I have seen it as an anomaly in the colored races of men, and it has been recorded as also occurring in the white races. The only differences as regards the superficial muscles of the anterior aspect of the forearm as compared with those of man are that the pronator radii teres arises by only one head, and by that from the internal condyle of the humerus, and that the palmaris longus is absent. This, however, is sometimes absent in man. There was no appreciable difference in the origin and insertion of the flexor carpi radialis, flexor carpi ulnaris, or flexor sublimus digitorum. Of the deep muscles of the forearm, the pronator quadratus[1] and flexor profundus digitorum offer in this specimen nothing specially different from those of the same muscles in man. But an interesting peculiarity is the entire absence of a flexor longus pollicis. According to Duvernoy, the flexor profundus digitorum in the Gorilla gives off a tendinous slip which passes to the thumb, and corresponds to the flexor longus pollicis. Such a disposition I have seen in the various genera of monkeys I have dissected. But in this Gorilla there was no trace of a flexor longus pollicis either as a distinct muscle or as a tendinous portion of the flexor longus digitorum. Thinking that perhaps this might be an anomaly, I looked carefully for the muscle or the tendon in the other hand, but could find no trace of either. The entire absence of the flexor longus pollicis in the Orang, also, is well known. On the back of the forearm, in my specimen, were well-developed, in no wise different from man, the supinator longus, supinator brevis, extensor carpi radialis longior and brevior, extensor indicis, extensor communis digitorum, extensor minimi digiti, extensor carpi ulnaris, extensor ossis metacarpi pollicis, extensor primi internodii pollicis, and extensor secundi internodii pollicis. According to Prof. Huxley,[2] the muscle usually described as the extensor primi internodii pollicis in the Chimpanzee and other apes, is the metacarpal division of the extensor ossis metacarpi. While appreciating this criticism, I am nevertheless satisfied that there exists a distinct extensor primi internodii pollicis in this

[1] The pronator was only slightly developed in this specimen.

[2] Anatomy of Vertebrates, p. 408.

specimen of the Gorilla. As regards the hand the tendons *a* of the flexor sublimus digitorum *h*, Plate VI., fig. 1, split so as to enable the tendons *b* of the flexor profundus digitorum, Plate VI., fig. 1 *i*, to pass through to their insertion. Part of the flexor profundus *i* in the figure is concealed by the flexor sublimis *h*. The lumbricales are well developed. The thumb presented fully developed the abductor, flexor brevis, adductor, Plate VI., fig. 1 *c*, *d*, *e*, and opponens pollicis, and the little finger, the abductor, flexor brevis and opponens minimi digiti. In the disposition and relative development of these muscles I can see no difference from those exhibited in the hand of man. Briefly, then, the muscular system of the upper extremity of the Gorilla differs from that of man in that the latissimo-condyloideus is present in the former, while the palmaris longus and flexor longus pollicis are absent, and that the pronator arises by only one head.

In the thigh I noticed the tensor vaginæ femoris, the rectus, the vasti and crurens, the adductors and pectineus, the sartorius, biceps, gracilis, semi-membranosus, and semi-tendinosus. The last two muscles in the Gorilla are more fleshy than in man, but in other respects these muscles, as well as those just mentioned, are essentially the same in their origin and insertion as in man. On the anterior aspect of the leg may be seen the tibialis anticus, extensor longus hallucis, extensor longus digitorum. The little slip from this last muscle, unfortunately called the peroneus tertius in human anatomy, is absent in the Gorilla; I say unfortunately, because the name peroneus tertius would lead the comparative anatomist to suppose it inserted in the third toe, just as the names peroneus quartus and peroneus quintus of the rabbit and marmoset monkeys imply that these muscles are inserted into the fourth and fifth toes respectively, which is the case in these animals, whereas the peroneus tertius of human anatomy arises from the dorsal side of the fibula, and is inserted into the metatarsal bone of the fifth toe. It seems to be peculiar to man, and is sometimes absent The peroneus longus and peroneus brevis in the Gorilla repeat essentially the characters of those muscles in man, and there is an extensor brevis digitorum. The posterior aspect of the leg of the Gorilla exhibits the flexor longus digitorum, flexor longus hallucis, tibialis posticus, and gastrocnemius, similar to the corresponding muscles in man. The soleus, however, only arises from the fibula in the Gorilla, as I have also noticed was the case in other monkeys. The plantaris is absent in this specimen. The plantaris is, however, well developed in the Baboons, Macaeques, etc The abductor, flexor brevis, adductor of the hallux, are as evident in the Gorilla as in man, as also the transversus pedis, abductor and flexor brevis minimi digiti. The flexor accessorius is, however, absent in the Gorilla and in the Gibboon and Orang, but sometimes present in the Chimpanzee. I have found it well developed in Macaeques, Baboons, Vervets, etc. The flexor brevis digitorum, Plate VI., fig. 2, *a*, in the Gorilla is somewhat different from that in man. The part supplying the second and third toes, Plate VI., fig. 2, *a'*, only arises from the calcaneum, *a*, the tendons going to the fourth and fifth toes coming off from the tendons of the flexor longus digitorum, *d*, and flexor longus hallucis, *e*, respectively. The tendon for the fifth toe is not perforated. The flexor longus digitorum, *d*, supplies especially the deep tendons for the second and fifth toes, Plate VI., fig. 2, *i*, *c*. The flexor longus hallucis, Plate VI., fig. 2, *e*, divides into two tendons, one of which, *f*, supplies the big toe, and the other, *g*, after giving uniting fibres to the tendon of the flexor longus digitorum, passes to be inserted to the third and fourth toes, *h*, *k*. The flexor longus digitorum, *d*, supplies the superficial tendon for fourth toe, *b*, and the deep tendon for the fifth one, *c*. The flexor longus hallucis, *e*, the superficial tendon for the fifth toe, and the deep one for the fourth toe, *k*. The superficial tendon for the fifth toe is not represented in the figure, it having been unfortunately torn off before it could be drawn. There are well-developed lumbricales. On comparing the lower extremity of the Gorilla with that of man, the principal differences in the muscular system are the absence, in the Gorilla, of the plantaris, the so-called peroneus tertius, flexor accessorius, the soleus arising by only the fibular head, and the flexor brevis digitorum only in part from the calcaneum, and the defined share that the flexor longus hallucis takes in forming the deep tendons of the third and fourth toes. Surely these differences cannot be strained into proving that the termination of the lower extremity of the Gorilla is a hand, especially when it is remembered that two of the muscles which are absent in the Gorilla are present in the lower monkeys. I must respectfully protest, therefore, against the conclusions arrived at by Prof. Bischoff[1] in his elaborate me-

[1] Munich, 1870.

moir on the *Hylobates*, namely, that the monkeys are four-handed, structurally. That the monkeys use their feet like hands is a matter of every-day observation. But to conclude from that fact that their feet are anatomically hands is as illogical as it would be to conclude that the *Ateles* and *Colobus* possess only rudimentary thumbs, and having, therefore, no grasping power and using their hands like feet, are four-footed, not four-handed. To be consistent, those who assume that the Gorilla and other monkeys are four-handed should hold that the tail of *Ateles* is anatomically a finger, simply because it is used like one, and its upper extremity terminates in a foot and its lower in a hand.

It is interesting to notice that in the Gorilla the great bloodvessels come off from the aorta in the same manner as in man. Thus the subclavian and left carotid arteries spring separately from the aorta, while the right carotid and right subclavian originate in a common trunk—the innominate. This disposition of the vessels is also seen in the Chimpanzee, according to Vrolik.[1] With this exception, the arrangement of these bloodvessels in all the other monkeys is that the left subclavian comes off separately from the aorta, but that the left carotid originates in the innominate, as well as the right carotid and right subclavian. I have noticed a similar arrangement, with minor differences, in such animals as the Tiger, Squirrel, Guinea-pig, Kangaroo. It should be mentioned, however, that the origin of the bloodvessels which obtains in man, the Gorilla, and Chimpanzee, is not characteristic of these animals, as I have seen a similar arrangement in the Hedge-hog, Seal, Beaver, Sloth, Wombat, and, according to Meckel,[2] is found in the Ornithorhynchus. In reference to the vascular system of the upper extremity of the Gorilla, there was nothing essentially different from that of man. The brachial artery divided into the radial and ulnar; the palmar arch and digital vessels exhibited the human arrangement. I noticed the cephalic and basilic veins, the radial, median, and ulnar. The only peculiarity about the vessels of the lower extremity was that of the femoral artery giving off, in the middle of its course, a good-sized vessel, which accompanied the long saphenous nerve and vein to the inner aspect of the foot. Possibly, this is only an

[1] Recherches sur la Chimpanzee.

[2] Ornithorhynchus, 1826.

anomaly, but Dr. Morton found the same vessel in the right leg. Should this vessel be found in future instances, I would call it the long saphenous artery. The distribution of the plantar arteries is the same as that in man. As regards the nerve system, the external cutaneous nerve passes through the coraco-brachialis muscle in the Gorilla as in man; the ulnar nerve, however, is imbedded in the latissimo-condyloideus muscle; the median nerve, opposite the articulation of arm and forearm, gives off a branch that anastomoses with the ulnar. I have never seen such an anastomotic branch in man: possibly it is only an anomaly. The median nerve, Plate VI., fig. 1, *f*, supplies, in the Gorilla, the thumb, index, middle, and the inner side of ring finger; the ulnar, Plate VI., fig. 1, *g*, the outer side of the ring and little finger. The back of the hand receives filaments from the radial and ulnar nerves. The whole disposition is similar to that seen in the hand of man. In a similar manner to that of man, the plantar nerves furnish the nervous supply to the foot of the Gorilla. Inasmuch as the nerves, arteries, and veins of the extremities in the Gorilla are essentially the same as in man, it confirms the statement made above, deduced from the arrangement of the bones and muscles, that the Gorilla has anatomically two hands and two feet in just the same sense that man has, and what is true for the Gorilla is true for all the monkeys. I do not mean that the hand of every monkey is alike and exactly similar to that of man, or that the foot is absolutely similar in all these animals. On the contrary, I have often noticed minor differences; but, in my opinion, to say that a monkey is quadrumanous in its structure is to state what can be demonstrated as false in the monkey of any species, whether high or low.

Unfortunately the thoracic and abdominal organs were too much decomposed in this specimen to give any detailed account of their structure. The peritoneum entering into the formation of the great omentum had been so much torn that I cannot say positively whether the transverse colon was separate from the great omentum, as is seen in monkeys and in man when in an embryonic condition—or fused with it, as exhibited in the adult human being. There were no valvulæ-conniventes in the intestine. The only mammals, indeed, with the exception of man, in which I have noticed these folds of the mucous membrane, are the Elephant and the Camels; according to Meckel, they are also present in the Ornithorhynchus. In that portion of the small intestine that was intact I observed the glands of Peyer, relatively large and well developed. The vermiform appendix was present, and measured two and a half inches. This interesting structure is also found in the Chimpanzee, Orang, and Gibbon, but is absent in other monkeys; it is, however, found in the Wombat. I noticed it in three animals of that species that I have dissected. The intestines contained the remains of half-undigested vegetable food.

Although the Gorilla was said to be nearly eighteen months old, the scrotum was hardly developed; the testes, however, could be felt just below the external abdominal ring, and the communication between the greater cavity of the peritoneum and that of the tunica vaginalis testis was unclosed.

What conclusions can be drawn from this brief account of the structure of the Gorilla as to its place in Nature? In 1864 appeared the admirable "Man's Place in Nature," by Prof. Huxley, in which the general proposition is maintained that the gap between the Gorilla and the lower monkeys is greater than that between the Gorilla and man.[1] With all deference to that profound thinker, it appears to me that that proposition, while generally true, is not strictly so, since there are present in man and the lower monkeys certain muscles, like the flexor longus pollicis, or its homologue, and the flexor accessorius, which are absent in the Gorilla; while the Gorilla and the lower monkeys possess the latissimo-condyloideus muscle, which is absent in man, except as an anomaly. I call attention to the above essay of Prof. Huxley, not so much in a spirit of criticism, for I am in accord thoroughly with the tenor of the work, as to account for the general error so common among non-professionals, that evolutionists hold that man has descended from the Gorilla. Prof. Huxley certainly did not intend, in the famous work referred to above, to leave the reader with the impression that man had descended from a Gorilla. But as a detailed comparison was made between man and the Anthropods, there was a widespread impression developed by the publication of that book, that such a view was held by Darwinians, and advocates of the development theory generally, for which Prof. Huxley is unjustly held responsible, as too many criticize his work without having read it.

[1] Man's Place in Nature, pp. 84, 103.

Having had the opportunity of dissecting numerous genera of monkeys, and always while so doing reflecting on their structure as compared with that of man, I venture to state that I do not think any monkey now known can be regarded as the ancestor of man in general, and the Gorilla certainly not in particular. On the contrary, however, I believe that all the facts go to show that the different kinds of monkeys are the modified descendants of one ancestor, and that the different races of men have similarly descended from a common ancestor, and, further, that the ancestors of the monkeys and man had a common ancestry. In a word, man, the Gorilla, the Chimpanzee, and the Orang, etc., are distantly related, man and monkeys being members of the same order, Primates, and that there is no race of man, recent or fossil, or kind of monkey, now living or fossil, that will adequately represent the primitive man or the primitive monkey, and still less the common ancestor of both. If this view be correct, a "missing link" ought not to be expected to be found. While a firm believer in the doctrine of evolution, and while being entirely satisfied that the form of any animal or plant is the resultant of incidental forces upon plastic matter, and that the problems of morphology are questions of the redistribution of matter and motion, simple physical problems to be considered in the same spirit as the phenomena of electricity and chemistry are investigated, I must say that the genealogy of man has not as yet been worked out.

DESCRIPTION OF A NEW SPECIES OF DOLABELLA, FROM THE GULF OF CALIFORNIA, WITH REMARKS ON OTHER RARE OR LITTLE-KNOWN SPECIES FROM THE SAME REGION.

BY ROBERT E. C. STEARNS.

The forms referred to herein are part of a collection made in 1876, by Mr. William J. Fisher, of San Francisco, and kindly presented to me by the collector. In connection with the previous abundant material in my cabinet from Lower California and the shores and waters of the Gulf of California, Mr. Fisher's contribution adds much to our knowledge of the forms inhabiting the above province, their distribution and variation. I propose to publish additional papers in continuation of this, with notes and comments relating to these points.

Dolabella Californica, Stearns. (New Species.)

This form appears to have escaped detection until collected by Mr. Fisher, who found it living in Mulege Bay, Gulf of California; it prefers "dark places in pools left by the tide."

Though several specimens of the animal were procured, I was unable to obtain a specimen for investigation. Mr. Fisher, who made no drawings at the time of collecting, informs me that the animal is of the same general form as authors have given for *Aplysia*;[1] the color of the above species being a dark-brown, and the surface covered with warty papillæ. As to color, this species probably varies somewhat as do the individuals of others.

The species heretofore made known are principally inhabitants of the Indo-Pacific province, and the Mediterranean region is also credited with a representation of this group.

The figures, Plate VII, 1 and 2, of natural size, which I have carefully drawn from the largest of the two shells in my collections, resemble in outline, somewhat, the shells of *D. Rumphii* of Cuvier, = *D. scapula*, Martyn. The nuclear callosities vary more or less in different specimens.

Murex (Ocinebra) erinaceoides, Val. (= ? M. Californicus Hds.)

In the late Dr. Carpenter's Reports to the British Association, reference is made to the foregoing species (*Muricidea erinaceoides*) by name only. In his Mazatlan Catalogue, however, he

[1] See Woodward's Manual, 2d ed., p. 321.

has described a "var. indentata," of a form which he presumes to be Valenciennes, species, and suggests a comparison with Kiener's *Murex alveatus.* In the Smithsonian Check List (June, 1860 , he included Kiener's name, but omitted that of Valenciennes. As neither Kiener's nor Reeve's monographs are accessible, I have only been able to compare with Chenu's figure 583, as presented in the latter's Manual, Vol. I., p. 137, which is quite a different form from that herein considered, and which I have no doubt is the shell described by Valenciennes, for his name is so eminently appropriate, that if there is any question or confusion of names, his should be retained. The shell referred to has frequently been under my notice, and its determination has sorely puzzled others as well as myself. The specimen before me at this moment, which is only about half the size of some in my collection, is exceedingly suggestive of the European *erinaceus*, and the characters and range of variation in the two species are very much alike, though large adults vary more than do the smaller individuals. The West American form, when adult, is more triangular, and exhibits a general variation in the direction of *Pteronotus*.

The genera *Muricidea* and *Ocinebra*, as defined in Adams's Genera, when considered in the light of some of the species included by said authors in each of the two groups, will be found on comparison to approximate so closely as to create a doubt as to, in which of them, certain forms should be placed. I have grouped the form under review with *Ocinebra* because the Adams' have so placed its European analogue *erinaceus*, and for the further and better reason that most of the small muricoids of this part of the West American coast fall naturally into said genus. I am under the impression that some of the many *Ocinebræ* of the southerly part of the Californian and Vancouver province will prove to be northern varieties of this species. La Paz, Gulf of California, rare, Fisher; but, judging from the number of beach shells which I have seen, it must be abundant at some point in the Gulf or on the mainland or islands along the western or ocean side of the peninsula.

I append the following note from Mr. Tryon, who has kindly traced the synonymy. It is not unlikely that this form may prove to be a *Cerastoma*, as he suggests.

[Reference to the original description and distinctive characters of *Murex erinaceoides*, Val. (Recueil d'Observations, etc. II., 302, 1833), indicates that Mr. Stearns' identification of this species is correct. It has been since described by Mr. Hinds in Zool. Proc. London, 128, 1843, under the name of *Murex Californicus* Hinds; and excellent colored figures are given in Voy. Sulphur., t. 3, f. 9, 10. It is also figured in Reeve, Conch. Icon. sp. 144, under the latter name. Hinds describes the shell as having six varices, but his figures only show three; Reeve's description is correct in mentioning three varices alternating with nodes or ribs. The specimen sent by Mr. Stearns, with his paper, has but three varices. I think that Mr. Hinds has erred in including the three internodes as varices in his description. The species cannot be placed in either *Ocinebra* or *Muricidea*. Until the operculum shall be examined, it will be impossible to group it with certainty; if the operculum is muricoid, it is a *Chicoreus*, Montf.; if purpuroid, it is a *Cerastoma*, Conr. Geographical considerations lead me to surmise that it will prove to be the latter. Broderip (Zool. Proc. 175, 1832) described *Murex lugubris*, a species having five or six varices, and much resembling *M. erinaceus*. It occurs from Puerto Portrero, Central America, to Magdalena Bay, and is figured by Sowerby, Conch. Illust. f. 26, and by Reeve, Iconica, sp. 143. If this should prove to be the same as Valenciennes's species, the name would take precedence, having a year's priority.

G. W. T., Jr.]

Macron Æthiops, Reeve = *M. Kellettii*, Hinds.

Numerous fine specimens were found alive on mud flats in San Quentin bay, which indisputably connect the foregoing.

Reeve's species was probably described from a large specimen, in which the entire surface of the whorls was broadly and more or less deeply channeled or grooved, as in specimens in my collection, which measure 2.9 inches in length by 1.92 inch in width; from this, younger specimens, as small as 1 inch in length by .58 inch in width (the outer lip thin at this age), show the same characters.

In *Kellettii*, the type, as figured in Chenu's Manuel, measures 1.80 inch in length by 1.10 inch in width, and exhibits only three of these channels near the base of the body whorl. Mr. Fisher's specimens prove that the grooving is an uncertain character. The number of individuals collected by him was fortunately ample enough to settle all doubts, and prove that the two forms as above should be united under one specific name; as Mr. Reeve's appears to be the first in order of time, it must be adopted.

All of these shells, when alive or fresh, are covered with a black or nearly black epidermis, which is apt to flake or peel off when very dry. (The epidermis has the same characters in the rare *Mitra Belcheri*, in common with other West American related forms, and we may presume lives in *mud* stations.)

The varieties of *Macron* may be described as follow:—

I. Length 2.02, breadth 1.28 inches; channelled throughout; more conspicuously on lower part of body whorl than elsewhere. Plate VII., fig 3.

II. Length 1, breadth .57 inch; outer lip immature; channelled throughout.

III. Length 1.76, breadth 1.10 inch; channels obsolete or nearly so on upper part of body whorl. Plate VII., fig. 4.

IV. Length 1.22, breadth .82 inch; channels strongly marked below, fainter above and on the greater part of body whorl; on upper part of same barely perceptible.

V. Length 1.58, breadth 1 inch; three grooves on lower part of body whorls; otherwise smooth; typical of Hinds' form. Plate VII., fig. 5.

Although the other West American species, described by A. Adams, and named *M. lividus*. Plate VII., 6, habitat San Diego, on the ocean coast in the State of California, is a smaller form, with a smooth, unchannelled surface, suture somewhat deeply impressed; seldom attaining the length of one inch (averaging only .77), and rather slender than robust, and at present, I believe, universally regarded as a "good species," nevertheless I am of the opinion that it will prove to be a variety of the larger gulf forms, dwarfed by reason of its extreme northerly and extra limital position.

Mr. Reeve's form is also found at "Cedros" or Cerros Island, off the coast on the ocean side of the peninsula, and the range of forms herein referred to, it will be noted, extends from San Diego, California, in the north, around (probably at many points) on both coasts, the inner and outer shores of Lower California, and on the adjacent islands.

Numerous specimens in my collection and that of W. J. Fisher.

Cypræa (Luponia) controversa, Gray.

In Sowerby's monograph of Cypræa, in his Conch. Illustr., species 30, figure 136, no habitat given, reference is made to what I have always regarded as applying to the form under consideration. The only comment in the text as above is: "30—C. contraversa, *Gray*, Zool. Journ., t. 7 and 12, p. 7. *Obs.* This may prove to be only a variety of C. Isabella."

While its general coloration would lead to its being grouped with *C. isabella* of the Indo-Pacific and *C. lurida* of the Mediterranean regions, it differs more from the former than it does from the latter named species. While it is a more ventricose form than *C. isabella*, in this respect being nearer to *C. lurida*, the edges of the lips are not as finely and closely crenulated as in *isabella*, nor as coarsely as in *lurida*.

As the specimens which first attracted the attention of Californian collectors and naturalists were beach shells, they were regarded as ballast specimens of *isabella* from some Indo-Pacific port, thrown over from some ship, or accidentally mixed in with gulf shells by sailors, and were not carefully examined or considered. Their frequent reception from the gulf has led me to look into the matter, with the result as above stated.

Mr. Fisher collected several fresh living specimens at the Maria Madre, and at San Juanico Islands of the Tres Marias group, and the species should be added to the faunal list of the Mazatlan province.

Onchidella Carpenteri, Stearns = **Onchidium Carpenteri**, W. G. Binney.

The form referred to herein, which I presume to be the same imperfectly described from alcoholic specimens by Mr. Binney in the Proceedings of the Philadelphia Academy of Natural Sciences, 1860, page 154, is an *Onchidella*, as said genus is defined by Woodward,[1] the generic description and type (*O. Typhæ*, Buchanan) being considered, together with numerous specimens collected by Mr. Fisher at various places in the gulf of California.

Although Mr. Fisher's specimens are somewhat contracted and distorted by alcohol, they are probably in better condition than were those examined by Mr. Binney, and I am therefore able to add the following to that author's descriptive remarks:—

Body oblong ovate, about one-third longer than wide; convex

[1] Recent and Fossil Shells, 2d ed., 299.

or rounded above, flat on the under side; anterior and posterior ends equally rounded. Dorsum formed by the mantle, and entirely covering the back, which is of a smoky brown color, coriaceous and quite thick at the edges, as seen from the under side, which latter is of a dingy yellowish color. Surface of dorsum closely covered with rough wart-like papillæ, some larger than others; the largest placed so as to present somewhat the aspect of regularity, the interspaces being filled with the smaller. Creeping disk or belly elongated, nearly as long as the animal, and its width about one-third of the entire width, as seen from below.

Respiratory orifice on the left side, between the edge of the creeping disk and the mantle, at a point about two-fifths of the total length, from the posterior end. Anal outlet on the right side, very near the posterior extremity of, and just above the edge of, the creeping disk.

The eye peduncles rather short, and these, together with the buccal appendages, are obscured through the contraction caused by the alcohol.

The creeping disk, being comparatively soft, is much contracted by the same cause.

[Abundant, attached to the under side of stones, at low tide. Sometimes overlapping each other —W. J. Fisher.]

Habitat. Gulf of California, in San Francisquita Bay, Los Animas Bay, and Angeles Bay.

The above was written, and Plate VII., figure 7, drawn (twice the actual size) from an alcoholic specimen in my collection. It shows the ventral; *o*, oral orifice; *a*, anal orifice; *r*, respiratory orifice; *d*, creeping disk.

Specimens are also contained in the collections of Mr. Fisher, Museum of University of California.

Figure 8, Plate VII., restored as suggested by Mr. Fisher, to whom the drawing was submitted; he writes: "Your figure No. 2, (8) has the exact shape of the species."

Judging by figures 2 and 2*a*, of *Onchidella granulosa*, Lesson, in Adams' Genera of Recent Mollusca, Pl. LXXXI., it somewhat resembles that species, except in color.

Mr. F. W. Hutton, in his "Catalogue of the Marine Mollusca of New Zealand," includes a species *Onchidella nigricans*, Quoy, color "uniform black" . . . . "common on rocks between tide marks," having the same habit in this respect as *O Carpenteri.*

The Adams say, "The species of this genus live on aquatic plants, in ditches and damp places." According to Woodward, the California species belongs in a different genus from that in which I have placed it, for he says: "Those which frequent sea-shores have been separated under the name of *Peronia*, Bl. (*Onchis*, Fer.)." The type of this last genus *P. tongana*, Quoy, is too conspicuously different to admit of this; the balance of characters being decidedly in favor of the group first named herein, and to which I regard it as more nearly related.

The dorsal eyes, detected by Prof. Semper in certain forms of *Onchidiæ*, and which he has so carefully illustrated and described, I have not been able as yet to discover in any of the specimens collected by Mr. Fisher.

ON A BELT OF SERPENTINE AND STEATITE IN RADNOR TOWNSHIP, DELAWARE COUNTY, PA.

BY THEO. D. RAND.

There is a well-known belt of serpentine passing through Radnor Township, in a direction about N. 80° E. from near Radnor Station, P. R. R., continuing probably to West Chester, S. 75° W., and which is probably identical with that apparent at the Schuylkill at Rose's quarry, nearly opposite Lafayette Station, P. G. & N. R. R.

This serpentine is very dark, and is almost without other minerals except asbestos. Northwest of this is another belt, which I believe has never before been described.

Its southeasternmost outcrop is on the S. W. side of the gulf road, about 150 yards S. E. of the road from Radnor Station to Conshohocken, and in, but near the southeastern border of, the Edge Hill hydro-mica schists, which a quarter of a mile N. W. form the Gulf Hills, the continuation of which is known as the South (Chester) Valley Hill. Its outcrop is a very small one, not over six or eight feet in width, and has been exposed by a cutting of the road.

The serpentine is of a reddish- and also of a blackish-green color, quite compact. No other minerals are visible.

About a mile, S. 73° W., from this point, a similar serpentine appears, ploughed up in a field on the property of the heirs of Mark Brooke. This point is about five-eighths of a mile nearly N. E. from Radnor Station, and about a quarter of a mile N. N. W. from the well-known serpentine belt.

At this point it is accompanied by a bed of steatite, indeed nearly pure talc. On both sides occur the primal sandstone rocks of Rogers. This observation, however, is made, except as to one outcrop of steatite, on surface specimens ploughed up, but the beds are so well defined and the rocks so abundant that I believe it is accurate, and it is confirmed by another exposure hereafter mentioned.

The accompanying minerals are chlorite and a foliated chloritic mineral, and on the N. E. a garnetiferous schist. This garnetiferous schist is found apparently southwest of the steatite, on the road from Radnor Station to Conshohocken, N. E. of the road separating Delaware from Montgomery County. The steatite, with two distinct parallel outcrops, with primal sandstone between, appears near the same road in a ploughed field, but only as loose masses, on a farm formerly owned by Christopher Pechin; no serpentine was found.

These two exposures of the steatite are about half a mile apart, and the direction is nearly N. 70° E.

The serpentine on the gulf road is very nearly in the same direction, and although no steatite was found on the gulf road, except one small piece, I was assured by Mr. Garrett Williamson, who has resided in the neighborhood for years, and who first called my attention to the fact that steatite existed in the vicinity, that steatite had been found in place in digging the gutters of the road, about one hundred yards southeast of the serpentine, and on searching at this point the small specimen mentioned was found.

The continuation of the line was followed, but no other exposure was seen. The strike is nearly the same as that of the Edge Hill rocks, the trap, the primal slates, and the Gulf Valley; varying about 18° from that of the steatite of the soapstone quarry, from Chestnut Hill to the black rocks near Merion Square, and its probable continuation from Rosemont southwestwardly.

The question at once suggests itself: Is this steatite of the soapstone belt on the northeasterly side of an anticlinal axis? The presence of the garnetiferous mica schist favors this view, but the occurrence on the gulf road on the Edge Hill rocks, and the presence on the northeast of the primal slates are opposed to it. I desire at present merely to put the facts upon record, hoping that future discoveries may render them of value towards development of the geology of the region.

The line of strike of this belt would be just at the brow of the hill on the southwest side of the Schuylkill, overlooking Conshohocken. Granitoid gneissic rocks are there in abundant outcrops, but no serpentine or steatite has been noticed.

I desire also to call attention to a fact which probably indicates a line of fault in the upper part of the valley of Mill Creek. The steatite belt of the soapstone quarries is found in a very nearly perfect line, about S. 54° W. from Chestnut Hill, Philadelphia, to near Merion Square, Montgomery County, where it is very prominent in the so-called black rocks. It continues, however, in the same direction at least half a mile further, being exposed in the Black Rock Road at the curve in that road N. E. of Mr. Chas. Wheeler's, beyond which it does not appear. The prolongation of this bearing would strike the Penna. R. R. at or near the bridge by which the Black Rock Road crosses it. The railroad cutting is here some thirty feet deep for over half a mile in decomposed mica schist, without a trace of steatite, but at Rosemont, a distance, measured at right angles to the strike, of about half a mile, and in direction due west, it again appears, northeast of the railroad. Near Darby Creek, about two and a half miles S. 55° W. are other outcrops, the course being S. 55° W., beyond which it widens into a broad belt of serpentine and allied rocks to the West Chester road, identified by the pseudomorphs of serpentine after staurolite. the so-called bastard serpentine.

Blue Hill, Providence Township, is nearly in the prolongation of this line, as also Walter Green's in Marple.

The serpentine belt first mentioned has a similar change in direction; from Rose's quarry to a point on the Barr farm, two miles north from Bryn Mawr, its direction is about N. 65° E., a prolongation striking the Pennsylvania Railroad at a point half a mile above Rosemont, whereas, at its first outcrop near Radnor Station, it is about half a mile north of this assumed line, and thence pursues a course about S. 75° or 80° W. The outcrop is about half a mile in length. Both terminations are abrupt, and, in situations in which, if continuous, its continuation should be plainly visible.

DECEMBER 3.

The President, Dr. RUSCHENBERGER, in the chair.

Thirty-four persons present.

On Tænia mediocanellata.—Prof. LEIDY exhibited two specimens of tapeworms, *Tænia mediocanellata*, both retaining the head. These had been recently submitted to him for examination by Dr. James J. Levick and Dr. Walter F. Atlee. Tapeworm appears not to be a common affection with us. Several physicians, in extensive practice in this city, had informed him that they never had a case. During the last ten or fifteen years, from one to two specimens annually had been submitted to him, but the present year he had seen five specimens. He had been surprised to find that all pertained to the species indicated. Formerly he supposed that our common species was the *Tænia solium*, but later experience would indicate that the *Tænia mediocanellata* is the more common. The distinction between the two had been observed only comparatively recently, so that no doubt many specimens formerly attributed to the former actually belonged to the latter.

When the head is present, the two species are readily distinguished. The *Tænia solium*, whose larval form is found in the "measle" of pork, has the head provided with a crown of hooks. *Tænia mediocanellata*, derived from beef and mutton, has a larger head, which is unarmed. The ripe segments are also usually readily distinguished in the two species. In the *T. mediocanellata*, the ovaries are divided into many more pouches than in *T. solium*.

In Dr. Levick's case, the man had been in the habit of eating raw buffalo meat. In one of the specimens exhibited, the suckers of the head appeared as black spots, from the black pigment on their interior surface. The genital apertures were also black from the same cause. In the other specimen, the head appeared less black from pigment about and around the position of the suckers, and the genital apertures do not appear black.

Mountain Soap of California.—Prof. GEORGE A. KŒNIG stated that the so-called mountain soap has a uniform, impure white color, and is gritty to the touch. Examination with the lens does not reveal the composite nature of the substance, but when crushed (not ground), and stirred with water, it assumes a pasty consistency like Kaolinite, and by continued stirring with much water passes into a milky suspension. From this in a short time a sandy material deposits, while the remainder requires many hours to settle in the water into a flocculent mass. Thus two portions were obtained, a sandy one, A (45 per cent.), and a flocculent one, B (55 per cent.), roughly. Both were dried over sulphuric acid.

Analysis of B:—

Ignition	6.70 per cent.	
Decomposed by H_2SO_4	28.00 per cent.	$Al_2O_3 = 12.60$ $SiO_2 = 15.40$
Dissolved by KHO	38.30 per cent.	(Amorphous SiO_2)
Insoluble residue	24.35 per cent.	$SiO_2 = 22.4$ $Al_2O_3 = 1.50$
Not determined $CaOK_2O_1Na_2O_1$	2.075	
	100.00	

B is, therefore, a mixture of Kaolinite, opal silica, feldspathic mineral, and quartz.

Examination of Part A:—

Ignition	12.24
SiO_2	69.40
Al_2O_3	13.50
CaO	0.60
MgO	0.30
Alkalies (difference)	4.00
	100.00

But this also parts into a soluble and an insoluble portion.

Insoluble	38.50 per cent.	$SiO_2 = 32.00$ $Al_2O_3 = 6.40$
Soluble	61.50 per cent.	$SiO_2 = 42.2$ $Al_2O_3 = 6.8$

It is absolutely impossible to identify any species with certainty under these circumstances.

December 10.

The President, Dr. Ruschenberger, in the chair.

Twenty-six members present.

Aspidium aculeatum in Pennsylvania.—At the meeting of the Botanical Section of the Academy, held Dec. 9, 1878, Mr. Crozer Griffith announced that while spending the past summer at Long Pond, North Mountain, Sullivan Co., Pa., he had found *Aspidium aculeatum*, Swz., var. *Braunii*, Koch, growing abundantly along the watercourse at the foot of Ganogo Falls, in a rocky, cool, and shaded locality. These falls are near the junction of the southeast corner of Sullivan and the northwest corner of Luzerne Counties, perhaps within the boundary of the latter.

So far as North America is concerned, this fern is distinctly a northern species. Canadian botanists have observed it at Gaspe and Temisconata, and from the north shore of Lake Huron to Kamouraska, eastward and northward, in restricted localities.

Tuckerman found it in the White Mountains of New Hampshire; Rush credited it to the Green Mountains of Vermont, and it has long been known to occur in that State at Mt. Willoughby, and in Smuggler's Notch at the base of Mt. Mansfield; Frost found it also near Brattleboro, Vermont; Macrae, many years ago, collected it in the Adirondack Mountains, Essex Co., N. Y. In 1869, Mr. Redfield found it at Stony Clove, in the Catskill Mountains, N. Y., and in 1873, Mr. S. H. Hall collected it at Haines Falls, in the Kaaterskill Clove of the same mountains, these being our most southern localities until now, when we find it in northeastern Pennsylvania, about latitude 41° 20′, and at an elevation of about 2000 feet above tide.

DECEMBER 17.

The President, Dr. RUSCHENBERGER, in the chair.

Forty-one members present.

A paper, entitled "Morphology of the Limbs of Amphiuma, and the probable Synonymy of the Species," by John A. Ryder, was presented for publication.

The deaths of Eli Geddings, M.D., a correspondent, and Samuel J. Reeves, a member, were announced.

The Publication Committee reported in favor of the publication of the following papers in the Journal of the Academy:—

"Descriptions of new species of fossils from the Pliocene Clay Beds between Limon and Moen, Costa Rica, together with notes on previously known species from there, and elsewhere in the Caribbean Area." By Wm. M. Gabb.

"Descriptions of Caribbean Miocene Fossils" By Wm. M. Gabb.

DECEMBER 24.

The President, Dr. RUSCHENBERGER, in the chair.

Fifteen persons present.

A paper, entitled, "On the Land Shells of the Mexican Island of Guadaloupe, collected by Dr. E. Palmer," by Wm. G. Binney, was presented for publication.

December 31.

The President, Dr. Ruschenberger, in the chair.

Thirty-seven persons present.

Mineralogical Notes: Randite.—Professor George Aug. Kœnig laid before the Academy some specimens of granite from the neighborhood of Philadelphia, showing an incrustation or coating of a canary or lemon-colored substance, which he had analyzed. This substance is probably crystalline, with generally an earthy habitus. It is translucent, with a fine yellow color, and a hardness from 2–3. Owing to the impossibility of complete separation from the underlying orthoclase, the specific gravity was not determined.

Heated in a closed tube, the mineral yields a small quantity of water (not acid), and turns to orange-red. Heated in the forceps in a strong oxidizing flame, it becomes shining black. It dissolves in a bead of microcosmic salt with effervescence (CO_2), imparting to the glass the characteristic yellowish-green color of uranium, changing to bluish-emerald green in the reducing flame. Concentrated cold hydrochloric acid dissolves it before ignition; after ignition only hot acid dissolves it completely. On no other part of the rock would hydrochloric acid produce effervescence, except where the yellow crust was visible. It is reasonably but not absolutely certain, therefore, that the substance examined was not a mixture of calcite with the yellow material. The quantitative analysis was made with 47 mlgrs. of material, as follows: The substance was put into a platinum boat, and brought to beginning red heat in a tube of hard glass, 6 inches long, $\frac{3}{16}$ bore, the tube being in horizontal position, and loosely stoppered at the open end. Water condensed in the cold part of the tube. While the one end was yet in the flame, the front part of the tube was severed by means of a red hot glass rod, and immediately weighed. Weighed again after complete drying, the difference (2.0 mgrs.) being water. The substance weighed now 43 mgrs. It was digested with HCl until the residue was perfectly white, a strong effervescence taking place. Insoluble part weighed 16.4 mgrs. (This is orthoclase and quartz, both quite insoluble in acids.) The real substance was, therefore, 30.6 mgrs. Uranium was separated from calcium by converting the latter into sulphate, and precipitating it with $1\frac{1}{2}$ volumes of strong alcohol. $CaSO_4 = 24.2$ mgrs. $= 9.67$ mgrs. CaO. It was again determined by ammonium oxalate, 9.64 mgrs. CaO. After evaporation of the alcohol, uranium was precipitated by ammonium hydrate, and weighed 9.5 mgrs. U_3O_4.

Percentage composition,

$CaO = 32.50$	requires	$CO_2 = 25.49$	
$U_2O_3 = 31.63$	"	" $= 4.83$	
$H_2O = 6.53$			
$CO_2 = 29.34$	(difference)	$CO_2 = 30.32$	(calculated).
100.00			

$$CaCO_3 : U_2CO_5 : H_2O = 5.3 : 1 : 3.3$$

or, $$Ca_5U_2C_6O_{20} + 3H_2O.$$

Qualitatively this mineral is identical with *Liebigite*, but the ratio and the percentage of water is very different. Liebigite has a fine green color. Voglite is green likewise, contains copper, and has twice the quantity of water.

Thus: Liebigite = $CaU_2C_2O_8 + 20H_2O$
Voglite = $Cu_3Ca_2U_2C_6O_{19} + 14H_2O$
Randite = $Ca_5U_2C_6O_{20} + 3H_2O$

The name is proposed in honor of Mr. Theo. D. Rand, of Philadelphia, who mentioned some qualitative tests with this mineral to the author some two years since. The specimens were obtained from Dr. A. E. Foote. It is self-evident that further examination, with a more liberal supply of material, is needed to establish this mineral thoroughly as a new species.

The following reports were read and referred to the Publication Committee:—

REPORT OF THE PRESIDENT FOR THE YEAR ENDING NOVEMBER 30, 1878.

The progress of the Academy during the year has been satisfactory. The means to facilitate investigations in the several departments of natural science have at no time been greater since the foundation of the Society. Valuable additions to the library have been made by exchange of the Academy's publications for those of kindred societies at home and abroad, by the generosity of authors and editors, and largely by the I. V. Williamson Library Fund. Most of the collections of natural objects have been considerably augmented

Materials awaiting investigation and study are abundant, and the records of information relative to every department of natural history are not more numerous in any library in the country. All these materials and means of study are accessible to those interested in the pursuit of knowledge of natural objects. It is no fault of the Academy's organization or policy that the number disposed to avail themselves of these advantages is not greater than it is. All are invited, and all who accept the invitation to work in the building are cordially welcomed, and the resources of the museum and library are opened to them.

The financial condition of the Society has somewhat improved. The necessary expenses exceed the income of the year about five hundred dollars.

The present policy, which it is hoped will be always maintained, is to conduct the affairs of the Academy in such manner that it will remain free from debt, as it is now.

During the year 28 members and 32 correspondents have been elected, and during the same period the record shows that four members have resigned; 16 members and 11 correspondents have died, so that only 8 members and 21 correspondents have been added to the membership of the Society. The income of the Academy is to some extent dependent upon the number of its members.

Thanks to the generosity and public spirit of Mr. I. V. Williamson and the late Dr. Thomas B. Wilson, a library fund has been established which is sufficient to procure almost all new and current publications; though not enough to supply every standard work which naturalists may desire to consult. It may be said, however, that it assures a continuous increase of the library at a rate of about five hundred volumes a year.

An adequate publication fund is very much needed. Including the bequests of Mrs. Elizabeth P. Stott, Augustus E. Jessup, and Isaac Barton, the total income applicable to publication is about $700.

It is believed that the prosperty of the Academy depends largely on its publications. and without them it would be unknown and virtually cease to exist in a scientific sense. They constitute a bond of relationship with societies engaged in like pursuits in all parts of the world and make the Academy known to them and them to the Academy. Indeed the Journal and Proceedings are the vocal organs of the Society through the functions of which it holds communication with the naturalists in all civilized countries. Consisting chiefly of records of discoveries in natural science made by members of the Society, they contribute to the history of scientific progress. The respectability of the Academy is measurably dependent on the importance of the discoveries announced in these publications; and their quality is the criterion of the Academy's scientific character at home and abroad. Their value and importance cannot be precisely reckoned in money's worth. They encourage students to labor. for it may be safely conjectured that few would engage in original investigations without assurance of a way to make known their discoveries to the scientific world.

Besides, they bring to the library very essential and important additions. During the past year the Academy has received in exchange periodicals and serials from 45 editors and from 240 societies, or 285 publications, which, if the Academy ceased to publish, could not be procured for less than about $1400.

The Publication Committee carefully scrutinizes all expenditures, and spares no pains to secure economy in the execution of the work assigned to it. Important communications are sometimes rejected solely for want of means to publish them. Some authors contribute the plates necessary to illustrate their descriptions rather than their work should not appear under authority of the Academy's imprint; but there are many students whose financial condition will not permit them to give more than the results of their own labor.

The manufacture of the Journal of the Academy and of the Proceedings of the Academy costs, on an average of the past three years, $1740 a year. This sum includes the expense of paper, printing, plates, and binding. The authors of the papers published receive no pecuniary compensation for their labors. The difference between the sum ($700) applicable to publishing and the actual cost, is derived from the fees of a small number of subscribers and the general income of the Academy, and in amount is equal to one-fourth of the annual revenues, exclusive of trust and special funds.

Besides the "Journal" and "Proceedings" publications of another kind should be made from time to time for the benefit of those students who reside at distant points, as well as of those who live in the city. It is not entirely satisfactory to possess manuscript catalogues of the library and of the collections. It is desirable to have a descriptive or indicative list of specimens in each class of the several collections in the museum, so arranged that a naturalist might be at once informed by reference to it whether the object he wishes to inspect is in the Academy, before seeking it in the museum. Such lists carefully prepared and printed, to be furnished on application on such terms as may be considered proper, would make known what is in the museum as well as its deficiencies, and indirectly prompt friends of the institution at a distance to assist in supplying desiderata. The preparation and publication of lists of the kind would be expensive; but the advantages flowing from them to the Academy and to naturalists would fully compensate their cost.

It is believed that $2500 a year, economically expended, would not be more than enough to secure the publication of all matter that the Academy should issue under its imprint. It is therefore earnestly recommended that an effort be made to increase the funds applicable to this object sufficiently to yield an annual revenue of $2500; that is, an addition of $1800 to the yearly income appropriate to publication.

Relieved of the necessity to contribute to the cost of publication it is probable that the general income of the Academy will be sufficient to defray the current expenses for salaries, warming, lighting, freight, postage, stationery, etc., even after the completion of the edifice.

Attention is respectfully invited to the necessity of establishing a curators' or museum fund of five or six hundred dollars a year, to be expended for mounting, properly displaying, and preserving objects in the various collections, and procuring whatever may be necessary to their completeness.

Fees of initiation and life-membership might be appropriated to this purpose. In the course of a few years the amount necessary to create the fund required would be accumulated, and then those same resources could be made available for some other necessity.

Deficiencies and defects now noticeable in the museum are in a great degree fairly ascribable to the want of a curators' fund. A brief reference to its present aspect may possibly make this apparent.

The museum is the aggregate of gifts received in the course of the past sixty-six years from very many generous persons, some giving one or more specimens and some entire special collections. Those departments having numerous and enthusiastic votaries have grown greatly, while those which have attracted comparatively few students are very slenderly furnished. This inequality of representation of the several classes of objects is inevitable in this museum, which originated in and is entirely dependent upon individual bounty for its formation; and, until within the past three years, upon unpaid labor exclusively for its arrangement, and the suitably mounting and display of specimens. Yet, in spite of a want of sufficient means for the purpose, the thousands of valuable and rare objects collected here are carefully protected against the ordinary causes of deterioration and loss. Fragile and perishable specimens, which were presented more than sixty years ago, are still quite perfect. The richness of some of the collections in unique and type specimens, placed here from time to time since the early days of the institution, is well known. In this connection no complaint can be reasonably made. No pains have been spared to secure the preservation of specimens placed in charge of the curators, and no loss can be fairly ascribed to their want of attention or care.

Had there been power at the outset to form a museum on a carefully matured plan to be realized under competent direction, all its departments, we may reasonably conjecture, would have been provided for alike. Or, had there been at the commencement of the formation of this museum by individual contributors, each according to his taste or opportunity, a curators' fund applicable to the purchase of specimens required in the representation of a class or order, there would be no inequality in the several departments noticeable at this time. And it seems not extravagant to suppose that the creation of a curators' fund at this time would furnish the means to supply all deficiencies in the course of a few years.

A museum, according to the significance of the term, is a place of instruction. To render it effective to this end all the collections in it are required to be arranged according to the accepted systems of classification, and all the specimens illustrative of the class, order, or family to which they belong, to be appropriately located as far as practicable in an unbroken, continuous series, so that their relations may be readily observed.

This is illustrated in the cabinet of minerals, which has been arranged in accordance with an accepted system of classification based on composition. A student, by the aid of Dana's *Manual of Mineralogy*, may follow the arrangement from beginning to the end.

And with the assistance of Gray's *Manual*, a student may learn the accepted system of classification of plants in the botanical collections of the Academy, which are now so far arranged as to be available for study, thanks to the spontaneous labors of botanical experts of the Society.

But want of space has rendered such uniform arrangement of some of the other collections impracticable. The mollusca, for example, which are mostly represented only by their shells, cannot be arranged in a uniform series, including the soft parts of the animals which are necessarily preserved in alcohol, unless waxen or *papier maché* models of them were substituted in their place, a substitution which is expensive and unattainable without money.

Want of space is an insurmountable barrier to the location of the mammals, large and small, in an unbroken series according to a system of classification, each in its relative position, even if it were essential that mastodons and mice should stand on the same line of view.

It will be admitted by all that the museum is excessively crowded. At least one-third of the cases on the Wilson gallery might be taken away, and then at least one-half of the birds could be removed from the remaining cases advantageously to the appearance of the museum, as well to those taking first lessons in ornithology. At present this vast collection of birds is rather stowed than displayed in the cases.

One-tenth of the number of mounted birds judiciously selected and artistically arranged to occupy all the cases in which the twenty-six thousand specimens are now stowed — almost like things in a ship—would seem to general observers a more attractive and complete collection than it is at present. Ornithologists, however, for whose benefit the late Dr. Thomas B. Wilson devoted so much care and money to enlarge the Academy's collection of birds, regard the numerous representatives of each species in it to be a prominent feature of its value which distinguishes it among the most complete in the world. Good faith and respectful remembrance of Dr. Wilson's bounty require that the Academy should preserve it and endeavor to provide more space for its accommodation rather than withdraw specimens from the collection until it suitably fits the room given to it now.

Classification of objects and arrangement of them change under the influence of experience and scientific progress; and architectural construction and limited space may compel separation of affiliated collections and the location of parts of them in the museum out of their appropriate place in the accepted system of classification. Such displacements may be admitted to be blemishes in the arrangement of a museum without admitting that they are not excusable for reasons just stated. Such unavoidable defects of arrangement do not lessen the usefulness of the museum to students.

The continuous increase of the collections indicates that the building should be completed as soon as practicable. An application made to the Legislature of the State for aid in this connection failed. The committee of the Academy charged with the subject reported substantially, January 22, 1878, that it was unadvisable to press the matter further at that time and was discharged.

During the past year valuable additions to the collections have been made. Specimens pertinent to ethnics have become so numerous that they fill a room on the entresol floor in the southeast end of the building, as well as a series of flat cases placed around the middle room at the east end of the first floor. These collections, which are very valuable, prove that interest in ethnology has greatly increased among the members of the Society during the past few years. In popular estimation no department of natural science is more important or more attractive. It is certainly worthy of the fostering care of the Academy in the future.

An arrangement of the conchological cabinet in such manner that fossil species shall be appropriately intercalated in it, want of space in the museum renders impracticable at present, although the propriety of such an arrangement is daily becoming more apparent to proficients in conchological studies.

It is conjectured that large and highly interesting collections would come to the Academy if it could afford sufficient space for their proper display and study. Proprietors are rarely willing to give valuable collections or specimens to any institution known to lack capacity to exhibit them in a suitable manner.

Considerable collections and valuable specimens contributed to the Academy by exhibitors at the International Exhibition of 1876, and confided to the care of the Smithsonian Institution for delivery, will come to us after the contemplated building for the National Museum at Washington has been completed. At present they are mingled with gifts to that institution from the same source, and will remain packed as they were for transportation hence to Washington until a suitable place for their display has been provided.

The growth of the museum and the progress of the Academy, as well as that of natural science, would be accelerated by the immediate completion of the building according to the plans. It is not extravagant to suppose it possible that the collections made by the geological surveys of the State of Pennsylvania might be confided to the care of the Academy, if that part of the edifice which has been intended to contain only objects illustrative of the natural history of Pennsylvania were now ready for their reception. Collections of the kind while packed in boxes are of no value; but when suitably mounted, labelled, and displayed they become continuously important to successive generations of students and observers; and if placed in proximity to a great general collection and a large and appropriate library, their value is enhanced.

Earnest desire to realize, without loss of time, plans devised for benevolent purposes, may lead to the adoption of measures which experience will prove to have been unwise.

Assuming it to have been admitted that the building should be finished, a question for the Academy to decide is whether it is prudent to accept the inconveniences and losses incident to delay, and rely exclusively on the benefactions of intelligent and generous citizens to complete the work which they have so admirably begun, rather than seek an appropriation from the State treasury, which may be obtained, if at all, under conditions that may prove to be embarrassing or unsatisfactory hereafter.

Similar institutions are largely assisted from the public treasuries of the States in which they are. The Congress of the United States appropriates annually $20,000 to support the National Museum at Washington under the direction of the Smithsonian Institution. The Legislature of New York annually votes as much to support the State Museum at Albany, and it has appropriated nearly three-quarters of a million of dollars towards erecting a suitable building in the city of New York for the American Museum; and the Legislature of Massachusetts has voted more than a quarter of a million to aid the Museum of Comparative Zoology of Cambridge.

With such precedents in view, and considering that the Academy is eminently charitable in all its uses and purposes and educational in its character, and that all the work of its members is gratuitous, the worthiness of the Society to liberal and substantial aid from the State is scarcely to be doubted.

At this time the building fund consists of only $2344. More than a hundred times this sum is probably needed

The prospect of completing the building through the bounty of individuals within a reasonable time is not now encouraging, but may not be absolutely hopeless.

It is unfortunately true that the stagnation of business generally during the past three or four years has reduced incomes, and the times are not propitious to obtain such large contributions as were generously bestowed in the early days of this enterprise, but it is also probably true that the proportion of well-to-do and opulent citizens of liberal disposition is unchanged. Some may be found willing to give substantial aid to the work; and, as the cost of fire-proof construction is less now than it was when the corner-stone of this building was laid, the aggregate sum necessary to be raised will be proportionately less.

The obstacle in the way of this enterprise is not in want of ability in the community to accomplish it in spite of its great cost, but in the indifference of the public generally to the progress of scientific pursuits among us. It is probable that the existence of the Academy is unknown to thousands of our citizens; and of those who are aware of its existence thousands have never been inside of its doors, although it is among the institutions in the prosperity of which intelligent Philadelphians are supposed to be interested

The value of knowledge of natural objects, and of the laws which control their structure and relations, is duly appreciated chiefly by naturalists and students of nature; those of the population who are engaged in the numerous avocations affiliated more or less closely with commerce, the useful arts, including architecture and manufactures of all kinds, are generally heedless of this kind of information. They are mostly allured to the imitative and decorative arts, painting, sculpture, music, the drama, of various grades of quality. To persons of these classes, who constitute the great majority of the population, and include most of the opulent people of the city, natural science is unattractive. They regard the pursuits of naturalists to be merely the harmless, dull, uninteresting amusements of stupid people; and some look upon their labors as dangerous to religious belief: an erroneous notion, which reminds us of the famous trial which took place at Athens more than twenty-two centuries ago. The Athenian judges found their fellow-citizen Socrates, the wisest man of his day, guilty "of busying himself with prying into things under the earth and in the heavens, and making the worse appear the better reason, and teaching the same to others; and of not believing in the gods acknowledged by the state, but in other new divinities," and put him to death.

The spirit manifested by those Athenian judges has not entirely disappeared. The same intolerance of investigation of natural things, for the sake of ascertaining truth, has existed in the popular mind from the days of Socrates to the present, though now vastly abated and restrained.

The most prominent wants of the Academy and the obstacles to their removal have been stated, not in expectation that they may be very soon supplied, but under a belief that it is proper that members should be informed of their nature, in order that they may be considered, and such measures as in their judgment may seem expedient be adopted.

The annual reports of the curators, of the treasurer, of the secretaries, librarian, and several sections, show the progress of the Society during the year.

Professor J. Gibbons Hunt is delivering a course of very interesting and instructive lectures before the Biological and Microscopical Section, on the use of the microscope in the study of cryptogamic botany. They are heard with great pleasure. The course was commenced in October, and will be continued until April or May next.

The number of persons who consult the library, it is believed, has increased very much.

The average attendance at the stated meetings of the Academy is 32; but only about 4500 persons have visited the museum through the year. This fact suggests that in this city's population of 800,000, the taste for natural history is not very general, and that the uninstructed man here, as well as everywhere, is more interested in viewing specimens of his own genus and representation of their exploits by artists and poets than in samples of any other part of the creation. A museum which contains representatives of almost every kind of bird and shell in the whole world, besides extensive collections in all departments of natural history, it is supposed, should be attractive to great numbers of people; but experience shows that only those who are intelligently curious find the pleasure of visiting it worth the ten cent fee of admission.

Let us not be discouraged by this experience. The importance of special knowledge is slowly recognized The proportion of educated and cultivated people in the city's population is very much greater now than it was a century ago, and among them the value of all the natural sciences is more widely and justly appreciated. It is more generally believed that seeking to know precisely what is knowable in any and every direction is of interest and value to the community, and that such pursuits are worthy of substantial encouragement.

The whole is respectfully submitted,

W. S. W. Ruschenberger,

President.

REPORT OF THE RECORDING SECRETARY.

The Recording Secretary respectfully reports that during the year ending Nov. 30, 1878, twenty-eight members and thirty-two correspondents have been elected.

The following members have resigned: S. L. Shober, A. R. Hall, G. Schwartz, and R. M. Girvin.

The deaths of sixteen members, and eleven correspondents, whose names have been published in the current proceedings, have been announced.

Thirty-two papers have been presented for publication as follows: E. Goldsmith 3, Jacob Ennis 2, E. T. Cresson 2, J. A. Ryder 2, Drs. Elliot Coues and H. C. Yarrow 2, Rev. H. C. McCook 2, Wm. M. Gabb 2, C. A. White 1, Geo. A. Koenig 1, Wm. C. Stevenson, Jr. 1, J. S. Kingsley 1, B. W. Barton 1, J. H. McQuillen, 1, Charles Wachsmuth and Frank Springer 1, Alpheus Hyatt 1, Wm. G. Mazyck and A. W. Vogdes 1, James Lewis 1, T. H. Streets 1, H. C. Chapman 1, Theo. D. Rand 1, Victor W. Lyon 1, R. E. C. Stearns 1, Drs. Wm. H. Green and A. J. Parker 1.

Twenty-five of these papers have been printed in the Proceedings, four have been withdrawn, and one remains to be reported upon. The Publication Committee has recommended the publication of the two papers by the late Wm. M. Gabb, in the Journal of the Academy. They will form a valuable contribution to the geology of the Carribean area.

Seventy-nine pages of the Proceedings for 1877, and three hun-and twenty-eight for 1878, have been published; the volume for the year will be illustrated by seven lithographic plates.

Verbal communications have been made by Messrs. McCook, Leidy, Martindale, Meehan, Redfield, Ryder, Koenig, McQuillen, Allen, Lewis, Horn, Hunt, Goldsmith, Burk, Rothrock, Kelly, Ennis, A. J. Parker, Wharton, Willcox, Leffman, Foote, Chatard, Wells, Janeway, Ford, Tryon, Potts, Evarts, Benjamin, Haldeman, Barbeck, Chapman, Canby, and Ashburner. Experience has shown that if the secretary were enabled to announce in advance the communications to be made at each meeting, it would have the effect of largely increasing the attendance. Reports of all the communications of interest have regularly appeared in several of the morning papers, with, it is believed, the effect of increasing the popular interest in the Society.

Dr. C. N. Peirce was elected on Jan. 29 to fill a vacancy in the Council made by the election of Dr. R. S. Kenderdine as Curator.

Three members of the Finance Committee only having been elected at the annual meeting, Messrs. S. Fisher Corlies and C. S. Bement were elected on Jan. 29 to complete the number required by the by-laws.

Art. I., Chap. XII. of the by-laws was amended by substituting the words "at its first meeting" for the words "at the meeting in January."

EDW. J. NOLAN,
Recording Secretary.

REPORT OF THE CORRESPONDING SECRETARY.

The Corresponding Secretary begs leave to present the following report of the business of his office during the year ending Nov. 30, 1878.

During the year thirty-two correspondents have been elected, all of whom have been notified.

Letters have been received from corresponding societies or other institutions transmitting their publications or acknowledging the receipt of those of the Academy, numbering 105.

Miscellaneous, individual, and circular letters, 13.

Letters from correspondents acknowledging election, 50.

During the year numerous letters of a nature too trivial to be read before the Academy have been received, and many answered. These, for the most part, have been from persons who are ignorant of the objects of the Academy, or who offer for sale undesirable objects.

In addition to letters, numerous pamphlets or books, and some manuscripts for publication, have been received, the former have been handed to the librarian, and the latter read before the Academy.

Respectfully submitted,
GEO. H. HORN, M.D.,
Corresponding Secretary.

REPORT OF THE LIBRARIAN.

The additions to the library during the last six years have been steadily increasing, the number received and recorded during the twelve months ending Nov. 30. 1878, being 2946, or 248 more than were received in 1877, and more than double the number received in 1873.

Of these accessions 477 were volumes, 2344 pamphlets and part of periodicals, and 125 maps, engravirgs, photographs, etc.; 2169 were octavos, 579 quartos, 62 folios, and 11 duodecimos.

They were derived from the following sources:—

Societies	1203
Editors	675
Isaiah V. Williamson Fund	526
Authors	161
Wilson Fund	93
Dr. Robert Bridges	67
War Department	53
Geological Survey of New Zealand	29
Publishers	21
Department of the Interior	19
Conarroe Fund	13
Geological Survey of India	11
J. H. Redfield	9
Engineer Department. U. S. A.	6
Geological Survey of Pennsylvania	6
Minister of Public Works, France	5
Treasury Department	5
A. J. Parker	3
East Indian Government	3
Wm. S. Vaux	3
Geological Survey of Canada	3
T. R. Peale	3
Trustees of New York State Library	2
Heirs of Dr. Jos. Carson	2
Bureau of Education	2
Jos Leidy	2
Pennsylvania Board of Centennial Managers	2
Netherland Centennial Commission	2
Indian Museum	1
James M. Magraw	1
Geo. W. Childs	1
Council of the City of Manchester	1
John S. Haines	1
Smithsonian Institution	1
Department of Agriculture	1
S. S. Haldeman	1
Allen B. Lemmon	1
C. F. Parker	1
Pennsylvania Board of Agriculture	1
Mrs. Gabb	1
T. C. Chamberlain	1
Commissioners of Fairmount Park	1
R. J. L. Guppy	1
Department of Marine and Fisheries, Canada	1
Mariano Barcena	1

They were divided as follows:—

Journals	2057
Geology	266
Botany	100
General Natural History	93
Conchology	61
Anthropology	52
Anatomy and Physiology	46
History	44
Voyages and Travels	40
Ornithology	22
Medicine	21
Chemistry	17
Agriculture	17
Entomology	15
Physical Science	14
Ichthyology	14

Bibliography	13	Helminthology	6
Biography	11	Encyclopædias	5
Herpetology	9	Mammalogy	4
Mineralogy	9	Useful Arts	4
Literature	6		

The large number of journals and periodicals received during the year is consequent upon the efforts which have been made to obtain supplies of deficiencies from corresponding societies and editors. Most of the societies addressed on the subject have sent such of the missing parts of their publications as they could furnish. All the new scientific journals brought to the notice of the Library Committee during the year have been obtained either by exchange or subscription.

The accessions have been catalogued immediately upon their reception, and in addition, the catalogue of the department of general natural history has been completed, and the titles of nearly all the works on anatomy and physiology, with the exception of the pamphlets, have been entered on the cards. Reference catalogues of the departments of voyages and travels, and general natural history have been copied from the card entries by Mr. Thomas P. Parker, who has also proceeded as rapidly as possible with the numbering of the books.

For the most valuable of the monographic and special works we have again to acknowledge our indebtedness to the enlightened liberality of Mr. Isaiah V. Williamson. In the expenditure of the Williamson Fund care has been taken to order such works as are of most importance to the student, which are not, for the most part, to be found elsewhere in the city, and which give special character to the library of the Academy. All the books specially applied for by the working members of the Academy have been promptly ordered, and nearly all received.

For the reason stated in my last report, the general financial depression, but few books have been bound during the year, such expense being incurred only where it was absolutely necessary to preserve the volumes from injury.

All of which is respectfully submitted,

EDW. J. NOLAN,

Librarian.

REPORT OF THE CURATORS.

The Curators report that the Museum of the Academy continues in good state of preservation, and has steadily advanced in orderly arrangement, labelling, numbering, and cataloguing. While such is the case we take the opportunity of directing attention to what may be viewed as a serious defect in our otherwise valuable museum, one which greatly narrows its usefulness. We allude to the inequality of our collections, the incomplete condition, and almost apparent exclusion of certain departments, while others are so richly or even excessively represented. This state of things which we greatly regret is in a measure due to unavoidable circumstances. Notwithstanding the main object the Academy has had in view in forming and maintaining a museum, it has never had the means to establish it in such a way as to illustrate all classes, orders, and families of natural history. The museum has grown almost entirely through the gift of its members and friends, of specimens and collections of specimens accidentally picked up or sought as the favorites of collectors. While we have thus become greatly enriched in objects of more conspicuous character, we have received comparatively few of the things of less general interest, though of great proportionate value to the completion of the whole natural series. An attendant evil on this mode of growth of our museum, is that the means raised by the Academy through the generosity of its members and patrons have been insufficient to provide accommodation for the collections, except in a crowded and disjointed condition unfavorable for exhibition and study. Now that we have the more favorite departments of natural history so well represented, we are hopeful that the Academy may be able to induce its friends to place sufficient means at the disposal of the Curators, to make purchases, as opportunities may present, of such objects as shall be required to render the museum complete, and illustrate all departments of both organic and inorganic nature. For this purpose comparatively little means are required, even the sum annually of $500 for half a dozen years, would go very far towards giving the museum that completeness which we feel is so desirable to enable the student to read the book of nature from the beginning to end.[1]

In regard to what has been done in the museum during the year we present a brief report of the able Curator in charge:—

PHILADELPHIA, Dec. 12, 1878.

DR. JOS. LEIDY,

Chairman of Board of Curators.

DEAR SIR: I herewith inclose the following report of work done in the museum during the year:

Mr. John A. Ryder has completed the re-labelling and arrangement of the Ophidians, the Saurians, and the Batrachians, and a similar re-arrangement and re-labelling of the collection of Fishes has been commenced.

The collections of mammal skins, birds, and insects have been thoroughly examined; also the alcoholic collections have been attended to, and the alcohol renewed when necessary. The re-labelling of the collection of minerals has been finished, and a numbered catalogue of the same prepared; numbers will be attached to each specimen corresponding with catalogue. The large increase of donations to this department has required the addition of six cases.

Progress is being made in the labelling and arrangement of the bird collection; this work being done by Mr. Spencer Trotter.

Most of the specimens presented, deposited, and purchased during the year have been labelled, and put in their proper places.

Respectfully, C. F. PARKER.

Besides the additions to the museum announced in special reports of Conservators of Sections, the Curators present the following list:—

The most important donations consist of a superb articulated specimen of a male Gorilla, and a young animal, in alcohol, from Ogove River, Africa, presented by Dr. Thomas G. Morton, and the original specimen of a slab of red sandstone, with foot prints of the Sauropus primævus, of Lea, from the lower coal strata of Pottsville, Pa., presented by Dr. Isaac Lea.

Mammals.—Phascolarctos cinereus, Belideus breviceps, B. tasmanoides, Phalangista, Macropus (fœtus fem.), and Ornithorhynchus anatinus, eight specimens from Australia, presented by Dr. Clive DaCosta Belisario. Zapus hudsonicus, Geomys bursa-

[1] It may be worthy of note, that the Academy has never been able to place at the disposal of the Curators annually even a few dollars for the purchase of desirable specimens.

rius, 2 Sorex Cooperi, Hesperomys leucogaster, 2 H. leucopus, 3 do. var. sonoriensis, Evotomys rutilus, 2 Arvicola austerus, Perognathus hispidus, from Fort Sisseton, Dakota, Dr. C. E. McChesney, U. S. A. Nine skulls and skins of Aluatta palliata, Cebus hypoleucus, Sapajou melanochir, Felis maragaya, Dicotyles torquatus, D. labiatus, 2 Cervus, Arctopithecus castaneiceps, and Tapirus, from Costa Rica, Wm. M. Gabb. Mounted skeleton of Rat Kangaroo, Joseph Jeanes. Belideus flaviventer, Philadelphia Zoological Society. Three skulls and skin of a squirrel, Wyoming, Dr. J. Van A. Carter. Tooth of sperm whale, Dr. Isaac Lea.

Birds.—A young male Bald Eagle, presented by George M. Tatham. Nest and eggs of the Snowbird, Giles Co., Va., Dr. H. Haupt, Jr. Six bird skins from Brazil, Mr. Sarmiento. Eggs of Penelope grayi, Geo. Pavonarius. Nests of American Goldfinch and Indigo birds, J. O. Shimmel.

Reptiles and Fishes.—Two Jacare. Thrasops ahaetulla and Elaps, from Brazil, Mr. Evans. Two jars of snakes, from Alabama, Dr. Joseph K. Corson. Skin of Boa, from Brazil, Mr. Sarmiento. Two Ophibolus doliatus, S. P. Monks. Shed skin of Coluber, John A. Krider. Tropidonotus leberis, R. C. Davis. Limb bones of the Leather Turtle, New Jersey, John Ford.

Twenty-seven bottles with fishes, etc., obtained during a cruise of the U. S. ship Portsmouth, 1872–75, in the Pacific; also a minute Balloon Fish from the Pacific, presented by Dr. W. H. Jones, U. S. N. Amphioxus lanceolatus, from Mediterranean, Dr. H. E. Evarts. Young Shark, Pacific, Mr. W. M. Rodes, Chief Engineer U. S. Coast Survey. Buffalo Fish, Ouachita River, Ark., Dr. G. W. Lawrence. Elops saurus and Echeneis remora, from Atlantic, Mr. Holbrook. Two bottles of fishes, Alaska, Dr. Geo. H. Horn. Dental apparatus of Zygobates jussieu, Dr. Isaac Lea.

Mollusks.—A bottle of Ascidians, New York harbor, presented by Dr. George H. Horn.

Articulates.—Twenty-seven bottles minute Crustaceans, etc., dredged in the Pacific, during a cruise of the Portsmouth, 1872–75, presented by Dr. W. H. Jones, U. S. N. Twenty-one species Crustaceans dredged off the coast of Massachusetts, presented by Dr. T. H. Streets.

Thelyphonus giganteus, Florida, Dr. J. H. Janeway, U. S. A. Large Scolopendra obtained living in this city, and probably introduced in some packing material from the West Indies; also Hippa talpoidea, from John Ford. Squilla ampusa, Fortress Monroe, S. Powell. Nest of Trap-door Spider, from California, W. S. Vaux. Four specimens of insect architecture, Rev. H. C. McCook. Gall, from California, E. Goldsmith. Three bottles of Cirripeds, from New York harbor, Dr. George H. Horn.

Radiates and Protozoans.—Strongylocentrotus lividus, from Nantes, France. Presented by Dr. Isaac Lea. A beautiful coral, Halomitra pileus, Sandwich Islands, W. S. Vaux. Sertularia and 3 species Sponges, Fortress Monroe, N. C., from S. Powell.

Fossils.—Two large frames, with fossil foot-prints, from Connecticut; slab of Triassic shale with rain-drop marks and sun-dried cracks, from Gwynedd, Pa.; Pentacrinus briareus, from lias, England, Dr. Isaac Lea.

Molar of Mastodon, from York Co. Pa., Mr. Snyder. Bones of Crocodile, etc., near Hornerstown, N. J., T. A. Conrad. Sharks teeth, vertebræ, shells, echinoderms, etc., from the marl of Vincenttown, N. J., C. B. Barrett. Crinoids from Canton, Ohio, and Crawfordsville, Indiana, J. W. Pike. Dorycrinus mississipiensis, Keokuk, Iowa, Gen. W. W. Belknap. Clupea humilus, from tertiary of Wyoming, Dr. Joseph Leidy. Cetacean bones, Miocene of Va., Prof. Jeffries Wyman. Fossil wood, numerous Eudea dichotoma, and 2 rock specimens, Col. T. M. Bryan. Favosites niagarense, Jackson Co., Ky., W. S. Vaux. Vertebra of a Plesiosauroid, Arkansas, Dr. G. W. Lawrence. Molar of Bison and rib fragments of Manatee, from near Tallahassee, Florida, Prof. S. S. Haldeman. Bones of deer, bear, weasel, etc., from a cave, Bedford Co., Pa., Mr. Wm. Hartley.

Ethnological and Miscellaneous.—Indian axe, Moorestown, N. J., E. D. Stokes. Carved drinking cup, from Fiji Islands, Dr. J. P. Bethell. Plaster model of the great pyramid of Cheops, from Wm. H. French; and water-proof coat, made from the intestines of bear, Alaska, Dr. W. H. Jones. Terra-cotta head, found near Nashville, Tenn., and fragments of stone axe, Holmesburg, Pa., T. R. Peale. Four stone implements, Santa Cruz Island, Cal. Stone axe and necklace, from Oahu, Sandwich Islands. Idol from ruins of a temple near Honolulu. Ava cup found with the idol, Dr. W. H. Jones, U. S. N. Water-tight basket, of the Pima Indians of Arizona, from J. B. Ellis.

Two conical caps of the Spathe, or the Trooly Palm, feather head-dress, skin pouch, Cassava grater, three native baskets, one used for carrying children, etc., on the back, from British Guiana; two marten skins, dressed by the Ute Indians, from Colorado; stone adze, with carved handle, New Zealand; do. Hawaii, Sandwich Islands; rattles, "Shak-shak," used by the Caribs in dancing, paddle, used also as war club and seat, sandals, and carved rattles, from British Guiana; shield of "Roaring Bull," a Comanche chief, scalp of a Comanche Indian. do. of a Modoc Indian, tanned squirrel skin, Idaho; saddle-blanket, made by the Navajo Indians of northern New Mexico; feather head-dress, of the Macusi Indians, of British Guiana; boat with open ends, used to navigate dangerous rivers, made of a single piece of bark, by the Accawois tribe of Indians, British Guiana; a collection of the manufactures of the Indians of British Guiana, consisting of two fans, two wicker trays, two baskets, Matapi, or Cassava squeezer, three bark shoes, sail of the pith of the Ite palm, maqnami, or whips, bow, and stone-pointed arrows, blow-gun, and poisoned arrows, two canoe paddles; bamboo fiddle, with bow, drum and sticks, child's hammock, material for making hammock, watsapura, or flute, rattle of a dancing pole, candle, etc., from British Guiana; and a hat, native work of Hawaii, Sandwich Islands, presented by Prof. S. S. Haldeman.

Cast of face, from a mound, Greenup Co., Kentucky, from W. R. Mercer. Indian stone axe, Ashley River beds, South Carolina, from Geo. C. Lewis. Fragment of Indian pottery, containing crushed tourmaline, do. having the appearance of being marked with an ear of corn, Iredell Co., N. C.; fragments of human jaw, stone axe, and ornamented copper-plate, found in a mound 20 miles S. E. of Cedar Key, Florida, presented by Jos. Willcox. Indian pestle, Moorestown, N. J., from A. D. Trimble. Four stone implements, Pennsylvania, from Dr. Geo. H. Horn. Stone spear-head, Havre de Grace, Md., from C. A. Blake.

Minerals.—Labradorite, Labrador, E. R. Beadle.

Two Arkansites, Ludlamite, and a fine Orthoclase, C. S. Bement.

A case of Minerals (24 drawers) collected by the late Hugh Davids, Esq.; also, sixteen specimens from various localities, consisting of Corundum, Thulite, Mountain Cork, Grahamite, Topaz, Breunerite in Talc, Scheelite on Quartz, Leucaugite, Pyropissite, Margarodite and Chlorophane, Dufrenite, Clintonite, Zircon, Sphene, and Azurite, etc., Mrs. Hugh Davids.

Agate, and Geode of Limonite, Argentine Republic, Moses A. Dropsie. Twenty-five Amygdaloid rocks, from Scotland, Prof. J. Duns. Barite, Brown Co., Kansas; Magnesite, Texas, Lancaster Co., Pa., Prof. A. E. Foote. Vermiculite in Chlorite schist, Dolomite with Apatite and Talc, Steatite Quarry, above Manayunk, Pa., John Ford. Hematite, Morgantown, N. C., Col. B. S. Gaither. Olean oil, McKean Co., Pa.; Lubricating oil, Wood Co., W. Va., Morris W. Harkness. Indurated Talc, Black Horse, E. Bradford, Chester Co., Pa., W. D. Hartman. Limonite, Marble Hill, Montgomery Co., Pa., Russell Hill. Two fine specimens of Corundum, Hog-back Mt., Jackson Co., N. C., Joseph Jeanes. Emerylite, Jefferisite, Oligoclase, and Corundum, Newlin, Chester Co., Pa., W. W. Jefferis.

Magnesite in Serpentine with Chlorite, Putnam Co., N. Y.; Chlinochlore, Chester Co., Pa.; Oolitic Marble, Leavenworth, Indiana; Black and Crinoidal Marble, Actinolite, Glacier Roseg, Switz., Dr. Isaac Lea.

Forty-six minerals, and eight rocks, consisting of the following: Spinal in Chlorite, light-brown Tourmaline, green ditto in Granite, Corundum, Chlorastrolite in Trap, Hydrodolomite with Serpentine and Chromite, Deweylite, nodules of Geyserite, Efflorescence of Salt, group of Quartz crystals, Glauberite, Turquois, pale Rubellite in decomposing Albite, Corundum with partial metamorphosis into Ripidolite, ditto in Ripidolite and blue Corundum, Zinc Staurolite, Quartz with Sard, Quartz found with Apatite, Hyalite, Garnet, flattened crystal in Muscovite, calcareous Tufa, Muscovite, Menaccanite, Flint, Brookite, Jade, Calcite, Hercynite pseud. after Corundum, Feldspar associated with Corundum, Ceylon, Chlorite from Franklin, Macon Co., N. C., Orthoclase containing Quartz crystals, Biotite schist, Aragonite, Cypoline, etc., presented by Dr. Jos. Leidy.

Thirty-six minerals, and forty-four rocks from various localities, consisting of Phyllite, Bronzite, Stibnite, Topaz passing into Margarodite, Nuttabergite, Tourmaline, Apophyllite and Stilbite, Calcite, Albite, Hypersthene and Pyrrhotite with Quartz, Kainite, Kieserite, Stassfurtite, blue Quartz, Delawarite, Cassinite, Lennilite, Hyalite, Molybdenite, Apatite in Talc, Velvet Limonite, Chalcopyrite in Gneiss, Tremolite, Oligoclase, Topaz, Willemite, Gneiss with Lime Uranite, Pyrite, Idiocylophanous Calcite, Malakolite, Chlorite, and Antholite, etc., Theo. D. Rand.

Calcite, Geode of Quartz, ditto of Chalcedony, from Keokuk, Iowa, Dr. J. M. Shaffer and Hon. C. F. Davis. Limonite, Gneiss, Manganese, from Morgantown, N. C., Col. T. G. Walton. Sphene, Pyroxene, Hornblende, white Augite, Serpentine, Gurhofite, Pyrite, Trap, etc., S. A. Monks.

Meteorite, N. C.; Corundum, Muscovite, Quartz, Apatite, Staurolites, pseudomorph Quartz, Biotite, Jeffersonite, Sussex Co. N. J.; Orthoclase, Galenite with Blende, Rutile in Quartz, Alexander Co., N. C., Joseph Willcox.

Fine large specimen of Lilac Fluor Spar, Cumberland, England, Wm. S. Vaux.

Calcite, St. Louis, Mo.; Tourmaline, Warren, N. H.; Apatite with Feldspar and Epidote, Jefferson Co., N. Y.; Chilenite, Chili, in exchange.

Dufrenite, Lava, from Vesuvius; two crystals of smoky Quartz, two Fluorites, six crystals of Amazon Stone, one cluster of crystals of ditto, from Pike's Peak, Col.; Rutile, Lincoln Co, Ga.; Moonstone, Del. Co., Pa.; Arkansite, Hydrotitanite, Perofskite, ditto Cubo-octahedrons, from Magnet Cove, Ark.; Elæolite, Ozark Mts., Ark.; Stilbite, Phila., purchased.

Respectfully submitted by

JOSEPH LEIDY,

Chairman of Curators.

REPORT OF BIOLOGICAL AND MICROSCOPICAL SECTION.

The Microscopical and Biological Section of the Academy, in presenting their report for 1878, state that the year has been one of unusual interest in the Section.

Meetings have been held twice a month with an average attendance of 44 persons.

At most of the meetings papers were read on subjects in which the microscope is used for research, or on strictly biological matters. Among our contributors were Drs. J. G. Hunt, Lautenbach, A. J. Parker, Pierce, F. V. Green, U. S. N., Seiler, M'Quillen, Rev. Dr. McCook, Messrs. Pells, Lewis, Ryder, Perot, J. B. Zentmeyer, and C. Zentmeyer, and the Director, R. S. Kenderdine.

Prof. J. G. Hunt, M.D., will give a course of lectures on Cryptogamic Botany, extending through the winter and spring of 1879.

All the members of the Academy are cordially invited to attend them.

The membership of the Section is nearly 80. Two were added, one died, and four resigned during the year.

Nine contributors have also been added to the list.

A Zentmeyer histological stand, and numerous accessories, together with several histological specimens, have been purchased.

On December 2d, the following were elected officers for 1879:—

Director	R. S. Kenderdine, M.D.
Vice Director . . .	J. H. M'Quillen, M.D.
Recorder	J. Hess, M.D.
Corresponding Secretary .	J. N. Peirce, D.D.S.
Conservator . . .	J. G. Hunt, M.D.
Treasurer	I. Norris, M.D.
Curators	Carl Seiler, M.D. Charles Zentmeyer, M.D.
Auditors	S. Fisher Corlies, Charles Perot, Charles Dixon, M.D.

Submitted for the Section,

R. S. Kenderdine, M.D.,
Director.

REPORT OF THE CONCHOLOGICAL SECTION.

The Recorder of the Conchological Section respectfully reports that, during 1878, the following authors have contributed papers which have been published in the Academy's Proceedings:—

C. A. White, 3 pages, James Lewis, M.D., 2 pages.
Coues & Yarrow, 3 pages. Mazyck & Vogdes, 1 page.

In addition to these, several verbal communications of value have been made before the Academy by Prof. Joseph Leidy, Mr. John Ford, and others.

Death has again visited us, and taken from our number our much esteemed and valued Vice Director, William M. Gabb.

During his short but very active life as an explorer, author, and collector, Prof. Gabb made extensive collections, most of which are deposited in our museum; and contributed many valuable papers, upon both fossil and recent conchology, to the "American Journal of Conchology," Journal and Proceedings of the Academy, and other scientific periodicals.

At the time of his death, he had just completed an elaborate essay on the fossil Mollusca of Central America, illustrated by 80 drawings made by himself, which is now in the hands of the proper committee for publication in the Journal of the Academy.

From the report of our Conservator, we find that the additions to the museum, all of which have been labelled and arranged in the cases, aggregate 725 trays, 1570 specimens.

Of the "Robert Swift" cabinet, the non-operculate land shells have been labelled and arranged in 3933 trays, 18,348 specimens, making a total of 4658 trays, and 19,918 specimens. Adding these to the totals of former years, we have the following as the present census of the museum (recent shells only):—

Total number of trays, ...	34,658
Total number of specimens, ...	119,918

Our Conservator says: "The additions of the current year have all been cleansed and mounted by the experienced hands of Mr. Charles F. Parker, who has as usual freely devoted to this purpose a large portion of his time not occupied by his official duties as Curator. He has also labelled and mounted the fossil shells presented during the year. The unscientific separation, in our museum, of the fossil from the recent shells is much to be regretted; yet their rearrangement in a single series is impossible in the present crowded condition of the cases. A further great enlargement of the Museum of the Academy, needed by the unexampled growth of all its departments, will afford the only opportunity for consummating this reform in the conchological portion—a reform imperatively demanded by the present status and apparent future of the science, and which is already being realized in other museums.

The following are the additions to the Conchological Museum, received during the year:—

C. B. Barrett. Fossil shells from the marl of Vincenttown, N. J.

Dr. J. P. Bethell. Ostrea sp. and Perna maxillata, Conr., from Ashley River, South Carolina.

Thomas Bland. Eighteen species of terrestrial shells, from Polynesia and South America.

W. W. Calkins. Litiopa striata, from Florida.

T. A. Conrad (dec'd). Eight species of marine and fresh-water shells.

John Ford. Fossil oyster, from the Hadrosaurus marl-pit, Haddonfield, N. J.

Egg cases of Sycotypus canaliculatus, L., Atlantic City, N. J. Petricola pholadiformis (in situ), and fine group of Mytilus edulis, from Cape May, N. J.

Crepidula fornicata, L., Long Island Sound.

Mytilus hamatus, Say, Princes' Bay, N. Y. harbor.

Petricola pholadiformis, Atlantic City, N. J.

Wm. M. Gabb (dec'd). Thirty-three species of Tertiary mollusca, collected in the West Indies, by R. J. L. Guppy; one hundred and eighteen species of miocene and pliocene shells, 80 of which are types of new species, from Costa Rica: also a small collection from San Domingo.

Mrs. Gabb. Terrestrial shells, collected in San Domingo, by the late Wm. M. Gabb.

Henry Hemphill. A collection (139 species) of land and fresh-water shells made by him in Utah. (In exchange.)

Mr. Hergesheimer. Gyrodes, from Budd's Ferry, Lower Potomac, Va.

Russell Hill. Natica aurantia, Lam.

Dr. Geo. H. Horn. Five species (numerous specimens) of land shells from Polynesia.

Dr. W. H. Jones, U. S. N. A number of specimens of mollusks in alcohol, collected during a cruise of the U. S. ship Portsmouth in the Pacific. 1872–5.

Dr. Geo. W. Lawrence. Baculites, Ammonites, three Gasteropods, and a Lamellibranch. from Clark County, Ark.

Henry C. Lea. Types of 100 species of tertiary fossils, described by him.

Isaac Lea. Two large Ammonites.

Dr. Joseph Leidy. Donax fossor, Say, (numerous specimens), from Cape May, N. J.; Mactra solidissima, Chemn., bored by Natica heros, Say, Atlantic City, N. J.

Charles F. Parker. Nautilus pompilius, L., a fine section, showing the chamber partitions and siphon tubes.

John S. Phillips Fund. 533 species of shells (795 specimens), all new to the Academy's collection.

Mrs. Riggin. Marginella apicina, Mke., from Sarasota Bay, Fla.

Dr. W. S. W. Ruschenberger. Three species of shells from Apia, Island of Upolu, Navigators' Group.

John H. Redfield. Twenty-eight species of post-pliocene shells, from California.

S. R. Roberts. Anodonta implicata, Say, and A. fluviatilis, Dillw.

R. Swift Fund. Thirty-six species of post-pliocene fossil shells, from California.

G. W. Tryon, Jr. Eighteen species of Californian post-pliocene shells.

Wm. S. Vaux. One hundred and eighty species of post-pliocene and cretaceous shells, from California.

L. C. Wooster. Three species of land shells, from the alluvium of Cache-la-poudre River, Greely, Colorado.

The officers of the Section for 1879 are:—

Director . . . . W. S. W. Ruschenberger.
Vice Director . . . John Ford.
Recorder . . . . S. Raymond Roberts.
Secretary . . . . E. R. Beadle.
Treasurer . . . Wm. M. Mactier.
Librarian . . . Edw. J. Nolan.
Conservator . . . Geo. W. Tryon, Jr.

Respectfully submitted,

S. Raymond Roberts,
Recorder.

REPORT OF THE ENTOMOLOGICAL SECTION.

During the year that has elapsed since the last annual meeting of the Academy, the Entomological Section has regularly held its monthly meetings, with the exceptions of those of July and August, a recess having been taken from June to September. The meetings generally were quite interesting, on account of the numerous verbal communications made. These remarks have been principally directed towards the illustration of generic and specific forms of the families of various orders of insects, and as illustrated by blackboard drawings were calculated to render much assistance to the student.

During the year the Entomological Section has lost two of its members by death, viz., Mr. Robert Frazer, formerly President of the American Entomological Society, and Mr. Edward Tatnall. The private collection of the latter gentleman has been placed in the care of the American Entomological Society, which purposes to make use of the same, as a nucleus for the formation of a general collection for exhibition in the Museum of the Academy, if proper accommodations can be obtained. Such a collection must necessarily be solely for display, as it would be neither expedient nor safe to expose a valuable collection, such as is now contained in the cabinet of the Entomological Society, to the dangers of destruction.

Owing to the failure of the invested fund of the American Entomological Society to produce so large an income as in previous years, the Society has been compelled to limit its expenditures to a much smaller amount. Consequently the publications have not been so large as they otherwise would have been. Only five written communications, therefore, have been passed by the Publication Committee. Four of these contained descriptions of Coleoptera, by Dr. George H. Horn, and the other descriptions of Hymenoptera, by Mr. E. T. Cresson.

In the month of September, with consent of the Council, an extra heat coil was placed in the room occupied by the Section, the latter bearing the expense thereof.

Much time and labor have been devoted, during the past year, to the improvement of the collections. This is particularly noticeable in the collection of Hymenoptera, which has greatly increased by the addition of new and rare species derived more especially from Colorado and Nevada. The collection of Hymenoptera now within the walls of the Academy is, beyond all doubt, the finest and most valuable of that order in America, and is probably the best collection of North American species to be found in the world.

Great advances have also been made in filling up vacancies in the orders of Coleoptera and Lepidoptera, and the collections of both have been rendered more valuable.

New methods have been adopted, by which the drawers of the cabinets may be readily fumigated, and it is hoped by the greater facility thus obtained of reaching all specimens, the loss from infection will be greatly diminished.

The remains of the original collection of the Academy have also been attended to by the members in charge, and the loss from decay greatly lessened. This collection had already suffered to such an extent, that when it came under the supervision of the Section it was found to be of but little or no value as a scientific collection. What typical specimens it ever contained that were of special importance had been destroyed or transferred to other places, and the remainder was on a sure course of destruction for want of care. Under these circumstances the Section placed it under lock and key, and while bestowing upon it all the care of which it is in need, reserves it for use in the museum with such other specimens as may, from time to time, be added thereto.

When it is considered that the gentlemen who have in charge the Entomological Collection now in this building, have no leisure from their daily avocation, and are compelled to devote their evenings to the work, it will be realized that progress must necessarily be slow; but, for the first time in the history of the Academy, the collection is now safe beyond depredations of any sort.

At the meeting of the Entomological Section, held December 9th, the following named persons were elected officers for the year 1879.

Director	John L. LeConte, M.D.
Vice Director	George H. Horn, M.D.
Recorder	J. H. Ridings.
Treasurer	E. T. Cresson.
Publication Committee . . .	George H. Horn, M.D. Samuel Lewis, M.D.

All of which is respectfully presented,

J. H. Ridings,

Recorder Ent. Sect.

REPORT OF THE BOTANICAL SECTION.

The vice director of the Botanical Section has pleasure in reporting to the Academy that the work of this department has been very satisfactory during the past year, considering the means at its command. One member has resigned during the year, and four elected, making a list of thirty-two at the present time.

The Recorder's report shows that meetings have been held every month during the year, August excepted. At these meetings verbal communications have been made by Prof. Rothrock and Messrs. Redfield, Stevenson, Potts, Canby, Burk, Martindale, Scribner, Griffith, and Meehan. Of these, Mr. Stevenson's, on the Valsci of the United States, Mr. Griffith's, on Aspidium aculeatum, and Mr. Potts's, on the mechanism of the flowers of Stapelia and Asclepias, have been accepted for publication in the Proceedings of the Academy. Some of the other more important matters introduced to the notice of the Section have been reported to the general meetings of the Academy, and published by the general committee in its proceedings.

The report of the Conservator gives so clear an account of the condition of the Herbarium, that it is submitted entire, and while the vice director is sure the Academy will be gratified with the account of the progress made, he may take occasion to say that the good work is mainly due to Messrs. Redfield, Burk, and Schimmel, with such occasional assistance as Prof. Rothrock, Mr. Scribner, the writer of this, and Mr. Parker, outside of his duties as curator of the Academy, were able to render.

The officers elected at the last meeting, to serve for the ensuing year, are:—

Director	Dr. W. S. W. Ruschenberger.
Vice Director	Thomas Meehan.
Recorder	Isaac Burk.
Corresponding Secretary .	Isaac C. Martindale.
Conservator	John H. Redfield.
Treasurer	Jose O. Schimmel.

Respectfully submitted,

THOMAS MEEHAN,

Vice Director.

Conservator's Report.—Since the last annual report of the Conservator was made to the Botanical Section, the work of arranging the plants of the Herbarium in genus-covers has been completed, and the collection is now in a condition to be accessible and useful to students. The preparation of order tablets for the general Herbarium is suspended for the present, awaiting the appearance of the next portion of Bentham and Hooker's Genera Plantarum.

The additional case needed for the North American Herbarium has been provided by the Academy, and the space now at our disposal, though none too large, enables us to make a creditable and convenient display of our present representation of the Flora of North America. Mr. Isaac Burk has kindly devoted such time as he could command to the arrangement of this part of our collection, and to the distribution in their places of the new accessions. The preparation of the order tablets is now being rapidly pushed to completion, in which work we have had essential assistance from the Academy's efficient curator in charge, Mr. Charles F. Parker.

In proportion as the pressure of this preliminary work has abated, we have been enabled to give some attention to the important task of revising and elaborating the abundant and rich material of our collections. As already reported to the Section in fuller detail, the Conservator has, during the year, worked up the Ferns of both the General and North American Herbaria, and these are all now properly determined, labelled, and mounted, numbering over nine hundred species. Those of Dr. Short's Equatorial Herbarium yet need an examination and revision. This will soon be undertaken, and when completed the Conservator hopes to present a catalogue of this division.

Mr. M. S. Bebb, who has for many years made a specialty of the study of the North American willows, and who is now engaged in elaborating their species for the Flora of North America, and for the Botany of California, having kindly offered to make a critical examination of this difficult and perplexing genus, the Academy authorized us to accept his offer, and he has carefully revised the specimens of our North American Herbarium. And Prof. Rothrock has done us the additional favor of mounting them, and putting Mr. Bebb's critical notes in shape for permanent preservation. The willows of our general herbarium have been recently submitted to Mr. Bebb for the same service.

To our fellow-member, Mr. Wm. M. Canby, we are indebted for the revision and mounting of the species belonging to the leguminous genus Baptisia, and while he has been thus useful to us, it is a satisfaction to know that our material has been of service to him in preparing the revision of this genus which he is about to publish.

Mr. F. L. Scribner, of Girard College, a member of the Section, who has devoted himself to the study of the grasses, has kindly undertaken to arrange and mount this difficult and extensive portion of our collection, and has already entered upon the work, and from the careful, thorough, and conscientious study which he is giving to it, we may expect the best results.

In all these revisions the original determinations and tickets are carefully preserved, together with the notes of the revisor, whose work can, therefore, at all times be tested.

We should add that Mr. Sereno Watson, of the Cambridge Herbarium, has revised for us the species of Cupressus and Iris, detecting many errors, and supplying valuable notes.

It is to be hoped that thus in time the aid of specialists will bring order out of confusion in other portions of our collection.

In the month of April the Academy received a large collection of plants consisting of nearly three thousand species, mostly European and East Indian, from the Herbarium of the late John Stuart Mill. These were presented by Miss Taylor, through the director of the Royal Gardens, Kew, and were obtained through the kind offices of Dr. Asa Gray.

From Prof. George E. Post, of the American Protestant College, Beirut, Syria, has been received in return for Colorado and Utah plants furnished by the conservator, upwards of four hundred species from the maritime and mountain districts of Syria, and from Algeria, of which nearly one-half were new to our collection, and further accessions are promised from the same source.

All of these large additions, with others specified in the annual list of donations, have been thoroughly poisoned by Mr. Charles F. Parker, and their distribution to the proper places upon our shelves, has made large demands upon the time and labor of the Herbarium Committee, and these demands have been promptly and cheerfully met.

Additions to Botanical Museum and Herbarium, 1878.

Feb. Isaac C. Martindale; cones and twigs of Pinus mitis, Mx., collected by him near Moorestown, New Jersey, and 50 species of phanerogamous plants from New Zealand.

A. L. Siler, of Osmer, Utah, through Mr. Meehan; foliage and cones of Pinus aristata, Engelm.

John H. Redfield; 15 species of plants from Utah and California, mostly new to the collection.

March. A. Commons, Centreville, Del.; Galium hispidulum, Mx., from Cape May, New Jersey—the first notice of it in that State.

C. F. Parker; Pogonia affinis, Austin, from Closter, N. Y., and Pyrola oxypetala, Austin, from Deposit, N. Y—the author's type specimens with his original notes attached.

April. M. S. Bebb, Fountaindale, Ill.; 13 species of North American willows.

Dr Asa Gray, Cambridge, Mass.; about 3000 species of European and East Indian plants from the herbarium of the late John Stuart Mill, presented by Miss Taylor, through the director of the Royal Gardens, Kew.

Do.; 168 species of plants from China, India, Australia, California, etc., mostly new to the collection.

John H. Redfield; 22 species of flowering plants from Southern Utah, and 20 species ferns, mostly new to the collection.

Charles F. Parker; Schizœa pusilla, Pursh, from Toms River, New Jersey, and Botrychium lanceolatum, from Closter, N. Y.

Isaac C. Martindale; Bromus brevi-aristatus, Wats., from S. W. Utah.

May. Conchological Section of the Academy; 54 species of Californian marine algæ, collected by Henry Hemphill.

September. Dr. Asa Gray, Cambridge, Mass.; 160 species of plants, mostly from Oregon and California.

Prof. Joseph T. Rothrock; a suite of the collections made by himself and Prof. John Wolf, on Col. Wheeler's explorations in Colorado and Arizona in 1873, consisting of 335 species, all mounted.

October. Mrs. J. Elwood Cooper, of Santa Barbara, California; ten species of ferns, from vicinity of Santa Barbara, all choice specimens.

Dr. George E. Post, of American Protestant College, Beirut, Syria; in return for Colorado and Utah plants, furnished by J. H. Redfield; 212 species of plants from the maritime districts of Syria; 82 species from the mountain region of the same; 126 species from Algeria, a large proportion new to us.

November. Isaac C. Martindale; 1st Century of Ellis's North American Fungi, neatly mounted in bound volume.

John H. Redfield; 53 species ferns collected in the island of Trinidad, by Dr. A. Fendler in 1877-78, and named by Prof. D. C. Eaton; also Nymphæa flava, Leitn., and Baptisia calycosa, Canby, a new species, both collected in

Florida, by Mary C. Reynolds; and Camptosorus rhizophyllus, collected on Round Top, battle-field of Gettysburg.

December. Thomas Meehan; Polypodium falcatum, Kell., and Oenothera gracilifiora, collected by Mrs. Briggs in Washington Territory.

T. S. Brandegee, Canon City, Colorado; 8 new species of Fungi from Colorado, named by Prof. Peck.

REPORT OF THE MINERALOGICAL SECTION.

The Director of the Mineralogical Section of the Academy of Natural Sciences would respectfully report, that meetings of the Section have been held every month except July and August; the attendance has been fair. At nearly every meeting new facts of importance have been brought forward and discussed, so that there has been no lack of interest.

The donations for the year have been numerous, and many of them valuable. The items will be found attached to the report of the Curators of the Academy.

The increase of the cabinet may be deemed entirely satisfactory.

The Director would also call attention to the fact that a full catalogue of all the minerals in the collection has been made by Mr. Charles F. Parker during the year, who also has completed the relabelling of all the specimens, works of great labor most satisfactorily performed. In addition to this, Mr. Parker has prepared a list of minerals lacking in the collection. By distribution of this, it is believed many of the vacant spaces may be filled by gifts of the needed species.

Some progress has been made in the local collection of rocks and minerals, but much remains to be done It is purposed to make a list of desiderata in this collection for distribution.

By voluntary contribution of members of the Section, a Canfield Trimmer has been purchased and presented to the Academy.

Several new localities of minerals have been for the first time announced through the Section.

Respectfully submitted,

THEO. D. RAND,

Director.

The election of Officers for 1879 was held in accordance with the By-laws, with the following result:—

President . . .	W. S. W. Ruschenberger, M. D.
Vice-Presidents . .	Wm. S. Vaux, Thomas Meehan.
Recording Secretary .	Edward J. Nolan, M. D.
Corresponding Secretary	George H. Horn, M. D.
Treasurer . . .	William C. Henszey.
Librarian . . .	Edward J. Nolan, M. D.
Curators . . .	Joseph Leidy, M. D., William S. Vaux, Charles F. Parker, R. S. Kenderdine, M. D.
Councillors to serve three years	Edward S Whelen, C. Newlin Peirce, J. H. Redfield, S. Fisher Corlies.
Finance Committee .	Edward S. Whelen. Clarence S. Bement, Aubrey H. Smith, S. Fisher Corlies, Geo. Y. Shoemaker.

ELECTIONS DURING 1878.

MEMBERS.

January 29.—James Huneker, Albert H. Smith, M. D., Frank H. Rosengarten, John K. Valentine, George Wolf Holstein, Mrs. Charlotte Von Uhlen Olsen, M. D., John A. Ryder, Griffith E. Abbot, Ph.D.

March 26.—Wm. F. Sellers, H. Haupt, Jr., M. D.

April 30.—W. W. Frazier, Jr., Walter Wood, Jos. W. Anderson, M. D.

June 25.—George B. Cresson.

July 30.—Mrs. Emily T. Eckert, Herman C. Evarts, M. D.

August 27.—Dowling Benjamin, M. D.

September 24.—E. Gybbon Spilsbury, Henry A. Green, Francis X. Dercum, M. D., Henry C. Wood, M. D.

October 29.—William Ayres, William T. Haines, J. Bernard Brinton, M. D., Edmund Lewis.

November 26.—J. Ward Atwood, M. D., Wm. S. Baker, Dr. L. Ashley Faught.

CORRESPONDENTS.

January 29.—John McCrady, of Sewanee, Tenn.; Charles T. Minot, of Roslindale, Mass.; Henry Hicks, of London; J. W. Hulke, of London; Thomas Belt, of London; H. G. Seely, of London; W. T. Thistleton Dyer, of London; Archibald Geikie, of Edinburgh; James Geikie, of Edinburgh; Charles Barrois, of Lille; Dr. M. E. Jannettaz, of Paris; Dr. Emil Sauvage, of Paris; Ch. Velain, of Paris; Edmond Pellat, of Paris; H. Filhol, of Paris; Michael Vacek, of Vienna; Karl von Seebach, of Göttingen.

February 26.—J. Gozzardini, of Bologna; G. Meneghini, of Pisa; Antoine Stoppani, of Milan; Francisco Coello, of Madrid; Dr. J. J. Steenstrup, of Copenhagen; F. Steenstrup, of Copenhagen; R. Brough Smyth, of Melbourne; Edward Van Beneden, of Liege; Jules Künckel d'Herculais, of Paris.

March 26.—Auguste Forel, M. D., of Munich; James Wood Mason, of Oxford.

May 28.—Gumesindo Mendoza, of Mexico; Stephen Bowers, A. M., of Santa Barbara, Cal

July 30.—J. B. Ellis, of Newfield, N. J.

November 26.—R. Neilson Clark, of Rosita, Col.

ADDITIONS TO THE LIBRARY, 1878.

Agassiz, L. Journey to Switzerland, 1833. I. V. Williamson Fund.
Aiken, D. W. Remarks on the Report of the Commissioner of Forestry. The Author.
Alto Velo Island, 1868. I. V. Williamson Fund.
American Philosophical Society, Catalogue of the Library. Pt. 3. The Society.
Angelin, N. P. Iconographia crinoideorum in stratis Sueciæ Siluricis fossilium, 1878. Royal Academy of Sciences of Sweden.
Antal, K. A Dunai Trachytcsoport Jobbparti Részének, 1877. Hungarian Academy of Sciences.
Ashburner, C. A. Oil well records of McKean and Elk Counties.
Wilcox spouting water well. The Author.
Baillon, M. H. Dictionnaire de Botanique. 7me—10me Fasc. I. V. Williamson Fund.
Baird, S. F. Annual record of science and industry, 1877. I. V. Williamson Fund.
Balfour, F. M. Elasmobranch Fishes, 1878. I. V. Williamson Fund.
Barber, E. A. Vocabulary of Utah dialects.
Traces of solar worship in North America.
American anthropological notes.
Ancient pueblos. Pts. 1 and 2. The Author.
Barnard's Isthmus of Tehuantepec. I. V. Williamson Fund.
Barrande, J. Cephalopods de la Bohéme II, 5, 1877. The Author.
Barrois, C. Embryologie des Bryozoaires, 1877. Terrain crétacé sup. de l'Angleterre et de l'Islande. The Author.
Bastian, A. Culturländer des alten America, 2v, 1878. I. V. Williamson Fund.
Baswitz, M. Die Oxydationsprodukte des Acetessigesters. University of Wurzburg.
Battle-field of Gettysburg, three maps. War Department.
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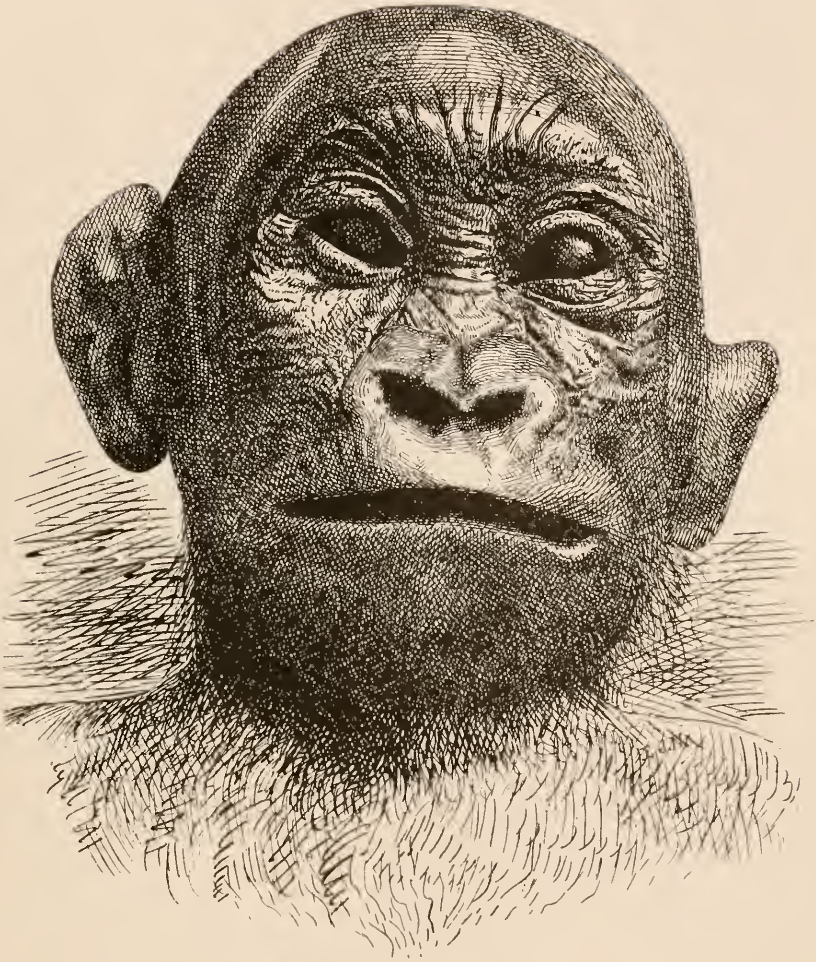

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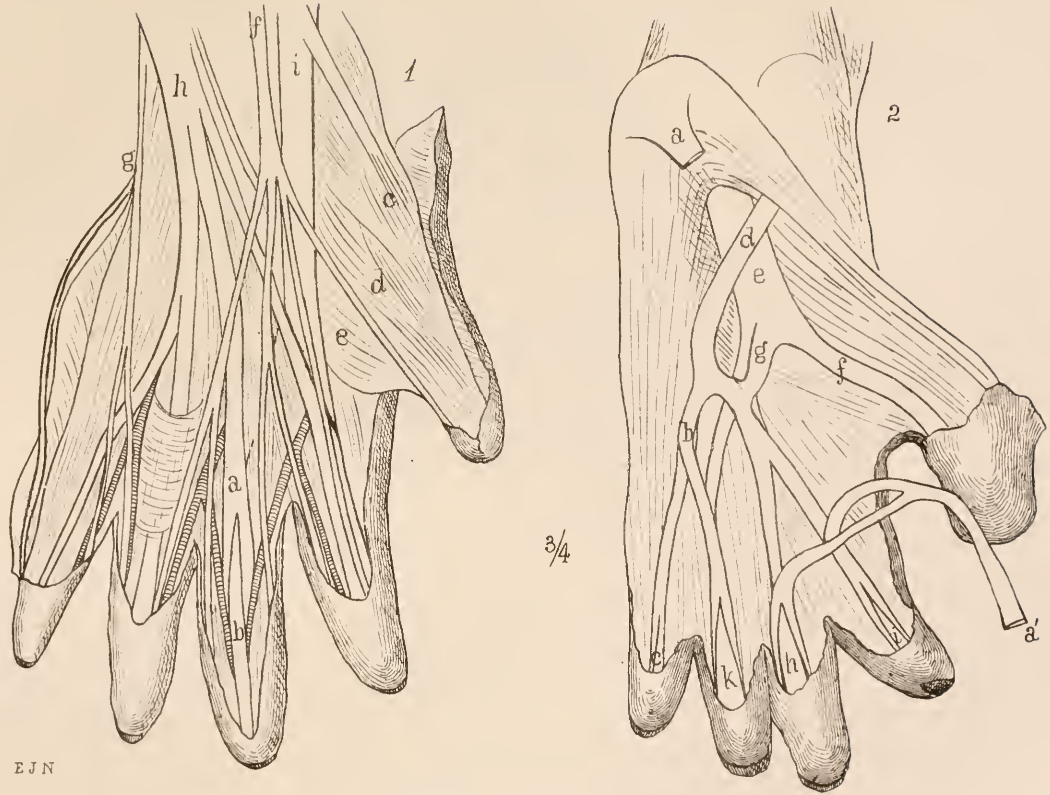

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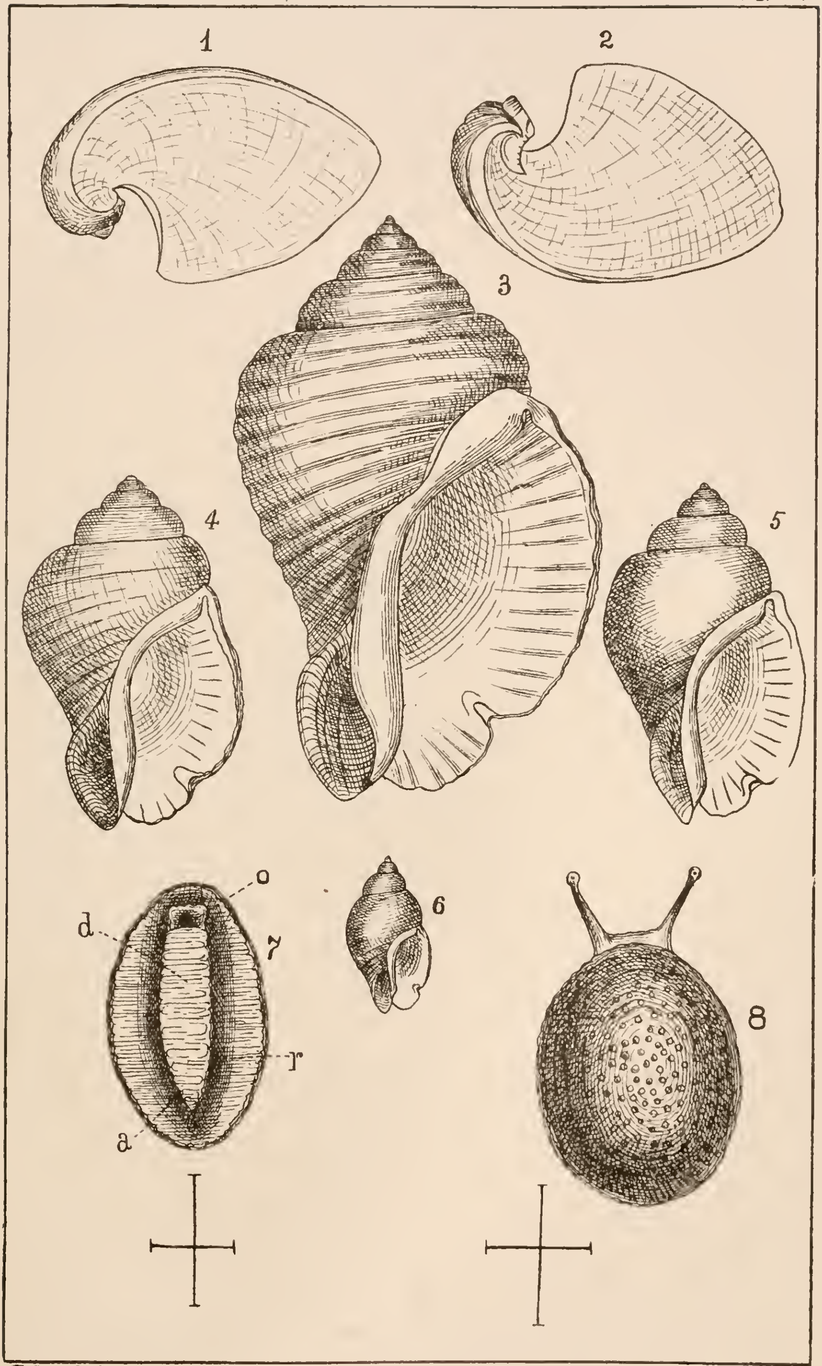

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OF

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PART I.—January—April, 1878.

PUBLICATION COMMITTEE.

Joseph Leidy, M.D., Geo. H. Horn, M.D.,
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Geo. A. Kœnig, Ph.D.

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